

Status of the U.S. NRC's ASP Program

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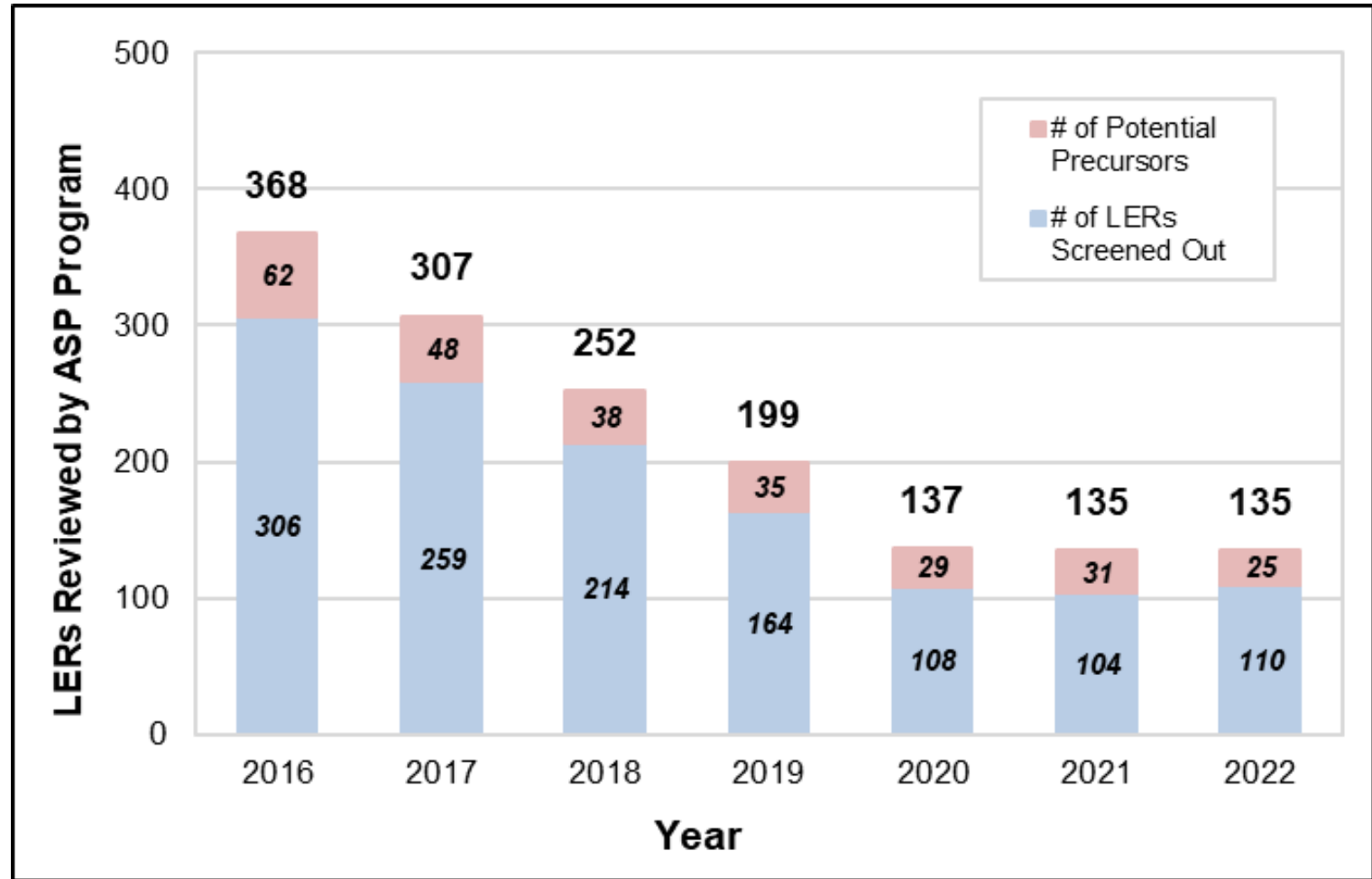
Program Status and Challenges

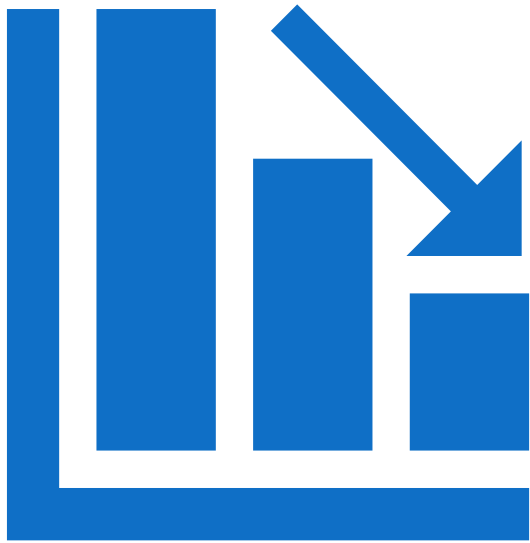
- Continue to evaluate hazards that are not currently included in all NRC SPAR models (internal fires, floods, etc.).
 - In addition, need to account for uncertainties associated with dated fire modeling based on IPEEEs.
 - Most of the events evaluated to date were associated with plants that did not have recent risk information provided to the NRC from risk-informed license amendment requests.
- Number of LERs reported is historically low.
 - There are fewer events occurring.
 - In addition, recent experience shows that some events that have historically been reported may not be in the future.
 - It is a known limitation that some risk significant events may not always be reported in LERs (e.g., single train failures).
 - Given these considerations, we are exploring the use of additional information sources for degraded conditions.

Evaluation of Internal Fire Risk

- About one-third of NRC SPAR models have internal fires.
 - In addition, some of these models are based on IPEEE information, which is considered dated.
- In 2020, the ASP Program began evaluating hazards not included in the SPAR models.
- A 2022 preliminary precursor has been identified by the qualitative evaluation of internal fires.
- ASP analyses should also acknowledge and evaluate (if possible) the uncertainties associated with IPEEE vintage fire models.
 - A quantitative evaluation is often not possible.

LER Data





ASP Results and Trends

2022 Precursors

Plant/Description	LER/IR	Event Date	Exposure Time	CCDP/ ΔCDP
Summer , Potential Condition Prohibited by Technical Specifications: Inoperable 'B' EDG (ML22287A184)	395-22-002	2/9/22	26 days	White Finding
Calvert Cliffs 1 , Failure to Properly Implement Foreign Material Exclusion Practices Results in EDG Failure (ML22314A100)	05000317/2022003 (No LER issued)	2/19/22	161 days	White Finding
Calvert Cliffs 2 , Failure to Properly Implement Foreign Material Exclusion Practices Results in EDG Failure (ML22314A100)	05000318/2022003 (No LER issued)	2/19/22	179 days	5×10 ⁻⁶
Quad Cities 2 , Electromatic Relief Valve '3B' Did Not Actuate Due to Incorrectly Oriented Plunger Well Plastic Guides (ML22313A150)	265-22-001	3/21/22	1 year	White Finding

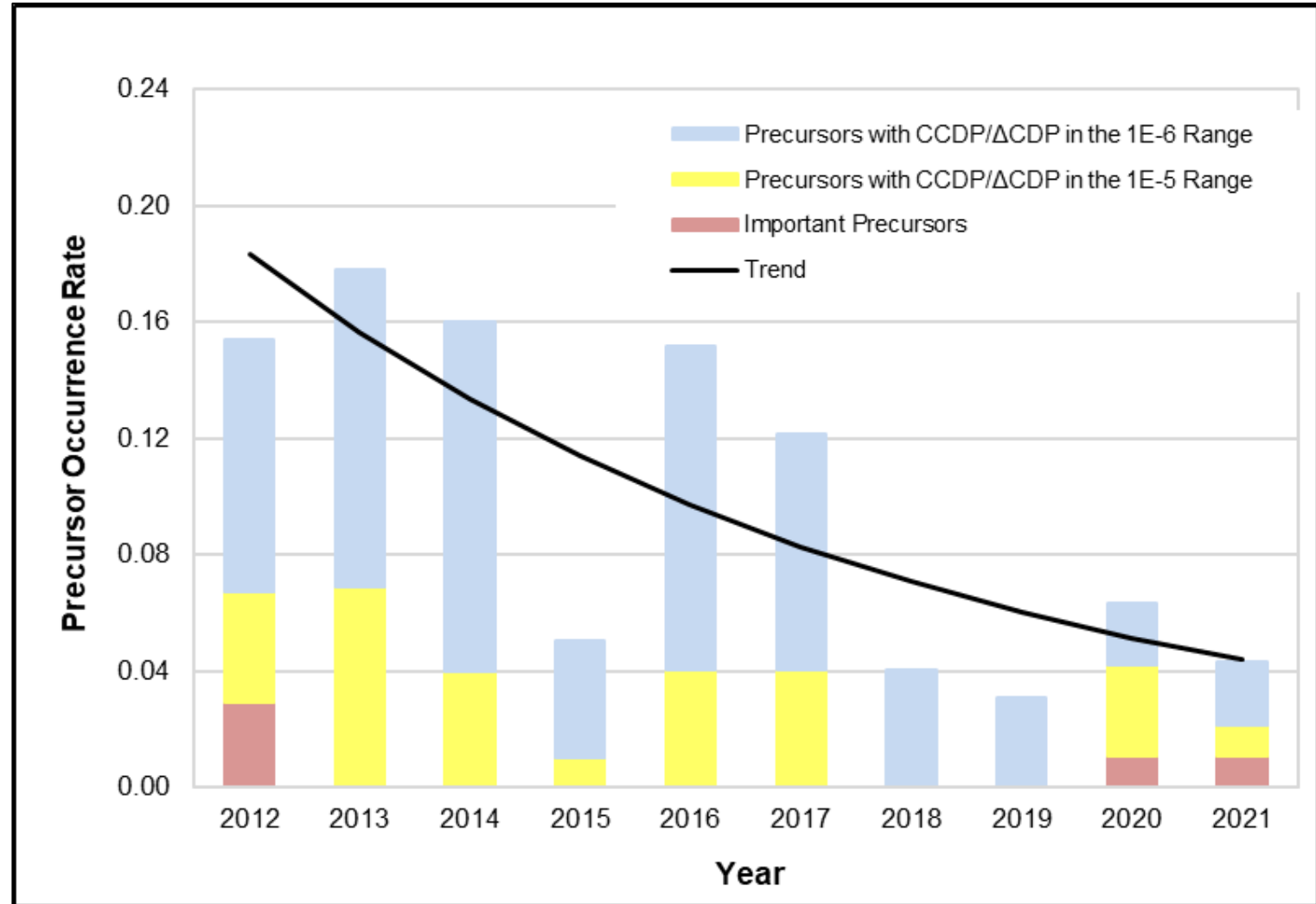
Potential Precursors Still Being Analyzed

Plant/Description	LER/IR	Event Date	Exposure Time
Quad Cities 1 , HPCI System Inoperable due to Gland Seal System Malfunction	254-22-001	12/1/21	55 days
River Bend , Division '1' EDG Speed Sensor Power Supply Failure	458-22-003	7/4/22	30 days
Browns Ferry 1 , HPCI System Declared Inoperable Due to a Corroded Actuator	259-22-002	7/12/22	48 days
Sequoyah 1 , Failure of 1B-B CCP Results in Condition Prohibited by TS	327-22-001	7/22/22	138 hours
Surry 1 , Failure of EDG Results in Operation or Condition Prohibited by TS	280-22-002	7/25/22	24 days
River Bend , HPCS Inoperable Due to Transformer Failure	458-22-004	9/19/22	26 days

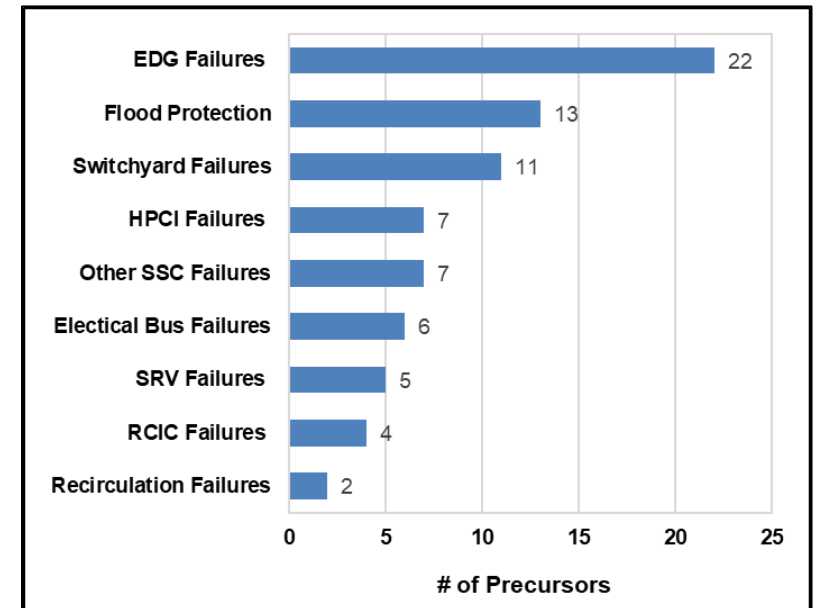
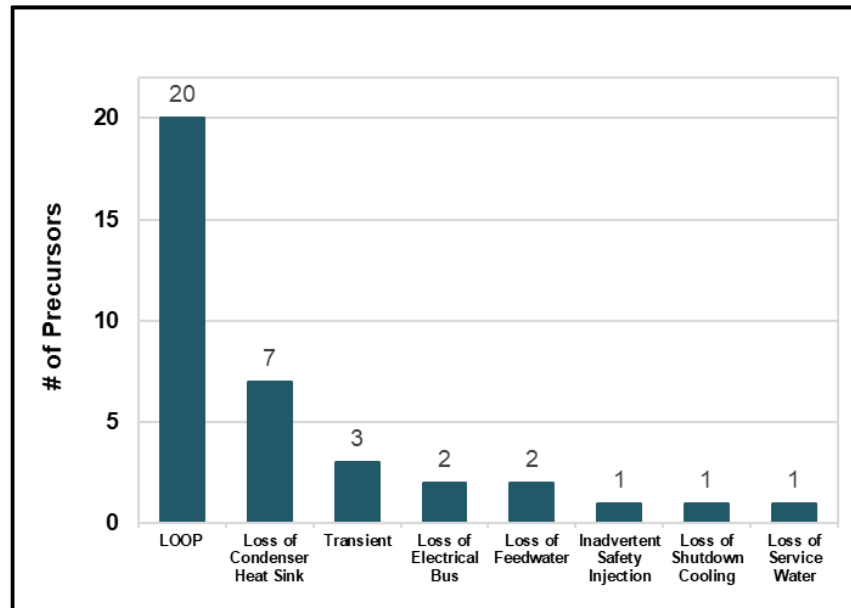
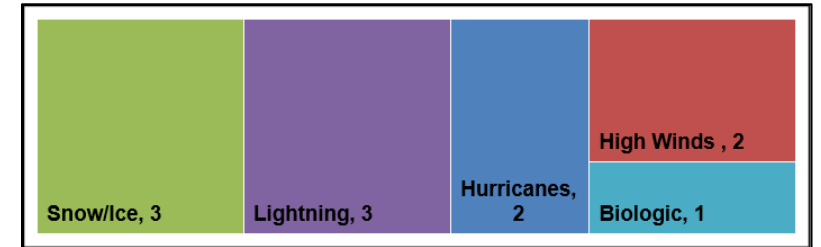
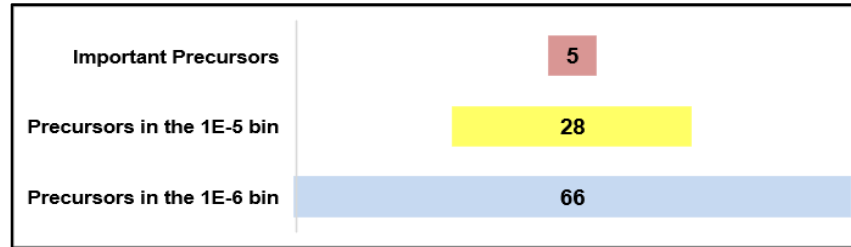
Precursor Trends (2012–2021)

Precursor Group	Trend	p-value
All Precursors	Decreasing	0.00001
Important Precursors (i.e., $CCDP/\Delta CDP \geq 10^{-4}$)	No Trend	0.4
Precursors with $CCDP/\Delta CDP \geq 10^{-5}$	Decreasing	0.01
Initiating Events	Decreasing	0.002
Degraded Conditions	Decreasing	0.001
LOOPs	Decreasing	0.01
EDG Failures	No Trend	0.9
BWR Precursors	Decreasing	0.02
PWR Precursors	Decreasing	0.0002

All Precursor Trend



Insights





Precursor Details

Summer- EDG Failure

- Faulty speed switch connector resulted in EDG load oscillations during monthly testing.
 - Load oscillations noted during monthly surveillance testing, but acceptance criteria were met, so no further action was taken.
 - Testing the following month resulted in more significant load oscillations.
 - Acceptance criteria still met for the 30-minute run, but analysis indicated the EDG would not meet its mission time.
 - Cause: Broken pin on amphenol connector between speed switch transmitter and governor.
- White SDP Finding
 - Δ CDF of $5E-6$ /year; relatively equal contributors from internal events, fires, and seismic.
 - Exposure time of 26 days.

Calvert Cliffs EDG Failure

- Foreign material in fuel injector results in Unit 1 EDG failure during testing.
 - Step changes noted in load followed by alarms and smoke.
 - Clogged fuel injector led to inadequate fuel delivery to the piston, resulting in damage to the engine cylinder, including a melted piston.
 - Foreign material identified as a rubber material not associated with the EDG or the fuel oil system, likely introduced during maintenance activities in August 2020.
- White SDP finding.
 - Δ CDF of $9E-6$ /year for Unit 1; relatively equal contributors from internal events and fires.
 - Exposure time of 161 days.
 - Unit 2 Δ CDF of $5E-6$ /year with 179-day exposure time.

Quad Cities 2 EMRV Failure

- Incorrectly installed plunger guides result in failure of EMRV.
 - Plastic guide inserted in the wrong direction reduced clearance available for the plunger.
 - Approved modification to correct for narrower plunger was not implemented, leading to bowing in high temperature conditions – passed bench test, but bound during surveillance test.
 - EMRV failure during previous cycle was a precursor event in 2020.
- White SDP finding.
 - Δ CDF of $6E-6$ /year; dominated by internal events (~75% of total).
 - Exposure time of 1 year (maximum).

Ongoing Analyses

- The ongoing analyses (with one exception) are associated with EDG or HPCI/HPCS failures.
- The analyses associated with EDG failure have a significant level of effort to ensure the modeling of FLEX strategies is appropriate.
- The evaluation of the hazards other than internal events (especially internal fires) is a challenge.
- The decisionmaking associated with risk estimates from non-mature modeling continues to evolve.

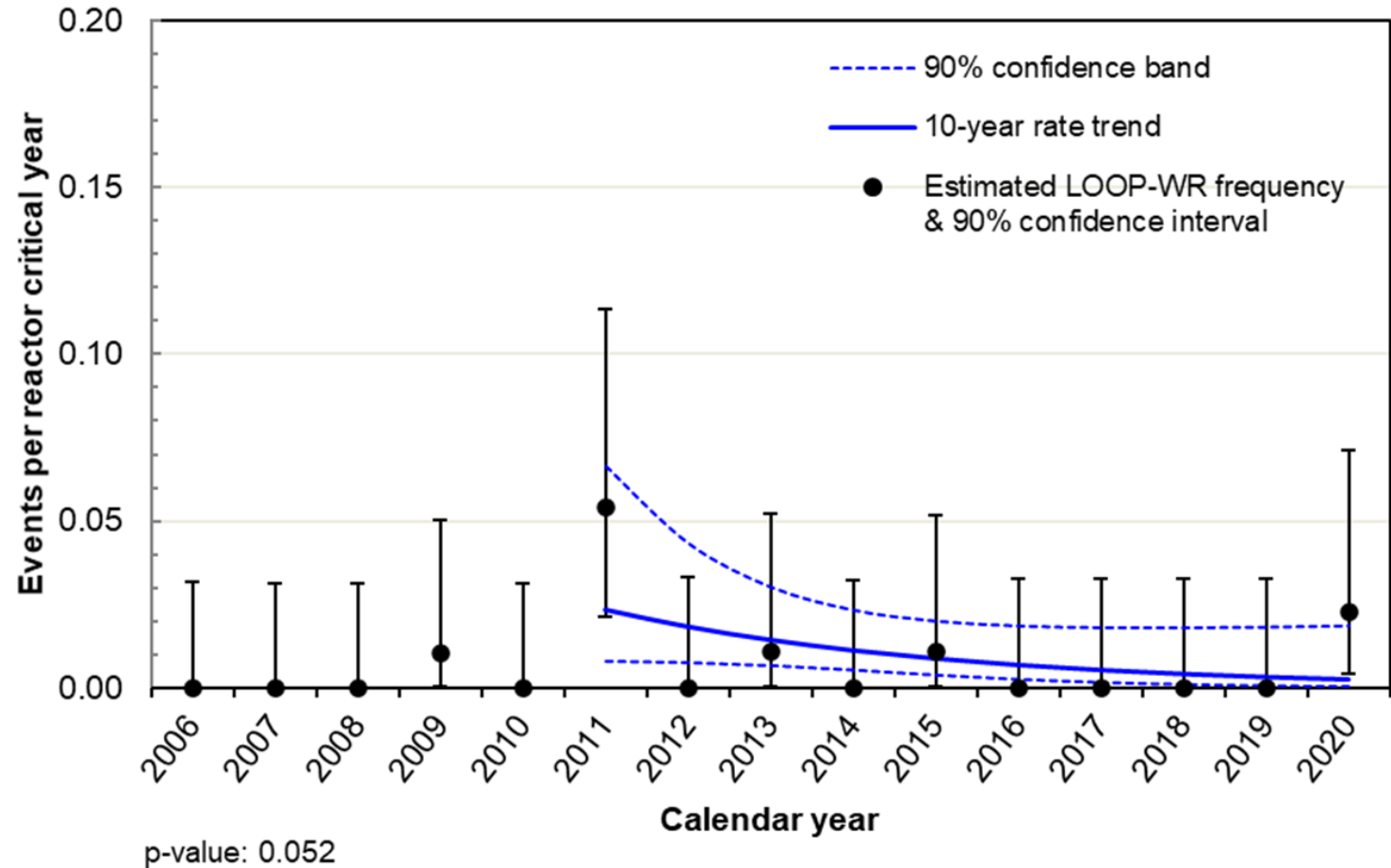


Climate Change Impacts

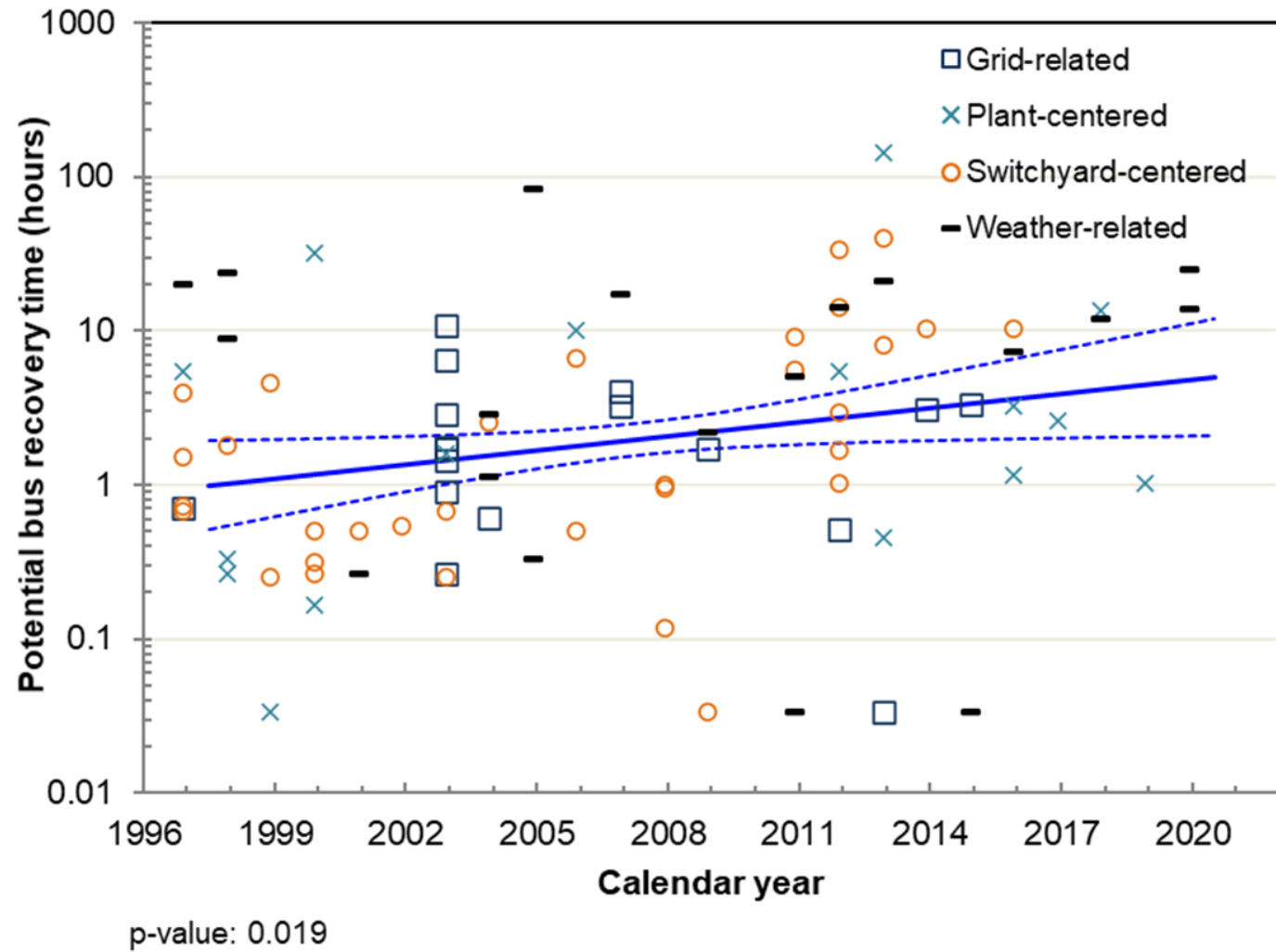
Climate Change Effects

- Initially explored LOOP and precursor data to determine what (if any insights) could be gained.
- Key Questions
 - Are the frequency and duration of weather-related LOOPS changing?
 - What do the ASP results and insights from recent weather-related LOOPS tell us?

Weather-Related LOOP Frequency Trend



LOOP Duration



General Risk Insights from Recent Weather- Related LOOPS

- SBO risk is dominant for two EDG plants for long-duration LOOPS.
 - Multi-unit sites with shared EDGs typically have much lower risk.
 - Having an EDG not included in the same common-cause component group as the other safety-related EDGs can be a significant benefit.
 - Modeling of common-cause failures across the units introduces significant uncertainties because the data do not support this modeling.
- LOOP duration has significant impact on plants that have dominant SBO risk.
- FLEX credit can have significant impact on the results.