

CASE HISTORIES

SOLIDSTATE CONTROLS, INC.

KEEPING BUSINESSES IN BUSINESS



PURPOSE STATEMENT

**THE PURPOSE OF OUR
BUSINESS IS TO
PROVIDE CONTINUITY
OF ELECTRICAL POWER
TO KEEP BUSINESSES IN BUSINESS .**

**WE DO THIS BY HELPING
CLIENTS SOLVE
THEIR POWER PROBLEMS AND
BY CREATING THE MOST
ECONOMICAL LONG-TERM
RESULTS .**

CASE HISTORY

*Another Example
Of Solidstate
Controls, Inc.
Keeping
Businesses In
Business.*

NUCLEAR POWER STATION INSTALLS NEW UPS SYSTEM

Safety in operation is of utmost importance to Maine Yankee Atomic Power Company in Wiscasset, Maine. This is why, during a recent refueling outage, the nuclear plant replaced an existing uninterruptible power supply (UPS) system with a new system and a new operating configuration.

The plant, which utilizes a pressurized water reactor design, is owned by a group of ten utility companies in New England. Maine Yankee began commercial operation in December, 1972 and was designed for a 40 year life cycle. The facility employs over 450 people.

The UPS system protects the power supply to vital AC buses. These are connected to distribution panels and provide power to critical instrumentation monitoring reactor operation parameters, as well as other essential equipment and systems.

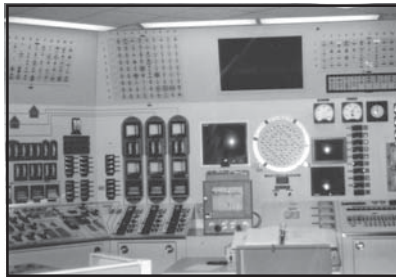
These AC loads include buses to four different channels that provide power for detectors that monitor neutron levels in the reactor; instrumentation for pressure, temperature, flow rate and level of water in the reactor; power for small motors in equipment such as strip recorders and pumps; warning alarms, and Reactor Protection Systems.

The complete UPS system is made up of battery chargers, DC-AC inverters and back-up batteries. The critical AC loads are powered directly by the DC-AC inverters which receive DC current from the battery chargers during normal operation. The inverter delivers a constantly clean, regulated power supply. In the event of a power outage, the inverter is instantaneously transferred to DC battery back-up with absolutely no break in current or voltage.

The old UPS system was removed and a new system installed during a scheduled eight-week refueling outage starting in February, 1992. The new UPS system was actually installed within four and one-half weeks including functional testing. During the shutdown, a number of other design changes were made, maintenance projects undertaken and one-third of the 512 fuel rods changed out.

There were two unique aspects to this UPS application and installation that made it challenging. First, the plant decided to replace the previous system of five individual

inverters and five individual battery chargers with a system incorporating four combination battery charger/inverters and one spare unit. The spare had to have the ability to be brought on-line to replace any of the other four which might be taken out of service. The second major concern was the crucial nature of the timing because of the limited period of the shutdown.



“The implementation of the spare inverter design was very important to Maine Yankee,” said Wes Frewin, project engineer for CIANBRO Corporation, who designed this aspect of the system. “Because of our requirements, we needed system specifications as well as equipment specifications.”

Frewin’s first step was to contact UPS vendors, culled from a utility survey, to see if these companies were still supplying equipment to nuclear plants. He discovered that most UPS manufacturers were no longer supplying nuclear qualified units because construction of new plants had ferroresonant-type inverters based on the performance and reliability of the units being replaced, which were manufactured by Solidstate Controls, Inc. (SCI). Only two of four vendors responded, one of which was SCI. The others did not offer ferro-resonant units.

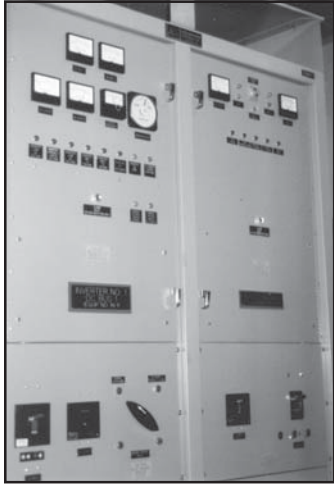
According to Don Hakkila, senior electrical engineer for Maine Yankee, “SCI put together an excellent bid package. Testing and optional testing were explained. Project schedules and a sequence of performance were provided. Everything in the technical specifications was addressed.” Key personnel from SCI and its local representative who would be involved in the project were also interviewed.

Frewin added, “Maine Yankee wanted some unique features that we weren’t quite sure how to address. This is where SCI helped. They knew what they were talking about.”



The new UPS system is made up of five custom-designed SCI 10kVA inverters and five 250 amp battery chargers. Both the battery charger and inverter are housed in the same cabinet, which is a unique design for this type of application. A custom manufactured circuit breaker/distribution cabinet was also installed as an integral part of the system.

The new units replaced SCI inverters purchased in 1971. These had reached their design life of 20 years. Separate battery chargers were used in the old configuration. The older units were commercial grade, while the new equipment is Safety Class 1E qualified for use in nuclear plants and provides an operating life of 40 years. It also has documented qualification test results which provide assurances of operability during applicable design basis events.



The new system design affected three low-voltage electrical systems: a 480 VAC system, 125 VDC system and a 120 VAC instrument power system.

The installation of a spare battery charger/inverter, as a ready replacement for any of the other four units, enhances the system's reliability by providing a means to substitute equipment removed from service due to routine maintenance or equipment failure. This is a preferred alternative to closing tie breakers between related channels, since tie breaker usage invokes specific technical specification-related operating restrictions.

Each channel related system interfaces with the spare battery charger/inverter unit via the circuit breaker/distribution cabinet. Each channel is electrically isolated, physically separated, and mechanically interlocked from one another to ensure system independence is maintained and to avoid the potential for cross-tie.

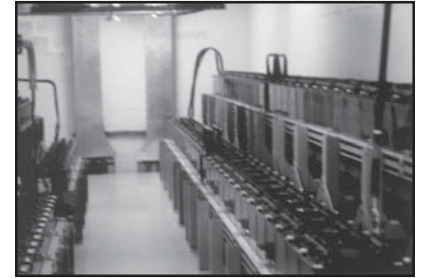
Under normal operating conditions, this design provides the ability to remove a channel designated battery charger/inverter unit from service without interruption of power to the respective DC bus and its associated 120 VAC Vital Instrument Bus. This is accomplished through the combined use of the spare battery charger/inverter unit and a make-before-break transfer switch. Under adverse conditions, such as equipment failure, this system provides the ability to isolate a failed battery charger/inverter and bring into service a one-for-one replacement with very limited disruption to the associated 120 VAC Vital Instrument Bus. This avoids prolonged remedial action associated with such equipment failures and is achieved by the same means as described above, along with the use of input and output circuit breakers to isolate the failed equipment prior to initiating the make-before-break transfer switch. It takes

less than one hour to switch over to the spare battery charger/inverter.

This is the first time, in this type of application, that all battery charger/inverter units have been run through a common circuit breaker cabinet. It is also the first time for using the spare unit in this manner. The NRC audited the plant in April, 1992 and did not identify any deficiencies in their review of the new design. SCI assisted in the audit by providing essential system component documentation.

The location of the battery charger/inverter units remains in the Protected Switchgear Room. The new units are comparable in size, electrically, to those they replaced.

Prior to the removal of the old inverters, it was necessary to redistribute the electrical loads that had previously been on the fifth inverter which was now being eliminated. The spare battery charger/inverter and a spare circuit breaker/distribution cabinet are permanently installed where the fifth inverter had been previously located.



Four battery banks are used in the system, each made up of 59 lead-calcium type cells. Two banks are located in a battery room adjacent to the room housing the inverters, while two additional battery banks are housed in an area directly beneath the other batteries. Two battery banks are also used to start the emergency diesel generators.

A new "human-factored" engineered equipment labelling procedure was also incorporated into the new installation. Color coding was added to enhance the labelling of channel designated equipment and devices; specifically, battery charger/inverter unit equipment labels, input circuit breaker labels on the spare battery charger, and both DC and AC circuit breaker cabinets. The use of color in combination with labelling nomenclature provides enhanced recognition of equipment and devices in an effort to improve operator interface.

In combination with alarms monitored in the control room, surveillance is performed every shift by plant personnel to make sure there are no local alarm conditions present on the inverters. Batteries are also checked periodically for proper operation.

Wes Frewin said, "The installation of these battery charger/inverters was one of the most challenging projects handled during the planned shutdown. Maine Yankee was impressed with how easily the equipment was installed. The units performed well at start-up."

"SCI was the better value for Maine Yankee," said Don Hakkila, "They have been responsive and very good to work with."

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NEBRASKA NUCLEAR POWER PLANT UPGRADES UPS SYSTEM

Nebbraska Public Power District's (NPPD) Cooper Nuclear Station is located near Brownville, Nebraska, occupying a 1,351-acre site on the west bank of the Missouri River. In commercial service since July 1974, the station has a capacity of 778 MW.

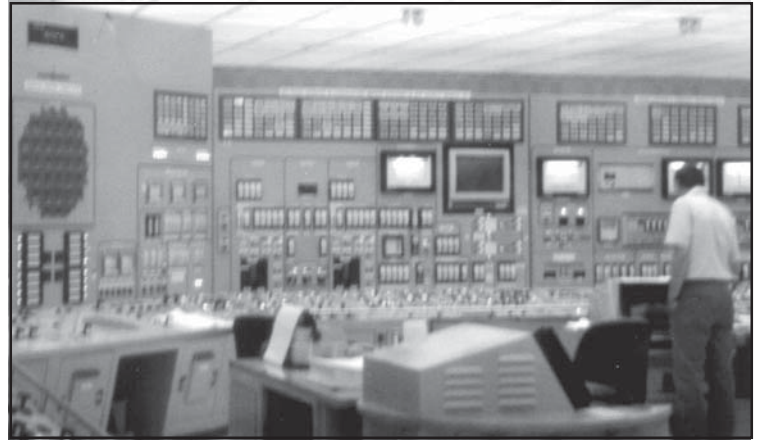
Recently, the Cooper Station replaced one of its uninterruptible power supply (UPS) systems because it had reached the end of its design life expectancy. This particular system provides back-up electrical power for the fire protection system, instrumentation such as the reactor water pressure level recorders, the public address system and the plant security system.

The station went through a systematic procedure of evaluating UPS vendors before purchasing new equipment. According to Ladislav F. Bednar, senior staff engineer at Cooper Station, "A primary criteria of our analysis was the number of nuclear installations a vendor had supplied over the years." Other nuclear plants were also contacted to gather information on how their UPS systems were performing.

Based on this research, Cooper Station discovered that SCI had handled the most nuclear facility installations of any UPS vendor. They also received recommendations from other plants that use SCI equipment.

Another endorsement of SCI's performance came from within Cooper Nuclear Station itself. A 45 kVA SCI system had been used to back-up the plant's management information system computer since 1975. Station personnel involved with this installation had always been very satisfied with the service from SCI, especially the excellent parts availability.

Cooper Station was also impressed with SCI's quick response during the quoting process for the



new system. Michael B. Kennedy, NPPD electrical engineer, said, "Same-day answers to changes in specifications or other questions were the rule, not the exception."

Before the unit was shipped for installation, NPPD personnel came to SCI's manufacturing facility for a day and a half of witness testing. Kennedy added, "This allowed us to observe testing of the system, ask questions about its operation and to actually operate the system under a variety of conditions."

The new UPS system, with a 30 kVA capacity, is quieter, gives off less heat and takes up less space than the unit it replaced. The single-phase system features a variety of custom alarm indicators which were specially laid out for easy reading by plant personnel.

The Cooper Station's UPS system is an industrial grade unit, designed for environments such as those found in nuclear power plants. The system employs ferroresonant technology that uses passive electronic and magnetic components in its design. This type of unit is better suited to industrial environments than UPS systems using more complicated power devices with complex feedback circuits.





Revised 03/2001

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