ADAMS/ACCESSION NO.: ML060170575

Risk Insights from "Reevaluation of Station Blackout Risk at Nuclear Power Plants" (NUREG/CR-6890)

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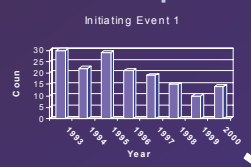
ENCLOSURE 3

LOOP and SBO Risk Factors

LOOP Frequencies



LOOP Durations

EDG Reliability

Plant-Specific SBO Coping Features

- Battery depletion time
- Turbine-driven pumps
- Alternate AC power sources
- RCP seal design

72 SPAR Models

Event Tree 1

SBO Core Damage Frequency

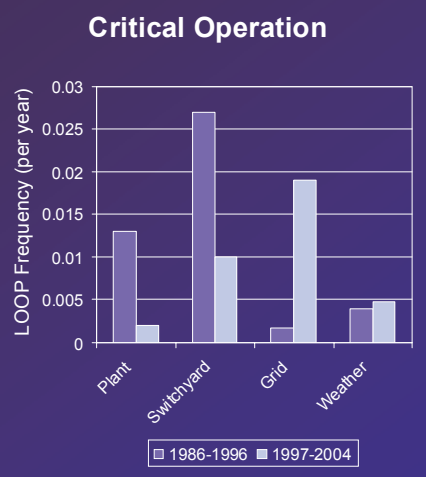
Outline of Presentation

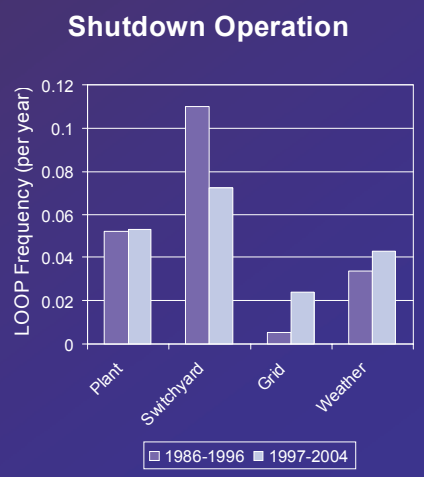
- Comparison of NPP LOOP frequencies 1986 – 1996 and 1997 – 2004
- "Seasonal" variations in NPP LOOP frequencies
- LOOP durations
- Grid performance trends and insights from NERC information

Definitions

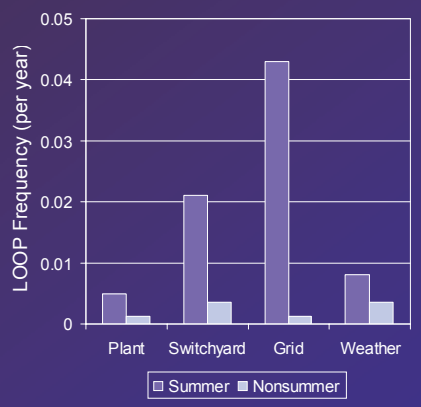
- Loss of offsite power (LOOP) is defined as loss of offsite power to all safety buses
- Station blackout (SBO) is the loss of all offsite and onsite AC power to the safety buses

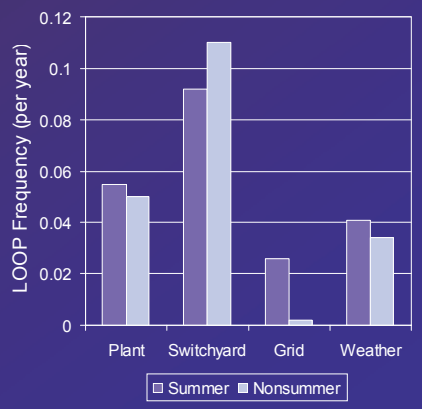
Comparison by Period





Seasonal Variation





Grid and Switchyard Events

Switchyard Events

Critical	86-96	97-04	Total
Summer	11	6	17
Nonsummer	12	1	13
Total	23	7	30

Grid Events

Critical	86-96	97-04	Total
Summer	1	13	14
Nonsummer	0	0	0
Total	1	13	14

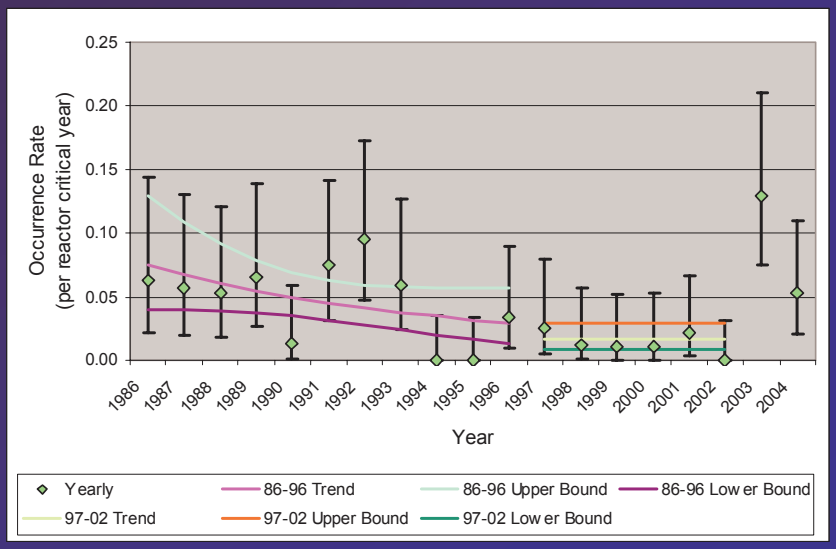
Switchyard Events

Shutdown	86-96	97-04	Total
Summer	11	1	12
Nonsummer	20	6	26
Total	31	7	38

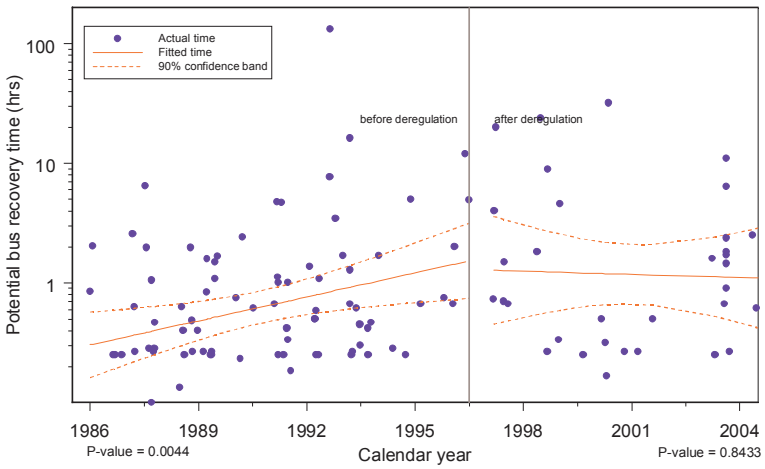
Grid Events

Shutdown	86-96	97-04	Total
Summer	1	2	3
Nonsummer	0	0	0
Total	1	2	3

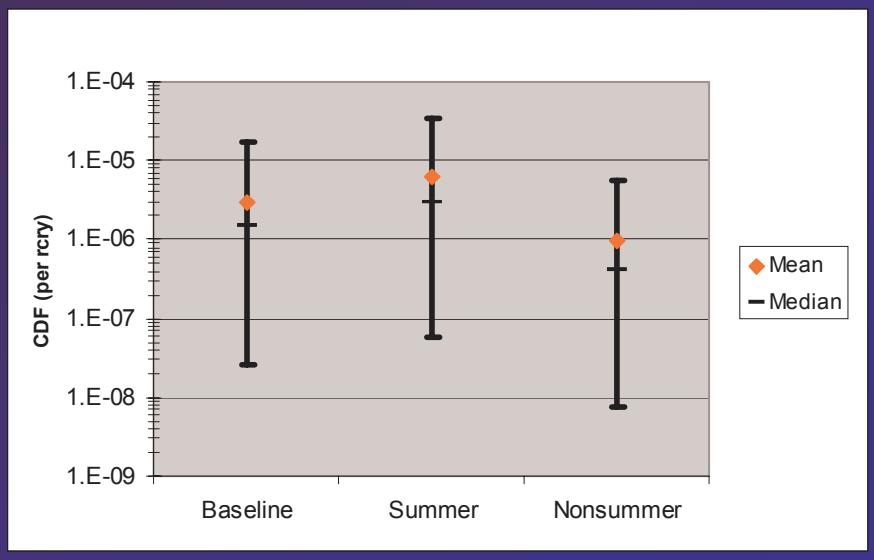
Annual LOOP Frequency Trend



Duration Trend



Seasonal SBO CDF Comparisons



Power Grid Background

- Changes in transmission system operation
  - Open access of generators to the transmission system
  - Blackout Task Force - absence of major transmission projects of last 10 -15 years
- Grid experience supports Generic Letter
  - Scope of grid impact on NPP includes LOOPs and reactor trips. Examples:

    August 1996 West Coast, August 1999 Callaway degraded grid event, August 2003 blackout, and June 2004 Palo Verde .
  - Also some experience shows grid event can occur when testing EDG to grid or when needed.

Increases and seasonal variation in the probability of a LOOP given a reactor trip

NUREG-1784

- 2.0E-03 for 1985-1996
- 4.5E-03 for 1997-2001
- 1.0E-02 for 1997-2001 May to September

NUREG-6890

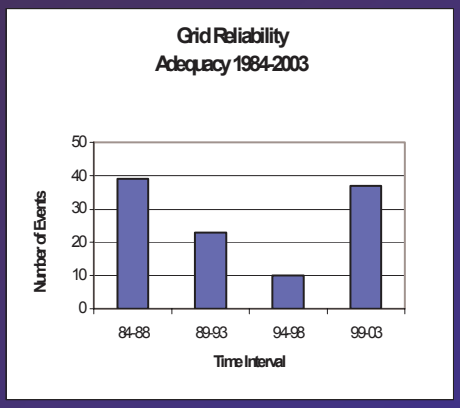
- 3.0E-03 for 1986-1996
- 5.3E-03 for 1997-2004
- 9.1E-03 for 1997-2004 May to September

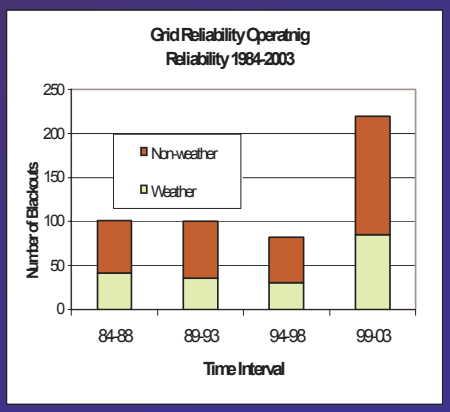
- Reactor trip is a random test of the capacity and capability of grid
- Risk implications of reactor trip that causes a LOOP

NERC definitons and data

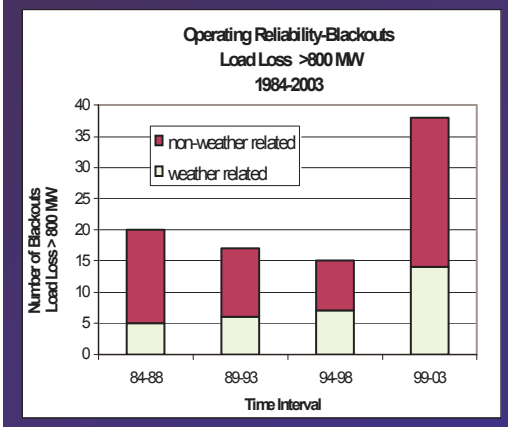
- **Reliability definitions**
  - **Operating reliability of the power system to withstand a sudden disturbance**
  - **Adequacy of generation to supply to demand to its customers**
- **Large amount of NERC data should provide confidence in its analyses**
  - **600 disturbances meeting NERC and DOE thresholds**
  - **7000 Transmission load relief requests**

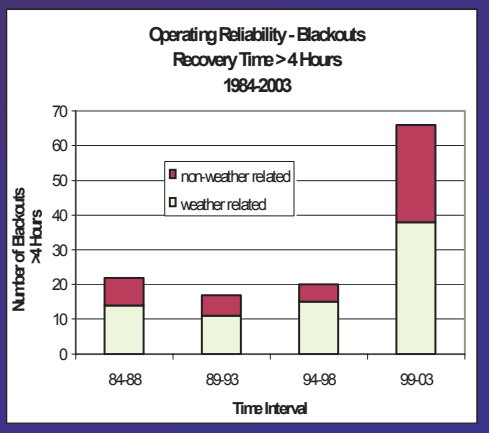
Grid reliability has changed since 1999-more disturbances



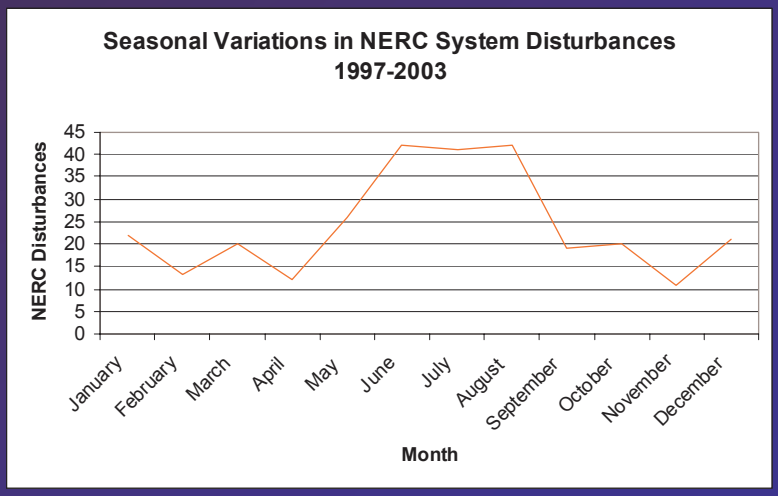


NERC disturbances getting bigger and longer



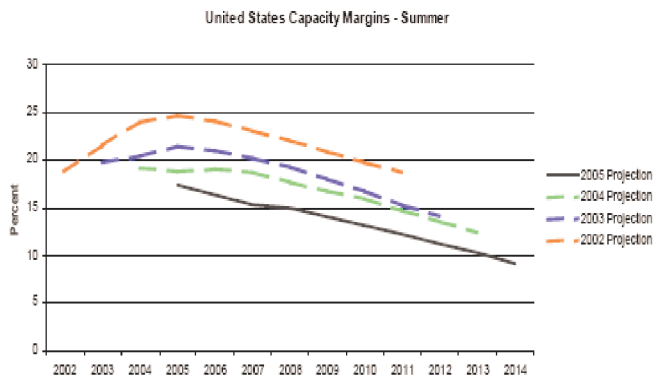


Seasonal variations in NERC grid disturbances

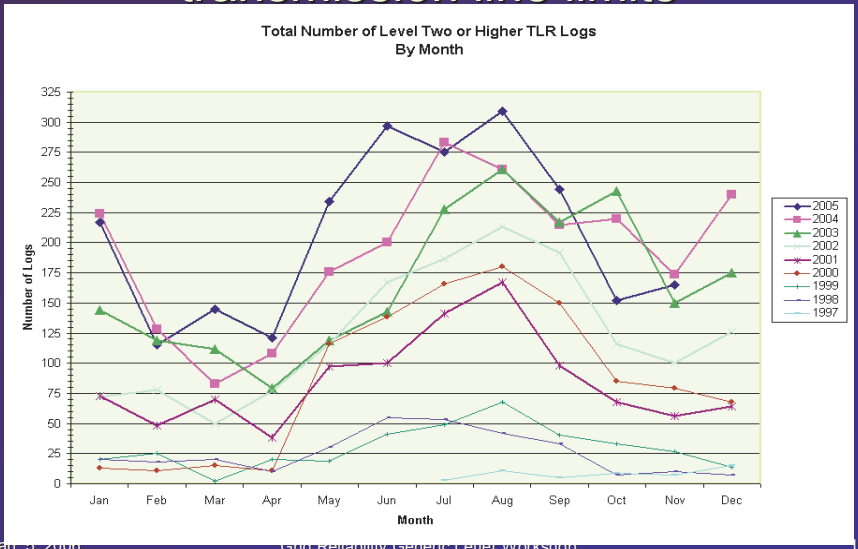


NERC
Forecasts Decrease in Summer Capacity Margin

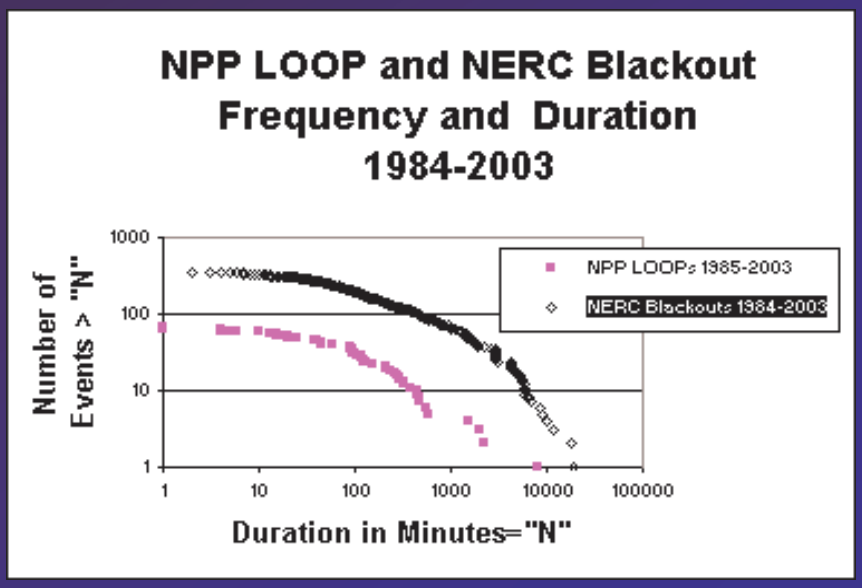
Figure 9: U.S. Summer Capacity Margin Projections



TLR trends show seasonal variation in power transfers that approach transmission line limits



August 14, 2003 not an outlier



Summary: Experience and data support Generic Letter

- The overall frequency of LOOP events has been declining since 1986, but there was an upturn in 2003 and 2004,
- Grid centered LOOPs are up significantly in recent years,
- The average LOOP duration has increased significantly since 1986,
- In recent years, almost all LOOP events have occurred in the “summer” (May-September),

Summary: Experience and data support Generic Letter (Cont.)

- Some recent events have raised questions about the likelihood of a LOOP caused by reactor scrams,
- The seasonal variations in LOOP events and grid reliability raises questions about maintenance of EDGs or SBO coping features during Summer months or during times of grid distress.
- Change adds uncertainty about the future,
- LOOP precursors, such a NERC grid "disturbances," have risen significantly in recent years,