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Accident Sequence Precursor Program



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ACCIDENT SEQUENCE PRECURSOR (ASP) PROGRAM

- ASP Program Description
- Results and Insights



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ACCIDENT SEQUENCE PRECURSOR (ASP) PROGRAM

- Objectives
 - Determine the Safety Significance of Events and Regulatory Implications.
 - Provide Feedback to Improve PRA models (e.g., Common-Cause Interactions and Events; Operator Recovery Actions; Inclusion of Support Systems; Alternate Success Paths).
 - Provide Performance Measures in Annual Performance and Accountability Report to Congress and Industry Trends Program.
 - Inform Commission of Results of ASP program in an Annual SECY Paper.



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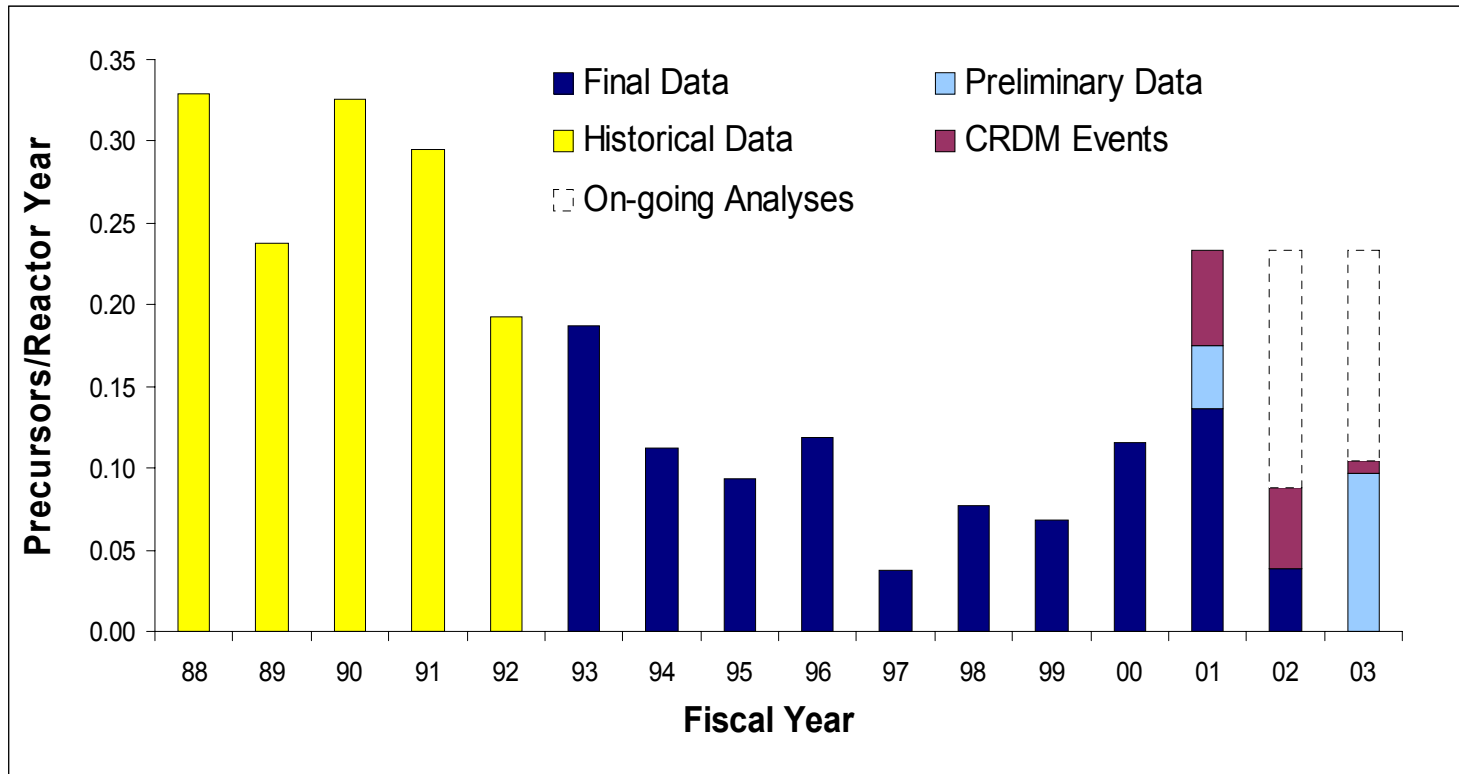
ASP ANALYSIS

- What is an accident sequence precursor ?
 - An accident sequence precursor is an observed event and/or condition at a plant, when combined with one or more postulated events (e.g., equipment failures, human errors), could result in core damage.
 - Conditional core damage probability " 10^{-6}
- What is an ASP Analysis?
 - An ASP analysis is a plant-specific risk analysis performed to determine the conditional likelihood of a core damage accident given an initiating event and/or plant equipment failures or unavailability.
 - Concurrent events and/or conditions are set to “true” in the risk model to generate the conditional core damage probability and identify dominant sequences (cut sets).



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ASP OCCURRENCE RATE



All Precursors % occurrence rate, by fiscal year. No trend was identified during the FY 1993-2001 period. A trend line is not shown in the figure because the slope is not statistically significant. *Note: analyses are still on-going for FY 02 and FY 03.*



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INSIGHTS FROM ASP PROGRAM (FY 1993-2003)

- Analysis of trends in ASP events for period FY 1993-2003
 - No statistically significant trend over past 10 years
 - “Significant” precursors (CCDP or Δ CDP " 1×10^{-3}) occur about once every 4-5 years; last one in 1996 (potential one in 2002)
- Most (~80%) precursors are consistent with PRA results in frequency of occurrence and also in dominant contributors
- However, a number (~20%) of precursor events involved event initiators or conditions that are typically not modeled in PRAs
 - Blowdown of the RCS to the RWST at hot shutdown
 - Reactor trip with loss of one train of essential service water due to frazil ice and the unavailability of the turbine-driven AFW pump
 - Potential failure of all CCW pumps due to steam intrusion resulting from a high-energy line break
 - Potential LOCA due to control rod drive mechanism degradation and reactor vessel head corrosion



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IMPORTANT ASP EVENTS SINCE 1997

Event Date	Description	CCDP
08/14/2003	Loss of Offsite Power and Reactor Trips as a Result of the Grid Event of August 14, 2003	$3 \times 10^{-5} - 5 \times 10^{-4}$
09/04/2002	Potential LOCA from CRDM Cracks and Vessel Head Corrosion	$>10^{-4}$ (Preliminary)
11/29/2001	Potential Common-Mode Failure of All Auxiliary Feedwater Pumps	7×10^{-4}
05/15/2000	Reactor Trip and Extended Plant-Centered Loss of Offsite Power	4×10^{-4}
02/15/2000	Manual Reactor Trip Following a Steam Generator Tube Failure	5×10^{-4}
10/22/1999	Potential High-Energy Line Break Conditions Affecting the Operability of Mitigating Systems	4×10^{-4}
06/24/1998	A Tornado Touchdown Caused a Complete Loss of Offsite Power	6×10^{-4}



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NORTHEAST BLACKOUT ASP ANALYSES RESULTS (PRELIMINARY)

- No major equipment failures (i.e., EDGs, turbine driven pumps, batteries), thus no major surprises in the results
 - CCDPs of these eight events range from 3×10^{-5} to 5×10^{-4}
 - Five analyses with CCDPs greater than 1×10^{-4}
 - LOOP durations between 1 and 6 hours

Plant	Complications Modeled	Mean CCDP	Time without power*
Fermi 2	Gas turbine failed to start – recovered in 3 hrs.	2E-4	6 hr. 19 min.
Fitzpatrick	None	9E-5	2 hr. 49 min.
Ginna	PORVs opened once; MDAFW failed to start	2E-4	0 hr. 49 min.
Indian Point 2	None	1E-4	1 hr. 37 min.
Indian Point 3	None	7E-5	1 hr. 37 min.
Nine Mile Pt. 1	None	3E-5	0 hr. 56 min.
Nine Mile Pt. 2	None	5E-4	6 hr. 24 min.
Perry	RCIC manually isolated at 3 hrs; LPCS and RHR pump B affected by keep fill system problem	5E-4	1 hr. 27 min.

* Length of time until power was available to the switchyard



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INSIGHTS FROM NORTHEAST BLACKOUT ASP ANALYSES

- All affected plants successfully coped with the loss of offsite power.
- The ASP analysis showed that given the occurrence of the loss of offsite power, each plant had about one chance in 10,000 of experiencing a sequence of failures that will lead to significant reactor fuel damage.
- The individual plant results are within the expected range, based on ASP evaluations of previous LOOP events.
- During the ten years before 2003, the industry experienced about two precursors per year that exceeded the one chance in 10,000. Based on the preliminary ASP analyses, five of the August 14, 2003 events exceeded one chance in 10,000.