

# System Integrity Protection Schemes for Enhanced Security and Capacity

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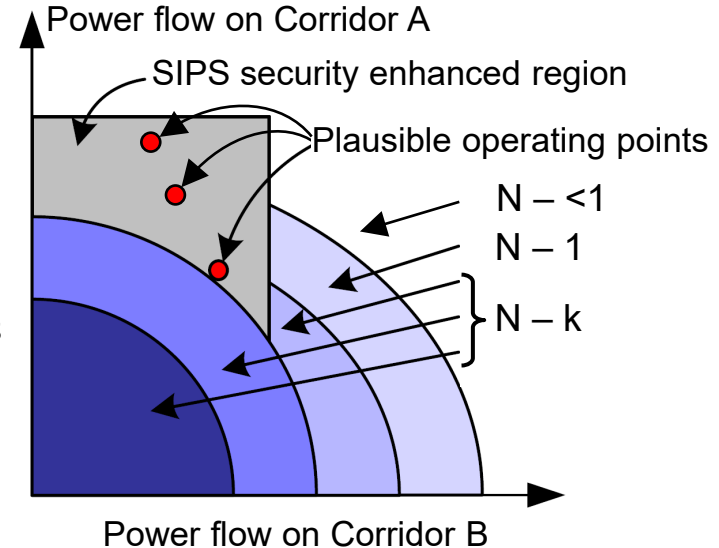
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# System Integrity Protection Schemes

## - SIPS - at a glance

- Prevent large disturbances & maintain system integrity
- Increase security of operation, for N-1, N-k & N-<1
  - Enable operation outside general security criteria
  - Increase secure power transfer capacity
  - Decrease sensitivity to severe/ multiple contingencies
- Typical protective actions:
  - Shed load; Trip generation
  - Network split; Fast ramp HVDC



# SIPS categories

## **Event based:**

- Triggered by event (breaker status etc)
- Static, complex enabling criteria (operating status of large no of breakers etc.)
- Fast (direct trip signals), foreseeable result

## **Response based:**

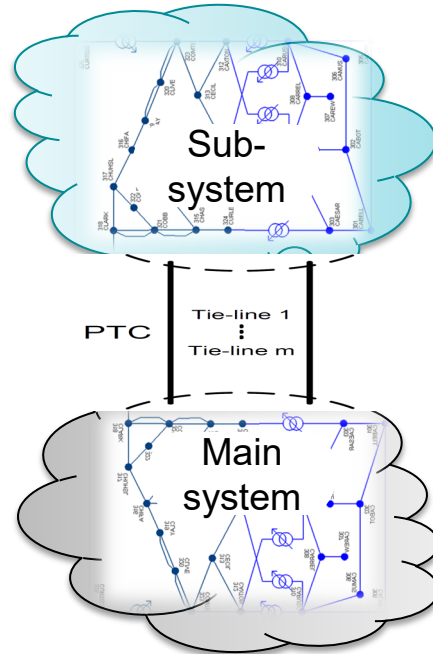
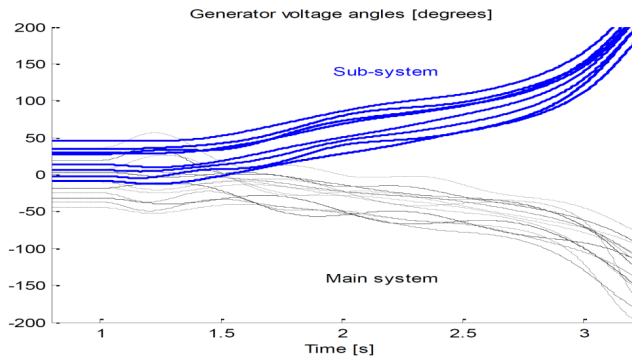
- Threshold trigger (f, U, etc)
- Dynamic/adaptive, effective for multitude of scenarios and unforeseen contingencies
- Slower (dependent on measurement signals and data processing), effectiveness subject to operating scenario

# SIPS enhancement with PMU/WAMS

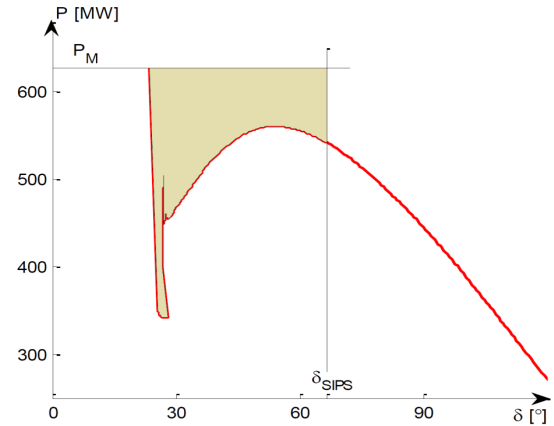
- **Increased observability** enabling performance enhancement
- **Novel approaches** for detection and prevention
- **Dependency of PMU signals** in critical protection systems

# Example of SIPS design with PMU: Power-angle monitoring of corridors

## Clustering of critical machines



## PTC P- $\delta$ characteristics



**Thank you!**

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