

**SITE AUDIT REPORT FOR THE  
STEP-2 REVIEW OF THE  
INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS  
AT SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2**

**SITE AUDIT PLAN**

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## 1 INTRODUCTION

The "submittal only" review [1] of the Individual Plant Examination of External Events (IPEEE) for the Susquehanna Steam Electric Station, Units 1 and 2 [2,3], has raised some important concerns which may be substantially addressed in a plant site audit. The plant site audit is expected to assist the Nuclear Regulatory Commission (NRC) in determining whether the licensee's IPEEE process meets the objectives of Supplement 4 to Generic Letter 88-20.

The objective of the site visit is to access and review information not contained in the IPEEE submittal, but nonetheless required to evaluate the licensee's IPEEE process. The site visit will primarily include the following activities:

- An entrance/orientation meeting to discuss the site audit objectives and approach, and to satisfy requirements pertaining to radiological and security controls for plant walkdown.
- An onsite audit of "Tier 2" IPEEE information, as described in Section 8 and Appendix C of NUREG-1407, related to the seismic and fire analyses. For instance, such information may include system notebooks and analytical models, walkdown reports, supporting calculations and data, plant procedures supporting any credit taken for operator actions, plant configuration data, etc. However, the site audit will focus on a review of information pertaining to those issues (i.e., unresolved requests for additional information [RAIs], identified potential weaknesses of the IPEEE analyses, and potential plant improvements) which have been documented as a result of the submittal-only review process.
- Interviews with licensee personnel and/or licensee contractors who are capable of explaining the facets of the IPEEE analyses under review consideration and familiar with the aspects of plant operations, configuration, and design that are relevant to the issues under review consideration (as identified in Sections 2 and 3 of this report).
- Plant walkdowns which consist of a review evaluation of the appropriateness of IPEEE screening decisions, modeling assumptions, and identification of potential plant improvements. Again, these walkdowns will focus on issues which have been documented from the submittal-only review and which can be better assessed by means of physical inspection. For any such issues that may have broad relevance (i.e., are applicable to all components, to an entire safety system, or to a general class of components), as opposed to specific relevance to a particular area or component at the plant, then the walkdown will be limited to a physical inspection that samples only representative items.
- Identification and collection of information that may require subsequent evaluation to resolve a remaining review issue or a specific issue revealed as a result of the site audit.
- An exit meeting to summarize the approach and results of the site audit (including any problems encountered), and to clarify further action items, if any.

The first and last activities identified above should involve all relevant review and licensee personnel. The remaining activities should be coordinated via separate groups of relevant review and licensee personnel for the seismic and fire portions of the IPEEE site audit. Hence, for the most part, the audit and walkdown activities for the seismic and fire analyses will be performed independently and concurrently.

Specific details regarding the site audit plan for seismic and fire events are provided below in Sections 2 and 3, respectively. Sections 2.1 and 3.1 list the principal issues to be investigated during the site audit. Sections 2.2 and 3.2 identify the plant areas to be walked down. Sections 2.3 and 3.3 identify the licensee and plant personnel to be interviewed during the site audit. Sections 2.4 and 3.4 provide a list of additional documentation to be reviewed either at the site, or used for subsequent post-site visit evaluations. Lastly, Sections 2.5 and 3.5 identify some additional weak points highlighted in the "submittal only" review [1], which may be addressed during the site audit, at the discretion of the licensee.

## 2 SEISMIC IPEEE SITE AUDIT PLAN

### 2.1 Principal Issues to be Investigated

The principal issues to be investigated during the seismic IPEEE site audit have been documented in RAIs to the licensee [4] and in a technical evaluation report (TER) [1] resulting from the submittal-only review. These issues pertain to unresolved questions, potential weaknesses identified in the seismic IPEEE analyses, and the potential need for plant improvements. The specific issues are as follows:

- The approach described in the Susquehanna IPEEE submittal for assessment of high confidence of low probability of failure (HCLPF) capacities was apparently neither the conservative deterministic failure margin (CDFM) method, fragility analysis method, or other conventional approach. The submittal indicates that HCLPF assessments were based on the original seismic design or on qualification reports, but the details of the methodology were not provided.

During the site audit, the audit team will review the HCLPF calculations and supporting data (including seismic design documents, drawings, seismic qualification report [SQRT] binders, etc.). The purpose of this review will be to check whether or not the HCLPF calculations have been based on established practice, to ascertain whether or not the approach and findings are reasonable, and to confirm whether or not the calculations are consistent with screening decisions and criteria, as well as with the installed condition and configuration. To achieve the last of these objectives, it is expected that some components will be walked down, as judged necessary during the site audit.

- The seismic IPEEE identified certain concerns with respect to low seismic capabilities for (a) adjacent panels and cabinets in close proximity that are not fastened together, (b) unanchored color video CRTs, and (c) HCLPF capacities of four components (two valves, an automatic transfer switch, and a motor control center); however, no hardware changes, or other enhancements, have been documented to rectify these concerns. Also, anomalous conditions were encountered during the walkdown evaluation of seismic-fire interactions, but again, no relevant corrections were proposed.

During the site audit, the audit team will review the licensee's resolution approach for these items, including examination of relevant drawings and seismic capacity calculations, and/or by physical inspection.

- For the two identified low-capacity valves (which may potentially be damaged through adverse seismic-spatial interactions) the submittal stated that these valves will be manually operated following a seismic margin earthquake (SME).

During the site audit, the audit team will evaluate the licensee's basis for this recovery action, including any relevant procedural enhancements or severe accident management guidelines that may have been proposed by the licensee.

### 2.2 Plant Areas to be Walked Down

The seismic walkdown will include examination of the following items discussed in the IPEEE submittal:

- Motor Control Center (MCC) 2B237 (Interaction Concern)
- Valves HV-155-F006 and HV-251-F024B (Interaction Concerns)
- Control and Instrumentation Panels and Cabinets (Unanchored CRTs)
- Control and Relay Rooms (Cabinets Not Bolted Together)
- Automatic Transfer Switch OATS556 (Interaction Concern)
- Fire Pumps Housed in the Non-Seismically Designed Circulating Water Pumphouse
- Seismically Unsupported CO<sub>2</sub> Supply Tank Located in the Plant Yard
- Batteries/Racks for the Diesel-Driven Fire Pump (No Spacers or Stops)
- Unsupported Metal Cabinets Containing Combustibles

**2.3 Licensee Personnel to be Interviewed**

Licensee personnel and/or licensee contractor personnel who participated in, and can explain in detail, the seismic screening walkdown and its findings, the seismic HCLPF calculations, and the disposition approach and status for identified seismic outliers/anomalies should be available during the seismic site audit. At least one of these participants should be closely familiar with design documents and procedures for their ready retrieval during the site audit. A licensee participant familiar with the seismic success paths, plant systems, and operating procedures should also be available to discuss the seismic systems analysis and treatment of operator actions. Additionally, a plant operator who is familiar with plant systems, and who has reviewed the safe shutdown equipment list (SSEL), should be on hand during the seismic review walkdown.

**2.4 Licensee/Site Documentation to be Audited**

The licensee should provide the following documentation in support of the site audit of the Susquehanna seismic IPEEE:

- Systems analysis report supporting the development of seismic success paths and the identification of random failures and operator actions that affect the integrity of the success paths.
- HCLPF calculation notes and supporting SQRT binders, engineering calculations, results of dynamic response calculations (i.e., in-structure spectra), and drawings.
- Seismic IPEEE walkdown report, including screening evaluation work sheets (SEWS), walkdown notes, checklists, and summary of walkdown findings.
- Documentation (internal memorandums or other) on resolution of the open items identified in Section 3.10.6 of the Susquehanna seismic IPEEE submittal, and summarized in Table 4.1 of Reference [1].

**2.5 Additional Site Audit Considerations (Optional)**

Aside from the items listed in Section 2.1, Reference [1] has identified some additional weak points of the IPEEE submittal. These additional points are not considered to be sufficiently serious to alter the acceptability of the submittal; however, the licensee may, at its discretion, provide additional clarification or information that may result in resolution of the associated issues, so that reference to some weaknesses can be eliminated in the contractor technical evaluation report. The optional issues to be investigated may include the following:

- The submittal's treatment of seismic containment performance was limited. A licensee response to a related RAI relied on the argument that core damage would not occur, and did not provide sufficient information on plant seismic capacity related to accident mitigation.

During the site audit, the licensee may provide additional information regarding seismic containment performance. This information should include an equipment list for successful early accident mitigation, description of success criteria for early accident mitigation, comparison of the containment equipment list with the SSEL for accident prevention, and assessment of the plant seismic capacity to resist early containment failure and radiological releases, given core damage.

- The submittal did not apply screening criteria to non-seismic failures and human actions, as recommended in NUREG-1407 for an Electric Power Research Institute (EPRI) seismic margin assessment (SMA).

During the site audit, the licensee may clarify its treatment of non-seismic failures and human actions, and to demonstrate that rates of random failures and operator errors are sufficiently low so as to not compromise seismic success paths.

Walkdowns of specific areas of the plant may be needed to support the licensee's presentation of additional information regarding these additional issues. The licensee personnel to be interviewed, and the level of detail of information to be audited, will be similar to what has already been identified in Sections 2.3 and 2.4.

In Section 3.10.6 of the Susquehanna seismic IPEEE submittal, the licensee has identified a number of issues and has described approaches for their resolution. These issues have been summarized in Table 4.1 of Reference [1]. During site-audit walkdowns, the licensee may choose to demonstrate that these issues have been satisfactorily addressed. Examples of some specific items from Table 4.1 of Reference [1] that may be included in the site-audit walkdowns include the following:

- Low Voltage Switchgear 1/2B210, 1/2B220, 1/2B230, 1/2B240 (Breaker Hoist Removal)
- Fans OV-116A and OV-116B (Anchorage)
- Heating, ventilation and air conditioning (HVAC) Components in Control Structure (Interaction Concerns)
- Load Centers (Breaker Hoist Removal)
- Batteries and Racks (Block Wall Interactions)
- Tanks OT528A-E and OT529A-E (Unscreened Atmospheric Storage Tanks)
- Containment Instrument Gas Bottles (Lateral Support)

### 3 FIRE IPEEE SITE AUDIT PLAN

#### 3.1 Principal Issues to be Investigated

The principal issues to be investigated during the fire IPEEE site audit have been documented in RAIs to the licensee [4] and in a TER [1] resulting from the submittal-only review. These issues pertain to unresolved concerns identified in the fire IPEEE analyses. The specific issues are as follows:

- There are at least two cable spreading rooms, 0-25E and 0-27C, that may have been screened out prematurely. The licensee has screened these cable spreading rooms out on the basis of their low combustible loading. Given that these rooms may contain a large number of redundant and diverse circuits and contain cables protected with Thermo-lag fire barriers, the screening method is not valid. Indeed, there is much uncertainty in the likelihood of a fire that could damage cables in such compartments. However, given the potential severe impact on safe shutdown equipment, such compartments should not be screened out without gaining an understanding of the possible accident sequences associated with cable failures (i.e., sequences of equipment / system losses or other such failures as vital instrumentation circuits). A potential vulnerability may have been overlooked.

To gain an understanding of how the licensee has dealt with this issue, as well as the other issues mentioned below, the audit team will need to gain an overall understanding of how the licensee has conducted the IPEEE, and what types of documentation were generated. The audit team will need to gain an understanding of the overall plant layout and internal configuration with respect to the cable spreading rooms, remote shutdown panel (RSP) and the control room.

The documentation supporting the statements made in the submittal in conjunction with screening of the cable spreading rooms and presence of redundant and diverse safe shutdown circuits will be reviewed for each compartment. Licensee documentation will be reviewed for the types of accident scenarios that may result from cable failures within a cable spreading room.

- The possibility of using the RSP is not modeled in the analysis. It is assumed that evacuation of the control room will not be needed. This overlooks the possibility of un-inhabitable conditions in the main control room, or the decision of the shift supervisor to abandon the room. Lack of analysis of the RSP, which is installed for mitigating a control room or cable spreading room fire, is a significant omission in the fire analysis.

The documentation that support the assumption regarding the lack of need to evacuate the control room, and possible sources that can lead to control room inhabitability, will be reviewed during the site visit. The review may also include the procedural and training documentation that discuss control room evacuation and use of the RSP. The audit team may need to gain an understanding of possible paths between the control room and the RSP, and the possibility of blockage from a fire that may require control room abandonment. As part of this effort, the audit team may need to review the RSP circuits (control and instrumentation), and associated isolation switches.

- The overall core damage frequency attributed to fire events is estimated to be  $10^{-9}$  per refueling cycle (12 to 18 months), which is much smaller than frequencies typically reported in other IPEEE submittals. The reason for the small frequency is that the conditional core damage probability adopted from the Individual Plant Examination (IPE) model is very small, which in turn is

dominated by human actions and recovery activities. The human actions and recovery analyses of the IPE cannot be used for fire-induced core damage frequency evaluation without an adjustment for the influences of fire on the operators and recovery actions (e.g., the effect on man-power, control room habitability, control panel alarms and instrumentation reading, use of equipment from the opposite unit, potential shutdown of both units following a single fire, etc.). The core damage frequencies for various fire scenarios, as reported in the IPEEE submittal, may be overly optimistic because of this omission.

To investigate this issue, the supporting documentation for the dominant fire-induced core damage scenarios, and associated human error probability (HEP) evaluation, will be reviewed. Selected plant areas may need to be visited, and control room sequences may need to be reviewed.

### **3.2 Plant Areas to be Walked-Down**

The following areas have been selected as priority areas for the walk-down:

- The cable spreading rooms and adjacent compartments
- The control room
- Areas where the RSP and associated isolation switches are located
- Pathways connecting the control room to the RSP and isolation switches
- The turbine building

### **3.3 Licensee Personnel to be Interviewed**

It will be beneficial to interview the licensee personnel who have been involved in the preparation and submittal of the fire portion of the IPEEE. These personnel will be asked to display the documentation and computer files that were generated in the course of preparing the IPEEE, and provide a walk-through of the documents and the files that support the submittal, and describe how they support the submittal. The team of experts who conducted the human error analysis, and estimated the HEPs for the dominant fire-induced core damage scenarios, will be needed to provide an explanation of how the HEPs were arrived at.

### **3.4 Licensee/Site Documentation to be Audited**

The documentation and computer files that were generated in the course of preparing the IPEEE will be audited. These may include such items as the following:

- Calculation sheets and other supporting documents for fire frequency evaluation.
- Documents supporting the screening of fire zones, in general, and supporting the screening of the control room and cable spreading rooms, in particular.
- Documents supporting the assumption that there is no need to evacuate the control room, and procedures that discuss control room evacuation and use of the RSP.
- COMPBRN inputs and outputs for cases involving the control room or cable spreading rooms.

- A description of the fire-induced initiating event analysis (e.g., reactor trip, transients and loss of coolant accidents [LOCAs]).
- Cable routing information for the cable spreading rooms and for the RSP.
- Information on the model used for fire-induced core damage analysis leading to the overall core damage frequency reported in the submittal.
- Documentation supporting the assignment of the HEPs used in calculating core damage frequencies for the dominant fire scenarios.

### 3.5 Additional Site Audit Considerations (Optional)

Aside from the items listed in Section 3.1, Reference [1] has identified some additional potential weak points of the IPEEE submittal. These additional points are not considered to be sufficiently serious to alter the acceptability of the submittal; however, the licensee may, at its discretion, choose to provide additional clarification or information that may result in resolution of the associated issues, so that reference to some weaknesses can be eliminated in the contractor technical evaluation report. The optional issues to be investigated include the following:

- The licensee has assumed that fires originating in a cabinet will not affect cables and equipment outside the cabinet. This assumption may be valid only if there are no openings on top of the cabinets, cabinet doors and structural elements (i.e., doors, frame, body etc.) of the cabinets do not have temperature sensitive weak points, and combustible loading inside the cabinets cannot create an excessively strong fire.

During the site audit, the licensee may provide additional information regarding electrical cabinet characteristics. Those cabinets that are in the vicinity of cables from other circuits or other electrical cabinets will be inspected.

- The licensee has assumed that small motors (<50 hp) do not pose a fire threat or fire ignition source to other materials. This assumption is valid only if there are no cables from other circuits above or near these motors.

During the site audit, the licensee may provide additional information regarding the characteristics of the areas where small motors are located. Those areas where such motors are located may be visited to verify the relative location of cables and other equipment.

As mentioned above, walkdowns of specific areas of the plant may be needed to support the licensee's presentation of additional information regarding these additional issues. The licensee personnel to be interviewed, and the level of detail of information to be audited, will be similar to what has already been identified in Sections 3.3 and 3.4.



4      **REFERENCES**

1.      R. T. Sewell, et al., "Technical Evaluation Report on the Submittal-Only Review of the Individual Plant Examination of External Events at Susquehanna Steam Electric Station, Units 1 and 2," ERI/NRC 95-512, Final Report, February 1998.
2.      "Susquehanna Steam Electric Station Individual Plant Examination of External Events (IPEEE)," Pennsylvania Power & Light Company, June 27, 1994.
3.      "Susquehanna Steam Electric Station Response to Request for Additional Information on Individual Plant Examination of External Events (IPEEE) Submittal, Units 1 and 2 (TAC Nos. M74478 and M744790," letter to NRC Document Control Desk, from R. G. Byram, Pennsylvania Power & Light Company, August 9, 1996.
4.      M. Cunningham (NRC), memorandum to J. Stolz (NRC), Subject: Request for Additional Information on Susquehanna IPEEE Submittal, March 11, 1998.

