NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Sequoyah, Unit 1	0 5 0 0 0 3 2 7	1 OF 0 6

TITLE (4)
Reactor Trip Signals Generated From Electromagnetic Interference Caused By Welding Machine Operated At High Frequency Near Source Range Nuclear Instrument Cabling

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
										0 5 0 0 0
0 4 2 4	8 8	8 8	— 0 1 9	— 0 0	0 5	2 1	8 8			0 5 0 0 0

OPERATING MODE (9)	5	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	0 0 0	20.402(b)	20.405(c)	XX 50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
Tom Rogers B. E. Kilgore , Plant Operations Review Staff	AREA CODE 6 1 5 8 7 0 - 7 0 8 7

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	XX NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

On April 24, 1988, at 2204 EDT, unit 1 was in cold shutdown with the reactor trip breakers open, a reactor trip signal was generated from a source range (SR) nuclear instrument channel spike. The reactor operator (RO) acknowledged the alarm and subsequently contacted Modifications personnel that were known to be in containment performing welding tasks. The RO had suspected a welding machine being used by Modifications personnel as the cause of the SR spike. The welding machine was operated at high frequency again to ascertain that it was the cause of the SR spike. Upon doing so, a similar spike and a reactor trip signal were generated by the SR channel. On May 2, 1988, at 2108 EDT with unit 1 in cold shutdown with the reactor trip breakers open, another reactor trip signal was generated from the SR channel. The RO acknowledged the alarm and then contacted Modifications personnel in the containment and in the Auxiliary Building (AB) that were known to be performing welding tasks to locate welding machines that could have caused the SR spike. Troubleshooting ensued on two welding machines in containment and one in the AB. On May 4, 1988, the welding machine in containment was identified as the source that caused the SR spike. The welding machine was removed from containment to be tested for proper radio frequency power transmissions. The welding machine was found to have normal transmissions. The root cause of this event is attributed to the noise susceptibility of the existing SR channel design. Plant operations and maintenance experience with respect to SR channel noise susceptibility has been previously identified and will require hardware changes to correct. These changes will be made when the present Westinghouse nuclear instrumentation system is upgraded to meet Regulatory Guide 1.97 requirements. As interim corrective actions, the welders have been informed by memorandum that high frequency use of the welding machine is prohibited. A caution label has also been attached on the applicable welding machines to prohibit high frequency operation.

IE 22
1/1

NRC Form 366
(9-83)

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Sequoyah, Unit 1	0 5 0 0 0 3 2 7	8 8	— 0 1 9	— 0 0	0 2 OF 0 6

TEXT (If more space is required, use additional NRC Form 366A's) (17)

DESCRIPTION OF EVENT

On April 24, 1988, at 2204 EDT with unit 1 in mode 5 (0 percent power, 4 psig, 118 degrees F) and on May 2, 1988, at 2108 EDT with unit 1 in mode 5 (0 percent power, 3 psig, 130 degrees F), reactor trip signals were generated by the reactor protection system (EIIS Code JC) from the source range nuclear instrument (EIIS Code IG) high neutron flux trip. Both of these occurrences were determined to be the results of electrical "noise" induced in the source range channel from a welding machine being used in containment. The following report provides a synopsis of the conditions and activities associated with each event.

Event 1

Initial Conditions - Unit 1 was in cold shutdown, reactor trip breakers were open, source range channel N-31 was inoperable, and its output signal to the reactor protection system logic was blocked. The redundant source range channel (N-32) was operable and selected for output recording on the NR-45 trace recorder.

At 2134 EDT on April 24, 1988, a welder from Sequoyah's Modifications Group informed the unit 1 reactor operator (RO) that he would be performing grinding and welding operations on the train "B" containment lower compartment coolers (EIIS Code BK) to replace essential raw cooling water (EIIS Code BI) containment isolation valves under Workplan 7378-01. This work was to be performed in fan rooms No. 1 and No. 2 inside of containment. The Plant Operations Impact Evaluation Sheet, used at Sequoyah to evaluate the effects work will have on plant equipment, did recognize possible interference on control room instrumentation resulting from the operation of welding machines in fan rooms No. 1 and No. 2.

At 2204 EDT, the welder plugged in the welding machine to set it up for welding in the No. 1 fan room. Upon plugging it in, he noticed that the welding machine was on continuous high frequency, and he immediately turned the primary overload switch to the "OFF" position to deenergize the welding machine. At the same time, the RO received a reactor trip first-out annunciator alarm from the source range channel 2 (N-32) detector and a high flux at shutdown alarm in the main control room. The NR-45 recorder indicated the N-32 spiked at approximately 1.075 E5 counts per second. The source range high flux trip setpoint is 1 E5 counts per second and is initiated when either source range channel exceeds the setpoint. The high flux at shutdown alarm only provides a warning to the control room operators that the neutron count rate is one-half of a decade above background.

The RO suspected the cause of the source range spike to be the welding activities ongoing in containment and subsequently contacted the welders. The operator discussed the activities that occurred in the No. 1 fan room with one of the welders and subsequently requested the welder to operate the welding machine on continuous high frequency to confirm that it was the source of the source range spike. At 2300 EDT, the welder in the No. 1 fan room turned on the welding machine on continuous high frequency, and it resulted in a similar source range high flux trip signal and N-32 trace on NR-45. At 2301 EDT, it was tried again, and the results were the same. The RO concluded the operation of the welding machine at high frequency was the cause of the source range spike and informed the welder to cease work and inform his foreman of the situation.

Event 2

Initial Conditions - Unit 1 was in cold shutdown, reactor trip breakers were open, source range channel N-31 was inoperable, and its output signal to the reactor protection system was blocked. Source range channel N-32 was operable and selected for output recording on the NR-45 trace recorder.

On May 2, 1988, at 2100 EDT, welders from Sequoyah's Modifications Group entered the No. 1 and No. 2 fan rooms in containment to install support hangers for the containment lower compartment cooler ducts under Workplan 7340-01. Two welders proceeded to the No. 1 fan room to set up the welding machine for their job. While setting up the welding machine, several adjustments were made to the machine's current and the frequency settings. Adjustments were made up to the maximum current and frequency positions because the welders were having difficulty in attaining a proper arc from the machine.

At 2108 EDT, while the welders were adjusting the welding machine, the RO received a reactor trip first-out annunciator alarm from the channel 2 source range channel and a high flux at shutdown alarm. The NR-45 recorder indicated N-32 spiked at 2 E5 counts per second. The RO then informed the assistant shift operations supervisor (ASOS) of this occurrence. The ASOS suspected the welding activities as the cause of the spike since he was familiar with the source range high flux trip signal that occurred on April 24, 1988. He, therefore, requested the Modifications general foreman to cease welding activities in fan room 1 and 2 until the cause of the trip signal could be positively determined. Troubleshooting ensued to determine if any of the welding machines were the source of the noise.

Troubleshooting commenced on May 3, 1988, at 0227 EDT. Welding machines used in the No. 1 and No. 2 fan rooms and in the Auxiliary Building at the 690 feet elevation were run at various currents and frequencies and by simulating welding activities, but conditions could not be created that resulted in spiking of the source range channels at levels that would result in a reactor trip.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Sequoyah, Unit 1	0 5 0 0 0 3 2 7	8 8	— 0 1 9	— 0 0	0 4 OF 0 6

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Troubleshooting ceased at 0300 EDT, to allow Modifications personnel to continue their welding since the welding machines appeared to be acceptable. The results of all welding operations from that time was monitored by the shift technical advisor with respect to source range spiking until the noise source could be determined.

On May 4, 1988, troubleshooting on the welding machine used in the No. 1 fan room was resumed. At 2210 EDT, while the welding machine was operated at high frequency, it created a reactor trip signal by causing a source range spike at 2.5 E6 counts per second. This test was conducted again at 2213 EDT and 2214 EDT with the same results. It was then concluded that this was the source of noise that caused the trip signal on May 2, 1988, while Modifications personnel were making adjustments to the machine settings. This is the same welding machine identified as the source of noise that caused the high flux trip signal on April 24, 1988. Welding activities from May 2 to May 4, 1988, did not create a source range reactor trip signal because high frequency welding was not used during this period.

CAUSE OF EVENTS

The source range high flux trips signals that occurred on April 24 and May 2, 1988, were caused by noise induced in source range channel N-32 cabling that resulted in exceeding the 1E5 log count rate trip setpoint monitored by the reactor protection system. The noise was caused by the operation of a welding machine at high frequency in the vicinity of the source range channel 2 cabling.

The root cause of the source range spiking is attributed to the high noise susceptibility of the nuclear instrumentation system (NIS) design to electrostatic, electromagnetic, and radio frequency interference. The source range is particularly sensitive to noise interference because it has a low level pulse signal that is transmitted over long lengths of cabling, from the detectors mounted in containment, to the nuclear instrument cabinet located ir the control room. At Sequoyah, an older system design configuration is installed and has not been enhanced with improved design features recommended by Westinghouse for noise reduction. Though hardware changes could be made to reduce noise susceptibility for the Westinghouse design, it has not been pursued at Sequoyah because the existing system will be upgraded using Gamma-Metrics supplied hardware to meet Regulatory Guide 1.97 requirements for postaccident monitoring. Complete noise reduction in these circuits is unlikely with any compensatory measures for sources of noise such as the welding machine operated at high frequency.

ANALYSIS OF EVENT

This report is submitted pursuant to the requirements of 10 CFR 50.73, paragraph a.2.iv, as a condition that resulted in the automatic actuation of the reactor protection system.

The reactor protection system is provided with a source range high flux trip to ensure a controlled power increase into the "power range" is maintained. No credit has been taken in Sequoyah's accident analysis for this trip function albeit it is required to be functional by technical specification to terminate an excessive power increase at low core power levels. The source range trip is provided to ensure the operators maintain control of the reactor power increase during a startup by subjecting the reactor's neutron count rate to a reactor trip. This is implemented by two source range excore detectors and backed up by two intermediate range excore detectors, that monitor the core's neutron level. If either detector provides a signal to the reactor protection system that is above the setpoint limit before an operator manually blocks the reactor trip function, a reactor trip will occur to shut down the reactor. During these events, however, the source range signal was not a result of a high neutron count rate, but was a result of noise induced in the source range cabling of sufficient magnitude to exceed the reactor trip setpoint. Reactor trip breaker actuation did not occur during these events because they were already open. The reactor trip logic did respond correctly by providing a reactor trip signal in both events as the noise induced in the cabling did exceed the trip setpoint (1E5 counts per second). It is therefore concluded that the occurrence of these events had no significant adverse affect on the health and safety of the public.

CORRECTIVE ACTION

The only required immediate operator actions was to acknowledge the reactor trip and the high flux trip at shutdown annunciator in both events since the trip signal was not the result of the core power level and because the reactor trip breakers were already open. As subsequent operator actions, the operators had all welding activities in the containment suspended and initiate troubleshooting to locate the noise source.

To ascertain the cause of the high source range channel signal, operation of the welding machines was performed in an attempt to recreate the conditions at the time of the source range high flux trip signal. Operation of the welding machine used for welding in the No. 1 fan room following the April 24, 1988 trip immediately verified that it was the source of noise.

Following the May 2, 1988 source range high flux trip signal, an immediate determination of the noise source could not be made during troubleshooting efforts made on welding machines used in the No. 1 fan room, the No. 2 fan room, and the Auxiliary Building. Welding tasks were then allowed to resume, and their effects on control room instrumentation were monitored by the shift technical advisor to locate the noise source if a source range spike recurred. On May 4, 1988, continued troubleshooting identified the welding machine used in the No. 1 fan room as the source of the noise when it is operated at high frequency. This machine was subsequently removed and was tested to determine if it was emitting expected transmissions. Testing was conducted on May 11, 1988, by measuring the welding machine's output radio frequency power level across a board spectrum of frequencies. It was concluded from this testing that the welding machine was emitting expected radio frequencies and power levels.

To reduce recurrence of source range trip signals caused by noise will require long-term system hardware changes to reduce the systems susceptibility to noise interference. This will be done by the upgrade of the existing Westinghouse NIS with Gamma-Metrics equipment. This upgrade is scheduled to be made before the Cycle 4 restart of unit 2 for both units. Though the Gamma-Metrics NIS is being installed to meet Regulatory Guide 1.97 postaccident monitoring requirements, its installation should reduce many of the problems caused by noise interference on the system. These problems should be mitigated because the Gamma-Metrics equipment offers enhanced system design features, employing techniques to minimize noise susceptibility of the system.

As corrective actions to prevent recurrence of this event, the welders have been instructed by memorandum dated May 13, 1988, to ensure welding machines with high-low frequencies are operated at low frequencies. Additionally, the applicable welding machines have been labeled to provide a caution statement to ensure high frequency welding operation is not performed in the plant.

COMMITMENTS

Upgrade installed Westinghouse NIS equipment, in both units, with Gamma-Metrics hardware by Cycle 4 restart of unit 2.

ADDITIONAL INFORMATION

The NRC Operations Center was notified of the April 24, 1988 reactor trip signal on April 25, 1988, at 0117 EDT pursuant to 10 CFR 50.72, paragraph b.2.ii.

The NRC Operations Center was notified of the May 2, 1988 reactor trip signal on May 2, 1988, at 2248 EDT pursuant to 10 CFR 50.72, paragraph b.2.ii. The NRC resident inspectors were also notified of this event.

The welding machine involved in these events were manufactured by Miller-No. 2 - Model No 330A/BP.

There have been no previously reported occurrences of reactor trips caused by the operation of welding machines.

0951Q

TENNESSEE VALLEY AUTHORITY
Sequoyah Nuclear Plant
Post Office Box 2000
Soddy-Daisy, Tennessee 37379

May 21, 1988

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Gentlemen:

TENNESSEE VALLEY AUTHORITY - SEQUOYAH NUCLEAR PLANT UNIT 1 - DOCKET NO. 50-327 - FACILITY OPERATING LICENSE DPR-77 - REPORTABLE OCCURRENCE REPORT SQRO-50-327/88019

The enclosed licensee event report provides details concerning source range high flux reactor trip actuations caused by electromagnetic interference in the source range nuclear instrument cabling from a welding machine operated at high frequency. This event is reported in accordance with 10 CFR 50.73, paragraph a.2.iv.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

S. J. Smith
Plant Manager

Enclosure
cc (Enclosure):

J. Nelson Grace, Regional Administrator
U. S. Nuclear Regulatory Commission
Suite 2900
101 Marietta Street, NW
Atlanta, Georgia 30323

Records Center
Institute of Nuclear Power Operations
Suite 1500
1100 Circle 75 Parkway
Atlanta, Georgia 30339

NRC Inspector, Sequoyah Nuclear Plant

IE22
1/1