UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
475 ALLENDALE RD, STE 102
KING OF PRUSSIA, PENNSYLVANIA 19406-1415

November 8, 2022

Brad Berryman
Senior Vice President and Chief Nuclear Officer
Susquehanna Nuclear, LLC
769 Salem Blvd., NUCSB3
Berwick, PA 18603

SUBJECT: SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2 – INTEGRATED INSPECTION REPORT 05000387/2022003 AND 05000388/2022003

Dear Brad Berryman:

On September 30, 2022, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at Susquehanna Steam Electric Station, Units 1 and 2. On October 27, 2022, the NRC inspectors discussed the results of this inspection with Doug LaMarca, Director Strategic Planning, and other members of your staff. The results of this inspection are documented in the enclosed report.

One finding of very low safety significance (Green) is documented in this report. This finding involved a violation of NRC requirements. One Severity Level IV violation without an associated finding is documented in this report. We are treating these violations as non-cited violations (NCVs) consistent with Section 2.3.2 of the Enforcement Policy.

If you contest the violations or the significance or severity of the violations documented in this inspection report, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001; with copies to the Regional Administrator, Region I; the Director, Office of Enforcement; and the NRC Resident Inspector at Susquehanna Steam Electric Station, Units 1 and 2.

If you disagree with a cross-cutting aspect assignment 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 U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001; with copies to the Regional Administrator, Region I; and the NRC Resident Inspector at Susquehanna Steam Electric Station, Units 1 and 2.

This letter, its enclosure, and your response (if any) will be made available for public inspection and copying at http://www.nrc.gov/reading-rm/adams.html and at the NRC Public Document Room in accordance with Title 10 of the *Code of Federal Regulations* 2.390, “Public Inspections, Exemptions, Requests for Withholding.”

Sincerely,

Jonathan E. Greives

Digitally signed by Jonathan E. Greives
Date: 2022.11.08 09:24:40 -05'00'

Jonathan E. Greives, Chief
Projects Branch 4
Division of Operating Reactor Safety

Docket Nos. 05000387 and 05000388
License Nos. NPF-14 and NPF-22

Enclosure:
As stated

cc w/ encl: Distribution via LISTSERV

SUBJECT: SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2 – INTEGRATED INSPECTION REPORT 05000387/2022003 AND 05000388/2022003 DATED NOVEMBER 8, 2022

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U.S. NUCLEAR REGULATORY COMMISSION
Inspection Report

Docket Numbers:	05000387 and 05000388
License Numbers:	NPF-14 and NPF-22
Report Numbers:	05000387/2022003 and 05000388/2022003
Enterprise Identifier:	I-2022-003-0040
Licensee:	Susquehanna Nuclear, LLC
Facility:	Susquehanna Steam Electric Station, Units 1 and 2
Location:	Berwick, PA
Inspection Dates:	July 1, 2022 to September 30, 2022
Inspectors:	C. Highley, Senior Resident Inspector M. Rossi, Resident Inspector C. Hobbs, Reactor Inspector
Approved By:	Jonathan E. Greives, Chief Projects Branch 4 Division of Operating Reactor Safety

Enclosure

SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) continued monitoring the licensee's performance by conducting an integrated inspection at Susquehanna Steam Electric Station, Units 1 and 2, in accordance with the Reactor Oversight Process. The Reactor Oversight Process is the NRC's program for overseeing the safe operation of commercial nuclear power reactors. Refer to https://www.nrc.gov/reactors/operating/oversight.html for more information.

List of Findings and Violations

Inadequate Plant Modification Results in Equipment Inoperability			
Cornerstone	Significance	Cross-Cutting Aspect	Report Section
Mitigating Systems	Green NCV 05000388/2022003-01 Open/Closed	[H.12] - Avoid Complacency	71153
A Green finding of licensee procedure IP-ENG-001, "Standard Design Process," and resultant non-cited violation (NCV) of Technical Specification (TS) Limiting Condition for Operation (LCO) 3.7.8, "Main Turbine Pressure Regulation System," was self-revealed when the licensee failed to ensure a design modification of a pressure regulator isolation valve maintained the valve open. Specifically, the licensee determined that a valve encapsulation with sealant would be adequate to prevent valve closure, but it was not adequate for the application and resulted in the 'B' pressure regulator isolation valve failing closed, rendering a main turbine pressure regulator inoperable.			

Condition Prohibited by Technical Specifications Due to Drift of Reactor Pressure Switch			
Cornerstone	Severity	Cross-Cutting Aspect	Report Section
Not Applicable	Severity Level IV NCV 05000388/2022003-02 Open/Closed	Not Applicable	71153
A self-revealed Severity Level IV non-cited violation (NCV) of Technical Specification (TS) 3.3.5.1, "Emergency Core Cooling System (ECCS) Instrumentation," TS 3.5.1, "ECCS-Operating," and TS 3.0.3, "Limiting Condition for Operation (LCO) Applicability," was identified when the licensee failed to ensure the 'D' reactor steam dome pressure - low permissive pressure switch, Microswitch 2 (PS-B21-2N021 D), remained above its lower allowable value, which is intended to ensure that the ECCS injection prevents the fuel peak cladding temperature from exceeding the limits of 10 CFR 50.46.			

Additional Tracking Items

Type	Issue Number	Title	Report Section	Status
LER	05000388/2017010-02	LER 2017-010-02 for Susquehanna Steam Electric Station Unit 2, Condition Prohibited by Technical Specifications Due to Drift of Reactor Pressure Switches	71153	Closed
LER	05000388/2021-001-00	LER 2021-001-00 for Susquehanna Steam Electric	71153	Closed

		Station, Unit 2, Condition Prohibited by Technical Specifications Due to Drift of Reactor Pressure Switch		
LER	05000388/2021-001-01	LER 2021-001-01 for Susquehanna Steam Electric Station, Unit 2, Condition Prohibited by Technical Specifications Due to Drift of Reactor Pressure Switch	71153	Closed
LER	05000388/2021-004-00	LER 2021-004-00 for Susquehanna Steam Electric Station, Unit 2, Main Turbine Pressure Regulator Inoperable for Longer Than Allowed by Technical Specifications	71153	Closed
LER	05000388/2021-003-00	LER 2021-003-00 for Susquehanna Steam Electric Station, Unit 2, Automatic Reactor Scram Due to Main Turbine Trip	71153	Closed
LER	05000388/2021-003-01	LER 2021-003-01 for Susquehanna Steam Electric Station, Unit 2, Automatic Reactor Scram Due to Main Turbine Trip Caused by Inadvertent Trip of the Main Generator Output Breakers	71153	Closed

PLANT STATUS

Unit 1 began the inspection period at rated thermal power. On July 28, 2022, the unit was down powered to 58 percent for a rod sequence exchange and rod pattern adjustment. The unit was returned to rated thermal power on July 31, 2022. On August 1, 2022, the unit was down powered to 75 percent for a rod pattern adjustment. The unit was returned to rated thermal power on August 3, 2022.

Unit 2 began the inspection period at rated thermal power. On July 31, 2022, the unit was down powered to 59 percent due to a feedwater heater issue. The unit was returned to rated thermal power on August 1, 2022. On September 9, 2022, the unit was down powered to 65 percent for a rod sequence exchange and rod pattern adjustment. The unit was returned to rated thermal power on September 10, 2022. On September 28, 2022, the unit was down powered to 18 percent; and on September 29, 2022, the unit was shut down for planned maintenance.

INSPECTION SCOPES

Inspections were conducted using the appropriate portions of the inspection procedures (IPs) in effect at the beginning of the inspection unless otherwise noted. Currently approved IPs with their attached revision histories are located on the public website at http://www.nrc.gov/reading-rm/doc-collections/insp-manual/inspection-procedure/index.html. Samples were declared complete when the IP requirements most appropriate to the inspection activity were met consistent with Inspection Manual Chapter (IMC) 2515, “Light-Water Reactor Inspection Program - Operations Phase.” The inspectors performed activities described in IMC 2515, Appendix D, “Plant Status,” observed risk significant activities, and completed on-site portions of IPs. The inspectors reviewed selected procedures and records, observed activities, and interviewed personnel to assess licensee performance and compliance with Commission rules and regulations, license conditions, site procedures, and standards.

REACTOR SAFETY

71111.01 - Adverse Weather Protection

External Flooding Sample (IP Section 03.03) (1 Sample)

(1) The inspectors evaluated that flood protection barriers, mitigation plans, procedures, and equipment are consistent with the licensee’s design requirements and risk analysis assumptions for coping with external flooding on September 27, 2022.

71111.04 - Equipment Alignment

Partial Walkdown Sample (IP Section 03.01) (3 Samples)

The inspectors evaluated system configurations during partial walkdowns of the following systems/trains:

(1) Unit 2, division II emergency service water supplied loads during division I emergency service water inoperable for core spray unit cooler valve 211111 replacement on July 7, 2022
(2) Unit Common, 'D' emergency diesel generator prior to restoration of 'B' emergency diesel generator from system outage window on August 18, 2022

(3) Unit 2, 'C' residual heat removal pump and switchgear pre-alignment for potential use in shutdown cooling mode during maintenance outage on September 29, 2022

71111.05 - Fire Protection

Fire Area Walkdown and Inspection Sample (IP Section 03.01) (5 Samples)

The inspectors evaluated the implementation of the fire protection program by conducting a walkdown and performing a review to verify program compliance, equipment functionality, material condition, and operational readiness of the following fire areas:

(1) Unit 2, equipment access area, 683-foot elevation, FZ 2-3C-N, W, and S, on July 19, 2022
(2) Unit 2, standby liquid control, access corridor, and general access area, 749-foot elevation, FZ 2-5A-N, W, and S, on September 8, 2022
(3) Unit Common, division II lower cable spreading room, 714-foot elevation, FZ 0-25A and 0-25E, on September 9, 2022
(4) Unit 1, 'A' core spray pump room, reactor core isolation cooling pump room, 'A' residual heat removal pump room, and 'B' residual heat removal pump room, 645-foot elevation, FZ 1-1A, D, E, and F, on September 14, 2022
(5) Unit 2, dry well, FZ 2-4F, on September 30, 2022

71111.06 - Flood Protection Measures

Inspection Activities - Internal Flooding (IP Section 03.01) (1 Sample)

The inspectors evaluated internal flooding mitigation protections in the:

(1) Unit 2, service water and emergency service water intersystem leakage of the reactor building closed-loop cooling water, 683-foot elevation, and affected switchgear on September 14, 2022

71111.11Q - Licensed Operator Requalification Program and Licensed Operator Performance

Licensed Operator Performance in the Actual Plant/Main Control Room (IP Section 03.01) (1 Sample)

(1) The inspectors observed and evaluated licensed operator performance in the control room during the Unit 1 rod sequence exchange briefing and performance of the sequence exchange which included stuck rod actions in accordance with AOP-155-001, Revision 5, until movement was initiated and make up of nitrogen to the containment due to a high/low pressure annunciator on July 28, 2022.

Licensed Operator Requalification Training/Examinations (IP Section 03.02) (1 Sample)

(1) The inspectors observed and evaluated as-found operator requalification simulator training of a scenario involving anticipated transient without scram and primary system steam leakage on July 18, 2022.

71111.12 - Maintenance Effectiveness

Maintenance Effectiveness (IP Section 03.01) (2 Samples)

The inspectors evaluated the effectiveness of maintenance to ensure the following structures, systems, and components (SSCs) remain capable of performing their intended function:

(1) Unit 2, containment instrument gas compressor system, requiring evaluation for an (a)(1) determination, on September 13, 2022
(2) Units 1 and 2, containment radiation monitors repetitive failures on September 23, 2022

Quality Control (IP Section 03.02) (1 Sample)

The inspectors evaluated the effectiveness of maintenance and quality control activities to ensure the following SSC remains capable of performing its intended function:

(1) Unit Common, 'B' emergency service water pump reverse engineering, fabrication, and procurement on September 14, 2022

71111.13 - Maintenance Risk Assessments and Emergent Work Control

Risk Assessment and Management Sample (IP Section 03.01) (5 Samples)

The inspectors evaluated the accuracy and completeness of risk assessments for the following planned and emergent work activities to ensure configuration changes and appropriate work controls were addressed:

(1) Unit 1, 'B' core spray elevated risk due to a planned system outage window extended beyond original scope on July 11, 2022
(2) Unit 2, operational and industrial high-risk activities during exploratory emergency service water piping excavation on August 18, 2022
(3) Unit Common, elevated risk due to extension of 'B' emergency diesel generator system outage window on August 18, 2022
(4) Unit Common, emergent changes in plant risk due to 'A' emergency diesel generator failed surveillance on September 21, 2022
(5) Unit 2, yellow large early release frequency for de-inerting containment for maintenance outage for unidentified leakage on September 28, 2022

71111.15 - Operability Determinations and Functionality Assessments

Operability Determination or Functionality Assessment (IP Section 03.01) (9 Samples)

The inspectors evaluated the licensee's justifications and actions associated with the following operability determinations and functionality assessments:

(1) Unit 2, shutdown cooling suction pressure switch loop number two erratic during adjustment portion of the calibration procedure, CR-2022-12060 and CR-2022-12111, on August 9, 2022

(2) Unit Common, 'B' emergency diesel generator mounting screws not torqued past operability determination, CR-2022-11665, on August 17, 2022
(3) Unit 1, containment instrument gas compressor leaks functionality assessment, CR-2022-11694 and CR-2022-12027, on August 22, 2022
(4) Unit Common, spray pond nozzle blockage operability determination, CR-2022-12709, on September 12, 2022
(5) Unit 1, dry well unidentified leakage sumps A and B monitoring system pump down anomalies, CR-2022-11848, on September 13, 2022
(6) Unit 1, turbine bypass valve #3 indicates approximately equal to 37 percent open, CR-2022-11203, on September 13, 2022
(7) Unit Common, 'B' emergency diesel generator past operability due to incorrect installation of voltage regulatory components, discovered during 'B' emergency diesel generator system outage window, CR-2022-12561 and CR-2022-12774, on September 15, 2022
(8) Unit 1, safety relief valve number 13N tail pipe temperature above 200 degrees Fahrenheit and changing as power changes, action request 2022-10048, on September 19, 2022
(9) Unit Common, 'A' emergency diesel generator tripped during surveillance testing and output breaker 1A20104 failed to trip, CR-2022-13993, on September 21, 2022

71111.18 - Plant Modifications

Temporary Modifications and/or Permanent Modifications (IP Section 03.01 and/or 03.02) (2 Samples)

The inspectors evaluated the following temporary or permanent modifications:

(1) Unit Common, 'B' emergency service water pump reverse engineering and installation of permanent modification, EC-RIE-CC 2558108, EC-RIE-CC 2558109, EC-RIE-CC 2558112, and EC-RIE-CC 2558113, on August 7, 2022
(2) Unit 2, core spray unit cooler valve replacement removal of temporary modification to re-install permanent modification, EC 2356929 and EC 2470934, on August 23, 2022

71111.19 - Post-Maintenance Testing

Post-Maintenance Test Sample (IP Section 03.01) (3 Samples)

The inspectors evaluated the following post-maintenance testing activities to verify system operability and/or functionality:

(1) Unit 1, 'B' core spray system outage window for unit cooler and valve work on July 11, 2022
(2) Unit Common, 'B' emergency service water 8-year pump replacement, ERPM 2355615, on August 30, 2022
(3) Unit Common, 'B' emergency diesel generator 5-year overhaul WO 2146976, ERPM 2146976, and RTSV 2568135 on August 30, 2022

71111.20 - Refueling and Other Outage Activities

Refueling/Other Outage Sample (IP Section 03.01) (1 Sample)

(1) The inspectors evaluated the Unit 2 planned maintenance outage to address dry well leakage from September 28 to October 3, 2022.

71111.22 - Surveillance Testing

The inspectors evaluated the following surveillance testing activities to verify system operability and/or functionality:

Surveillance Tests (other) (IP Section 03.01) (2 Samples)

(1) Unit 1, reactor core isolation cooling quarterly flow surveillance, SO-150-002, on July 27, 2022
(2) Unit Common, Loop 'A' emergency service water flow verification, SO-054-A03, on September 27, 2022

Inservice Testing (IP Section 03.01) (1 Sample)

(1) Unit Common, 'C' emergency diesel generator operability run, SO-024-001C, on July 17, 2022

FLEX Testing (IP Section 03.02) (1 Sample)

(1) Unit Common, annual FLEX fire pump truck deployment testing on August 11, 2022

OTHER ACTIVITIES – BASELINE

71151 - Performance Indicator Verification

The inspectors verified licensee performance indicators submittals listed below:

IE01: Unplanned Scrams per 7000 Critical Hours Sample (IP Section 02.01) (2 Samples)

(1) Unit 1 (January 1, 2021, through December 31, 2021)
(2) Unit 2 (January 1, 2021, through December 31, 2021)

IE03: Unplanned Power Changes per 7000 Critical Hours Sample (IP Section 02.02) (2 Samples)

(1) Unit 1 (January 1, 2021, through December 31, 2021)
(2) Unit 2 (January 1, 2021, through December 31, 2021)

IE04: Unplanned Scrams with Complications (USwC) Sample (IP Section 02.03) (2 Samples)

(1) Unit 1 (January 1, 2021, through December 31, 2021)
(2) Unit 2 (January 1, 2021, through December 31, 2021)

MS05: Safety System Functional Failures (SSFFs) Sample (IP Section 02.04) (2 Samples)

(1) Unit 1 (July 1, 2021, through June 30, 2022)
(2) Unit 2 (July 1, 2021, through June 30, 2022)

MS06: Emergency AC Power Systems (IP Section 02.05) (2 Samples)

(1) Unit 1 (July 1, 2021, through June 30, 2022)
(2) Unit 2 (July 1, 2021, through June 30, 2022)

BI02: RCS Leak Rate Sample (IP Section 02.11) (2 Samples)

(1) Unit 1 (January 1, 2021, through December 31, 2021)
(2) Unit 2 (January 1, 2021, through December 31, 2021)

71152A - Annual Follow-up Problem Identification and Resolution

Annual Follow-up of Selected Issues (Section 03.03) (1 Sample)

The inspectors reviewed the licensee's implementation of its corrective action program related to the following issues:

(1) Corrective actions taken and extent of condition for Unit 1 Marathon C+ control rod blade (CRB) cracking observed on April 5, 2022

71152S - Semiannual Trend Problem Identification and Resolution

Semiannual Trend Review (Section 03.02) (1 Sample)

(1) The inspectors reviewed site issues to identify trends that might indicate the existence of more significant safety concerns.

71153 - Follow Up of Events and Notices of Enforcement Discretion

Event Report (IP Section 03.02) (4 Samples)

The inspectors evaluated the following licensee event reports (LERs):

(1) LER 05000388/2017-010-02, Condition Prohibited by Technical Specifications Due to Drift of Reactor Pressure Switches (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21182A041): The inspectors reviewed the updated LER submittal. The previous LER submittals were reviewed in Susquehanna Steam Electric Station - Integrated Inspection Report 05000387/2018004 and 05000388/2018004 (ML19045A259) under the Inspection Results Section, NCV 05000387,388/2018004-02.
(2) LER 05000388/2021-003-00 and LER 05000388/2021-003-01, Automatic Reactor Scram Due to Main Turbine Trip Caused by Inadvertent Trip of the Main Generator Output Breakers (ML21343A422 and ML22083A168): The inspectors determined that it was not reasonable to foresee or correct the cause discussed in the LER; therefore, no performance deficiency was identified. The inspectors did not identify a violation of NRC requirements.

(3) LER 05000388/2021-004-00, Unit 2 Main Turbine Pressure Regulator Inoperable for Longer Than Allowed by Technical Specifications (ML21343A425): The inspection conclusions associated with this LER are documented in this report under the Inspection Results Section, NCV 05000388/2022003-01.

(4) LER 05000388/2021-001-00 and LER 05000388/2021-001-01, Condition Prohibited by Technical Specifications Due to Drift of Reactor Pressure Switch (ML21244A284 and ML22080A215): The inspectors determined that it was not reasonable to foresee or correct the cause discussed in the LER; therefore, no performance deficiency was identified. The inspection conclusions associated with this LER are documented in this report under the Inspection Results Section, Severity Level IV NCV 05000388/2022003-02.

OTHER ACTIVITIES – TEMPORARY INSTRUCTIONS, INFREQUENT AND ABNORMAL

Impact of Financial Conditions on Continued Safe Performance

In that the licensee, Susquehanna Nuclear, LLC, and the licensee's parent company, Talen Energy Supply, was under bankruptcy protection/reorganization during the inspection period, NRC Region I conducted reviews of processes at Susquehanna. Using the flexibilities in the baseline inspection program, the inspectors evaluated several aspects of the licensee's operations to assess whether any identified plant performance issues could be related to the station's financial condition. The factors reviewed included: (1) impact on regulatory required plant staffing, (2) corrective maintenance backlog, (3) changes to the planned maintenance schedule, (4) corrective action program implementation, and (5) reduction in outage scope, including risk-significant modifications. In particular, the inspectors verified that licensee personnel continued to identify problems at an appropriate threshold and enter these problems into the corrective action program for resolution. The inspectors also verified that the licensee continued to develop and implement corrective actions commensurate with the safety significance of the problems identified.

The review of processes at Susquehanna included continuous reviews by the resident inspectors, as well as the specialist-led baseline inspections completed during the inspection period: 60854/60856 – Multipurpose Canister Welding Dry Run, Spent Fuel Pool Operations Dry Run, and Multipurpose Canister Processing Dry Run; 71152A – Marathon Control Blades Problem Identification and Resolution which is documented previously in this report; Material Control and Accounting Program Inspection Report 05000387/2022401 and 05000388/2022401 (ML22223A130); and Design Basis Assurance Inspection (Teams) Inspection Report 05000387/2022013 and 05000388/2022013 (ML22270A222).

INSPECTION RESULTS

Observation: Unit 1 Marathon C+ Control Rod Blade Cracking	71152A
During the Unit 1 refueling outage (RFO) on April 5, 2022, CRB M1125 was observed to have undergone planar separation in one of its four vertical wings, in which the outer stainless steel absorber tube failed due to a vertical elongated crack in the weld, and loss of boron absorber tubes occurred in the reactor core. This condition resulted in a delay in the RFO, in which the cause of the CRB failure was analyzed, and additional CRB detailed visual inspections were performed on 15 other General Electric Hitachi (GEH) Marathon C+ model CRBs. Ultimately, three other Marathon C+ CRBs were identified to have relevant cracks predominately in the upper one-half of the CRB. All four CRBs observed to have cracking were in peripheral core	

locations during the previous fuel cycle. All four CRBs passed scram time testing just before the RFO. Therefore, it was determined that the ability to insert these CRBs was not compromised during the previous fuel cycle, and these control rods were operable during the fuel cycle, in accordance with TSs.

Through consultation with the CRB manufacturer (GEH), the licensee determined the physical mechanism for the CRB cracking was irradiation-assisted stress-corrosion cracking (IASCC). Boron capsules inside the CRB swell over the lifetime of a blade due to high neutron radiation. Over time, the capsules can swell enough to come in contact with the outer sheath of the CRB. The stress imparted from boron capsule swelling can eventually cause the CRB to crack. The safety concern with absorber tube cracking is the potential leaching and loss of boron carbide neutron absorber and a reduction in nuclear reactivity worth of the affected control rods, which can then lead to an overall reduction in the core shutdown margin, which is a TS required core operating parameter related to the ability of the reactor core to safely shutdown the reactor with control rods alone. Corrective actions taken by the station during the Unit 1 April RFO included permanent discharge of 33 Marathon C+ CRBs with boron depletion values near the 4 CRBs observed to have cracking, approval of a technical decision making document to determine how to replace the 33 Marathon C+ discharged CRBs in the core design for the current Unit 1 fuel cycle, and a recalculation of the CRB shuffle plan for the Unit 1 core.

Past operating experience related to IASCC in boiling-water reactor (BWR) CRBs includes a Part 21 report issued by GEH in February 2011, describing the IASCC mechanism, and that CRB cracking had been observed in an international BWR. GEH determined at that time, IASCC CRB cracking only applied to BWR D and S fuel lattice plants and did not apply to C fuel lattice BWRs. The licensee reviewed this Part 21 report in 2011 and determined that since the Part 21 did not apply to C lattice BWRs, it did not apply to Susquehanna. In June 2011, NRC Information Notice 2011-13 was issued, describing CRB cracking reduced design lifetime limits for D and S lattice BWRs.

As a result of the observed Marathon C+ CRB cracking in April 2022, GEH determined that the original design for Marathon control rods considered nominal gap dimensions between the boron capsules and the blade sheath. These nominal dimensions did not account for tolerances and uncertainties in boron capsule swelling, which resulted in a non-conservative lifetime depletion limit for Marathon C+ CRBs. In addition, GEH reduced the recommended boron depletion limits for Marathon C+ CRBs and described the new recommended boron depletion limits in Safety Communication 22-03 in June 2022. The licensee incorporated the reduced Marathon C+ CRB depletion limits into station procedure NF-216, "Control Blade Change Specification Preparation," in August 2022. No Part 21 report has been made by GEH or the licensee regarding the observed Marathon C+ CRB cracking to date.

In addition, as part of extent of condition corrective actions, the currently operating Unit 2 core design was re-evaluated. The licensee determined that 59 CRBs will need to be replaced in the next RFO as a result of the underestimation of boron depletion in GEH CRB top nodes discussed in GEH Safety Communication 20-06, and the Marathon C+ CRB cracking issue discussed in GEH Safety Communication 22-03.

The NRC inspectors did not identify any findings or violations of more than minor significance.

Corrective Action References: CR-2022-05685

Observation: Follow-up of Adverse Human Performance Trend Identified in 2020	71152S

The NRC inspectors performed a semiannual review of site issues to identify trends that might indicate the existence of more significant safety concerns. As part of this review, the inspectors included repetitive or closely related issues documented by the licensee in the corrective action program database, trend reports, site performance indicators, major equipment problem lists, system health reports, maintenance rule assessments, and maintenance or corrective action program backlogs. The inspectors also reviewed how the licensee's corrective action program evaluated and responded to individual issues identified by the inspectors during routine plant walkdowns and daily condition report reviews.

Human Performance Trend Follow-up

In 2020, the inspectors identified an adverse human performance trend which spanned all four quarters. As a follow up, the inspectors reviewed the licensee corrective action program for human performance events across the first 6 months of a 3-year period (2020, 2021, and 2022), the overall numbers of adverse human performance trended documents decreased from 431 in 2020, to 374 in 2021, to 284 in 2022. The number of events requiring prompt investigations remained steady (22, 15, and 18 in 2020, 2021, and 2022, respectively), with numbers of events requiring evaluations (level 2 and 3 condition reports) reported as 10, 9, and 6. In the same time period, the number of external-identified human performance trended corrective action documents increased, with external oversight accounting for 6, 20, and 45 (1, 19, and 23 trended as NRC-identified specifically) in 2020, 2021, and 2022, respectively. In general, the ratio of external oversight to self-identified human performance trended condition reports has increased.

The inspectors identified several recent examples of human performance issues which, while not more than minor, constitute performance deficiencies which may have been avoided or identified by the site using the "Questioning Attitude" attribute described in NUREG-2165. Questioning Attitude is defined as: "Individuals avoid complacency and continuously challenge existing conditions and activities in order to identify discrepancies that might result in error or inappropriate action." Some examples included the failure to correctly identify an issue with mounting screws on an emergency diesel generator as a condition adverse to quality in the corrective action program (CR-2022-12083), the failure to ensure radioactive markings remained on a radioactive material container lid (CR-2022-11881), the failure to identify and correct an individual chewing gum in an radiological controlled area (CR-2022-11926), and a incorrectly posted protective equipment scheme on the emergency service water/residual heat removal service water pump house (CR-2022-12488).

Overall, the inspectors noted that the overall adverse trend in human performance events that was identified in 2020 appears to have been arrested. However, the increase in the portion of those events identified by external oversight is a potential adverse trend that warrants continued monitoring.

Inadequate Plant Modification Results in Equipment Inoperability			
Cornerstone	Significance	Cross-Cutting Aspect	Report Section
Mitigating Systems	Green NCV 05000388/2022003-01 Open/Closed	[H.12] - Avoid Complacency	71153

A Green finding of licensee procedure IP-ENG-001, "Standard Design Process," and resultant non-cited violation (NCV) of Technical Specification (TS) Limiting Condition for Operation (LCO) 3.7.8, "Main Turbine Pressure Regulation System," was self-revealed when the licensee failed to ensure a design modification of a pressure regulator isolation valve maintained the valve open. Specifically, the licensee determined that a valve encapsulation with sealant would be adequate to prevent valve closure, but it was not adequate for the application and resulted in the 'B' pressure regulator isolation valve failing closed, rendering a main turbine pressure regulator inoperable.

Description: The main turbine pressure regulation system is designed to control main steam pressure. The main turbine pressure regulation system contains two pressure regulators which are provided to maintain primary system pressure control. They independently sense pressure just upstream of the main turbine stop valves and compare it to two separate setpoints to create proportional error signals that produce each regulators output. The outputs of both regulators feed into a high valve gate. The regulator with the highest output controls the main turbine control valves. The lowest pressure setpoint gives the largest pressure error and thereby the largest regulator output. The backup regulator is nominally set at 3 psi or higher giving a slightly smaller error and a slightly smaller effective output of the controller.

Both main turbine pressure regulators are required to be operable to limit the pressure increase in the main steam lines and reactor pressure vessel during a postulated failure of the controlling pressure regulator so that the safety limit minimum critical power ratio (MCPR) and linear heat generation rate (LHGR) are not exceeded. With one main turbine pressure regulator inoperable, modifications to the MCPR limits and LHGR limits may be applied to allow this LCO to be met.

On April 24, 2021, during an RFO, a leak on the 'B' pressure regulator isolation valve was discovered by the licensee. A temporary design change was approved and implemented to remove the valve yoke, install a fabricated valve cap, and use "2X" sealant to secure the leakage. Under the design change documentation, the licensee did identify that to meet design requirements "the valve shall be open to provide a pressure signal to one of two pressure regulators that controls the turbine control valves and turbine bypass valves" and "must ensure the valve is open." In the course of licensee evaluation, engineering did question the need for a "hold open" device to ensure the valve did not inadvertently close, but ultimately the licensee determined that the "2X" sealant would be adequate to prevent valve closure. This determination was influenced, in part, from communications with a licensee vendor that had applied "2X" sealant in the past for other applications. This process was completed in accordance with licensee procedure IP-ENG-001, "Standard Design Process," which requires interdisciplinary and interdepartmental reviews to ensure that the design change maintains the requirements for site design and licensing basis, including the determination of design inputs which must be maintained by the modification.

On October 12, 2021, following a Unit 2 scram, all five bypass valves went full open and stayed open. Operators subsequently closed the main steam isolation valves to arrest the reactor depressurization. Upon licensee investigation, it was revealed that the 'B' pressure

regulator isolation valve which controls the bypass valves had failed closed, resulting in a continuous high-pressure signal, which resulted in maintaining the bypass valves open.

Corrective Actions: The licensee replaced the modified pressure regulator isolation valve and took administrative actions to limit the use of "2X" sealant to design function appropriate applications, specifically eliminating the allowance of "2X" for holding the valve position open.

Corrective Action References: CR-2021-14762

Performance Assessment:

Performance Deficiency: Licensee procedure IP-ENG-001, "Standard Design Process," Section 3.5.9, Revision 1, specifies, in part, that interdisciplinary and interdepartmental reviews are performed to ensure that each discipline and department that participated in the design has produced an accurate, reliable, and quality design that resolves the issue and can be implemented, tested, and operated in accordance with the site design and licensing basis. However, on April 24, 2021, the licensee failed to ensure that the design change resolved the issue in accordance with the site design basis. Specifically, the failure to account for the specific application of "2X" sealant in the pressure regulator isolation valve did not ensure that the design input to stay and remain open was met.

Screening: The inspectors determined the performance deficiency was more than minor because it was associated with the Design Control attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Specifically, the deficiency in the design modification resulted in the loss of bypass valve availability to control reactor pressure.

Significance: The inspectors assessed the significance of the finding using IMC 0609, Appendix A, “The Significance Determination Process (SDP) for Findings At-Power.” Using Exhibit 2 – Mitigating Systems Screening Questions, the inspectors determined that the degraded condition represented a loss of the probabilistic risk assessment function of the power conversion system for greater than 24 hours. Therefore, a detailed risk evaluation was performed.

A Region I senior reactor analyst (SRA) completed the detailed risk evaluation and estimated the increase in core damage frequency associated with the performance deficiency to be 3E-7/yr. or of very low safety significance (Green). The SRA used the Systems Analysis Programs for Hands-On Evaluation (SAPHIRE) 8.2.6, Standardized Plant Analysis Risk (SPAR) Model, Version 8.80, for Susquehanna Unit 2, to perform the risk assessment. The SRA reviewed the condition report, CR-2021-14762, associated with the degraded condition and noted that the failed pressure transmitter 20101B had been affected by a temporary leak repair modification performed in April 2021. During a subsequent transient and reactor scram, this repair failed and resulted in all five turbine bypass valves remaining open in response to a main turbine trip on October 11, 2021. The operators appropriately closed the main steam isolation valves to control the plant cooldown in response to the failed open bypass valves. The SRA used the Risk Assessment of Operational Events Handbook Volume I – Internal Events, Revision 2.02, as guidance for evaluating the exposure time of the deficiency. The exposure time was conservatively assumed to be from the installation of the temporary leak repair modification until the turbine trip plant transient on October 11, 2021. This was considered bounding because it is not specifically known if any aging mechanism could have impacted this failure. However, the condition report noted that the severe vibration associated

with the fast closure of the main turbine control valves likely contributed to the failure mechanism associated with the pressure transmitter. Therefore, a 6-month exposure time was assumed.

The SRA created a change set for the condition within the SPAR model by setting basic event MSS-MSV-OC-STEAM (Main Steam Isolation Valves (MSIVs) Fail to Remain Open) to TRUE. It is recognized that the MSIVs did not automatically close but were manually closed by the operators. However, their closure was required to control the plant cooldown due to the degraded condition associated with the performance deficiency. The dominant core damage cutset consisted of the loss of direct current bus 2D612 with the division II battery charger 2D623 unavailable due to test and maintenance with failure of the high-pressure coolant injection system to run. A similar contribution was the loss of direct current bus 2D622 with the division I battery charger 2D613 unavailable for test and maintenance with a failure of the reactor core isolation cooling system to run.

The SRA determined that the risk associated with this issue was dominated by internal events. Specifically, EC-RISK-0056, "Assessment of Key Assumptions and Sources of Uncertainty for Risk Informed Applications," Revision 0, Table 2.3-1, Fire Probabilistic Risk Assessment Sources of Model Uncertainty, states that for all fire scenarios a minimum of a turbine trip and MSIV closure is assumed. Therefore, the impact of this issue would be negligible for external events. The increase in large early release frequency from this finding was estimated by use of the SPAR model. The result showed an increase in large early release frequency to be below E-7/yr. or of very low safety significance.

Cross-Cutting Aspect: H.12 - Avoid Complacency: Individuals recognize and plan for the possibility of mistakes, latent issues, and inherent risk, even while expecting successful outcomes. Individuals implement appropriate error reduction tools. Specifically, in the past and at the time, communications with a licensee vendor indicated that the "2X" sealant becomes hard and would prevent movement of the valve stem. Licensee personnel relied on prior success and did not verify that the "2X" sealant would hold the valve open in this application, and personnel did not consider the vibrations the valve may be subjected to.

Enforcement:

Violation: Licensee procedure IP-ENG-001, "Standard Design Process," Section 3.5.9, Revision 1, specifies, in part, that interdisciplinary and interdepartmental reviews are performed to ensure that each discipline and department that participated in the design has produced an accurate, reliable, and quality design that resolves the issue and can be implemented, tested, and operated in accordance with the site design and licensing basis.

TS LCO 3.7.8 specifies that both main turbine pressure regulators shall be operable or limits as specified in the core operating limits report for MCPR; and LHGR shall be met within 2 hours, or thermal power must be reduced to less than 23 percent rated thermal power.

Contrary to the above, an interdisciplinary and interdepartmental review was performed which did not ensure that each discipline and department that participated in the design produced an accurate, reliable, and quality design that resolved the issue in accordance with the site design basis. Specifically, a temporary design change on the ‘B’ pressure regulator isolation valve used a “2X” sealant that did not resolve the issue in accordance with the site design basis for the valve to stay open and remain open. This inadequate design change resulted in a main turbine pressure regulator at Unit 2 being inoperable for an indeterminate period of time between April 21, 2021, and October 12, 2021, and the limits as specified in the core

operating limits report for MCPR and LHGR were not met within 2 hours; and thermal power was not reduced to less than 23 percent rated thermal power in accordance with TSs.

The disposition of this finding closes LER 05000388/2021-004-00, "Unit 2 Main Turbine Pressure Regulator Inoperable for Longer Than Allowed by Technical Specifications."

Enforcement Action: This violation is being treated as a non-cited violation, consistent with Section 2.3.2 of the Enforcement Policy.

Condition Prohibited by Technical Specifications Due to Drift of Reactor Pressure Switch			
Cornerstone	Severity	Cross-Cutting Aspect	Report Section
Not Applicable	Severity Level IV NCV 05000388/2022003-02 Open/Closed	Not Applicable	71153

A self-revealed Severity Level IV non-cited violation (NCV) of Technical Specification (TS) 3.3.5.1, "Emergency Core Cooling System (ECCS) Instrumentation," TS 3.5.1, “ECCS-Operating,” and TS 3.0.3, "Limiting Condition for Operation (LCO) Applicability," was identified when the licensee failed to ensure the 'D' reactor steam dome pressure - low permissive pressure switch, Microswitch 2 (PS-B21-2N021 D), remained above its lower allowable value, which is intended to ensure that the ECCS injection prevents the fuel peak cladding temperature from exceeding the limits of 10 CFR 50.46.

Description: Prior to September 2017, the licensee had been utilizing International Telephone and Telegraph-Barton 288A pressure switches in the reactor steam dome pressure – low channels [EIIS System/Component Identifier: JE/PS] that provide the injection permissive for the core spray system [EIIS System Identifier: BM] (TS 3.3.5.1, Function 1.d) and the residual heat removal/low pressure coolant injection (LPCI) system [EIIS System Identifier: BO] (TS 3.3.5.1, Function 2.d). Due to instrument drift concerns, all eight obsolete International Telephone and Telegraph-Barton 288A pressure switches were replaced with General Electric recommended Cameron-Barton 288A pressure switches between September 6, 2017, and November 15, 2017. Following replacement, instrument drift continued to be an issue, and an additional corrective action was determined necessary to resolve the drift concerns. The additional corrective action included procuring and installing Cameron-Barton 288A instruments that had been modified to remove an over-range condition and the movement assembly/associated linkages that were determined to be affecting instrument drift. The first of these modified instruments was installed and calibrated on July 8, 2020, in the Unit 2 'D' channel (pressure switch for PS-B21-2N021D).

On August 10, 2020, the new, modified PS-B21-2N021D switch, Microswitch 2, was tested for its first surveillance interval and found to be outside of TS acceptance criteria. The switch drifted 1.2 psig outside of the upper allowable value which is intended to ensure that the reactor dome pressure has fallen to a value below the core spray and residual heat removal/LPCI maximum design pressures to preclude over-pressurization of the low pressure systems prior to low pressure injection initiation. This event was reported in LER 05000388/2020-002-01, "Condition Prohibited by Technical Specifications Due to Drift of Reactor Pressure Switch Caused by Lack of Requirements for Acclimation of the Instrument to the Operating Environment," dated July 1, 2021 (ML21182A044).

On July 6, 2021, the Unit 2 ‘D’ reactor steam dome pressure – low permissive pressure switch, Microswitch 2, was found outside of the TS 3.3.5.1 allowable value. The switch drifted

outside of the lower allowable value which is intended to ensure that the ECCS injection prevents the fuel peak cladding temperature from exceeding the limits of 10 CFR 50.46.

Based on the information available, the condition likely existed for longer than allowed by TSs 3.3.5.1, 3.5.1, and 3.0.3. As such, this condition was prohibited by TSs and was reported to the NRC by the licensee in accordance with 10 CFR 50.73(a)(2)(i)(B). In addition, since the 'C' channel (PIS-B21-2N021C) was surveillance tested just prior to identification of the drift of the 'D' channel (PS-B21-2N021D), redundant channels were inoperable at the same time which impacted both core spray and LPCI functions; therefore, this was also considered a condition that could have prevented fulfillment of a safety function (10 CFR 50.73(a)(2)(v)(D)) and a common cause inoperability of independent trains or channels (10 CFR 50.73(a)(2)(vii)).

The licensee determined the direct cause of the instrument setpoint drift to be temperature/humidity changes and mechanical hysteresis. Additionally, the licensee's apparent cause involved the original design inputs not accounting for temperature and humidity effects on the switch.

Corrective Actions: The switch was returned to within TS allowable values immediately. The switch was subsequently replaced with an unmodified pressure indicating switch and a licensed amendment request was submitted to revise the allowable value for TS 3.3.5.1, Functions 1.c, 1.d, 2.c, and 2.d.

Corrective Action References: CR-2021-10267

Performance Assessment: The NRC determined this violation was not reasonably foreseeable and preventable by the licensee and therefore is not a performance deficiency.

Enforcement: The Reactor Oversight Process's significance determination process does not specifically consider a violation of requirements with no performance deficiency in its assessment of licensee performance. Therefore, it is necessary to address this violation which does not include an identified performance deficiency using traditional enforcement rather than assign a color (e.g., Green).

Section 6.1.d of the NRC Enforcement Policy provides examples of Severity Level IV violations. Section 6.1.d.1 states, in part, that failure to comply with the allowances for LCO and surveillance requirement applicabilities in TS Section 3.0 is an example of a Severity Level IV violation.

Violation: TS LCO 3.3.5.1 specifies that the ECCS instrumentation for each function in Table 3.3.5.1-1 shall be OPERABLE, which includes, but is not limited to, core spray system - reactor steam dome pressure low (initiation and injection permissive functions) and LPCI system - reactor steam dome pressure low (initiation, injection permissive, and recirculation discharge valve permissive functions), or to restore an INOPERABLE channel within 24 hours or declare the supported feature INOPERABLE.

TS LCO 3.5.1, Condition I, requires that one LPCI subsystem INOPERABLE for reasons other than the pump in that subsystem being INOPERABLE and one core spray subsystem INOPERABLE shall result in immediate entry into TS LCO 3.0.3.

TS LCO 3.0.3 specifies, in part, that action shall be initiated within 1 hour to place the unit, as applicable in MODE 2 within 7 hours; MODE 3 within 13 hours; and MODE 4 within 37 hours.

Contrary to the above, for an undetermined period of time until date of discovery, the ECCS instrumentation for the core spray and LPCI systems - reactor steam dome pressure low functions were not met. Specifically, when the permissive functions for the Barton pressure switch drifted out of TS acceptance criteria, the instrument was not restored to operable status within 24 hours, the supported LPCI and core spray systems were not declared inoperable, TS LCO 3.0.3 was not entered, and the licensee did not initiate action within 1 hour to place Unit 2, as applicable, in Mode 2 within 7 hours, Mode 3 within 13 hours, and Mode 4 within 37 hours.

The disposition of this violation closes LER 05000388/2021-001-00 and 05000388/2021-001-01, "Condition Prohibited by Technical Specifications Due to Drift of Reactor Pressure Switch," due to temperature/humidity changes and mechanical hysteresis as a result of original design inputs not accounting for temperature and humidity effects on the switch.

Enforcement Action: This violation is being treated as a non-cited violation, consistent with Section 2.3.2 of the Enforcement Policy.

EXIT MEETINGS AND DEBRIEFS

The inspectors verified no proprietary information was retained or documented in this report.

- On October 27, 2022, the inspectors presented the integrated inspection results to Doug LaMarca, Director Strategic Planning, and other members of the licensee staff.
- On September 14, 2022, the inspectors presented the Unit 1 Marathon C+ control rod blade cracking inspection results to Kevin Cimorelli, Site Vice President, and other members of the licensee staff.

DOCUMENTS REVIEWED

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
71111.05	Corrective Action Documents Resulting from Inspection		CR-2022-13662, CR-2022-13663, CR-2022-13664, CR-2022-13665, CR-2022-13666, CR-2022-13667, CR-2022-13668, CR-2022-13669, CR-2022-13670	
71111.12	Corrective Action Documents		CR-2021-13535, CR-2022-11523, CR-2022-13448	
71111.15	Corrective Action Documents		CR-2022-11203, CR-2022-12060, CR-2022-12111	
	Miscellaneous		Adverse Condition Monitoring and Contingency Plan for PSV141F013N MSRV Monitoring Plan	06/23/2022
	Operability Evaluations	ACT-01-CR-2020-07408	Prompt Operability Determination for Unit 1 Dry Well Floor Drains Sump Monitoring System	Revision 0
	Procedures	SO-100-006	Shiftly Surveillance Operating Log	Revision 105
	Work Orders	PCWO 1995474	Replace PSV-16180	05/17/2016
71111.22	Corrective Action Documents		CR-2022-11197	
71152A	Corrective Action Documents		CR-2022-05829, CR-2022-05848, CR-2022-06434, CR-2022-10044	
		CR-2022-05685	Marathon C+ Control Blade Square Absorber Tube Cracking, Level 2 Apparent Cause Evaluation	06/24/2022
	Engineering Evaluations	EC-Fuel-1931	Unit 1 Cycle 23 Control Blade Change Specification	Revision 1
		EC-Fuel-1936	Unit 2 Cycle 22 Control Blade Change Specification	Revision 0
	Procedures	LS-115	Operating Experience Program	Revision 4
		NDAP-QA-0725	Operating Experience Review Program	Revision 14
		NF-216	Control Blade Change Specification Preparation	Revision 12
71153	Corrective Action Documents		CR-2021-14745, CR-2021-14762	