BRUNSWICK PLANT

SYSTEM DESCRIPTION

CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT

UNITS 1 & 2

SYSTEM DESCRIPTION: SD-57

SEISMIC MONITORING SYSTEM

Revision 1

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Date: 12/16/81

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LIST OF FIGURES AND DRAWINGS

1.0 GENERAL DESCRIPTION

1.1 System Function

The function of the Seismic Monitoring System is to sense and record earthquake ground motion in the Reactor Building.

1.2 System Description

This system is identical for BSEP Units 1 and 2 except where noted.

The Seismic Monitoring System consists of a passive subsystem and an active subsystem. The passive subsystem displays no immediate visual indication, while the active subsystem actually displays an immediate visual indication. Only Unit 2 is equipped with the passive subsystem.

The passive Seismic Monitoring subsystem consists of three multi-element triaxial peak accelographs. Each multi-element triaxial peak accelograph consists of three peak shock recorders. The primary component of the multi-element triaxial peak accelographs is the peak shock recorder. All of the peak shock recorders sense and permanently record the movement of the concrete floors to which they are mounted. Locations of the multi-element triaxial peak accelographs are as follows:

1. Reactor Building Basement/Equipment Drain Tank (El. -17 ft.)
2. Reactor Building RHR Heat Exchanger Support (El. +20 ft.)
3. Reactor Building Refueling Area (El. +117 ft.).

The active seismic monitoring subsystem consists of a remote starter (ENV-XT-823-3), two remote accelerometers (ENV-XT-823-1, ENV-XT-823-2), and a seismic monitoring panel (ENV-XR-823). The remote starter, when actuated, energizes the multichannel accelograph recorder (SMA-3) and the on-line recorder (OR-1) located in the seismic monitoring panel. Each of the remote accelerometers sense earthquake ground motion and provide electrical signals to the seismic monitoring panel. The electrical signals are only recorded when the remote starter has been actuated. Means to record and visually display the earthquate ground motion signals is provided by the seismic monitoring panel. The panel consists of the following equipment:

1. Multichannel Accelograph Recorder and Control Unit (SMA-3)
2. Magnetic Tape Playback Unit (SMP-1)
3. On-line Recorder Unit (OR-1).

The seismic monitoring panel is located in the Electronics Equipment Room.

1.3 Component Description

1.3.1 Peak Shock Recorder

The function of the peak shock recorder is to sense and record earthquake ground motion. Each unit is a completely passive device covering the range of 2 to 25 Hertz in 1/3 octave increments, which means the elements in the unit are designed for a specific frequency. The peak shock recorder is completely self-contained and requires no startup time.

1.3.1 Peak Shock Recorder (Cont'd)

Each peak shock recorder consists of twelve spring steel reeds of different lengths and weights, one for each frequency. The spring steel reeds serve as the primary sensing element of the acceleration forces to which the peak shock recorder is subjected. Attached to the free end of each reed is a diamond-tipped stylus which inscribes a permanent record of its deflection on one of the twelve record plates.

Associated with each reed is a record plate which records the acceleration force of the reed. Each record plate can be inserted four different ways into its respective slot. This allows four recordings to be made before using a second set of plates. To prevent mixing up the record plates, they are labeled and mechanically interlocked by key slots.

1.3.2 Remote Starter

The function of the remote starter (ENV-XT-823-3) is to energize the multichannel accelograph recorders (SMA-3) and the on-line recorder (OR-1) so they can record the remote accelerometer signals. This is accomplished by the SMA-3 turn-on circuit which receives the remote starter signal. The remote starter is located in the Reactor Building basement at the -17 ft. elevation.

The remote starter consists of a horizontal starter assembly and a vertical starter assembly. Both starter assemblies actuate at an acceleration force of 0.01g's, and only one of the starter assemblies has to actuate to energize the SMA-3 turn-on circuit.

The horizontal starter assembly is a small electro-mechanical device which operates like a switch. Either the device is producing an output or no output at all. The assembly is of the inverted pendulum design. Supported from the pendulum is a gold conical mass which has a gold annulus on either side of it. When the assembly is subjected to an acceration force, the gold conical mass comes in contact with the gold annulus producing an electrical output signal to the SMA-3 turn-on circuit.

The vertical starter assembly is also a electromechanical device, but works on an electro-magnetic principle. The assembly is constructed of a spring mass sensor, amplifier, and a transistor switch. The spring mass sensor is a coil of wire suspended in a electromagnetic field which when subjected to an acceleration force, moves the coil of wire in the electro-magnetic field. This action produces an output signal which is amplified, and then fed through a transistor switch to the SMA-3 turn-on circuit.

1.3.3 Remote Accelerometers

The function of the remote accelerometers (ENV-XT-823-1, ENV-XT-823-2) is to sense the earthquake ground motion and provide signals to the multi-channel accelograph recorders (SMA-3), and the on-line recorder (OR-1) if applicable. Remote accelerometer ENV-XT-823-1 is located in the Reactor Building basement at the -17 ft. elevation, and provides a signal to magnetic tape cassette No. 1 in the multichannel accelograph recorder unit (SMA-3). The other remote accelerometer ENV-XT-823-2 is located in the Reactor Building

1.3.3 Remote Accelermeters (Cont'd)

at the +89 ft. 4 in. elevation, and provides a signal to magnetic tape cassette No. 2 in the multichannel accelograph recorder unit (SMA-3). The on-line recorder is capable of monitoring either channel, but is normally aligned to magnetic tape cassette No. 1.

The remote accelerometer is an electro-mechanical device composed of three, spring mass sensors mounted in a triaxial configuration. This arrangement allows the acceleration force to be measured in the longitudinal, transverse, and vertical directions, which produces three output signals for each remote accelerometer. These three signals are then amplified, filtered, and recorded on magnetic tape cassettes located within the multichannel accelograph recorder unit (SMA-3).

1.3.4 Multichannel Accelograph Recorder and Control Unit (SMA-3)

The function of the multichannel accelograph recorder and control unit (SMA-3) is to record the remote accelerometer signals on magnetic tape cassettes and provide the necessary controls to calibrate the magnetic tape cassettes. After a seismic event has been recorded, the magnetic tape cassettes are calibrated, and then removed to be played by the magnetic tape playback unit (SMP-1). The unit is mounted in the seismic monitoring panel (ENV-XR-823) which is located in the Electronics Equipment Room.

There are no controls on the unit which require operation during an earthquake. The unit is in a READY condition once the magnetic tape cassette is loaded and the power supply to the unit energized. The unit is capable of recording a single earthquake or a sequence of earthquakes, and aftershocks lasting as long as 30 minutes.

1.3.5 Magnetic Tape Playback Unit (SMP-1)

The function of the magnetic tape playback unit (SMP-1) is to provide a means of visually presenting the magnetic tape cassettes recorded on the SMA-3 unit. When the magnetic tape cassettes are played, the signals are converted to a strip chart recorder reading for visual indication and intepretation of the earthquake. The strip chart recorder is only capable of visually presenting one acceleration signal at a time, but for data processing all four acceleration signals are available simultaneously. The four signals available consist of: 3 acceleration signals, and 1 reference acceleration signal. The unit is mounted in the Seismic Monitoring panel (ENV-XR-823) and is normally powered from non-interruptible 120 VAC, but has internal batteries in case of power failure.

1.3.6 On-Line Recorder Unit (OR-1)

The function of the on-line recorder unit (OR-1) is to provide an immediate visual indication of the output of a selected triaxial accelerometer at the same time the data is being recorded on the magnetic tape cassette. The unit normally monitors magnetic tape cassette No. 1 (Reactor Building -17 ft. elevation accelerometer signal). The unit is mounted in the Seismic Monitoring panel (ENV-XR-823) and is normally powered from non-interruptible 120 VAC, but has internal batteries in case of power failure.

1.3.6 On-Line Recorder Unit (OR-1) (Cont'd)

The recorder itself is a direct-reading oscillograph which uses an incandescent tungsten lamp as a light source. This light is reflected from galvanometers through a precision optical system onto photosensitive recording paper. After a few seconds exposure to normal room light, a trace appears on the paper for indication.

2.0 INSTRUMENTATION AND CONTROL

2.1 Design Basis

Instrumentation and controls for the Seismic Monitoring System are designed for the operator to monitor the operation of the system and for the safe control of the system.

2.2 Functional and Operational Control

2.2.1 Peak Shock Recorder Operation

When the peak shock recorder is subjected to acceleration forces from earthquake ground motion, the spring steel reeds are vibrated inside the recorder. Vibration of the reeds, inscribes signals on the record plates located within the unit. These signals, which are in the form of scratches, are then measured and recorded on data sheets. From the data sheets, the measurements are then plotted on special graph paper. This plot of the recorders' twelve individual measurements is the low frequency response spectrum of the acceleration signal. The earthquake is analyzed from this response spectrum.

2.2.2 Active Seismic Monitoring Subsystem Operation

The Seismic Monitoring System remains in a standby condition until an earthquake causes the remote starter (ENV-XT-823-3) to actuate at an acceleration force of 0.01g's. Actuation of the remote starter energizes the SMA-3 turn-on circuit. Energizing the SMA-3 turn-on circuit starts the multichannel accelograph recorders (SMA-3) and the on-line recorder (OR-1). These units will start within 0.1 seconds from the time the earthquake is detected and will continue to operate for as long as the earthquake is present, plus an additional 10 seconds after the remote starter has deenergized.

Remote starting of the multichannel accelograph recorders provides the operators with local and remote annunciators. The local annunciator EVENT ALARM is received at the Seismic Monitoring panel (ENV-XR-923), while the remote annunciator SEISMIC EVENT is received on Ann. Pnl. UA-28. The alarms are only present while the multichannel accelograph recorders are running. Another indication at the local panel that an earthquake has been recorded, is the EVENT INDICATOR. Before an event, it is black; after an event, it is white. To reset the event indicator, the key switch is momentarily placed in the TEST position. The key switch is located on the multichannel accelograph control panel, and is used for calibrating the magnetic tape cassettes.

Once the multichannel accelograph recorders (SMA-3) and on-line recorder (OR-1) are energized, the remote accelerometer signals are recorded. Only the Reactor Building -17 ft. elevation remote accelerometer (ENV-XT-823-1) signal is displayed on the on-line recorder unit (OR-1). After the remote accelerometer signals are recorded on magnetic tape cassettes, the tapes are then calibrated and removed from the multichannel accelograph recorders. To retrieve the information recorded on the tapes, the tapes are then played on the magnetic tape playback unit (SMP-1) which provides a strip chart recorder reading of the earthquake. Analysis of the strip chart recorder reading provides the operator with another means to determine the magnitude of the earthquake.

2.2.3 Power Supplies

Component	Power Supply
Seismic Monitoring Cabinet	120 VAC PP 32 AB (Ckt. 18)

2.2.4 Annuciators

The following annunciator is associated with the Seismic Monitoring System. Refer to the Annunciator Procedure Manual for specific causes and additional information.

Annuciator	Units(s)	Annunciator Panel Number
Seismic Event	1 and 2	UA-28

2.2.5 Process Computer References

Various system values can be obtained by use of the process computer. Specific points can be obtained from the Cross-Reference List for the Analog Inputs to the Brunswick Process Computer (see SD-55).

2.3 Monitoring Instrumentation

Table 2.3.1 is a list of all instrumentation that provides monitoring functions for the safe operation of the Seismic Monitoring System. Instruments listed in this section that also provide trip functions, are again listed in Section 2.4, Instrument and Control Setpoints.

TABLE 2.3.1 MONITORING INSTRUMENTATION

FUNCTION	INSTRUMENT DESIGNATION	INDICATOR/RECORDER LOCATION
Reactor Building -17 ft. Elevation Accelerometer	ENV-XT-823-1	ENV-XR-823 on Seismic Monitoring Panel
Reactor Building +89 ft. 4 in. Elevation Accelerometer	ENV-XT-823-2	ENV-XR-823 on Seismic Monitoring Panel
Reactor Building -17 ft. Elevation Peak Accelograph	ENV-XRH-823-1	Local
Reactor Building +20 ft. Elevation Peak Accelograph	ENV-XRH-823-2	Local
Reactor Building +117 ft. Elevation Peak Accelograph	ENV-XRH-823-3	Local

2.4 Instrument and Control Setpoints

Table 2.4.1 is a list of all instrumentation that provides trip functions. In cases where an instrument from a system other than the Seismic Monitoring System is listed, the official setpoint and all trip functions will be found in the System Description to which that instrument belongs.

TABLE 2.4.1 INSTRUMENT AND CONTROL SETPOINTS

SEISMIC MONITORING SYSTEM

INSTRUMENT TRIP FUNCTION	INSTRUMENT DESIGNATION	INDICATOR/ RECORDER	TRIP SETPOINT AND FUNCTION	
Remote Starter (-1/ ft. Elevation of Reactor Building)	ENV-XT-823-3	ENV-XR-823	0.01g's increasing	-Annunciator "Seismic Event" on Ann. Pnl. UA-28. -Annunciator "Event Alarm" on Seismic Monitoring Panel. -Starts Multichannel Accelograph Recorder (SMA-3). -Starts On-Line recorder (OR-1).

3.0 SYSTEM AND COMPONENT DESIGN PARAMETERS

3.1 System Design Data

The Seismic Monitoring System is designed to detect ground accelerations of 0.01g or greater. The design of the plant is such that ground motion of less than 0.02g is of no interest. Detection of ground accelerations at 0.01g insures the multichannel recorder is operating by the time a ground motion of interest occurs.

3.2 Component Design Data

3.2.1 Peak Shock Recorder

Manufacturer	Engdahl Enterprises
Model	PSR 1200-H/V-4A/12A
Number of sensing elements	12
Damping	2% (Q of 25)
Arrangement of sensing elements	Coplanar
Accuracy	+1%
Acceleration	± 3% of full scale

3.2.2 Multichannel Accelograph Unit

Manufacturer	Kinemetrics
Model	SMA-3
Number of recorders	2
Voltage	110 VAC

3.2.3 On-Line Recorder Unit

Manufacturer	Kinemetrics
Model	OR-1
Frequency respone	0-60 Hz
Accuracy	± 5%
Chart speed	10 MM/Sec
Power consumption	50 watts

3.2.4 Magnetic Tape Playback Unit

Manufacturer	Kinemetrics
Model	SMP-1
Modulation type	FM
Accuracy playback System	± 2%

3.2.4 Magnetic Tape Playback Unit (Cont'd)

Overall accuracy with SMA-3	± 5%
Dynamic range	35 db (compensated)
Voltage	110 VAC/battery
Chart recorder	Single channel
Paper speed	25 MM/Sec or 50 MM/Sec

4.0 REFERENCES

4.1 Electrical Elementaries

9527-FP-7545-2 (Unit Nos. 1&2)	Seismic Monitoring System Cable Diagram
9527-FP-7546 (Unit Nos. 1&2)	Seismic Monitoring Panel
9527-FP-7547 (Unit Nos. 1&2)	Seismic Monitoring Panel
9527-FP-7548 (Unit Nos. 1&2)	Seismic Monitoring Panel

4.2 Instrumentation

9527-LL-70000 (Unit No. 1) 9527-LL-7000 (Unit No. 2)	Instrument Schedule X (Misc.)

4.3 Technical Manuals

9527-01-70027	Peak Shock Recorder
9527-01-7528-1	Magnetic Tape Playback Unit
9527-01-7528-2	Multichannel Accelograph Unit
9527-01-7528-3	On-Line Recorder Unit

4.4 Wiring Diagrams

9527-F-90044 (Unit No. 1) 9527-F-9044 (Unit No. 2)	Seismic Monitoring System Wiring Diagram

4.5 Final Safety Analysis Report (FSAR)

FSAR Section 2.6 (Unit Nos. 1&2)	Seismology

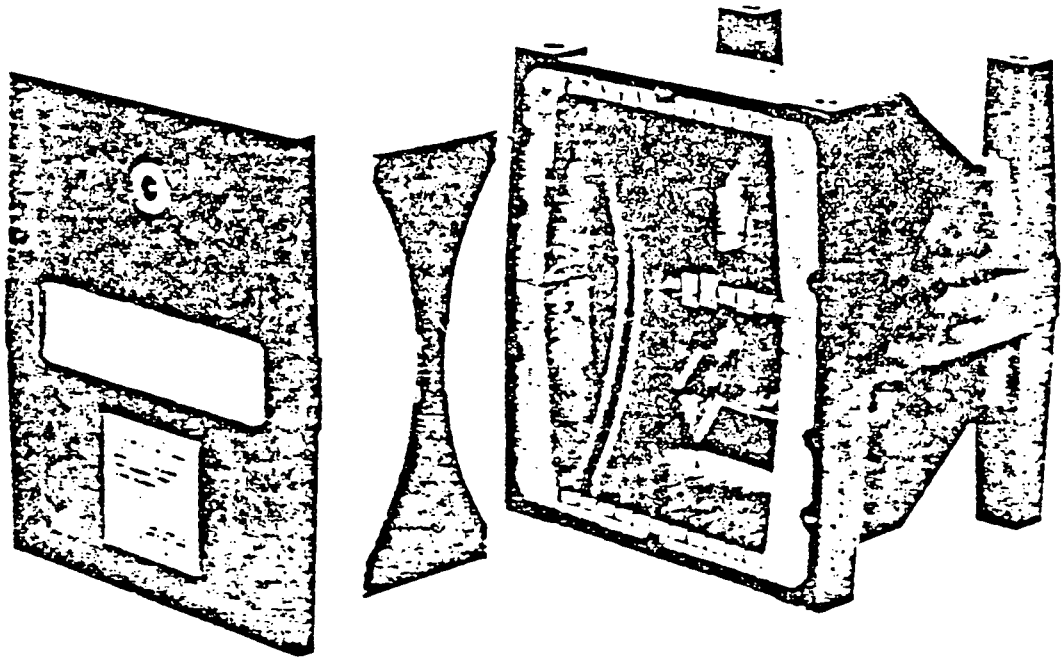

Figure 57-1
Peak Shock Recorder

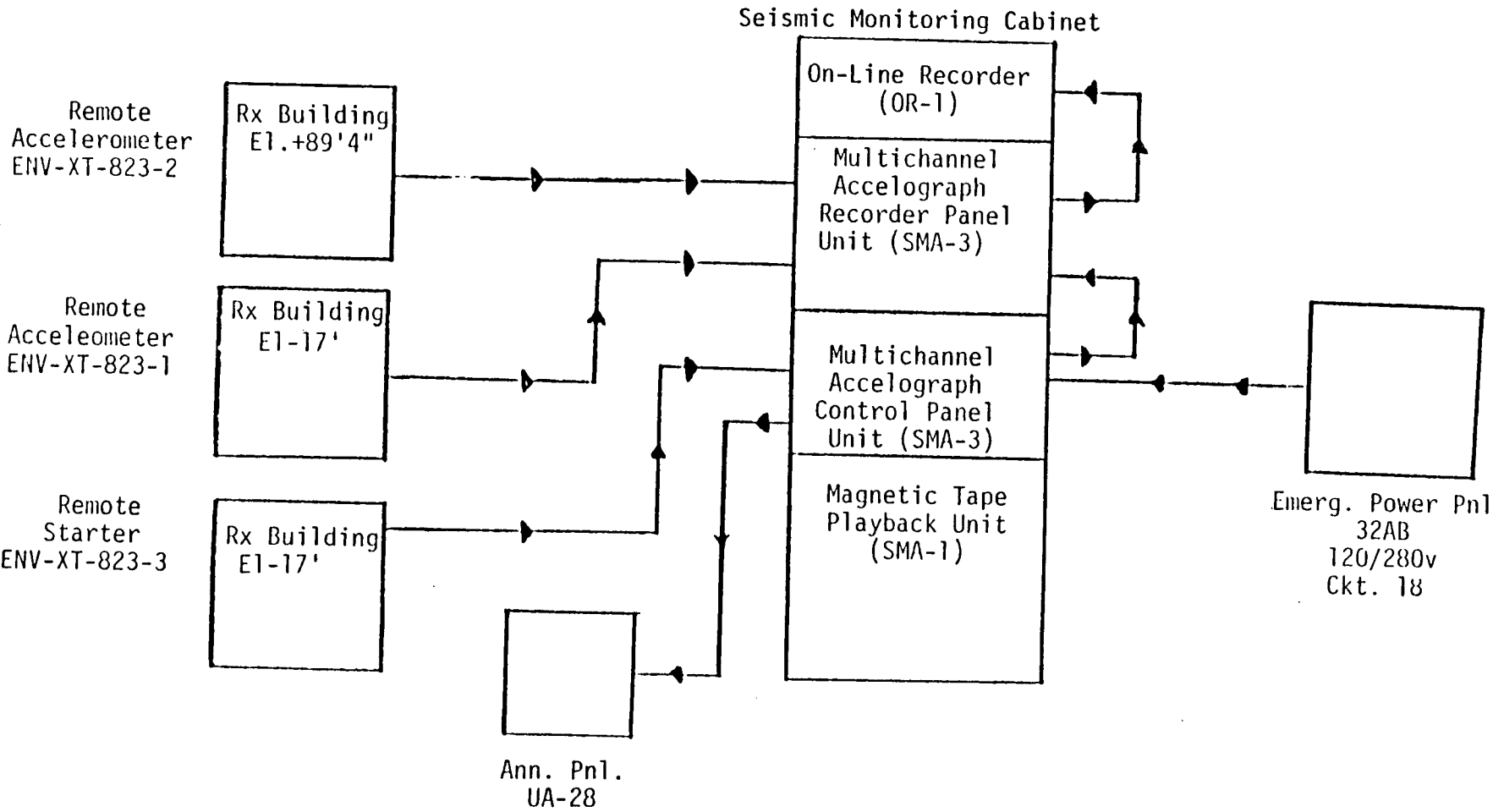

Figure 57-2
Seismic Monitor System