



UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PA 19406-1415

July 20, 2011

Mr. Timothy S. Rausch
Senior Vice President and Chief Nuclear Officer
PPL Susquehanna, LLC
769 Salem Blvd.
Berwick, PA 18603-0467

SUBJECT: SUSQUEHANNA STEAM ELECTRIC STATION - NRC TRIENNIAL FIRE
PROTECTION INSPECTION REPORT NO. 05000387/2011007 AND
05000388/2011007

Dear Mr. Rausch:

On June 24, 2011, the U.S. Nuclear Regulatory Commission (NRC) completed a triennial fire protection inspection at Susquehanna Steam Electric Station, Units 1 and 2. The enclosed inspection report documents the inspection results, which were discussed you and other members of your staff on June 24, 2011.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations, and with the conditions of your license. The inspectors reviewed selected procedures and records, observed activities, and interviewed personnel. The inspectors also reviewed some aspects of mitigation strategies for addressing large fires and explosions.

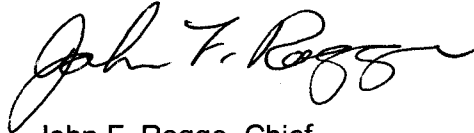
Based on the results of this inspection, two findings of very low safety significance (Green) were identified. The findings were also determined to be violations of NRC requirements. However, because of the very low safety significance, and because the findings were entered into your corrective action program, the NRC is treating these findings as non-cited violations (NCVs) consistent with Section 2.3.2 of the NRC's Enforcement Policy. If you contest the NCVs in this report, you should provide a written response within 30 days of the date of this inspection report with the basis for your denial, to the Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington D.C. 20555-0001; with copies to the Regional Administrator, Region I; the Director, Office of Enforcement; and the NRC Senior Resident Inspector at Susquehanna Steam Electric Station. In addition, if you disagree with the characterization of any findings in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your disagreement, to the Regional Administrator, Region I, and the Senior Resident Inspector at Susquehanna Steam Electric Station. The information you provide will be considered in accordance with Inspection Manual Chapter 0305.

T. Rausch

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Sincerely,

A handwritten signature in black ink, appearing to read "John F. Rogge". The signature is fluid and cursive, with a long horizontal stroke at the end.

John F. Rogge, Chief
Engineering Branch 3
Division of Reactor Safety

Docket Nos. 50-387; 50-388
License Nos. NPF-14, NPF-22

Enclosure:
Inspection Report No 05000387/2011007 and 05000388/2011007
w/Attachment: Supplemental Information

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Sincerely,

/RA/

John F. Rogge, Chief
Engineering Branch 3
Division of Reactor Safety

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U.S. NUCLEAR REGULATORY COMMISSION

REGION I

Docket Nos.: 50-387, 50-388

License Nos.: NPF-14, NPF-22

Report No.: 05000387/2011007 and 05000388/2011007

Licensee: PPL Susquehanna, LLC

Facility: Susquehanna Steam Electric Station, Units 1 and 2

Location: Berwick, PA 18603-0467

Dates: June 6, 2011 – June 24, 2011

Inspectors: K. Young, Senior Reactor Inspector, DRS (Team Leader)
W. Schmidt, Senior Reactor Analyst, DRS
J. Richmond, Senior Reactor Inspector, DRS
L. Scholl, Senior Reactor Inspector, DRS

Approved by: John F. Rogge, Chief
Engineering Branch 3
Division of Reactor Safety

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SUMMARY OF FINDINGS

IR 05000387/2011007, 05000388/2011007; 06/06/2011 – 06/24/2011; Susquehanna Steam Electric Station, Units 1 and 2; Triennial Fire Protection Team Inspection.

The report covered a two-week triennial fire protection team inspection by specialist inspectors. Two findings of very low significance were identified. These findings were determined to be non-cited violations. The significance of most findings is indicated by their color (Green, White, Yellow, Red) using Inspection Manual Chapter (IMC) 0609, "Significance Determination Process" and the cross-cutting aspects were determined using IMC 0310, "Components Within the Cross-Cutting Areas." Findings for which the significance determination (SDP) does not apply may be Green or be assigned a severity level after NRC management review. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 4, dated December 2006.

NRC-Identified and Self-Revealing Findings

Cornerstone: Mitigating Systems

- **Green.** The team identified non-cited violations of Susquehanna Unit 1 Operating License Condition 2.C.(6) and Unit 2 Operating License Condition 2.C.(3) for the failure to implement all provisions of the approved Fire Protection Program. Specifically, PPL had not adequately implemented a fire water supply system with two redundant 100% capacity fire water pumps and three sources of supply water. PPL's hydraulic analysis determined that after 20 minutes of single pump operation, two fire water pumps would need to operate to supply the design rated flow for several sprinkler systems required to be operable by the Susquehanna Steam Electric Station (SSES) Technical Requirements Manual. Subsequently, seven sprinkler systems were determined to be degraded because design flow rates could not be achieved and maintained by a single pump. PPL performed an operability evaluation that determined the affected sprinkler systems were capable of performing their intended functions at lower flow rates and for a shorter duration than originally specified by plant design. In addition, the Unit 2 cooling tower basin was determined to be inoperable as a sole source of supply water for the fire water system. An Operations Directive was issued to not align the fire water system to the Unit 2 cooling tower.

The team determined the failure to verify the adequacy of design to satisfy licensing basis requirements was a performance deficiency. This issue was more than minor because it was similar to NRC Inspection Manual Chapter (IMC) 0612, Appendix E, "Examples of Minor Issues," Example 3.k, which states that an analysis to verify the adequacy of design contained incorrect assumptions. The example concludes that the issue is more than minor if the error resulted in a condition where there was a reasonable doubt on the operability of the component. For this issue, a knowledgeable engineer could not determine the adequacy of design based on a review of the existing hydraulic analysis and associated design details without performing additional complex analysis and preliminary calculations. The team performed a Phase 1 Significance Determination Process screening, in accordance with NRC IMC 0609, Appendix F, "Fire Protection Significance Determination Process." This finding affected the fixed fire

protection systems category, and was screened to very low safety significance because the affected sprinkler systems were determined to have a low degradation rating. This finding did not have a cross-cutting aspect because it was determined to be a legacy issue and was not considered to be indicative of current licensee performance. (Section 1R05.03.1)

- Green. The team identified non-cited violations of Susquehanna Unit 1 Operating License Condition 2.C.(6) and Unit 2 Operating License Condition 2.C.(3) for the failure to implement all provisions of the approved Fire Protection Program. Specifically, PPL established acceptance criteria in the fire pump performance tests that was non-conservative compared to design basis requirements and the test acceptance criteria was insufficient to demonstrate that the fire pumps could provide sufficient pump pressure to satisfy required sprinkler system hydraulic needs. PPL performed an operability evaluation that determined the fire pumps were capable of performing their intended functions based on predicted flow rates and current pump degradation.

The team determined the failure to establish acceptance criteria in annual pump performance tests that demonstrated the pumps would perform satisfactorily in service was a performance deficiency. This issue was more than minor because it was similar to NRC Inspection Manual Chapter (IMC) 0612, Appendix E, "Examples of Minor Issues," Example 3.k, which states that an analysis to verify the adequacy of design contained incorrect assumptions. The example concludes that the issue is more than minor if the error resulted in a condition where there was a reasonable doubt on the operability of the component. For this issue, a knowledgeable engineer could not determine whether pump performance was adequate to satisfy design needs based on a review of the existing pump test results, hydraulic analysis, and associated design details without performing additional complex analysis and preliminary calculations. The team performed a Phase 1 Significance Determination Process screening, in accordance with NRC IMC 0609, Appendix F, "Fire Protection Significance Determination Process." This finding affected the fixed fire protection systems category, and was screened to very low safety significance because the affected sprinkler systems were determined to have a low degradation rating. This finding had a cross-cutting aspect in the area of Problem Identification and Resolution, Corrective Action Program because annual fire pump performance testing in 2009 and 2010 identified significant pump degradation, but PPL failed to initiate a condition report or correct the condition. [IMC 0310, Aspect P.1(a)] (Section 1R05.03.2)

Other Findings

None

REPORT DETAILS

Background

This report presents the results of a triennial fire protection inspection conducted in accordance with NRC Inspection Procedure (IP) 71111.05T, "Fire Protection." The objective of the inspection was to assess whether PPL Susquehanna, LLC has implemented an adequate fire protection program and that post-fire safe shutdown capabilities have been established and are being properly maintained at the Susquehanna Steam Electric Station (SSES), Units 1 and 2. The following fire areas (FAs) and fire zones (FZs) were selected for detailed review based on risk insights from the SSES Individual Plant Examination (IPE)/Individual Plant Examination of External Events (IPEEE):

- FA CS-20/FZ 0-28A-II, Unit 2, Division I, Equipment Room;
- FA CS-28/FZ 0-24D, Unit 1, Division II, Lower Relay Room;
- FA CS-32/FZ 0-27B, Unit 2, Division I, Upper Cable Spreading Room; and
- FA R-1F/ FZ 1-4D, Unit 1, Division I, 4.16 kV Switchgear Room.

Inspection of these areas/zones fulfills the inspection procedure requirement to inspect a minimum of three samples.

The inspection team evaluated the licensee's fire protection program (FPP) against applicable requirements which included plant Technical Specifications, Operating License Conditions 2.C.(6) for Unit 1, and 2.C.(3) for Unit 2, NRC Safety Evaluations (SEs), 10 CFR 50.48, 10 CFR 50, Appendix R, and Branch Technical Position (BTP) Chemical Engineering Branch (CMEB) 9.5-1. The team also reviewed related documents that included the Updated Final Safety Analysis Report (UFSAR), Section 9.5.1, and the fire protection review report (FPRR). The FPRR included the fire hazards analysis (FHA) and the post-fire safe shutdown analyses.

The team also evaluated aspects of one licensee mitigating strategy for addressing large fires and explosions as required by Operating License Conditions 2.C.(34) for Unit 1, and 2.C.(18) for Unit 2. Inspection of the strategy fulfills the inspection procedure requirement to inspect a minimum of one sample.

Specific documents reviewed by the team are listed in the attachment.

1. REACTOR SAFETY

Cornerstones: Initiating Events, Mitigating Systems, and Barrier Integrity

1R05 Fire Protection (IP 71111.05T)

.01 Protection of Safe Shutdown Capabilities

a. Inspection Scope

The team reviewed the FPRR, safe shutdown analyses and supporting drawings and documentation to verify that safe shutdown capabilities were properly protected. The team ensured that applicable separation requirements of BTP CMEB 9.5-1, Section III.G

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of 10 CFR 50, Appendix R, and the licensee's design and licensing bases were maintained for the credited safe shutdown equipment and their supporting power, control and instrumentation cables. This review included an assessment of the adequacy of the selected systems for reactivity control, reactor coolant makeup, reactor heat removal, process monitoring, and associated support system functions.

b. Findings

No findings were identified.

.02 Passive Fire Protection

a. Inspection Scope

The team walked down accessible portions of the selected fire areas to evaluate whether the observed material conditions of the fire area boundaries were adequate for the fire hazards in the area. The team compared the fire area boundaries, including walls, fire doors, fire dampers, penetration seals, electrical raceway fire barriers, and redundant equipment fire barriers to design basis requirements, industry standards, and the SSES fire protection program, as approved by the NRC, to identify any potential degradation or non-conformances.

The team reviewed selected engineering evaluations, installation work orders, and qualification records for a sample of penetration seals to determine whether the fill material was properly installed and whether the as-left configuration satisfied design requirements for the intended fire rating. The team also reviewed similar records for selected fire protection wraps to verify whether the material and configuration was appropriate for the required fire rating and conformed to the engineering design.

In addition, the team reviewed the most recent test results for the Unit 1 lower relay room CO₂ fire damper functionality test, and inspection records of penetration fire barrier seals and fire separation barriers for the selected fire areas, to verify whether the inspection and testing was adequately conducted, the acceptance criteria were met, and any potential performance degradation was identified.

b. Findings

No findings were identified.

.03 Active Fire Protection

a. Inspection Scope

The team evaluated the fire detection and suppression systems in the selected fire areas to determine whether they were installed, tested, maintained, and operated in accordance with NRC requirements and approved deviations, National Fire Protection Association (NFPA) codes of record, and the SSES Fire Protection Program (FPP), as

approved by the NRC. The team also assessed whether the suppression systems capabilities were adequate to control and/or extinguish fires associated with the hazards in the selected areas.

The team reviewed PPL's alternative analysis, performed in lieu of a full discharge test, for the carbon dioxide (CO₂) suppression systems to evaluate whether design input assumptions for room pressure integrity remained valid. In addition, the team assessed PPL's configuration controls to determine whether they were adequate to maintain room allowable leakage rates within the leakage limits specified in EC-013-0968, "CO₂ Mass Addition Requirements." The team reviewed functional testing, design specifications, and vendor requirements for the carbon dioxide (CO₂) and Halon suppression systems for the Unit 1 lower relay room. The team also reviewed and walked down the associated fire fighting strategies and CO₂ system operating procedures.

The team reviewed the as-built capability of the fire water supply system to verify whether design and licensing basis and NFPA code requirements were satisfied for the hazards involved. The team reviewed the fire water system hydraulic analyses to assess the adequacy of either the motor-driven or diesel-driven pump to supply the largest single hydraulic load on the fire water system plus concurrent fire hose usage. The team evaluated the motor-driven and diesel-driven pump performance tests to assess the adequacy of the test acceptance criteria, for pump minimum discharge pressure at the required flow rate, to satisfy design basis and hydraulic analysis requirements. The team also evaluated the underground fire loop flow test to verify whether the test adequately demonstrated that the flow distribution circuits were able to meet design basis requirements. In addition, the team reviewed the most recent pump and loop flow test results to verify whether the testing was adequately conducted, the acceptance criteria were met, and any potential performance degradation was identified.

The team walked down accessible portions of the detection and suppression systems in the selected areas and major portions of the fire water supply system, including motor and diesel driven pumps and clarified water storage tank (CWST), interviewed system and design engineers, and reviewed selected open condition reports (CRs) to assess the material condition of the systems and components. In addition, the team reviewed the most recent test results for the fire detection and suppression systems in the selected fire areas to verify whether the testing was adequately conducted, the acceptance criteria were met, and any potential performance degradation was identified.

The team assessed the fire brigade capabilities by reviewing training, qualification, and drill critique records. The team also reviewed pre-fire plans and smoke removal plans for the selected fire areas to determine if appropriate information was provided to fire brigade members and plant operators to identify safe shutdown equipment and instrumentation, and to facilitate suppression of a fire that could impact post-fire safe shutdown capability. The team independently inspected the fire brigade equipment, including personnel protective gear (i.e., turnout gear) and smoke removal equipment, to determine operational readiness for fire fighting.

b. Findings

.1 Redundant Fire Water Pump & Water Source Deficiency

Introduction: The team identified a finding of very low safety significance (Green) involving non-cited violations of SSES Unit 1 Operating License Condition 2.C.(6) and Unit 2 Operating License Condition 2.C.(3), for the failure to implement and maintain all aspects of the approved FPP, in that PPL had not adequately implemented a fire water supply system with two redundant 100% capacity fire water pumps and three sources of supply water, as required by the approved FPP. Specifically, PPL's fire water system hydraulic analysis determined that after 20 minutes of single pump operation, two fire water pumps would need to operate to supply the design rated flow for several sprinkler systems required to be operable by the SSES Technical Requirements Manual (TRM).

Description: The team used the following SSES licensing basis requirements to assess the adequacy of PPL's hydraulic analysis methodology:

- Two 100% redundant 2500 gpm, 125 psi fire pumps are provided.
- Three separate water sources (CWST, Unit 1 and 2 cooling tower basins).
- Fire pumps can draw water for any or all water sources.
- CWST capacity for fire protection is 300,000 gallons; cooling tower basins are 6 million gallons each.
- One fire pump can supply the largest single suppression system water demand (all sprinkler heads open), plus 500 gpm for hose streams.
- The fire water supply (total capacity and flow rate) should be calculated on the basis of the largest expected flow rate for a period of two hours, but not less than 300,000 gallons.

Fire water system hydraulic analysis, EC-013-0022, "Fire Protection Piping Pressure Losses," determined the pressure available at the interface valves (i.e., OS&Y valve) between the fire water supply system and sprinkler or deluge systems. The purpose of the analysis was to verify that piping pressure losses at the design rated flow value for each sprinkler or deluge system was within the capacity of a single fire water pump (i.e., verification of design adequacy).

In reviewing EC-013-0022, the team identified a number of pre-action sprinkler systems with low margins between the minimum design pressure at the OS&Y valve and the calculated available pressure with the sprinkler system at its design rated flow. The sprinkler's design rated flow and the minimum design pressure needed at the OS&Y valve were determined in a separate vendor calculation, performed by the sprinkler system designer (e.g., Grinnell), in order to ensure that the sprinkler system could deliver the design specified water spray density per square foot to the area protected by the sprinklers. Three pre-action sprinkler systems had pressure margins of less than 3 psig, while several more had margins that ranged from 7 to 14 psig.

The team identified that the analysis was performed with a pump aligned to the CWST. The team determined the use of the CWST as the analyzed suction source for the pumps was non-conservative because the Unit 2 cooling tower provided a lower suction pressure to the pumps. The CWST minimum tank level was at elevation (Elev.) 695 foot (ft.), while the Unit 2 basin minimum level was at Elev. 687 ft., a difference of about 3.5 psig. The Unit 1 basin was about 15 ft. higher than the CWST. In addition, the team identified that PPL did not have any administrative or operational controls on the cooling tower minimum water level to ensure compensatory measures or fire protection impairments were taken if adequate suction pressure to the fire pumps was not available. PPL entered the Unit 2 cooling tower issue into their corrective action program (CRs 1420386 and 1421627). PPL's operability evaluation determined that the Unit 2 cooling tower could not supply sufficient suction pressure to a single fire water pump to satisfy the design rated flow demands for a number of sprinkler systems. PPL issued Operations Directive 11-05, which stated that the Unit 2 cooling tower can not be credited as an operable suction source for fire protection; if the Unit 2 cooling tower is aligned, then, appropriate fire system impairments are required. The team concluded that PPL's interim compensatory measure was appropriate and implemented in a timely manner, commensurate with the risk significance of this issue.

The team identified a second non-conservative difference between licensing basis requirements and PPL's analytical methodology, in that EC-013-0022 stated:

- For large systems, with the CWST water level above Elev. 752 ft., a single pump will provide adequate flow and pressure for the initial 20 minutes; two pumps in operation at lower water level.
- For small systems at high elevation, minimum water levels are based on the maximum water level minus the system demand for 20 minutes.

The team's review of the analysis identified 3 pre-action sprinkler systems that were evaluated within the analysis as needing two pump operation to satisfy rated flow requirements after 20 minutes of single pump operation. A subsequent review by PPL identified a total of seven pre-action sprinkler systems that required two pump operation to satisfy design rated flow after 20 minutes. All seven sprinkler systems protected safety related equipment areas and were required to be operable by the TRM. PPL entered this issue into their corrective action program (CRs 1418013, 1419667, 1421795, and 1422262).

In response to this issue, PPL performed a preliminary calculation as part of a comprehensive operability evaluation which concluded that single pump operation could not supply design rated flow to the affected sprinkler systems for an extended period of time. PPL also concluded that the affected sprinkler systems could perform their intended functions, based on flow rates that were lower than the design specified values and for flow durations that were also shorter than originally specified by licensing requirements. The team reviewed PPL's operability evaluation and concluded that the reduced flow rates and durations satisfied NFPA 13, "Installation of Sprinkler Systems," requirements and appeared to be commensurate with the combustible loading and fire hazards in the affected areas.

The team identified an additional inconsistency between the analysis and the as-built system configuration. EC-013-0022 used a vendor pump curve to determine the design input value for pump developed head which was used to calculate available pressure to each sprinkler system. However, the curve used in the calculation did not match either vendor pump curve for the two installed fire pumps. Although the differences between the three pump curves appeared to be small, on the order of 1 or 2 psig, the curve used in the analysis appeared to be slightly non-conservative compared to the pump curve for the motor driven pump. PPL entered this issue into their corrective action program (CRs 1421627 and 1425748).

Analysis: The team determined that the failure to verify the adequacy of design to satisfy licensing basis requirements was a performance deficiency. Specifically, PPL did not adequately incorporate licensing basis requirements into the fire water system hydraulic analysis. As a result, design flow rates could not be achieved and maintained by a single fire water pump for all required sprinkler systems. PPL performed an operability evaluation and determined the affected sprinkler systems were capable of performing their intended functions at lower flow rates and for a shorter duration than originally specified by plant design. In addition, the Unit 2 cooling tower basin was determined to be inoperable as a sole source of supply water for the fire water system. An Operations Directive was issued to not align the fire water system to the Unit 2 cooling tower.

This issue was more than minor because it was similar to NRC Inspection Manual Chapter (IMC) 0612, Appendix E, "Examples of Minor Issues," Example 3.k, which states that an analysis to verify the adequacy of design contained incorrect assumptions. The example concludes that the issue is more than minor if the error resulted in a condition where there was a reasonable doubt on the operability of the component. For this issue, a knowledgeable engineer could not determine the adequacy of design based on a review of the existing hydraulic analysis and associated design details without performing additional complex analysis and preliminary calculations.

PPL's hydraulic analysis had assumed single fire pump operation was not required after an initial 20 minute period, and had only evaluated the CWST to determine whether adequate suction pressure was available to the fire pumps. As a result of these errors, the as-built design did not satisfy licensing basis requirements, and the Unit 2 cooling tower basin was subsequently determined to have insufficient suction pressure, such that seven affected sprinkler systems would not be capable of performing their intended functions whenever the Unit 2 cooling tower basin was aligned as the sole water source for the fire pumps. Therefore, this error represented a reasonable doubt of operability for the affected sprinkler systems. In addition, this finding adversely affected the design control attribute of the Mitigating Systems cornerstone and affected the cornerstone objective of ensuring the availability and reliability of systems that respond to initiating events to prevent undesirable consequences.

The team performed a Phase 1 Significance Determination Process (SDP) screening, in accordance with NRC IMC 0609, Appendix F, "Fire Protection Significance Determination Process." This finding affected the fixed fire protection systems category, and was screened to very low safety significance (Green) because the affected sprinkler

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