Redefining System Strength for the Modern Grid

ESIG Spring Workshop 2026

About MISO

MISO's reliability footprint and regional control center locations.

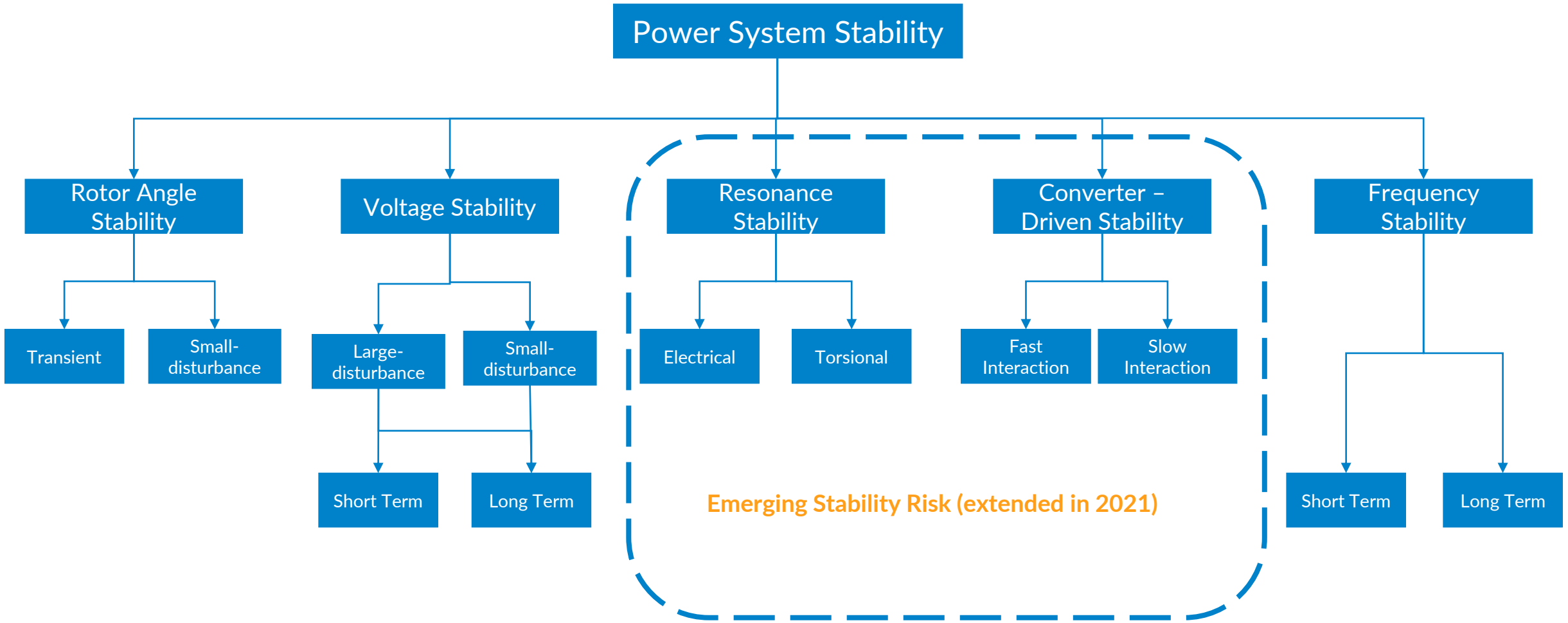
KEY FACTS

Area Served	15 U.S. States and Manitoba, Canada
Population Served	45 Million
Transmission Line	79,000 Miles
Generating Units (Commercial Model)	1,979
Record Demand	127.1 GW 7/20/2011
Wind Peak	25.6 GW 1/12/2024
Solar Peak	14.5 GW 9/7/2025
Members	57 Transmission Owners
	176 Non-transmission Owners
Market Participants	>550
Carbon Reduction	Approximately 32% since 2014

MISO TRANSMISSION EXPANSION PLAN (MTEP24)

	MTEP25	MTEP24
Approved New Projects	432	482
Miles of Transmission Line	1,901	5,053

Traditional stability categories were built around synchronous machines, not power electronics. Emerging risks occur in the fast electromagnetic domain.



The changing energy landscape fundamentally change system stability behavior

System Strength

Driven by short-circuit strength, network impedance, generation mix and load characteristics

Determines how well equipment and overall system stay stable and recover from disturbances

Electrical robustness at the point of connection

Drivers

Impact

High IBR density where fast inverter controls interact and oscillatory risks increase.

Large electronic loads act like “IBRs on the demand side,” weakening system strength and increasing converter-driven stability risks in both directions.

Fewer strong transmission paths as synchronous plants retire and new loads appear in remote areas

3-Layered Stability Strategy

Layer 01: NSCR

Screening Metric
Identify weak areas and flag potential IBR-driven stability risks

Layer 02: Oscillations

Small-Signal Analysis
Evaluate oscillatory interactions between IBRs and the grid; identify unstable mode.

Layer 03: Large Signal EMT

Confirm robustness under major disturbances (faults, trips, large load/generation changes)

First Layer: NSCR (System Strength Screening)

Purpose:

- Provide system-wide situational awareness of system strength
- Identify weak areas and flag potential IBR-driven stability risks early

Key Concept:

- Scalable, system-wide screening across topology and dispatch conditions
- Identifies weak pockets and IBR clustering, including interaction effects
- Triggers targeted actions:
  - Prioritizes locations and conditions requiring deeper EMT or oscillation studies
  - Flags areas for heightened operational awareness and close monitoring

NSCR is not a pass/fail metric—it is a risk flag that guides deeper analysis and operational focus

NSCR — Key Capabilities

Scalable Screening

Evaluates the entire network efficiently without full EMT simulations.

Consistent Thresholds

Robust across topology, dispatch, and operating changes.

Interaction Awareness

Captures multi-node voltage coupling and identifies potential IBR clusters.

Flexible Consideration

Accounts for benefits of both GFM and GFL converters.

Actionable Output

Highlights where deeper studies or operational monitoring are needed.

Key Insights: System Strength Metric NSCR

Identifies Weak Areas	Flags low-strength pockets and clustered IBR developments.
Guides Targeted Studies	Directs where EMT or oscillation assessments are needed.
Supports Operational Planning	Helps anticipate stress points from ramps and variability.
Informs Reinforcements	Prioritizes upgrades and system-strength additions (e.g., GFM, synchronous condensers).
Enhances Reliability	Ensures robust voltage, frequency, and ride-through performance in high-IBR grids.