

DEC 17 1985

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FOREWORD

This report contains the technical evaluation of the Yankee Rowe Nuclear Power Station response to Generic Letter 83-28 (Required Actions Based on Generic Implications of Salem ATWS Events), Item 1.2, "Post Trip Review: Data and Information Capabilities." This report supersedes report number SAIC-85/1521, part 7, dated July 10, 1985. This report contains an evaluation of material received by SAIC after July 10, 1985.

For the purposes of this evaluation, the review criteria, presented in part 2 of this report, were divided into five separate categories. These are:

1. The parameters monitored by the sequence of events and the time history records
2. The performance characteristics of the sequence of events records
3. The performance characteristics of the time history recorders
4. The data output format
5. The long-term data retention capability for post-trip review material

All available responses to Generic Letter 83-28 were evaluated. The plant for which this report is applicable was found to have adequately responded to, and met, categories 3, 4 and 5.

The report describes the specific methods used to determine the categorization of the responses to Generic Letter 83-28. Since this evaluation report was intended to apply to more than one nuclear power plant, specifics regarding how each plant met (or failed to meet) the review criteria are not presented. Instead, the evaluation presents a categorization of the responses according to which categories of review criteria are satisfied and which are not. The evaluations are based on specific criteria (Section 2) derived from the requirements as stated in the generic letter.

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INTRODUCTION

SAIC has reviewed the utility's response to Generic Letter 83-28, item 1.2, "Post-Trip Review: Data and Information Capability." The response (see references) contained sufficient information to determine that the data and information capabilities at this plant are acceptable in the following areas.

- o The time history recorder(s) performance characteristics
- o The output format of the recorded data
- o The long-term data retention, record keeping, capability

However, the data and information capabilities, as described in the submittal, either fail to meet the review criteria or provide insufficient information to allow determination of the adequacy of the data and information capabilities in the following areas.

- o The sequence-of-events recorder(s) performance characteristics
- o The parameters monitored by both the sequence-of-events and time history recorders

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1. Background

On February 25, 1984, both of the scram circuit breakers at Unit 1 of the Salem Nuclear Power Plant failed to open upon an automatic reactor trip signal from the reactor protection system. This incident occurred during the plant startup and the reactor was tripped manually by the operator about 30 seconds after the initiation of the automatic trip signal. The failure of the circuit breakers has been determined to be related to the sticking of the under voltage trip attachment. Prior to this incident, on February 22, 1983, at Unit 1 of the Salem Nuclear Power Plant an automatic trip signal was generated based on steam generator low-low level during plant startup. In this case, the reactor was tripped manually by the operator almost coincidentally with the automatic trip. At that time, because the utility did not have a requirement for the systematic evaluation of the reactor trip, no investigation was performed to determine whether the reactor was tripped automatically as expected or manually. The utilities' written procedures required only that the cause of the trip be determined, and identify the responsible personnel that could authorize a restart if the cause of the trip is known. Following the second trip which clearly indicated the problem with the trip breakers, the question was raised on whether the circuit breakers had functioned properly during the earlier incident. The most useful source of information in this case, namely the sequence of events printout which would have indicated whether the reactor was tripped automatically or manually during the February 22 incident, was not retained after the incident. Thus, no judgment on the proper functioning of the trip system during the earlier incident could be made.

Following these incidents, on February 28, 1983, the NRC Executive Director for Operations (EDO), directed the staff to investigate and report on the generic implications of these occurrences at Unit 1 of the Salem Nuclear Power Plant. The results of the staff's inquiry into the generic implications of the Salem Unit incidents is reported in NUREG-1000, "Generic

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Implications of AIWS Events at the Salem Nuclear Power Plant." Based on the results of this study, a set of required actions were developed and included in Generic Letter 83-28 which was issued on July 8, 1983, and sent to all licensees of operating reactors, applicants for operating license, and construction permit holders. The required actions in this generic letter consist of four categories. These are: (1) Post-Trip Review, (2) Equipment Classification and Vendor Interface, (3) Post Maintenance Testing, and (4) Reactor Trip System Reliability Improvements.

The first required action of the generic letter, Post-Trip Review, consists of action item 1.1, "Program Description and Procedure," and action item 1.2, "Data and Information Capability." In the next section the review criteria used to assess the adequacy of the utilities' responses to the requirements of action item 1.2 will be discussed.

2. Review Criteria

The intent of the Post Trip Review requirements of Generic Letter 83-28 is to ensure that the licensee has adequate procedures, data, and information sources to understand the cause(s) and progression of a reactor trip. This understanding should go beyond a simple identification of the course of the event. It should include the capability to determine the root cause of the reactor trip and to determine whether safety limits have been exceeded and, if so, to what extent. Sufficient information about the reactor trip event should be available so that a decision on the acceptability of a reactor restart can be made.

The following are the review criteria developed for the requirements of Generic Letter 83-28, action item 1.2:

The equipment that provides the digital sequence-of-events (SOE) record and the analog time history records of an unscheduled shutdown should provide a reliable source of the necessary information to be used in the

post trip review. Each plant variable which is necessary to determine the cause(s) and progression of the event(s) following a plant trip should be monitored by at least one recorder [such as a sequence-of-events recorder or a plant process computer for digital parameters, and strip charts, a plant process computer or analog recorder for analog (time history) variables]. Each device used to record an analog or digital plant variable should be described in sufficient detail so that a determination can be made as to whether the following performance characteristics are met:

- o Each sequence-of-events (SOE) recorder should be capable of detecting and recording the sequence of events with a sufficient time discrimination capability to ensure that the time responses associated with each monitored safety-related system can be ascertained, and that a determination can be made as to whether the time response is within acceptable limits based on FSAR, Chapter 15, Accident Analyses. The recommended guideline for the SOE time discrimination is approximately 100 msec. If current SOE recorders do not have this time discrimination capability, the licensee or applicant should show that the current time discrimination capability is sufficient for an adequate reconstruction of the course of the reactor trip. As a minimum, this should include the ability to adequately reconstruct the accident scenarios presented in Chapter 15 of the plant FSAR.
- o Each analog time history data recorder should have a sample interval small enough so that the incident can be accurately reconstructed following a reactor trip. As a minimum, the licensee or applicant should be able to reconstruct the course of the accident sequences evaluated in the accident analysis of the plant FSAR (Chapter 15). The recommended guideline for the sample interval is 10 sec. If the time history equipment does not meet this guideline, the licensee or applicant should show that the current time history capability is sufficient to accurately reconstruct the accident sequences presented in Chapter 15 of the FSAR.

- o To support the post trip analysis of the cause of the trip and the proper functioning of involved safety-related equipment, each analog time history data recorder should be capable of updating and retaining information from approximately five minutes prior to the trip until at least ten minutes after the trip.
- o The information gathered by the sequence-of-events and time history data collectors should be stored in a manner that will allow for retrieval and analysis. The data may be retained in either hard copy (computer printout, strip chart output, etc.) or in an accessible memory (magnetic disc or tape). This information should be presented in a readable and meaningful format, taking into consideration good human factors practices (such as those outlined in NUREG-0700).
- o All equipment used to record sequence-of-events and time history information should be powered from a reliable and non-interruptible power source. The power source used need not be safety related.

The sequence-of-events and time history recording equipment should monitor sufficient digital and analog parameters, respectively, to assure that the course of the reactor trip can be reconstructed. The parameters monitored should provide sufficient information to determine the root cause of the reactor trip, the progression of the reactor trip, and the response of the plant parameters and systems to the reactor trip. Specifically, all input parameters associated with reactor trips, safety injections and other safety-related systems as well as output parameters sufficient to record the proper functioning of these systems should be recorded for use in the post trip review. The parameters deemed necessary, as a minimum, to perform a post-trip review (one that would determine if the plant remained within its design envelope) are presented on Tables 1.2-1 and 1.2-2. If the applicants' or licensees' SOE recorders and time history recorders do not monitor all of the parameters suggested in these tables, the applicant or licensee should show that the existing set of monitored parameters are

sufficient to establish that the plant remained within the design envelope for the appropriate accident conditions, such as those analyzed in Chapter 15 of the plant Safety Analysis Report.

Information gathered during the post trip review is required input for future post trip reviews. Data from all unscheduled shutdowns provides a valuable reference source for the determination of the acceptability of the plant vital parameter and equipment response to future unscheduled shutdowns. It is, therefore, necessary that information gathered during all post trip reviews be maintained in an accessible manner for the life of the plant.

Table 1.2-1. PWR Parameter List

<u>SOE Recorder</u>	<u>Time History Recorder</u>	<u>Parameter / Signal</u>
x		Reactor Trip
(1) x		Safety Injection
x		Containment Isolation
(1) x		Turbine Trip
x		Control Rod Position
(1) x	x	Neutron Flux, Power
x	x	Containment Pressure
(2)		Containment Radiation
	x	Containment Sump Level
(1) x	x	Primary System Pressure
(1) x	x	Primary System Temperature
(1) x		Pressurizer Level
(1) x		Reactor Coolant Pump Status
(1) x	x	Primary System Flow
(3)		Safety Inj.; Flow, Pump/Valve Status
x		MSIV Position
x	x	Steam Generator Pressure
(1) x	x	Steam Generator Level
(1) x	x	Feedwater Flow
(1) x	x	Steam Flow
(3)		Auxiliary Feedwater System; Flow, Pump/Value Status
x		AC and DC System Status (Bus Voltage)
x		Diesel Generator Status (Start/Stop, On/Off)
x		PORV Position

(1): Trip parameters

(2): Parameter may be monitored by either an SOE or time history recorder.

(3): Acceptable recorder options are: (a) system flow recorded on an SOE recorder, (b) system flow recorded on a time history recorder, or (c) equipment status recorded on an SOE recorder.

Table 1.2-2. BWR Parameter List

<u>SOE Recorder</u>	<u>Time History Recorder</u>	<u>Parameter / Signal</u>
x		Reactor Trip
x		Safety Injection
x		Containment Isolation
x		Turbine Trip
x		Control Rod Position
x (1)	x	Neutron Flux, Power
x (1)		Main Steam Radiation
(2)		Containment (Dry Well) Radiation
x (1)	x	Drywell Pressure (Containment Pressure)
(2)		Suppression Pool Temperature
x (1)	x	Primary System Pressure
x (1)	x	Primary System Level
x		MSIV Position
x (1)		Turbine Stop Valve/Control Valve Position
x		Turbine Bypass Valve Position
	x	Feedwater Flow
	x	Steam Flow
(3)		Recirculation; Flow, Pump Status
x (1)		Scram Discharge Level
x (1)		Condenser Vacuum
x		AC and DC System Status (Bus Voltage)
(3)(4)		Safety Injection; Flow, Pump/Valve Status
x		Diesel Generator Status (On/Off, Start/Stop)

(1): Trip parameters.

(2): Parameter may be recorded by either an SOE or time history recorder.

(3): Acceptable recorder options are: (a) system flow recorded on an SOE recorder, (b) system flow recorded on a time history recorder, or (c) equipment status recorded on an SOE recorder.

(4): Includes recording of parameters for all applicable systems from the following: HPCI, LPCI, LPCS, IC, RUC.

3. Evaluation

The parameters identified in part 2 of this report as a part of the review criteria are those deemed necessary to perform an adequate post-trip review. The recording of these parameters on equipment that meets the guidelines of the review criteria will result in a source of information that can be used to determine the cause of the reactor trip and the plant response to the trip, including the responses of important plant systems. The parameters identified in this submittal as being recorded by the sequence-of-events and time history recorders do not correspond to the parameters specified in part 2 of this report.

The information provided in the submittal indicates that the equipment used to monitor the analog parameters meets the minimal requirements set forth in part 2 of this report. The analog time history recorders are powered from a non-interruptible power supply. The monitoring characteristics are all within the guidelines of the review criteria. However, this plant does not have equipment that meets the minimum requirements for sequence-of-events recorders.

The data and information recorded for use in the post-trip review should be output in a format that allows for ease of identification and use of the data to meet the review criterion that calls for information in a readable and meaningful format. The information contained in this submittal indicates that this criterion is met.

The data and information used during a post-trip review should be retained as part of the plant files. This information could prove useful during future post-trip reviews. Therefore, one criterion presented in part 2 of this report is that information used during a post-trip review be maintained in an accessible manner for the life of the plant. The information contained within this submittal indicates that this criterion will be met.

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4. Conclusion

The information supplied in response to Generic Letter 83-28 indicates that the current post-trip review data and information capabilities are adequate in the following areas:

1. Time history recorders, as described in the submittal, meet the minimum performance characteristics.
2. The recorded data is output in a readable and meaningful format.
3. The information recorded for the post-trip review is maintained in an accessible manner for the life of the plant.

The information supplied in response to Generic Letter 83-28 does not indicate that the post-trip review data and information capabilities are adequate in the following areas.

1. The sequence-of-events recorders meet the minimum performance characteristics.
2. As described in the submittal, sufficient analog and digital parameters are not recorded for use in the post-trip review.

It is possible that the current data and information capabilities at this nuclear power plant are adequate to meet the intent of these review criteria, but were not completely described. Under these circumstances, the licensee should provide an updated, more complete, description to show in more detail the data and information capabilities at this nuclear power plant. If the information provided accurately represents all current data and information capabilities, then the licensee should either show that the parameters currently recorded will enable the licensee to determine that the reactor trip progressed within the design limits of the Safety Analysis Report accident analysis, or detail future modifications that would enable the licensee to meet the intent of the evaluation criteria.

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References:

NRC Generic Letter 83-28, "Letter to all licensees of operating reactors, applicants for operating license, and holders of construction permits regarding Required Actions Based on Generic Implications of Salem ATWS Events." July 8, 1983.

NUREG-1000, Generic Implications of ATWS Events at the Salem Nuclear Power Plant, April 1983.

Letter from L. H. Heider, Yankee Atomic Electric Company, to D. G. Eisenhut, NRC, FYR 83-94 dated November 5, 1983, in response to Generic Letter 83-28 of July 8, 1983, with attachment.

Letter from J. A. Kay, Yankee Atomic Electric Company, to D. M. Crutchfield, NRC, dated November 8, 1983, Accession Number 8311220322 providing additional information in response to Generic Letter 83-28, item 1.1.

Letter from J. A. Kay, Yankee Atomic Electric Company, to D. M. Crutchfield, USNRC, FYR 84-09, dated January 13, 1984, Accession Number 8401300317, providing additional information in response to Generic Letter 83-28 for Yankee-Rowe Nuclear Power Station.

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Supporting Document for Telecon

Yankee-Rowe

1. Parameters recorded: Unsatisfactory
See attached table for discrepancies.
2. SOE recorders performance characteristics: Unsatisfactory

There are no digital (on/off) indications available as part of the data and information capability of the plant.
3. Time history recorders performance characteristics: Satisfactory

Strip charts/circular charts are used to collect all data. Recorders are continuously in service and are powered from one of several uninterruptible power supplies.
4. Data output format: Satisfactory

No SOE output data.

Analog output is in strip chart format.
5. Data retention capability: Satisfactory

Data is retained for the life of the plant.

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Desirable PWR Parameters for Post-Trip Review (circled parameters are not recorded)

<u>SOE Recorder</u>	<u>Time History Recorder</u>	<u>Parameter / Signal</u>
<input checked="" type="checkbox"/>		Reactor Trip
(1) <input checked="" type="checkbox"/>		Safety Injection
<input checked="" type="checkbox"/>		Containment Isolation
(1) <input checked="" type="checkbox"/>		Turbine Trip
<input checked="" type="checkbox"/>		Control Rod Position
(1) <input checked="" type="checkbox"/>	x	Neutron Flux, Power
<input checked="" type="checkbox"/>	x	Containment Pressure
(2)		Containment Radiation
	x	Containment Sump Level
(1) <input checked="" type="checkbox"/>	x	Primary System Pressure
(1) <input checked="" type="checkbox"/>	x	Primary System Temperature
(1) <input checked="" type="checkbox"/>		Pressurizer Level
(1) <input checked="" type="checkbox"/>		Reactor Coolant Pump Status
(1) <input checked="" type="checkbox"/>	x	Primary System Flow
<input checked="" type="checkbox"/>		Safety Inj.; Flow, Pump/Valve Status
<input checked="" type="checkbox"/>		MSIV Position
<input checked="" type="checkbox"/>	x	Steam Generator Pressure
(1) <input checked="" type="checkbox"/>	x	Steam Generator Level
(1) <input checked="" type="checkbox"/>	x	Feedwater Flow
(1) <input checked="" type="checkbox"/>	x	Steam Flow
<input checked="" type="checkbox"/>		Auxiliary Feedwater System; Flow, Pump/Value Status
<input checked="" type="checkbox"/>		AC and DC System Status (Bus Voltage)
<input checked="" type="checkbox"/>		Diesel Generator Status (Start/Stop, On/Off)
<input checked="" type="checkbox"/>		PORV Position

(1): Trip parameters

(2): Parameter may be monitored by either an SOE or time history recorder.

(3): Acceptable recorder options are: (a) system flow recorded on an SOE recorder, (b) system flow recorded on a time history recorder, or (c) equipment status recorded on an SOE recorder.

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