CHAPTER 8

ELECTRICAL POWER SYSTEMS

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Acronyms and Abbreviations

Acronym/Abbreviation	**Definition**
A	ampere
AC	alternating current
ANSI	American National Standards Institute
CAAS	criticality accident and alarm system
CAMS	continuous air monitoring system
DC	direct current
ESF	engineered safety feature
FFPS	facility fire detection and suppression
FSAR	Final Safety Analysis Report
HCFD	hot cell fire detection and suppression system
hp	horsepower
HVAC	heating, ventilation, and air conditioning
Hz	hertz
IEEE	Institute of Electrical and Electronics Engineers
IF	irradiation facility
kV	kilovolt
kVA	kilovoltampere
kW	kilowatt
LEU	low enriched uranium
LOEP	loss of electric power
LOOP	loss of off-site power
LWPS	light water pool system
MCC	motor control center
NACE	National Association of Corrosion Engineering
NDAS	neutron driver assembly system
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association

Acronyms and Abbreviations (cont'd)

Acronym/Abbreviation	Definition
NFPA	National Fire Protection Association
NPSS	normal electrical power supply system
RAMS	radiation area monitoring system
RCA	radiologically controlled area
SCADA/HMI	supervisory control and data acquisition/ human machine interface
SDG	standby diesel generator
SHINE	SHINE Medical Technologies, Inc.
SWGR	switchgear
TPS	tritium purification system
TOGS	TSV off-gas system
TPCS	TSV process control system
TRPS	TSV reactivity protection system
TSV	target solution vessel
UPSS	uninterruptible power supply system
V	volts
VAC	volts – alternating current
VDC	volts – direct current

CHAPTER 8

ELECTRICAL POWER SYSTEMS

8a1 HETEROGENEOUS REACTOR ELECTRICAL POWER SYSTEMS

The SHINE Medical Technologies, Inc. (SHINE) facility is not a reactor-based facility; therefore, this section does not apply to the SHINE facility.

8a2 IRRADIATION UNIT ELECTRICAL POWER SYSTEMS

8a2.1 NORMAL ELECTRICAL POWER SYSTEMS

The normal electrical power supply consists of 480 volts-alternating current (VAC) off-site power service from the local utility, Alliant Energy, and an on-site commercial standby diesel generator (SDG). The normal power is used for normal operation and normal shutdown of the facility.

8a2.1.1 SHINE FACILITY OFF-SITE POWER SERVICE

The SHINE facility receives a single, independent power off-site circuit from the transmission electric network. This power circuit feeds into two 12 kilovolt (kV) power feeds connected to two local outdoor 12 kV – 480Y/277 VAC 3-phase transformers at 2000 kilovoltampere (kVA) each. Approximate connected facility loads to each of these transformers are about 1500 kVA. Table 8a2.1-1 provides a listing of the loads connected to the main facility switchgear (SWGR) A and B. The 12 kV feeders originate from the Alliant Energy Turtle substation located in Turtle Township, Rock County, Wisconsin about 4.5 circuit miles from the SHINE facility. The 12 kV feeders and transformers are utility-owned equipment. The SHINE facility metering point is at each of the transformer secondary sides at 480 VAC. The metering point is the interface between the SHINE facility and the utility.

Each of the two transformers is connected to one of the SHINE facility’s two main 480 VAC switchgear buses. Figure 8a2.1-1 depicts the off-site connections to the SHINE facility.

8a2.1.2 SHINE FACILITY POWER DISTRIBUTION SYSTEM

The SHINE facility power distribution voltages are 480Y/277 VAC and 208Y/120 VAC 3-phase, 60 hertz (Hz). The outdoor lighting system utilizes 480Y/277 VAC, 3-phase, 60 Hz. The power distribution is designed to operate within the service voltage range of 504Y/291 V to 456Y/263 V (ANSI, 2011). Larger 480 VAC motor loads consist of heating, ventilation, and air conditioning (HVAC) chillers, supply and exhaust fans, and a motor driven fire pump which is connected directly to the off-site transformer A. Each main facility switchgear feeds two motor control centers (MCCs) which supply the smaller motor loads, cranes, heaters, facility indoor and outdoor lighting, etc. Table 8a2.1-1 contains the normal electrical power switchgear nominal load list. Table 8a2.1-3 contains component data for the normal electrical power supply system (NPSS).

8a2.1.3 SHINE FACILITY STANDBY DIESEL GENERATOR

The standby power system is powered by an on-site commercially available diesel generator system and supplies power to selected loads in the event of loss of off-site power (LOOP). Availability of the standby diesel generator (SDG) power source is not required for any Class 1E safety function at the SHINE facility.

If loss of voltage is detected at both SDG switchgear (SWGR) A and B, the SDG starts automatically and is directly connected to both SDG SWGR A and B.

If loss of voltage is detected at only one SDG SWGR, either SWGR A or B, the SDG starts automatically and is directly connected only to the bus that lost voltage.

In all cases, the SDG voltage and frequency is established before the connection and is directly connected in less than sixty seconds from a detected loss of voltage. The SDG SWGRs and SDG MCCs are fed automatically. The SDG operates in an isochronous mode when operating under a LOOP event.

When off-site power is available to be restored to main SWGR buses A and B, the SDG is disconnected from the SDG SWGR before off-site power is re-connected to the main switchgear buses A and B via a manually initiated dead bus (slow) transfer.

When off-site power is available to be restored to either main SWGR bus A or B, the SDG is disconnected from the SDG SWGR bus A or B before off-site power is re-connected to its respective main switchgear bus via a manually initiated dead bus (slow) transfer.

Table 8a2.1-4 contains component data for the SDG system.

8a2.1.4 SHINE FACILITY LOADS SUPPORTED BY SDG

The SDG load profile contains priority loads for asset protection, battery chargers, inverter bypass voltage regulating transformers, emergency lighting, and other nonsafety-related loads that are required during a loss of off-site power. Table 8a2.1-2 contains an SDG load list.

The SDG is sized to provide power to the asset protection loads such as battery chargers, inverter bypass voltage regulating transformers, emergency lighting, and SDG MCCs. Under normal operation these loads are powered from the off-site source. Upon loss of off-site power, the SDG is automatically connected to SDG switchgears and associated SDG MCCs. The operator has the option of adding additional facility loads to the SDG bus manually based on SDG capacity availability.

8a2.1.5 POWER DISTRIBUTION EQUIPMENT

Low voltage switchgear, MCCs, power distribution panels, lighting panels, and other electrical components comply with acceptable industry standards such as Institute of Electrical and Electronics Engineers (IEEE), American National Standards Institute (ANSI), and National Electrical Manufacturers Association (NEMA). The installation of the electrical power distribution system and associated equipment complies with local codes and National Fire Protection Association (NFPA) 70 (National Electrical Code [NEC]) (NFPA, 2011a).

8a2.1.6 SHINE FACILITY GROUNDING SYSTEM

The SHINE facility grounding system complies with the guidelines provided in local codes, NFPA 70 (NEC) (NFPA, 2011a), and IEEE 1050 (IEEE, 2004b). It consists of facility grounding grid, system grounding, equipment grounding, and instrument/computer grounding.

The grounding grid consists of buried, interconnected bare copper rods and ground rods forming a facility ground grid matrix.

The system grounding provides grounding of neutrals of transformers and SDG.

The equipment grounding sub-system provides grounding of equipment enclosures, metal structures, metallic tanks, low voltage switchgear, MCCs, and control cabinets.

The instrument/computer grounding design is consistent with the guidance provided in IEEE 1050 (IEEE, 2004b). Surge suppression devices are placed as needed on incoming 480 VAC feeds from the utility.

8a2.1.7 LIGHTNING PROTECTION SYSTEM

The SHINE facility lightning protection system complies with local codes and NFPA 780 (NFPA, 2011b) and is directly connected to the facility ground system.

8a2.1.8 CATHODIC PROTECTION SYSTEM

The buried metallic pipes, tanks, structures are provided with a cathodic protection system in accordance with guidance provided in National Association of Corrosion Engineering (NACE).

8a2.1.9 FREEZE PROTECTION

Equipment and piping runs that are required for normal functions and are impacted by extreme winter temperature elements are provided with freeze protection.

8a2.1.10 CABLE AND RACEWAY COMPONENTS

The design, installation, and separation of the cable raceway components for SHINE facility complies with NFPA 70 (NEC) (NFPA, 2011a) and local codes. Circuit voltages are designated per the guidance provided in ANSI C84.1 (ANSI, 2001).

Circuit voltages are:

- 480Y/277 VAC power
- 250 volts-direct current (VDC) power (limited to battery connections to uninterruptible power supply system [UPSS])
- 208Y/120 VAC control and power
- Instrumentation circuits (less than 120 V).

8a2.1.11 RACEWAY AND CABLE ROUTING

There are three separation groups for cables and raceways: Group A, B, and N. Separation Group A contains safety-related circuits from Division A. Similarly, separation Group B contains safety-related circuits from Division B. Group N contains remaining facility non-safety related cables. Spatial separation between groups is in accordance with IEEE 384 (IEEE, 2008) and Regulatory Guide 1.75.

Non-Class 1E circuits are electrically isolated from Class 1E circuits by isolation devices in accordance with IEEE 384 (IEEE, 2008).

8a2.1.12 SHINE FACILITY IRRADIATION UNITS

Each irradiation unit (IU) requires two separate power supplies, one at 480 VAC, 3-phase, 60 Hz and one at 208 VAC, 3-phase, 60 Hz. The anticipated loads for each IU are as follows:

- 480 VAC load is approximately 50 kVA
- 208 VAC load is approximately 11 kVA

The fission process is monitored and controlled for conditions from source range through high operating ranges. The source and high ranges of the flux monitoring system detect neutron flux during startup and irradiation modes and provide a signal to the TSV reactivity protection system (TRPS). Flux monitors, located in the light water pool, are used for neutron detection. The monitors are located to provide optimum monitoring in the source and high ranges. This information is input to the TRPS for appropriate automatic response. The TRPS protects the TSV integrity by monitoring IU parameters and causing an IU shutdown when predetermined setpoints are exceeded. Separation of the TRPS functions and normal TSV process control function prevents failures in the TSV process control system (TPCS) control circuit from affecting the TRPS circuitry. Items that are safety-related are supported by the safety-related UPSS and are not dependent on utility power. Therefore, any LOOP, either for a short or long duration, does not affect the safe operation of the IUs.

8a2.1.13 DESIGN BASES

The design function is to provide sufficient, and reliable electrical power to all SHINE facility systems and components requiring electrical power for normal operations and abnormal operations. The normal electrical power supply system (NPSS) is nonsafety-related but may support safety-related systems or components during normal operations. In the event of the loss of normal AC electrical power, the UPSS automatically provides power to the safety-related systems and components. Systems powered by the NPSS are described in Chapters 4, 5, 9, and 11. Further information on the design bases is provided in Chapter 3.

8a2.1.14 TECHNICAL SPECIFICATIONS

There are no potential variables, conditions, or other items that will be probable subjects of a technical specification associated with the normal electrical power system.

Table 8a2.1-1 Normal Electrical Power Switchgear Load List

Bus	Load Description	Nominal Connected Load (kVA)	Nominal Demand Load (kVA)
SWGR A	Zone 2 Exhaust Fan B (Stand-by) (100 horsepower [hp])	82.9	0.0
	Zone 2 Exhaust Fan A (100 hp)	82.9	82.9
	Distribution Panel for Tritium Purification System (TPS) 1,2,3,4	75.0	60.0
	Chiller 1 (200 hp)	165.8	165.8
	Chiller 2 (200 hp)	165.8	165.8
	Feeder to MCC A1	387.8	381.8
	Feeder to MCC A2	374.5	368.5
	Feeder to SDG SWGR A	219.6	119.6
	Misc Load	45.3	45.3
	SWGR A Total Nominal Demand Load		**1389.7**
SWGR B	Zone 1 Exhaust Fan A (125 hp)	103.6	103.6
	Zone 1 Exhaust Fan B (Standby) (125 hp)	103.6	0.0
	Distribution Panel for TPS 5,6,7,8	75.0	60.0
	Chiller 3 (200 hp)	165.8	165.8
	Chiller 4 (200 hp)	165.8	165.8
	Feeder to MCC B1	466.5	421.7
	Feeder to MCC B2	356.9	350.9
	Feeder to SDG SWGR B	240.5	140.5
	Misc Load	45.3	45.3
	SWGR B Total Nominal Demand Load		**1453.6**

Table 8a2.1-2 Standby Diesel Generator Load List

Load	Description	Nominal Connected Load (kVA)	Nominal Demand Load (kVA)
TPS System	TPS 480V Loads	84.0	84.0
	TPS 208V Loads	150.0	150.0
	Control Power Transformer 208/120 VAC - 30 kVA: TPS Support	30.0	30.0
RCA HVAC	Zone 1 Exhaust Fan A	103.6	103.6
	Zone 1 Exhaust Fan B (Standby)	103.6	0.0
Instrument Air	Instrument Air compressor	41.4	41.4
Facility HVAC	Air Handling Unit	12.4	12.4
	Exhaust Fan for UPSS A	0.1	0.1
	Unit Heater 1	0.1	0.1
	Unit Heater 2	0.1	0.1
	Unit Heater 3	0.1	0.1
	Unit Heater 4	0.1	0.1
	Unit Heater 5	0.1	0.1
	Unit Heater 6	0.1	0.1
	Air Cooled Condenser	3.7	3.7
	Exhaust Fan for UPSS B	0.1	0.1
	Unit Heater 7	0.1	0.1
	Unit Heater 8	0.1	0.1
	Unit Heater 9	0.1	0.1
	Unit Heater 10	0.1	0.1
	Unit Heater 11	0.1	0.1
	Unit Heater 12	0.1	0.1
Emergency Lighting	Facility Emergency Lighting	6.0	6.0
	RCA Emergency Lighting	13.0	13.0
UPSS	Battery Charger A	100.0	100.0
	UPSS Voltage Regulating Transformer Assembly A	0.0	0.0
	Battery Charger B	0.0	0.0
	UPSS Voltage Regulating Transformer Assembly B	0.0	0.0
Misc Loads	Sump Pumps	8.3	8.3
	On-Site Fire Systems	4.1	4.1
	Security	22.2	22.2
	Freeze Protection	5.6	5.6
	Raw Material Storage Area Heaters	16.7	16.7
	Emergency Operating Center	5.6	5.6
		SDG Total Nominal Demand Load	**608.0**

Table 8a2.1-3 Normal Electrical Power Supply System Major Component Data

Equipment	Specification	
Main Utility Transformer A	Rating (Power)	2000 kVA
	Primary Voltage	12 kV – delta connected
	Secondary Voltage	480Y/277 V – wye connected, solidly grounded
	Phase/Frequency	3 phase, 60 Hz
	Environment	Outdoor type
Switchgear (typical for SWGR A & B)	Rating (Voltage)	600 V
	Main Bus Rating (Current)	2000 ampere (A) minimum
	Phase/Frequency	3-phase, 60 Hz
	Environment	Indoor type
	Interrupting Rating	65,000 A
	480 V Breakers	Metal enclosed draw-out circuit breakers or motor starter (contactors)
Motor Control Center (typical for MCC A1, A2, B1, B2)	Rating (Voltage)	600 V
	Horizontal Bus Rating (Current)	800 A
	Vertical Bus Rating (Current)	300 A
	Phase/Frequency	3-phase,60 Hz
	Environment	Indoor type
	Interrupting Rating	65,000 A
	480 V Breakers	Molded case circuit breakers

Table 8a2.1-4 Standby Diesel Generator System Major Component Data

Equipment	Specification	
Standby Diesel Generator	Voltage	480Y/277 V, solidly grounded
	Phase/Frequency	3 phase, 60 Hz
	Environment	Indoor type
Switchgear (typical for SDG SWGR A & B)	Rating (Voltage)	600 V
	Main Bus Rating (Current)	1200 A minimum
	Phase/Frequency	3-phase, 60 Hz
	Environment	Indoor type
	Interrupting Rating	65,000 A
	480 V Breakers	Metal enclosed draw-out circuit breakers or motor starter (contactors)
Motor Control Center (typical for SDG MCC A & B)	Rating (Voltage)	600 V
	Horizontal Bus Rating (Current)	800 A
	Vertical Bus Rating (Current)	300 A
	Phase/Frequency	3-phase, 60 Hz
	Environment	Indoor type
	Interrupting Rating	65,000 A
	480 V Breakers	Molded case circuit breakers

8a2.2 EMERGENCY ELECTRICAL POWER SYSTEMS

The emergency electrical power system in the SHINE facility consists of the UPSS and provides reliable power for the safety-related equipment required for facility instrumentation, control, monitoring, and other vital functions needed for shutdown of the plant. The UPSS contains a 250 VDC battery subsystem, inverters, bypass voltage regulating transformers, distribution panels, and other distribution equipment necessary to feed safety-related alternating current (AC) or direct current (DC) loads.

8a2.2.1 CLASS 1E UPSS

The Class 1E UPSS provides two independent divisions of 208Y/120 VAC to emergency power buses. Each division of the Class 1E UPSS consists of a 250 VDC battery subsystem, inverter, battery charger, voltage regulating transformer, panels, and 208Y/120 VAC bus system. For the UPSS loads, refer to Table 8a2.2-1.

Refer to Figure 8a2.2-1 for UPSS components configuration. The buses provide feeds to instrument and control distribution panels. The inverter is powered from the 250 VDC bus connected to the battery bank with associated battery charger. During normal operations, the battery charger provides the battery float charge load requirements and also provides normal operational controls, and critical instrument and monitoring loads.

Under normal operation, the Class 1E inverters receive 250 VDC from the 250 VDC bus tied to batteries and battery chargers. If an inverter is inoperable, or the Class 1E 250 VDC input to the inverter is unavailable, the power is transferred automatically to the back-up AC source via a voltage regulating transformer by a static transfer switch.

Refer to Table 8a2.2-2 for UPSS major component specifications.

The UPSS meets the guidance in IEEE 603 (IEEE, 2009) and IEEE 308 (IEEE, 2012b).

For further discussion of the design bases of the UPSS see Subsection 3.5b.1.11 and Tables 3.5-1 and 3.5a-1.

8a2.2.2 250 VDC CLASS 1E BATTERY SUBSYSTEM

The SHINE facility is provided with a 250 VDC, redundant, Class 1E battery subsystem. Under normal facility operation and normal shutdown, the battery charger provides power to the required operational loads via the Class 1E inverter while the battery bank is kept fully charged and maintained at float charge.

During LOOP, an on-site battery subsystem supplies power to the Class 1E 208Y/120 VAC 60 Hz inverter to critical monitoring and control functions. As the voltage and frequency are established with automatic start of the SDG, the battery chargers associated with the Class 1E battery subsystem are connected to the bus fed by the SDG. The brief interruption of power to the Class 1E battery chargers is restored and the battery bank returns to the fully charged status.

In the event of loss of AC power to the facility (LOOP concurrent with unavailable SDG), the Class 1E battery subsystem continues to provide uninterrupted emergency power to the required safe shutdown loads of the SHINE facility operations. The battery chargers provide the required isolation between the non-1E NPSS and Class 1E 250 VDC. The AC input breakers on both battery chargers and voltage regulating transformers are qualified as isolation devices using guidance from IEEE 384 (IEEE, 2008).

Each of the redundant Class 1E battery subsystems is capable of delivering required emergency power for the required duration during facility normal and abnormal operations. The scope of compliance encompasses physical separation, electrical isolation, equipment qualification, effects of single active component failure, capacity of battery, battery chargers, instrumentation, protective devices, and surveillance test requirements. Each of the Class 1E battery subsystems is separately housed in a seismically qualified Seismic Category I structure.

Class 1E battery subsystem equipment sizing is designed using guidance from IEEE 485 (IEEE, 2010a) and IEEE 946 (IEEE, 2004a).

8a2.2.3 SHINE FACILITY SYSTEMS SERVED BY THE CLASS 1E UPSS

- TRPS – TSV reactivity protection system (Section 7a2.4)
- TRPS/HMI – TSV reactivity protection system/human machine interface (Subsection 7a2.6.8)
- NFDS – neutron flux detection system (Subsection 7a2.4.3)
- PVVS – process vessel vent system blower (Section 9b.6.1)
- CAMS – continuous air monitoring system (Subsection 7a2.7.4.1)
- RAMS – radiation area monitoring system (Subsection 7a2.7.4.2)
- CAAS – criticality accident and alarm system (Section 7b.6)
- RICS – radiological integrated control system (Section 7b.2.3)
- ESFAS – engineered safety features actuation system (Section 7a2.5)
- ESFAS/HMI – engineered safety features actuation system/human machine interface (Subsection 7a2.5.2)
- TOGS – TSV off-gas system (Section 4a2.8)

8a2.2.4 NONSAFETY-RELATED LOADS

The SHINE facility Class 1E UPSS is primarily designed to serve facility essential monitoring and control functions and safe shutdown of the irradiation units. Under normal operating conditions, a limited use for nonsafety-related loads may be acceptable after approved analysis is established that such use has no adverse impact on the safety function of the system. The non-Class 1E circuits are designed with the independence and isolation guidance from IEEE 384 (IEEE, 2008).

8a2.2.5 MAINTENANCE AND TESTING

Maintenance and testing of the UPSS is designed using guidance from IEEE 450 (IEEE, 2010b) and IEEE 336 (IEEE, 2010c).

8a2.2.6 SURVEILLANCE METHODS

Surveillance of the UPSS is designed using guidance from IEEE 338 (IEEE, 2012a) and IEEE 308 (IEEE, 2012b).

8a2.2.7 SEISMIC QUALIFICATION

The UPSS Class 1E power system equipment is qualified using guidance from IEEE 323 (IEEE, 2003). Additionally, battery chargers and inverters are qualified using guidance from IEEE 650 (IEEE, 2006a) and batteries are qualified using guidance from IEEE 535 (IEEE, 2006b).

8a2.2.8 INDEPENDENCE

Independence of redundant UPSS equipment and circuits is designed using guidance from IEEE 384 (IEEE, 2008).

8a2.2.9 SINGLE-FAILURE CRITERION

The application of single-failure criterion in the UPSS is designed using guidance from IEEE 379 (IEEE, 2000).

8a2.2.10 SAFE SHUTDOWN OF THE IRRADIATION UNIT

The present design for the SHINE radiologically controlled area (RCA) does not require any electrical power (normal or emergency) to attain a safe shutdown. The overriding design criteria are for active safety related systems within the RCA to acquire their respective safe states without the assistance of electrical power.

The eight IU cells have safety-related isolation and dump valves that isolate and dump any filled TSV of its contents upon loss of off-site power (LOOP) without any UPSS electrical input. A LOOP is a condition defined as a loss of AC power to the facility. The target solution can remain in the criticality-safe dump tank located in each IU cell until power is returned.

In order to maintain a safe shutdown during a LOOP event, the UPSS is required to power active safety related systems in the TOGS. These safety related systems specific to TOGS are a small recirculating electric blower that will continue to move the off-gas that is being produced by the irradiated target solution and the hydrogen recombiners. During normal operation, radiolytic hydrogen gas is produced and is circulated through a catalytic hydrogen recombiner that keeps the hydrogen concentration below preset limits. For the LOOP event, the target solution is dumped into the criticality-safe dump tank, but hydrogen off-gas production continues even without irradiation from the neutron driver. To address this limited hydrogen off-gas production that continually decreases over time, the UPSS powers the TOGS recirculating blower to the hydrogen recombiner in the TOGS post-LOOP. Loss of off-site power blower systems are in place in the TOGS for each IU cell.

The TSV and TSV dump tank are both immersed in the light water pool. In the LOOP event, the target solution flows to the TSV dump tank without need of power because the TSV dump tank is below the TSV. When in the criticality-safe dump tank, the residual heat contained in the target solution is passively transferred to the LWPS without the requirement of any cooling pumps or motors. The light water pool is sufficiently-sized to passively absorb the residual heat from the target solution without the need for any UPSS electrical power input.

In addition, with the LOOP event, the neutron driver assembly system (NDAS) loses its ability to function as the accelerator section of the NDAS will be without power. For the LOOP event, Class 1E interrupting devices are utilized to facilitate the complete shutdown of the NDAS and its control system for each one of the IU cell's NDASs. The operator follows an approved procedure to re-energize any of the systems that tripped during a LOOP event.

Detailed discussion of the LOOP event is provided in Subsections 13a2.1.5 and 13a2.2.5. Use of the UPSS for other design basis accidents is discussed throughout Chapter 13.

8a2.2.11 MONITORING SYSTEMS ON UPSS

There are a number of monitoring systems that require UPSS power upon the LOOP. The primary function of the various systems post-safe shutdown due to LOOP is to monitor reactivity and radiation levels in the RCA, and those systems are listed in Subsection 8a2.2.3.

The TOGS design includes hydrogen monitoring capability. This analytical monitoring system needs to be powered by the UPSS for as long as the monitoring is required for the facility.

All of the outlined systems serve to monitor the status and health of the primary system and process components within the RCA.

The RAMS and CAMS both require UPSS power upon the LOOP.

8a2.2.12 TECHNICAL SPECIFICATIONS

Potential variables, conditions, or other items that will be probable subjects of a technical specification associated with the emergency electrical power system are provided in Chapter 14.

8a2.2-1 UPSS Load List[a]

Load Description	Nominal Connected Load (kW)	Nominal Demand Load (kW)
TSV Reactivity Protection System (TRPS)	7.20	7.20
Neutron Flux Detection System (NFDS)	1.2	1.2
Continuous Air Monitoring System (CAMS)	2.40	2.40
Radiation Area Monitoring System (RAMS)	2.40	2.40
Criticality Accident and Alarm System (CAAS)	2.40	2.40
Radiological Integrated Control System (RICS)	3.60	3.60
Engineered Safety Features Actuation System (ESFAS)	7.20	7.20
TSV Off-Gas System (TOGS) Recirculating Blower	5.57	13.92
Human Machine Interface (HMI)/ESFAS	2.40	2.40
Process Vessel Vent System (PVVS) Blower	5.57	13.92
HMI/TRPS	3.60	3.60
	UPSS Total Nominal Demand Load	**61.44 kW**

a) Load information above is for a single train. The same loads apply to the redundant UPSS train.

Table 8a2.2-2 Emergency Electrical Power Supply System Major Component Data

Equipment	Specification[(a)]	
Battery	Nominal Voltage	250 VDC
	Battery Type:	Lead calcium
	Number of Cells	120
	kW/cell @ 2 hours	1.26
Battery Charger	AC Input	480 VAC
	DC output	250 VDC
	Rating	400 A
Inverter	DC Input	210 - 280 VDC
	AC Output: Voltage	208Y/120 VAC +/- 5%
	AC Output: Frequency	60 Hz +/- 0.5%
	AC Output: Rating	100 kVA
Voltage Regulating Transformer	AC Input	480 VAC
	AC Output: Voltage	208Y/120 VAC
	AC Output: Regulation	+/ 2%
	AC Output: Frequency	60 Hz
	AC Output: Rating	112 kVA

a) Preliminary specifications above are for equipment for a single train. The same ratings apply to the redundant UPSS train equipment.

8a2.3 IRRADIATION FACILITY ELECTRICAL POWER SYSTEMS TECHNICAL SPECIFICATIONS

Potential variables, conditions, or other items that are probable subjects of a technical specification associated with the IF electrical power systems are provided in Chapter 14.

8a2.4 REFERENCES

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8b RADIOISOTOPE PRODUCTION FACILITY ELECTRICAL POWER SYSTEMS

8b.1 NORMAL ELECTRICAL POWER SYSTEMS

The SHINE facility has one common normal electrical power system. The common normal electrical power system is described in Section 8a2.1.

8b.2 EMERGENCY ELECTRICAL POWER SYSTEMS

The SHINE facility has one common emergency electrical power system. The common emergency electrical power system is described in Section 8a2.2.

8b.3 RADIOISOTOPE PRODUCTION FACILITY ELECTRICAL POWER SYSTEMS TECHNICAL SPECIFICATIONS

Potential variables, conditions, or other items that are probable subjects of a technical specification associated with the RPF electrical power systems are provided in Chapter 14.