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FirstEnergy Nuclear Operating Company

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March 31, 2006
L-06-046

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Subject: **Beaver Valley Power Station, Unit No. 2**
BV-2 Docket No. 50-412, License No. NPF-73
Responses to a Request for Additional Information
(RAI dated March 2, 2006) in Support of
License Amendment Request No. 202

On October 14, 2005, FirstEnergy Nuclear Operating Company (FENOC) submitted License Amendment Request (LAR) No. 202 by letter L-05-157, dated October 14, 2005. This submittal proposed changes to permit implementation of station battery charger upgrades including installation of new battery chargers for Beaver Valley Power Station (BVPS) Unit No. 2.

By letter dated March 2, 2006, the U.S. Nuclear Regulatory Commission (NRC) issued a request for additional information pertaining to LAR No. 202. The enclosure to this letter contains the FENOC response to the March 2, 2006 request for additional information.

The request for additional information response forwarded with this letter has no impact on either the proposed Technical Specification changes or the no significant hazards consideration forwarded with LAR No. 202 letter L-05-157, dated October 14, 2005.

No new regulatory commitments are contained in this transmittal. If you have questions or require additional information, please contact Mr. Gregory A. Dunn, Manager - Licensing, at 330-315-7243.

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I declare under penalty of perjury that the foregoing is true and correct. Executed on March _31_, 2006.

Sincerely,

James H. Lash

Enclosure:

Response to Request for Additional Information dated March 2, 2006

c: Mr. T. G. Colburn, NRR Senior Project Manager
Mr. P. C. Cataldo, NRC Senior Resident Inspector
Mr. S. J. Collins, NRC Region I Administrator
Mr. D. A. Allard, Director BRP/DEP
Mr. L. E. Ryan (BRP/DEP)

L-06-046 ENCLOSURE

Response to Request for Additional Information
Beaver Valley Power Station, Unit No. 2
Station Battery Charger Upgrade

By letter dated October 14, 2005 (Agencywide Documents Access and Management System Accession No. ML052920419), FirstEnergy Nuclear Operating Company requested an amendment to the BVPS-2 Technical Specifications (TSs). The proposed changes would revise TSs 3/4.8.2.3 and 3/4.8.2.4 to permit implementation of station battery charger upgrades, including installation of new battery chargers. The Nuclear Regulatory Commission (NRC) staff has determined that the information contained below is needed for the NRC staff to complete its review.

1. **Provide assurance that any spare charger that could be credited by removing '2-7' from TS 3.8.2.3 ACTION b and the note in TS 3.8.2.4 would be equivalent to what is detailed in the BVPS-2 Updated Final Safety Analysis Report (UFSAR).**

Response:

FirstEnergy Nuclear Operating Company (FENOC) has planned to upgrade the BVPS Unit No. 2 Class 1E Uninterruptible Power Supply (UPS) systems by systematic replacement of rectifiers, inverters and battery chargers.

The original SPARE battery charger, identified as 2-7, is a portable unit. When a spare charger is needed for any of the four Class 1E 125-VDC busses, the unit is moved to the location, fastened to the floor, electrically connected to the bus via dedicated power outlets and placed into service.

The proposed change will eliminate the existing portable spare battery charger unit in favor of two spare charger units. Each of these units will be permanently mounted in their respective emergency bus rooms, eliminating the need to roll a spare charger between rooms and secure it prior to placing it into service.

The existing portable spare battery charger was fully capable of recharging the connected battery while simultaneously carrying the associated DC bus load on any of the Class 1E 125-VDC busses.

Electrical Specifications for the existing portable SPARE battery charger unit are as follows:

Input Voltage	480 VAC (+/- 10%), 60 Hz (+/- 5%)
Nominal Float Voltage	120-138
Nominal Equalize Voltage	135-144
Rated Output Current	100 amps

Electrical Specifications of the replacement spare battery chargers are as follows:

Charger DC output

Input Voltage	480 VAC (+ 10% / -15%), 60 Hz (+/- 5%)
Nominal Float Voltage	120-144
Nominal Equalize Voltage	140 (+/- 5%)
Rated Output Current	100 amps

The electrical performance specifications of the replacement chargers meet the performance specifications of the existing portable SPARE battery charger 2-7.

Qualification of the replacement units to IEEE STD 323-1974 and IEEE STD 344-1975 will be documented by provision of prototype testing data and Certificate of Conformance by the equipment manufacturer. Electrical, environmental and seismic performance criteria have been provided to the manufacturer via engineering specification. These criteria are equivalent to those specified in the original engineering specification.

Any spare charger credited for performing the design function of the existing charger 2-7, would be procured in accordance with the replacement charger engineering specification.

The replacement charger engineering specification meets the requirements for the battery chargers as set forth in the BVPS Unit No. 2 Updated Final Safety Analysis Report (UFSAR).

2. **The Institute of Electrical and Electronics Engineers (IEEE) Standard - 450 (1987-2002), "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications," states that degradation is indicated when the battery capacity drops more than 10% from its capacity on the previous performance test, or is below 90% of manufacturer's rating.**

   Provide assurance that the current definition for battery degradation being used at BVPS-2 provides an accurate indication of each battery's condition.

Response:

The new battery chargers, installed as described in response to question 1 above, will operate the same as the existing battery chargers, (capable of recharging the connected battery while simultaneously carrying the associated DC bus load on any of the Class 1E 125-VDC busses).

The equalize and float voltage settings will not be changed. Changing out the chargers will have no effect on how battery degradation is measured. BVPS Unit No. 2 Technical Specification Surveillance 4.8.2.3.2.f states: "At least once per 18 months, during shutdown, performance discharge tests of the battery capacity shall be given to any battery that shows signs of degradation or has reached 85% of the service life expected for the application. Degradation is indicated when the battery capacity drops more than 10% of rated capacity from its average on previous performance tests, or is below 90% of the manufacturer's rating." This surveillance meets the intent of IEEE-STD-450.

Note:

Although IEEE 450 recommends that the performance testing be performed on a yearly basis, an 18 month surveillance frequency has previously been discussed and approved by the NRC for BVPS Unit No. 1. Refer to the safety evaluation associated with Unit No. 1 License Amendment No. 54.* In that safety evaluation the NRC staff concluded: "Imposing the new requirement to conduct an annual performance discharge test on a battery that shows signs of degradation would require an unscheduled plant shutdown and unnecessarily restrict plant availability without a significant increase in plant safety." BVPS Unit No. 1 License Amendment No. 54 revised Technical Specification Surveillance 4.8.2.3.2.f to state: "At least once per 18 months, during shutdown, performance discharge tests of the battery capacity shall be given to any battery that shows signs of degradation or has reached 85% of the service life expected for the application. Degradation is indicated when the battery capacity drops more than 10% of rated capacity from its average on previous performance tests, or is below 90% of the manufacturer's rating." The NRC subsequently approved the same wording for BVPS Unit No. 2 Technical Specification Surveillance 4.8.2.3.2.f with the issuance of NUREG 1259 in May of 1987.

* Reference letter from Peter Tam, NRC Project Manager to Mr. J. J. Carey, Vice President Duquesne Light Company, dated July 27, 1982, forwarding License Amendment No. 54 to Facility Operating License No. DPR-66 for Beaver Valley Power Station, Unit No. 1.

3. Provide assurance that the BVPS-2 UFSAR will reflect the proposed design change.

Response:

The Updated Final Safety Analysis Report (UFSAR) will be updated as required by 10 CFR 50.71(e) to reflect the station battery charger upgrade. As part of the FirstEnergy Nuclear Operating Company (FENOC) Engineering Changes process, a Licensing Document Change Notice has been prepared which details the Beaver Valley Power Station Unit No. 2 UFSAR changes that will be made.

A preliminary copy of UFSAR pages marked to show changes has been provided for information as Attachment 1.

4. Provide an updated electrical one-line diagram that shows the proposed design configuration.

Response:

Attachment 1 includes Figure 8.3-14, "Class 1E 125-VDC Distribution System." This figure provides the requested one-line diagram showing the proposed design configuration. Changes are shown within revision clouds.

5. How will you prevent the rectifier assemblies from providing direct current input to the respective 125 Volt direct current bus?

Response:

Refer to the preliminary updated BVPS Unit No. 2 UFSAR Figures 8.3-3 and 8.3-14, provided for information in the attachment to letter L-06-046, and note the location of the "Blocking Diodes."

The existing UPS units for Vital Busses 2-1 (Red) and 2-2 (White) contain a rectifier, an inverter and a blocking diode. This figure revision which adds the blocking diodes to Busses 2-1 and 2-2 does not reflect a physical plant change, or a change associated with License Amendment Request No. 202. The addition of the blocking diodes to busses 2-1 and 2-2 are intended as an editorial change to reflect the existing equipment configuration.

The function of the blocking diode is to prevent the UPS rectifier output from providing direct current input to the respective 125 Volt DC Bus. DC bus voltage is set slightly lower, upstream of the blocking diode, to prevent the DC bus from providing power to the Vital Bus loads during normal system operation. Upon loss of sufficient rectifier output, the DC bus will provide power to the associated Vital Bus loads, via the battery charger output if available or ultimately from the batteries.

As part of the planned upgrade of the Class 1E UPS systems, new replacement UPS units will be installed at the same time as the addition of new battery chargers for DC Busses 2-3 (Blue) and 2-4 (Yellow). Components within these new UPS units will perform the same design function as in the existing UPS units for DC busses 2-1 and 2-2.

In the new system configuration, the UPS rectifier will feed its respective Vital Bus loads via its UPS inverter. The blocking diode within the new UPS unit will prevent the UPS rectifier output from providing direct current input to the respective 125 Volt DC Bus.

ATTACHMENT 1
TO L-06-046 ENCLOSURE

Updated Final Safety Analysis Report
Changes for Station Battery Charger Upgrade

7.6 ALL OTHER SYSTEMS REQUIRED FOR SAFETY

7.6.1 Instrumentation and Control Power Supply System

7.6.1.1 Description

The following is a description of the instrumentation and control power supply system:

1. Figure 7.6-1 gives a single line diagram of the instrumentation and control power supply system.

2. There are four inverters and their associated distribution panels. Each inverter is connected independently to one or more distribution panels.

3. The inverters provide a source of 118 V 60 Hz power for the operation of the nuclear steam supply system instrumentation. This power is derived from the 480 V ac, three-phase, 60 Hz distribution system (preferred power supply), or the station batteries, which assure continued operation of instrumentation systems in the event of a station blackout.

4. Each of the four sets of distribution panels may be connected to a backup source of 120 V ac power. The tie is through a local electrically-operated manual bypass switch, which is mechanically interlocked with the breaker connecting the inverter to the distribution panel such that the distribution panels cannot be connected to both sources simultaneously.

7.6.1.2 Analysis

There are two independent 480 V ac power sources, each serving two inverters. Loss of either 480 V ac power source affects only two of the four inverters.

There are four independent batteries. EACH ~~Two~~ of the batteries are supplied with independent battery chargers. ~~The remaining two batteries are equipped with battery chargers which are integral with their respective inverter.~~

Since not more than two inverters are connected to the same bus, a loss of a single bus can only affect two of the four inverters.

Each inverter is independently connected to its respective vital bus distribution panels so that loss of an inverter cannot affect more than one of the four sets of vital bus distribution panels.

PRELIMINARY

pigtails, and terminal cabinets, located inboard of the containment.

Nuclear instrumentation system (NIS) triaxial penetrations are similar to the ones mentioned previously; however, they will have connectors in place of terminal cabinets, with pull boxes inboard and outboard of the containment. Two NIS triaxial penetrations, 2RCP*21E (white) and 2RCP*06B (blue), deviate from the spatial separation requirements of item 5C above. The separation is 4'-0" between the respective train and channel. This arrangement precludes NIS noise interference concerns, and is acceptable based on the availability of a separate safety-related nuclear instrumentation system.

The 5 kV cable penetrations are of the bushing type with suitable connectors.

6. Fire Stops and Seals

Fire stops and seals are detailed in Section 8.3.3.3.

7. Cable

All Class 1E cable is type-tested in accordance with IEEE Standard 383-1974 to ensure its ability to perform its required function for all normal and accident environments.

Power cables are sized in accordance with Power Cable Ampacities, published by the Insulated Power Cable Engineering Association (IPCEA), or manufacturers data. Cable sizes for safety-related motors are based on 125 percent of full load, 90°C conductor temperature, and 40°C ambient temperature for cable installation one layer deep with maintained horizontal spacing (refer to Table 8.3-4). Cable trays have a depth of 4 in. Cable tray fill for K cables is limited to 50 percent of the available cross-sectional area of a 3-inch deep cable tray for randomly filled trays (Table 8.3-4) and is derated accordingly. In actual practice, the cables in randomly filled trays are not as tightly packed as assumed in IPCEA P-54-440, Ampacities in Open-Top Cable Trays, and the calculated cable derating is conservative.

8.3.1.1.17 120 V AC Vital Bus Uninterruptible Power Supply System

There are four independent Class 1E vital bus power supplies constituting the 120 V ac vital bus UPS. Each bus provides 120 V ac instrumentation and control power for the ESF protection channels, and is uniquely identified by the assigned colors red, white, blue, or yellow corresponding respectively to vital buses UPS*VITBS2-1, 2-2, 2-3, and 2-4. Each vital bus UPS consists of an inverter, rectifier ~~(systems *2-1 and *2-2), or an inverter, rectifier/charger (systems *2-3 and *2-4),~~ static switch/manual bypass switch, and alternate source line voltage regulator (Figure 8.3-3).

VITAL BUS UPS UNITS *2-1 AND *2-2 PROVIDE 20KVA OUTPUT AT 0.8 POWER FACTOR.
VITAL BUS UPS UNITS *2-3 AND *2-4 PROVIDE 15KVA OUTPUT AT 0.8 POWER FACTOR.

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Each vital bus (*2-1, *2-2, *2-3, *2-4) is capable of providing 120 V ac ±2.4 V, single-phase, 60 HZ ±.03 Hz, ~~20 kVA at 0.8 power factor~~ at the output of the inverter unit.

Each bus normally receives power from the rectifier units via an emergency 480 V MCC. The rectifiers convert 480 V ac to 125 V dc and supply it to the inverter input. The interconnection with an emergency 480 V MCC provides the vital buses with the capability of an offsite (preferred) power source or an on-site (emergency) power source. This satisfies NUREG-0737 (USNRC 1980), Item II.G.1, Position 4, with regard to pressurizer level indicators which are supplied from the vital instrument buses. The inverter shapes the output voltage waveform to 120 V ac, single-phase, 60 hertz by means of internally-triggered silicon control rectifiers. In the event that the rectifier source is lost, the inverter will receive 125 V dc directly from the 125 V dc battery input. Each system is designed such that the battery will not supply current to the UPS while ac power (rectifier input) is available and within specified limits. In the event that both the rectifier and battery sources are unavailable or the inverter malfunctions, the systems load is transferred within 1/4 cycle to the 480-120 V alternate source line voltage regulator by means of the static switch. The alternate source is regulated at 120 V ± 3.6 V.

The BVPS-2 operator also has the option, by means of the manual bypass switch, of manually overriding the automatic transfer feature to allow for manual transfer. The automatic transfer permissives, however, can not be manually defeated.

Vital buses *2-3 (blue) and *2-4 (yellow) are associated with Class 1E batteries *2-3 and *2-4, respectively. The dc loads on these systems are limited by design to only blue and yellow channel 125 V dc circuits. For this reason, the rectifier/chargers, in addition to being the primary source of dc power to the inverter assemblies, also serve as battery chargers for these batteries.

Vital buses *2-1 (red) and *2-2 (white) receive their dc inputs from Class 1E batteries *2-1 and *2-2, respectively, via dc switchboards. Several non-vital bus Class 1E dc loads not in this system are also powered from these two sources; consequently, batteries *2-1 and *2-2 are provided with separate battery chargers. Blocking diodes have been added to the input circuits of inverters *2-1 and *2-2, thus preventing back-feeding from rectifiers 2-1 and 2-2, and the rectifier assemblies from providing dc input to the respective battery bus. (Two non-Class 1E dc systems are provided for the non-safety dc loads, as discussed in Section 8.3.2.1).

A spare mobile battery charger is also available to provide charging current to the Class 1E batteries during charger maintenance of in

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the event that a Class 1E battery charger fails. This spare charger and its associated connecting receptacles are qualified for Class 1E use.

There are four Class 1E isolating voltage regulating transformers allocated to the four vital bus systems. They serve to isolate certain designated non-Class 1E loads from the Class 1E portion of the system (red, blue, yellow, white). These isolating regulators are identified as follows:

Vital buses *2-1 (red) and *2-2 (white) receive their dc inputs from Class 1E batteries *2-1 and *2-2, respectively, via dc switchboards *2-1 (orange) and *2-2 (purple), respectively. The dc switchboards exist on these two busses since there are several Class 1E dc loads which are not associated directly with the vital bus system. These non-vital bus loads are also supplied via the dc switchboards.

Vital busses *2-3 (blue) and *2-4 (yellow) receive their dc inputs directly from Class 1E batteries *2-3 and *2-4. The dc loads on these buses are limited by design to only blue and yellow channel 125 V dc circuits therefore, no dc switchboards exist on these buses.

Each of the four vital busses are provided with separate battery chargers. Blocking diodes have been provided at the input circuits of the inverters for each of the four buses. These blocking diodes prevent inverter rectifier output from back-feeding dc input to their respective battery bus. This ensures that each inverter rectifier output feeds only its intended Class 1E vital bus load. Upon loss of ac input to a rectifier, the diode allows for the battery power to carry the affected vital bus load.

Spare battery chargers are also available to provide to provide charging current to the Class 1E batteries during charger maintenance or in the event that a Class 1E battery charger fails. These spare chargers and their associated connecting receptacles are qualified for Class 1E use.

(mark-up to BV2 UFSAR pages 8.3-50 and 8.3-50a - LDCN No. 205-021)

Periodic testing is performed on a regularly scheduled basis to demonstrate the operability and continuity of all Class 1E systems and components. Testing of the onsite Class 1E emergency diesel generator units, which will be in accordance with Regulatory Guide 1.108, is addressed in Section 8.3.1.1.15.

All periodic testing and inspection will be performed with full integrity and availability of the entire Class 1E power systems in conformance with the bypassed or deliberately inoperable status requirements of Regulatory Guide 1.47.

Periodic testing and maintenance will be performed for all Class 1E protection systems in conformance with the requirements of Regulatory Guide 1.118.

Compliance with Regulatory Guide 1.6

The design of the onsite electrical safety-related (Class 1E) power systems is in compliance with Regulatory Guide 1.6. The Class 1E loads for all BVPS-2 voltage levels, that is, 4,160 V ac, 480 V ac, 120 V ac, and 125 V dc, are separated into redundant and completely independent load groups. Manual and automatic interconnections between buses and loads, interconnections between safety-related (Class 1E) and nonsafety-related (non-Class 1E) buses, automatic loading and stripping of buses, and independence of redundant systems are fully described in Sections 8.3.1.1.4, 8.3.1.1.5, 8.3.1.1.8, and 8.3.1.4, respectively.

The 125 V dc Class 1E system includes four battery and battery charger~~/rectifier~~ combinations, with redundant dc load groups specifically assigned to each dc bus without automatic connection to any other load group.

Each of the two emergency diesel generator units (Section 8.3.1.1.15) is completely redundant, physically and electrically separated relative to the other, and is connected exclusively to its designated 4,160 V ac Class 1E bus. This design ensures complete independence for the onsite emergency power sources.

Compliance with Regulatory Guide 1.9

Diesel-generator units used as onsite electric power systems at BVPS-2 have been selected, designed, and qualified following the guidance of this Regulatory Guide with the following clarifications:

The Class 1E diesel generators have been procured in compliance with IEEE Standard 387-1977 with the following clarifications:

1. Section 4.1(8): The BVPS-2 Class 1E diesels are qualified utilizing the mild environment concept acknowledged by 10 CFR 50.49(c).

2. Section 4.1(12): The BVPS-2 Class 1E diesels are seismically qualified in accordance with IEEE Standard 344-1971.

UPS*VITBS2-1 AND UPS*VITBS2-2 FALL WITHIN THEIR 20KVA OUTPUT RATING.
UPS*VITBS2-3 AND UPS*VITBS2-4 FALL WITHIN THEIR 15KVA OUTPUT RATING.

features of the vital bus inverters and the alternate regulating transformer supply. Further analysis on the separation provisions for independence of equipment, cables, and raceways is found in Section 8.3.1.4.

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Determination of the capacity requirements of the 125 V dc Class 1E battery systems includes a power requirement in the 2-hour duty cycle representing the required supply to the vital bus inverters.

The inverter output requirements for UPS*VITBS2-1, UPS*VITBS2-2, UPS*VITBS2-3 and UPS*VITBS2-4 have been verified by calculation, ~~and fall within their 20 kVA output rating.~~ Furthermore, sufficient capacity exists to supply a future load increase, if required, for each of the vital buses.

The alternate supply transformers are sized accordingly at 20 kVA AND 15KVA output. The other system regulating transformers, serving non-Class 1E loads, are specified with capacities of 10.0 kVA. The total connected non-Class 1E loads do not exceed 5.5 kVA. Also, cables are sized to correspond to the distribution breaker rating and allowable voltage drop limit. This assures sufficient voltage at the load. In general, voltage drop in the cable (from the distribution panel to the load) is confined to 1 percent. Final routing of cables (from distribution panels to the load) is controlled by a computer program. Routing includes circuit assignment to cable tray, conduit, junction boxes, etc. and does not allow, by program design, the sharing of a raceway with non-Class 1E cables or redundant color coded cables. Circuit routings have been sampled and verified for conformance with regard to the prescriptive implementation of separation requirements. Redundant components, cables, and raceways are uniquely identified by a mark number which includes a distinguishing color code. The color code is visually apparent as well.

Ventilation systems supporting the UPS equipment and circuits (Sections 9.4.1, 9.4.3, and 9.4.10) maintain temperature conditions between 55°F and 104°F, a range cited and integrated into the design requirements of relevant equipment performance specifications. Any single failure in a ventilation system will not preclude the system's function. It is 100 percent redundant and satisfies independence criteria.

The buildings and structures housing the UPS (service building, control building, cable tunnels, safeguards area, auxiliary building, fuel building, and cable vault) are Seismic Category I designed structures, and provide a controlled environment for the UPS equipment, to which the latter is qualified. This environment is fully described in Chapter 3.

The vital bus system load assignments and provisions for future connected loads are tabulated as part of a calculation to determine the sizing of the vital bus system. Correct final load assignments (proper correspondence between the safety class load and its designated vital bus source) have been confirmed utilizing this table.

Pre-operational and initial system testing will be specified in accordance with Regulatory Guides 1.41 and 1.68, and GDC 1. In addition, periodic onsite testing programs permit integral testing when the station is in operation, in accordance with Regulatory Guides 1.22 and 1.47. The test program capabilities satisfy the requirements of GDC 18 and 21. Any one of the vital bus inverters can be removed for testing without diminishing the system's ability to perform its safety functions. Also any battery charger can be removed for maintenance and replaced by the mobile spare charger. The alternate source regulating transformers can be isolated for testing without limiting the capability of the UPS.

The following instrumentation and monitoring devices provide system surveillance capability: an output voltmeter, ammeter, and a frequency meter for each inverter (detect inverter trouble); an elapsed time meter to indicate total operating time of the inverter (facilitate performance of scheduled maintenance); alarms for abnormal conditions including inverter low output voltage, low output current, and loss of cooling air to the inverter (provide system information to main control room operator); undervoltage and overvoltage alarms on each vital bus and voltage transducers on each distribution panel (provide continuous vital bus voltage indication and monitoring to the main control room operation).

The UPS equipment and cable are qualified to the most severe credible hostile environment in the equipment's location, including seismic conditions, radiation, thermal excursions, pressure, and temperature conditions, all assumed to occur at the end of the component's design life. Components are qualified to function for the required duration of the design basis conditions. The active UPS electrical equipment is located in the service building, a structure which protects the equipment and limits its exposure to moderate accident levels of radiation, temperature, and humidity.

8.3.1.2.3 Class 1E Equipment in a Hostile Environment

Class 1E equipment in a hostile environment is discussed in Section 3.11.

8.3.1.3 Physical Identification of Safety-Related Equipment

The identification scheme for the onsite safety-related (Class 1E) power system equipment, for cable/raceway equipment, and for terminal equipment is designed to ensure:

1. Marking permanence,

8.3.2 DC Power Systems

8.3.2.1 Description

8.3.2.1.1 Class 1E DC Power System

The Class 1E dc power system includes 125 V dc power supplies, distribution equipment, and load groups arranged to provide dc power to the safety class dc loads as depicted on Figure 8.3-14. This system is divided into four independent subsystems and two redundant trains with regard to power sources and corresponding distribution equipment. These four subsystems are designated with the following principal equipment as follows: Class 1E battery 2-1 (orange), battery charger 2-1 (orange), and distribution switchboard 2-1 (orange); Class 1E battery 2-2 (purple), battery charger 2-2 (purple) and distribution switchboard 2-2 (purple); Class 1E battery 2-3 (blue), vital bus ~~rectifier/~~charger 2-3 (blue) and distribution panel 2-19 (blue); Class 1E battery 2-4 (yellow), vital bus ~~rectifier/~~charger 2-4 (yellow) and distribution panel 2-20 (yellow).

Class 1E batteries 2-1 and 2-2 are connected to Class 1E 480 V MCCs via their respective battery chargers. These 480 V feeds maintain the batteries fully charged, and can also carry the redundant and independent 125 V dc load groups, which are supplied from these sources via distribution switchboards 2-1 and 2-2. Included in these loads groups are the vital bus inverters, namely 2-1 (output red) and 2-2 (output white).

Class 1E batteries 2-3 and 2-4 are connected to Class 1E 480 V MCCs via their respective BATTERY ~~rectifier/~~chargers. ~~which are part of the vital bus UPS units. Since the 2-3 and 2-4 dc distribution is limited by design to only the associated blue or yellow instrumentation, separate battery chargers are not required. Through the rectifier/chargers, the 480 V feeds maintain fully charged batteries, supply the 125 V dc instrumentation~~ via the dc distribution panels 2-19 and 2-20, and drive the vital bus inverters 2-3 (output blue) and 2-4 (output yellow).

INSERT: THESE 480 V FEEDS MAINTAIN THE BATTERIES FULLY CHARGED, AND CAN ALSO CARRY THE REDUNDANT AND INDEPENDENT 125 V DC LOAD GROUPS

EACH TRAIN HAS BEEN PROVIDED WITH A FULLY QUALIFIED SPARE BATTERY CHARGER. THESE UNITS

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Connection of battery chargers assigned to redundant subsystems to the same safety train does not depreciate subsystem independence. The battery chargers ~~and rectifier chargers~~ are specified to isolate the effects of any electrical perturbation due to an abnormality in a subsystem. ~~A spare, fully qualified battery charger 2-7 is also provided. This unit is portable and~~ can be connected to a permanent, enclosed safety switch with interlocked receptacle. One safety switch is provided for each battery to provide a backup method for battery charging and bus supply if the primary charger is out of service.

These features demonstrate that safety grade equipment is utilized in accomplishing the interconnection of the Class 1E 125 V dc system and the emergency buses, satisfying NUREG-0737, (USNRC 1980), Item II.E.3.1, Position 4, for control power for pressurizer heaters.

Each of the two redundant 125 V dc Class 1E buses switchgear 2-1 and switchgear 2-2 supply Class 1E loads for the following safety class items:

1. Reactor protection system,
2. Engineered safety features actuation system,
3. Class 1E 120 V ac vital bus inverters,
4. Class 1E 4,160 V and 480 V ac switchgear controls,
5. Emergency diesel generator field flashing.

Each 125 V dc bus voltage level is continuously monitored and displayed in the main control room. Alarms in the control room give warning in the event of low voltage, charger failure, battery breaker overcurrent trip, and supply breaker trips to 125 V dc switchgear and distribution panels. All electrical equipment connected to the Class 1E 125 V dc system is capable of operating over the 125 V dc system voltage range. The 125 V dc system operates ungrounded. Each dc bus is provided with a voltmeter which will indicate a grounded condition on either the positive or negative bus. The grounded dc bus condition is also annunciated in the main control room. The most probable mode of battery failure, a single cell deterioration, is indicated well in advance by the routine tests regularly performed on the unit batteries.

Batteries 2-1 and 2-2 are connected to their respective buses via circuit breakers. Distribution breakers feeding bus loads are coordinated for circuit protection. Circuit breakers are provided for each battery, with only longtime and shorttime trip attachments.

The independence of the redundant dc systems is implemented by analyzing the system for all identifiable sources of coupling, and either by physically separating or mechanically protecting and electrically isolating them from their redundant counterparts, preventing the occurrence of nonrandom failures in the system.

8.3.2.1.2 Non-Class 1E DC Power System

The non-Class 1E dc power system includes 125 V dc power supplies, distribution systems, and load groups arranged to provide dc power to the dc loads as depicted on Figure 8.3-15. This 125 V dc system comprises two 125 V dc, 120 cell lead-calcium type batteries (battery 2-5 and battery 2-6), each connected to its 125 V dc bus (switchgears 2-5 and 2-6) and battery charger (battery chargers 2-5 and 2-6). Battery 2-5 and battery 2-6 are each comprised of two strings of 60 cells in parallel, for a total of 120 cells for each battery set. Under normal conditions, 480 V MCCs (non-Class 1E) will supply power to each 125 V dc battery via a battery charger. Essential 120 V ac buses 2-5 and 2-6 are supplied from the essential bus inverters 2-5 and 2-6. The inverters are supplied from the non-Class 1E dc buses, switchgear 2-5 and 2-6, or from the 480 V ac switchgear 2-5 via rectifiers.

There is no interaction, sharing, or interface between the non-Class 1E and Class 1E dc systems, their equipment, raceways, loads, and support systems.

8.3.2.1.3 DC Power System Arrangement and Sizing

The arrangement of the Class 1E dc system equipment provides for four individual rooms for the four Class 1E batteries, and separate areas for the corresponding battery chargers, rectifier/chargers, static switches, circuit breakers, dc switchboards, and vital bus inverters. The latter are arranged in corresponding sets all located on el 730 ft-6 in of the service building (Figure 8.3-13). Since variations in electrolyte temperature of more than 2.8°C between cells may cause the warmer cells to become unequal in output, proper battery location, ventilation, and cell configuration are provided to keep this variation within the preceding limits, thus minimizing deterioration of the positive plates and prolonging battery life. The battery rooms are ventilated to prevent accumulation of hydrogen. The battery room ventilation system (Section 9.4.10.2) provides a minimum of 16 air changes per hour, which assures that hydrogen accumulation is limited to less than 2 percent of the total volume of each battery room.

Each dc subsystem has a charging component which is sized to supply all normal continuous loads and to simultaneously recharge the battery, after the design 2-hour duty cycle discharge, to the fully charged condition in 24 hours. The maximum equalizing voltage setting ensures that equipment connected to the batteries is not subjected to voltages greater than it was qualified for.

The Class 1E batteries have the ability to supply normal loads for a minimum of 2 hours. The battery and battery charging system then perform any necessary switching operations without help from any other source. The capacity of each Class 1E battery with the charger inoperable is large enough to cope with DBA conditions. Each battery system is sized in conformance with the principles set out in IEEE Standard 308-1974. The battery capacities for batteries 2-1 and 2-2 are 1,700 ampere hours (Ah) each. The capacities for batteries 2-3 and 2-4 are 1,140 Ah each. These capacities are sufficient to operate all connected dc loads under DBA conditions for a minimum of 2 hours.

An electrical calculation program is in place to monitor battery load additions and deletions and to periodically update the battery calculations. A new battery duty cycle shall be calculated for each load addition unless the loads being added are encompassed by the design margin calculation. This program ensures the capacity of the batteries continues to be adequate to power the prescribed loads.

The Class 1E batteries are lead-calcium type, consisting of 60 cells, each with a recommended float voltage of 2.25 V per cell. Battery cells are of the sealed type, having covers fixed in place with a permanent leakproof seal. Cell covers have vent and filler openings with vent plugs of the explosion-resistant type. Cell posts and all connectors have adequate capacities to prevent excessive losses and overheating.

Jumpering cells out of the battery sets may be allowed provided an engineering evaluation or calculation is performed to show that the battery still would have the capacity for the two hour duty cycle and maintain the required minimum voltage at load.

Batteries will be mounted on all-steel battery racks. These racks are provided with corrosion protection and are seismically designed, with restricting members to prevent cell motion. Design features include minimizing temperature differential between battery cells and cell accessibility for ease of inspection and maintenance.

Battery chargers (and rectifier chargers) convert ac power into regulated dc output voltage and are used to float and charge the batteries connected to them. Output voltage is regulated within ±1.0 percent of set point from no load to full load operation. Each battery charger has a nominal output of 130 V dc with an input of 460 480 V ac three-phase. The charger includes an input circuit breaker, an input transformer, power rectifier units, a voltage regulator, a current limiter, filters, and an output circuit breaker. The output circuit includes component as required to prevent damage to the charger from voltage transients originating in the dc distribution system. The output circuit breaker provides protection of the battery and the charger against internal charger faults and also serves as a manual disconnecting device. A circuit breaker in the input circuit provides protection for internal charger faults and can also be used as a manual disconnecting device. The charger is automatically current limiting. Its design is such that it can tolerate overloads, including a sustained short circuit at the output terminals, without damage to the components. The charger is designed to operate without the battery connected. The battery charger output is filtered to control the amplitude of ripple voltage.

8.3.2.1.4 DC Power System Distribution

Each battery distribution panel includes a low voltage dc power circuit breaker connecting the battery to the bus, molded case circuit breakers or fuses feeding the dc loads, coordinated overcurrent protection, instrumentation for overcurrent protection, instrumentation for system monitoring, and ground detection equipment. Buses are sized to carry rated full load current continuously with a maximum temperature rise of 50°C. The bus bars are braced to withstand mechanical forces of short circuit currents equal to or greater than the smallest interrupting current rating of the circuit breakers.

Emergency Power System

The emergency power system is an independent, automatic starting power source which supplies power to vital station auxiliaries if a normal power source is not available.

The following is a discussion of the independence between redundant emergency power sources and between their distribution systems.

1. The electrical power loads for emergency safety features are separated into redundant load groups fed from separate buses such that loss of one group will not prevent operation of minimum safety functions.

2. The redundant power loads are each connected to buses which may have power fed from an offsite power source or an emergency power source (that is, an emergency diesel generator unit).

3. Two 125 V dc systems, each complete with batteries, chargers, switchgear, and distribution equipment, are provided for ESF equipment. These systems are not tied together. In addition, two channel dedicated batteries are provided to supply 125 V dc to two vital bus inverters.

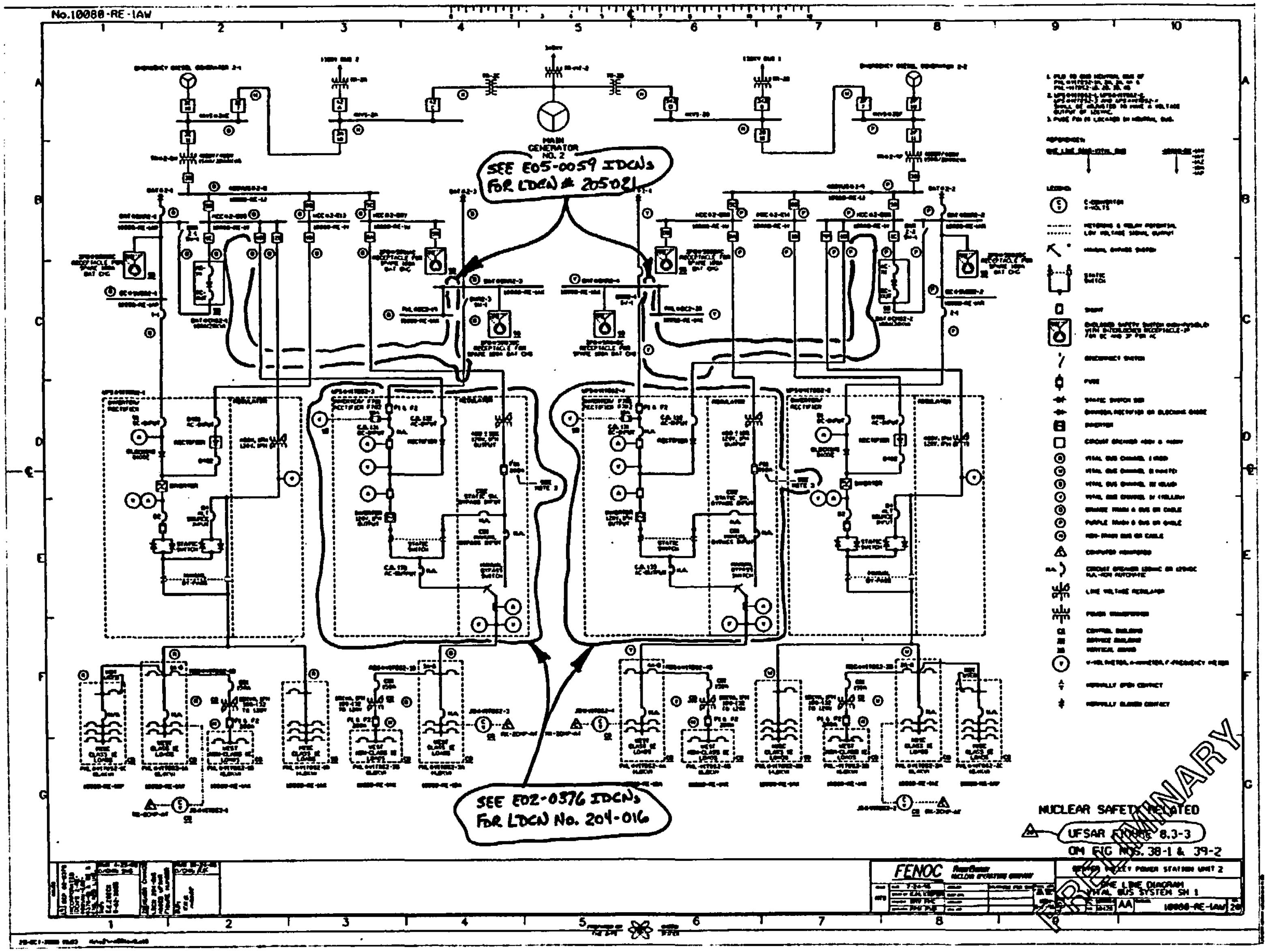
4. A standby source of power for one redundant load cannot be automatically paralleled with the standby source of power for the other redundant load.

5. Each redundant ac ESF load is supplied with power from a separate emergency diesel generator unit.

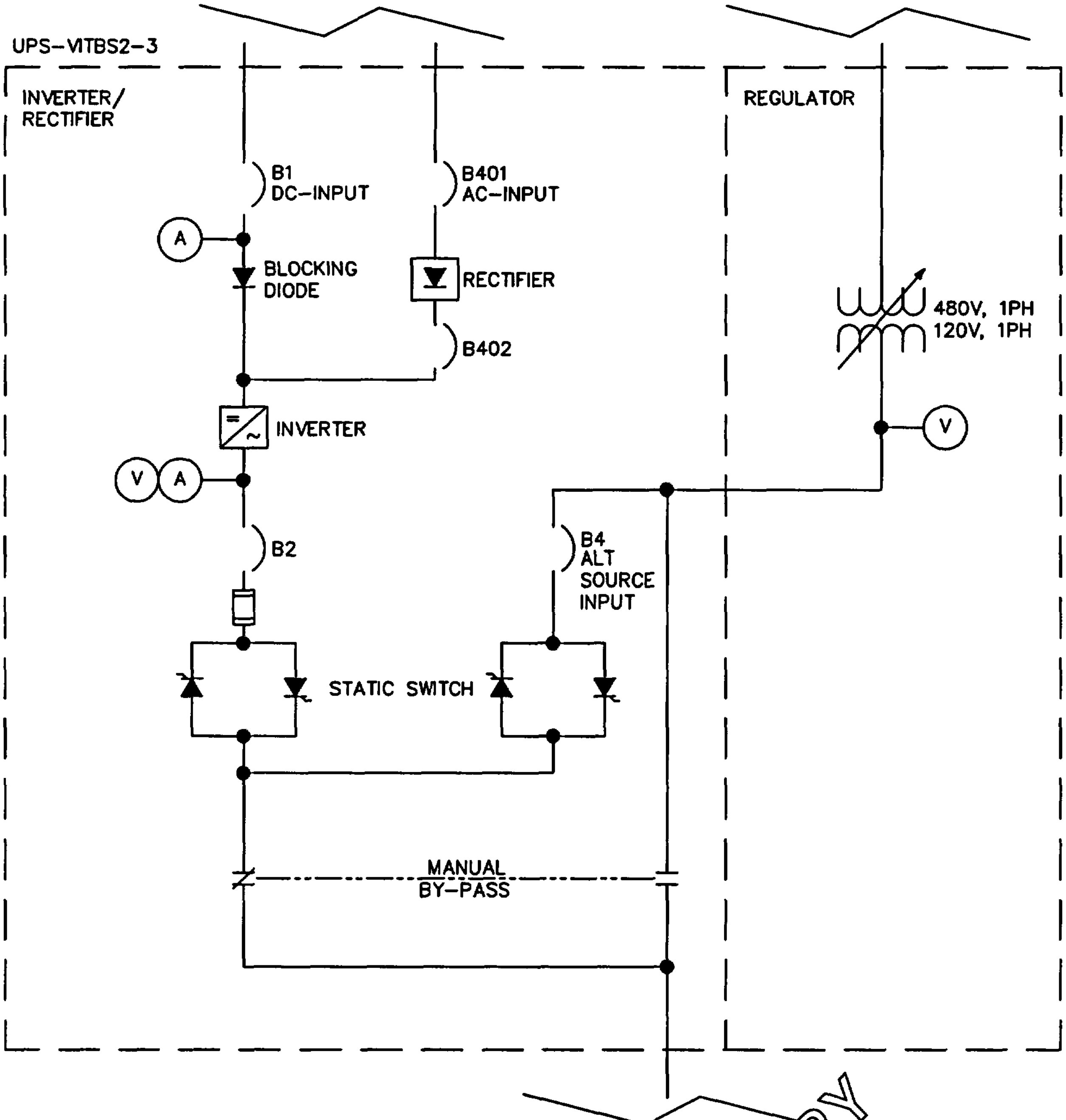
A color coding system is used to identify channel cables and to ensure that redundant instrument channels associated with the solid state protection systems are isolated from each other. Channels I, II, III, and IV are color-coded red, white, blue, and yellow, respectively. This channel identity need only be maintained until some channel terminating device is used. The device may be a qualified isolating transformer or an electromagnetic relay. Channel codings are generally applied to inputs from primary and secondary process systems, which are ultimately fed to the solid state protection systems. Redundant sources of power for primary process and ESF, protective equipment, and associated controls are identified as A and B, with orange and purple color coding, respectively. Where circuits may be supplied from either the A or B source, they are designated by C and color-coded green.

AC Emergency Power System

The ac emergency system includes power supplies, a distribution system, and load groups arranged to provide power to Class 1E loads.



No.10080-RE-1AW
MAIN GENERATOR NO. 2
SEE E05-0059 IDCNs FOR LDCN # 205021
SEE E02-0376 IDCNs FOR LDCN No. 204-016
NUCLEAR SAFETY RELATED
UFSAR FIGURE 8.3-3
OM FIG NOS. 38-1 & 39-2
PRELIMINARY
FENOC
ONE LINE DIAGRAM
VITAL BUS SYSTEM SH 1
AA
10080-RE-1AW



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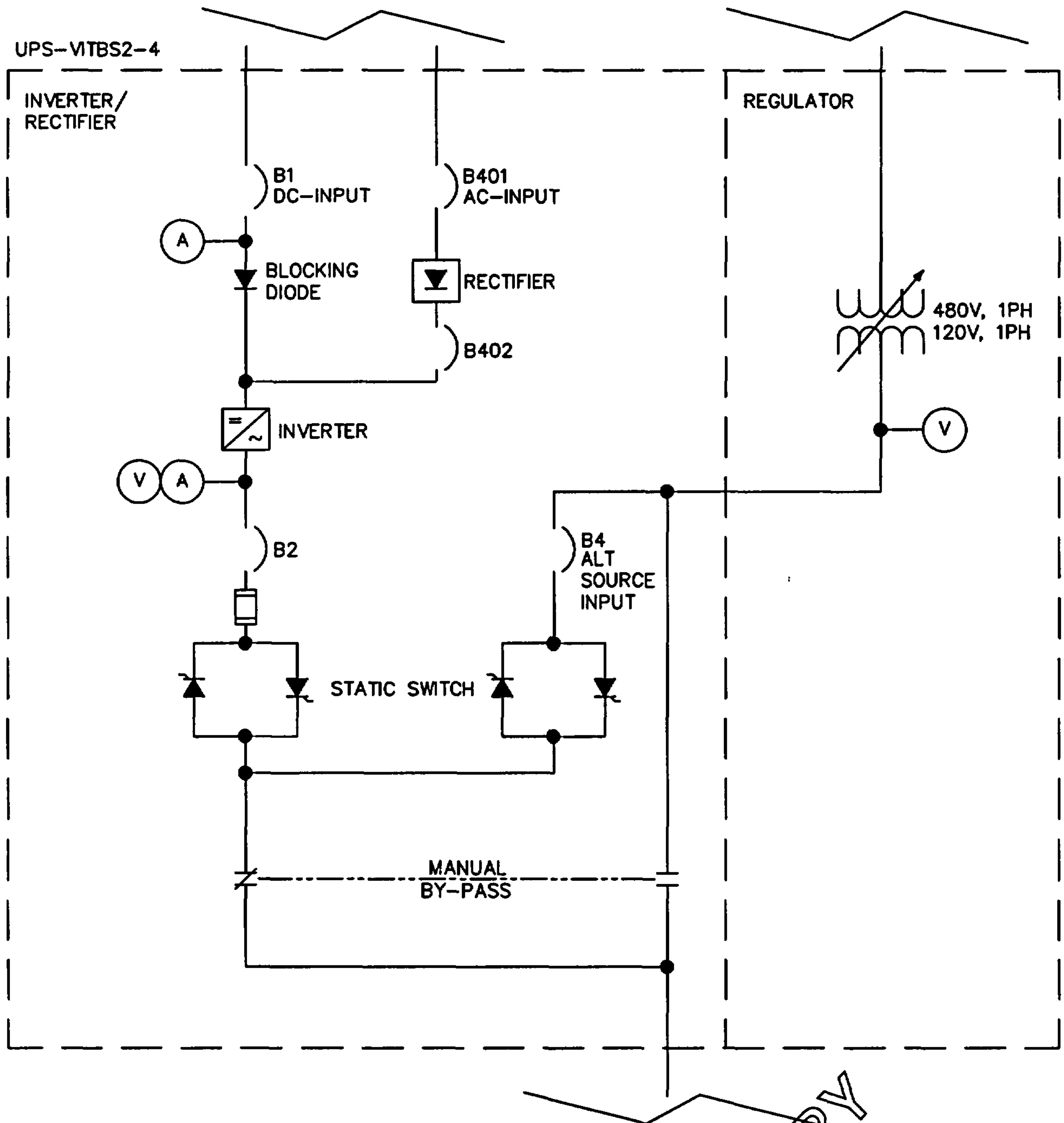
Beaver Valley Power Station

INTERIM DRAWING CHANGE NOTICE

B. Paul	R. C. Lubert	C. V. Mancuso
Preparer	Supervisor	Manager/Date (Print name and sign and date)

Sheet 1 of 1	IDCN Rev. 0	
Affected Drawing: RE-1AW	Unit 2	Rev. 19
Engineering Change: ECP 02-0376		
Implementation Document No.: 03		
IDCN No. 2-RE-0001AW-E02-0376-03		



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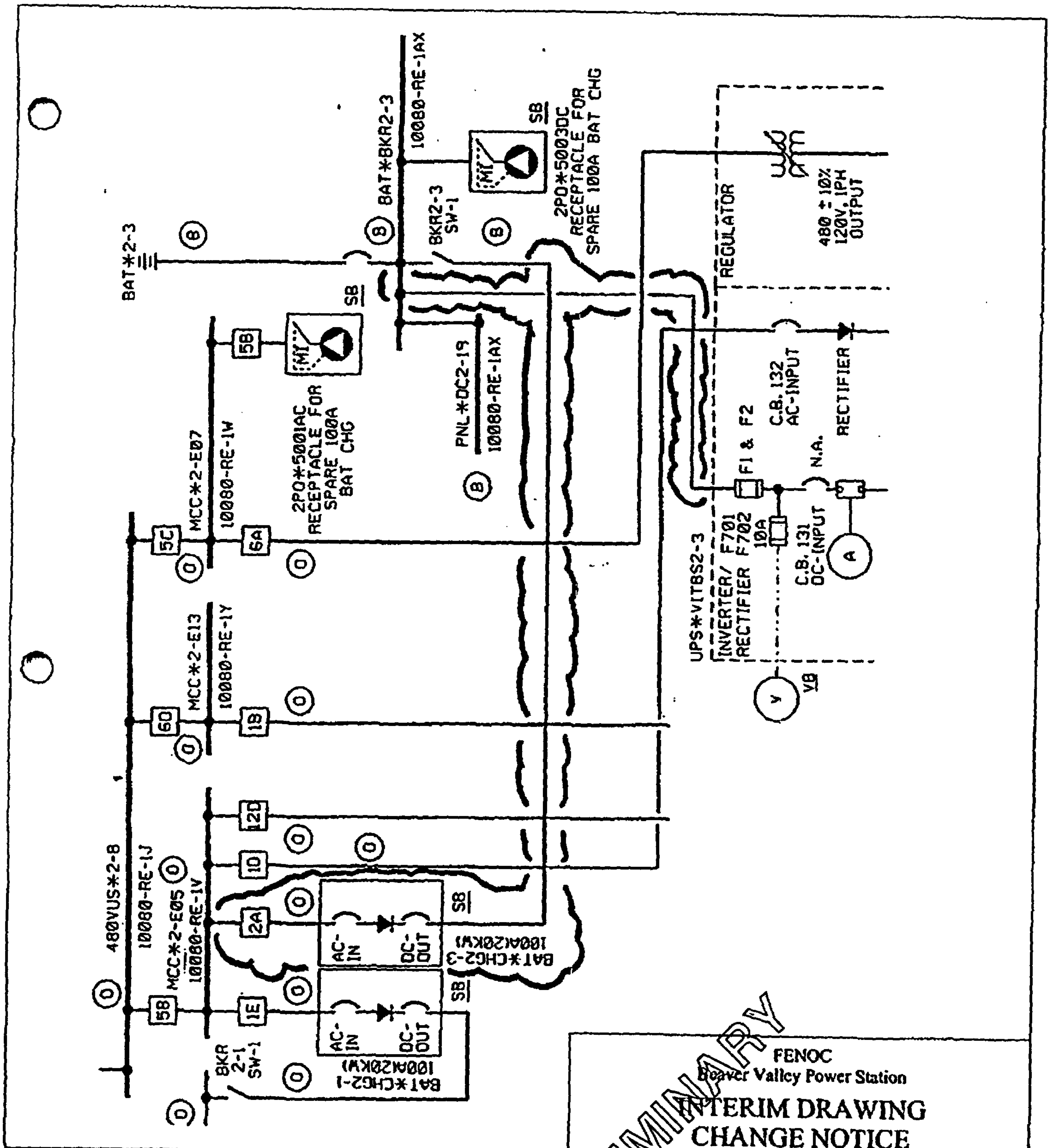
			FENOC Beaver Valley Power Station **INTERIM DRAWING CHANGE NOTICE**
			Sheet 1 of 1 | IDCN Rev. 1
			Affected Drawing: RE-1AW | Unit 2 | Rev. 19
			Engineering Change: ECP 02-0376
B. Paul	R. C. Lubert	C. V. Mancuso	Implementation Document No.: 04
Preparer	Supervisor	Manager/Date (Print name and sign and date)	IDCN No. 2-RE-0001AW-E02-0376-04



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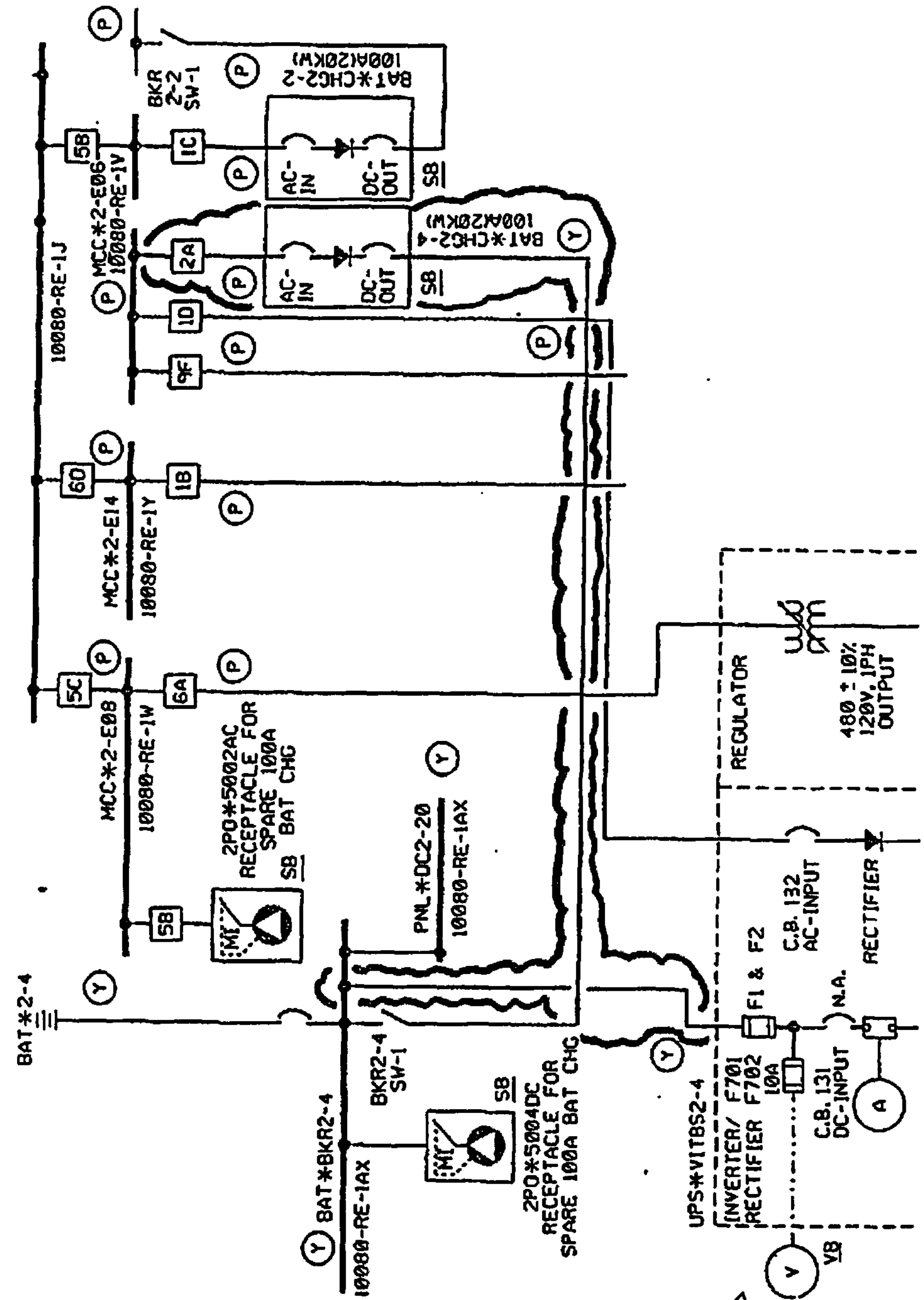
Beaver Valley Power Station

INTERIM DRAWING CHANGE NOTICE

Preparer	Supervisor	Manager/Date (Print name and sign and date)
B. Paul	R. C. Lubert	M. A. Manoleras [signed] 9-21-05

Sheet 1 of 1	IDCN Rev. 0
Affected Drawing: RE-1AW	Unit 2 Rev. 19
Engineering Change: ECP 05-0059	
Implementation Document No.: 03	
IDCN No. 2-RE-0001AW-E05-0059-03	



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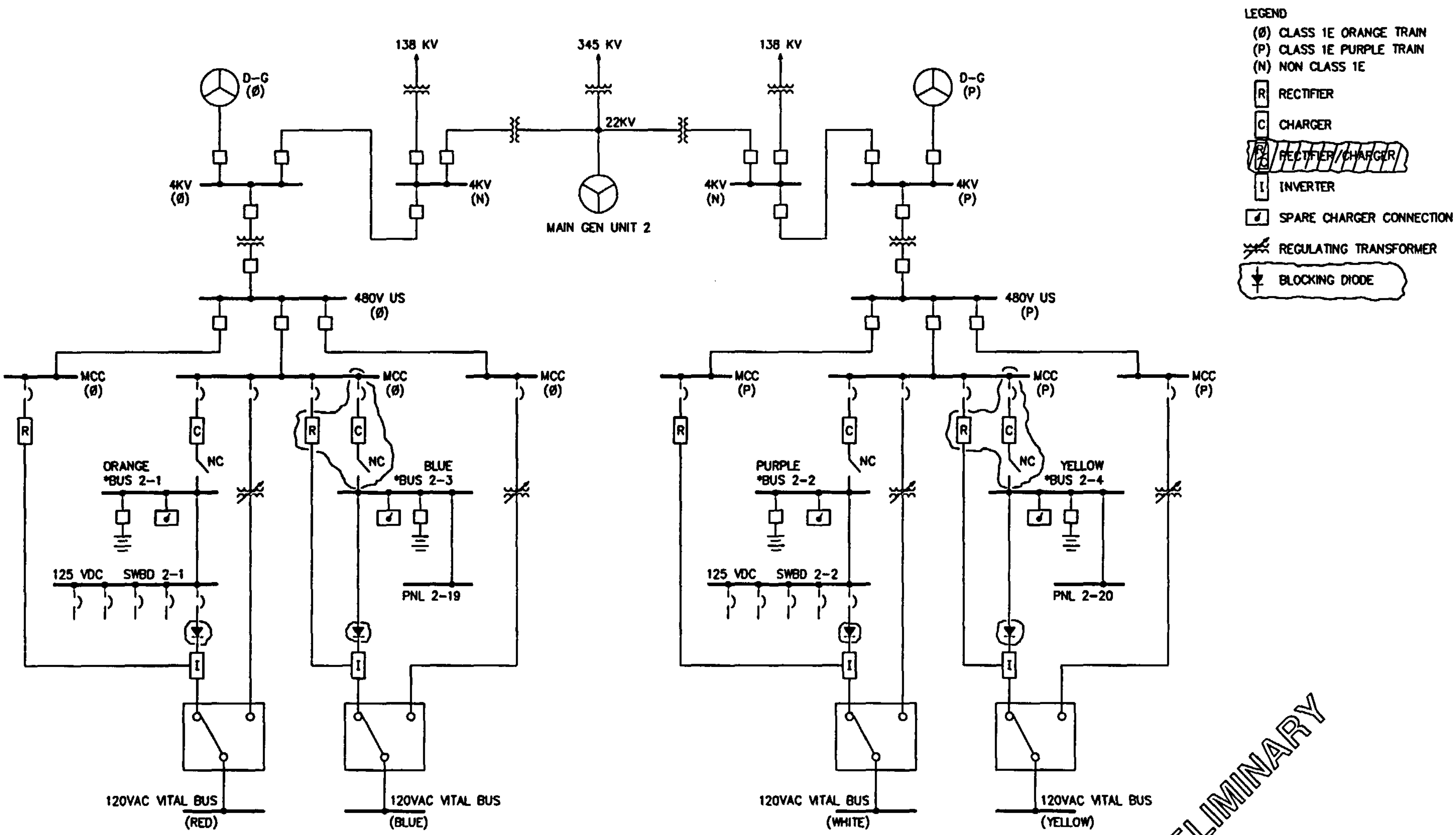
INTERIM DRAWING CHANGE NOTICE

			Sheet 1 of 1	IDCN Rev. 0		
			Affected Drawing: RE-1AW		Unit 2	Rev. 19
Bryan Paul	R. C. Lubert	RCL for MAM 9-21-05	Engineering Change: ECP 05-0059			
B. Paul	R. C. Lubert	M. A. Manoleras	Implementation Document No.: 04			
Preparer	Supervisor	Manager/Date (Print name and sign and date)	IDCN No. 2-RE-0001AW-E05-0059-04			

DRAFT



PRELIMINARY

FIGURE 8.3-14
CLASS 1E 125 VDC
DISTRIBUTION SYSTEM
BEAVER VALLEY POWER STATION – UNIT 2
FINAL SAFETY ANALYSIS REPORT