



## **Module 4: Constraint Management Plans, Remedial Action Schemes and Generic Transmission Constraints**



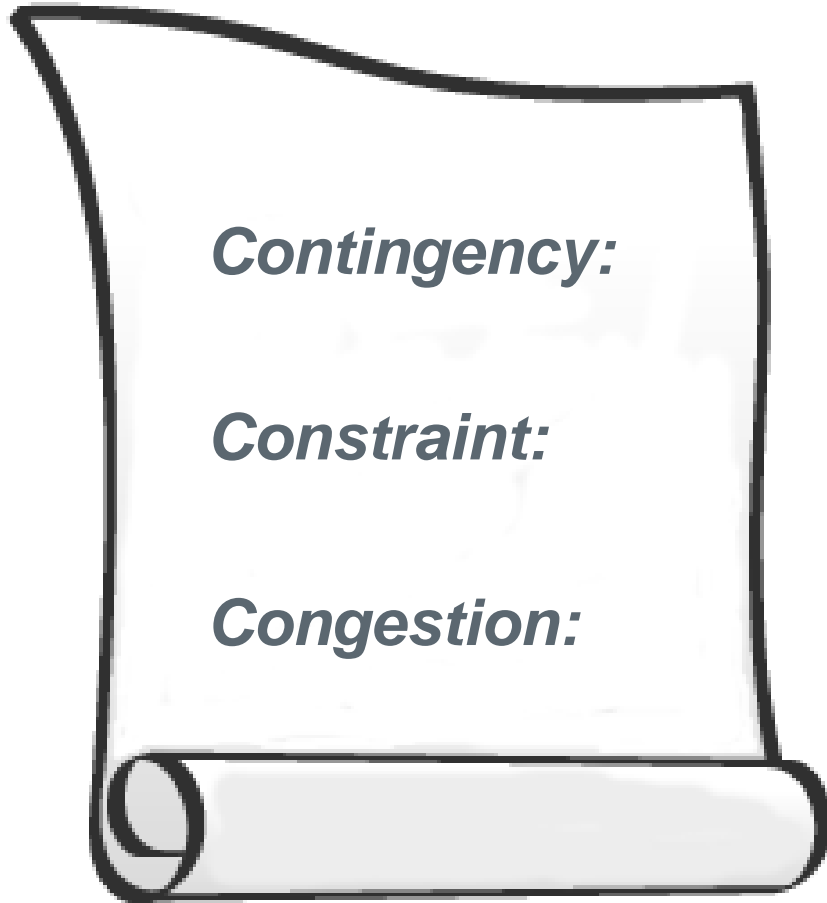
### Upon completion of this module you will be able to:

- Discuss the Three “C’s” of Transmission Security
- Differentiate between the different types of Constraint Management Plans
- Describe the use of Remedial Action Schemes
- Summarize ERCOT’s use of calculate Generic Transmission Constraints



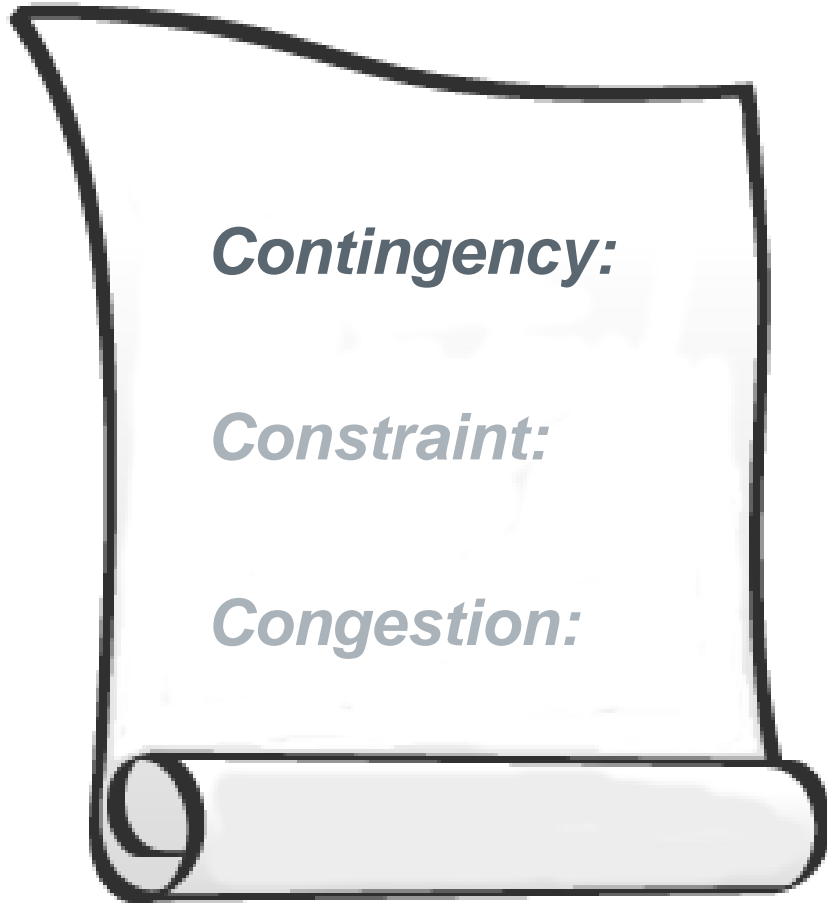
# Transmission Security

## The Three C's of Transmission Security



***Contingency: An event that could jeopardize reliability.***

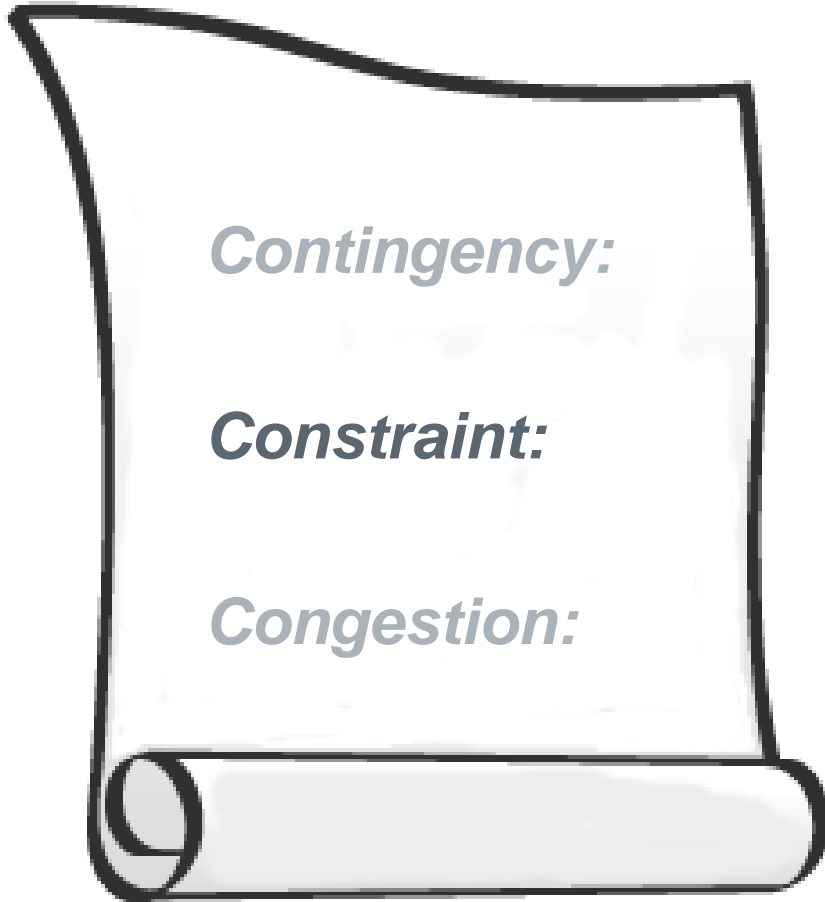
## The Three C's of Transmission Security



### *Contingency Analysis:*

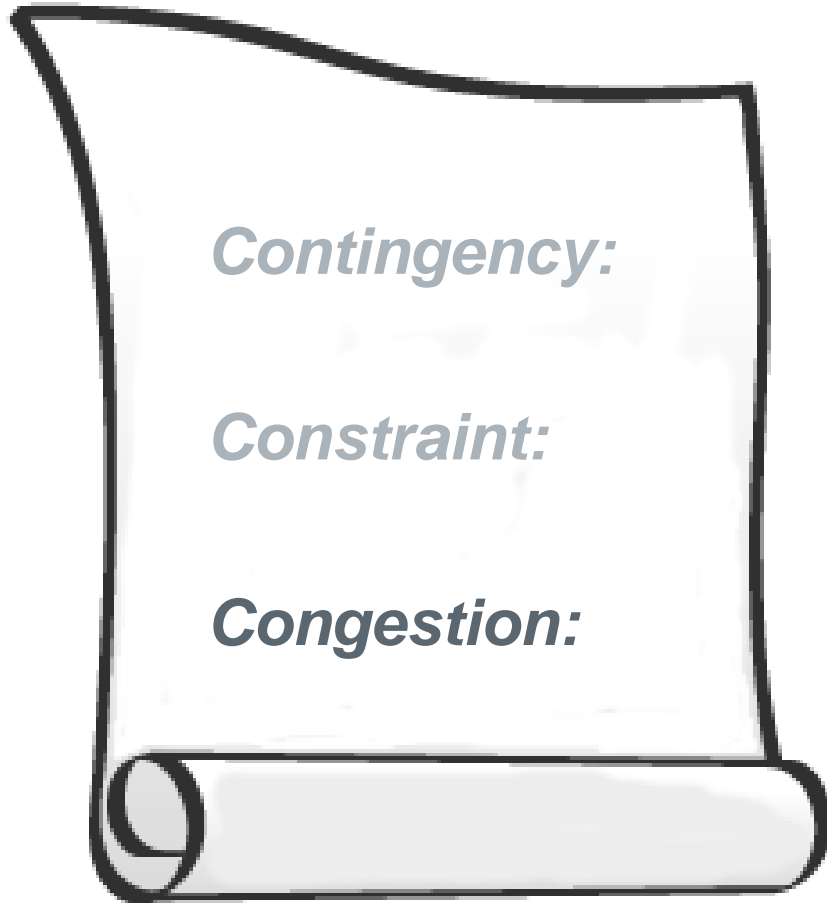
- *“What-if” Scenarios*
- *Studies a Base Case (N)*
- *Minus the loss of Transmission Lines, Autotransformers and Generation Units in a defined Contingency List*
- *One at a time (-1)*

## The Three C's of Transmission Security



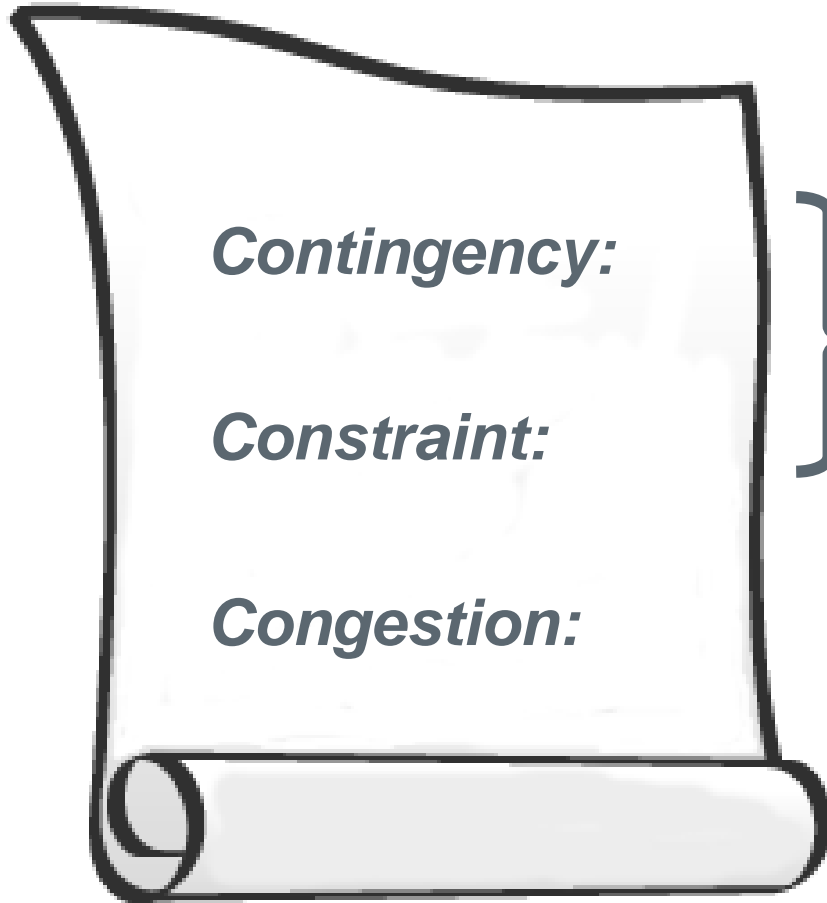
*Constraint: A contingency and limiting element pair which exceeds a System Operating Limit (SOL) that prevents us from using the cheapest power available*

## The Three C's of Transmission Security



***Congestion: When we must adjust power flows to keep from overloading a constraint under a specific contingency we say that the system is experiencing congestion***

## The Three C's of Transmission Security



***Security Violation*** is always a Contingency/Constraint pair



# **Constraint Management Plans (CMPs)**

## CMP

## Constraint Management Plans

CMPs are:

“Transmission switching actions developed to ensure grid reliability in the event a given contingency is anticipated or occurs”.

## CMP

## Constraint Management Plans

Pre-defined Manual or Automatic Transmission System Actions that do not constitute an Automatic Remedial Action Scheme (RAS)

ERCOT employs CMPs to:

- Facilitate market use of the Transmission Grid
- Maintain system security and reliability
- Optimize the transmission system
- Supplement, not replace, the use of SCED for resolution of one or more thermal or non-thermal security violations

## CMP

## Constraint Management Plans

CMPs are typically designed to protect against:

- High or abnormal system generation or load patterns
- Overloading of:
  - Transmission Lines
  - Transformers
  - Protective Relays
- Voltage Deviations
- Contingencies

## CMP

## Constraint Management Plans

CMPs include, but are not limited to:

- Automatic Mitigation Plans (AMP) which are modeled in Network Security Analysis
- Remedial Action Plans (RAP) which are also modeled in Network Security Analysis
- Temporary Outage Action Plans (TOAP)
- Pre-Contingency Action Plans (PCAP)
- Mitigation Plans

## AMP

## Automatic Mitigation Plans

- Detect predetermined abnormal system conditions and automatically take pre-coordinated corrective actions
- Executed Post-Contingency
- Proposed by TSPs or REs
- Address Voltage issues or to reduce over-loading of Transmission Facilities to below the Emergency Rating
- Limited only to schemes which switch Series Reactors

## AMP

## Automatic Mitigation Plans

- Shall not include Load shedding, generation re-dispatch or tripping nor be implemented on IROLs
- Is utilized in Network Security Analysis
- Transmission Switching –
  - Performed automatically by pre-defined actions

## RAP

## Remedial Action Plans

- Pre-Defined Manual Actions executed post-contingency
- Address Voltage issues or to reduce loading on monitored Transmission Facilities
- Restoration levels expected to be:
  - Below Emergency Rating within 15 minutes
  - Below Normal rating within 2 hours



## RAP

## Remedial Action Plans

- Shall not include Load Shedding or generation re-dispatch
- Is utilized in Network Security Analysis
- Transmission Switching –
  - Remedial Switching Action Outages entered into the Outage Scheduler as soon as practicable

## TOAP

## Temporary Outage Action Plans

Pre-Defined Temporary Manual Actions executed post-contingency for specified:

- Resource Outages
- Transmission Facility Outages
- Address Voltage issues or reduce over-loading of monitored Transmission Facilities
- Restoration of Normal operating conditions expected within 2 hours

## TOAP

## Temporary Outage Action Plans

- May include transmission switching or load shedding
- Not utilized in Network Security Analysis
- Transmission Switching
  - Restore Planned Outages

## PCAP

## Pre-Contingency Action Plan

- Pre-Defined Manual Actions
- Executed Pre-Contingency
- Address Voltage issues or reduce over-loading of monitored Transmission Facilities
- Restoration of Normal operating conditions expected within two hours

## PCAP

## Pre-Contingency Action Plan

- Shall not include Load Shedding or generation re-dispatch
- Not utilized in Network Security Analysis
- Transmission Switching –
  - Remedial Switching Action Outages entered into the Outage Scheduler as soon as practicable

## MP

## Mitigation Plans

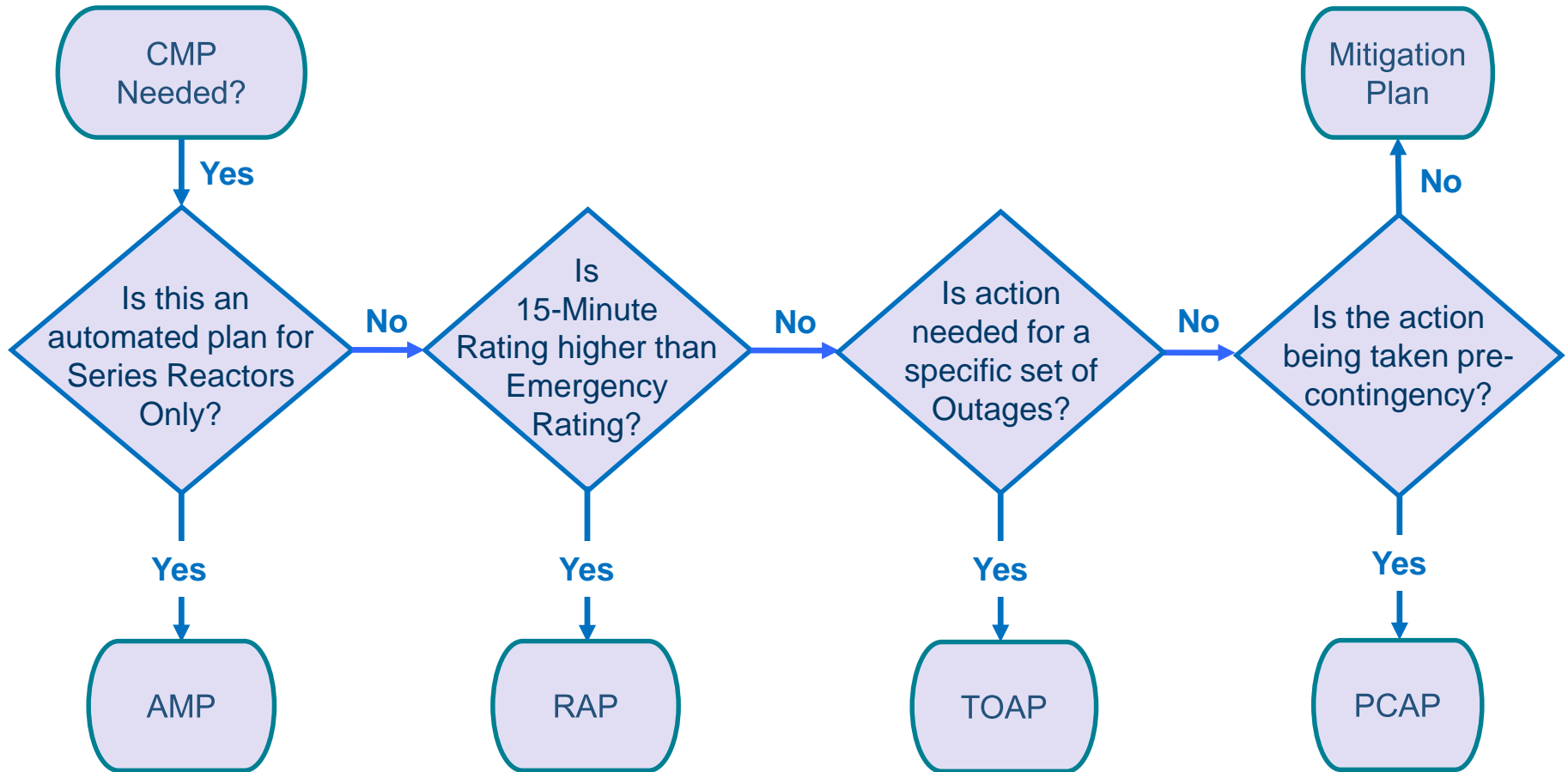
- Pre-Defined Manual Actions
- Executed Post-Contingency
- Address Voltage issues or reduce over-loading of monitored Transmission Facilities
- Restoration of Normal operating conditions expected within two hours

## MP

## Mitigation Plans

- May include load shedding but not include generation re-dispatch
- Not utilized in Network Security Analysis
- Transmission Switching –
  - Remedial Switching Action Outages entered into the Outage Scheduler as soon as practicable

## Criteria used to determine a CMPs Category:





# Remedial Action Schemes (RAS)

## RAS

## Remedial Action Schemes

- TSP or RE proposed schemes designed to detect predetermined abnormal system conditions and automatically take corrective actions.
- May include, but are not limited to:
  - Adjusting or Tripping Generation (MW and MVARs)
  - Tripping Load
  - System Reconfiguration

## RAS

## Remedial Action Schemes

- May Not include or be implemented on:
  - Under-frequency or Under-voltage Load Shedding
  - Isolation of Fault Conditions
  - Out-of-Step Relaying
  - Interconnection Reliability Operating Limits (IROLs)
- Is utilized in Network Security Analysis

**RAP**

Remedial Action Plans

**AMP**

Automatic Mitigation Plans

**RAS**

Remedial Action Schemes

- RAPs, AMPs and RASs are reviewed for changing system conditions:
  - Annually for RAPs and AMPs
  - Every Five Years for RASs
- Not considered permanent alternatives to system upgrades.
- Expected to be used until transmission improvements that resolve the associated constraints are implemented

# **ERCOT Notifications And MIS Postings**

Important: Transmission outage requests must include the following in the Notes area shown below:

- If a RAP, AMP or RAS system will be disabled or impacted
- Any RAP, AMP or RAS necessary during the outage
- The contingency which would require the RAP, AMP or RAS
- Email notes to [OPSOutageCoordination@ercot.com](mailto:OPSOutageCoordination@ercot.com)

Call ERCOT Outage Coordination at 512-248-6841 if additional explanation is necessary.

Notes

Requestor Notes

June 04, 2009 09:15 : NODALTEST **Here is my first note**

Remedial Actions or Special Protection Systems



ERCOT shall post on the MIS Secure site any CMPs or Remedial Action Schemes which have been:

- Approved
- Amended
- Removed
- Not included in the Model



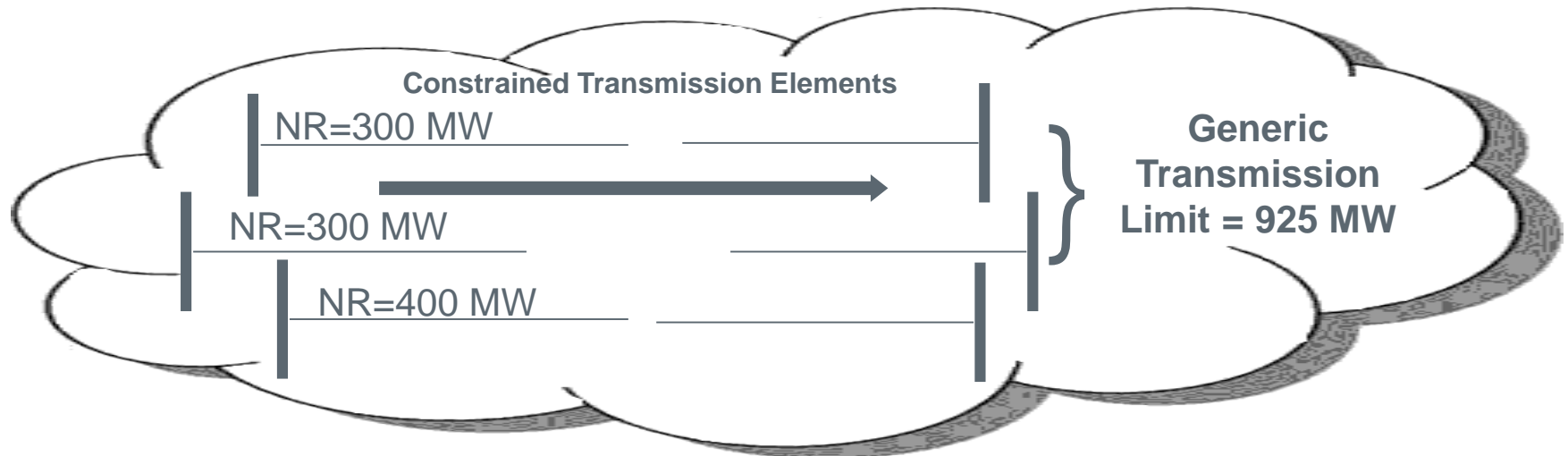
All postings have a Five Day comment period

# Generic Transmission Constraints



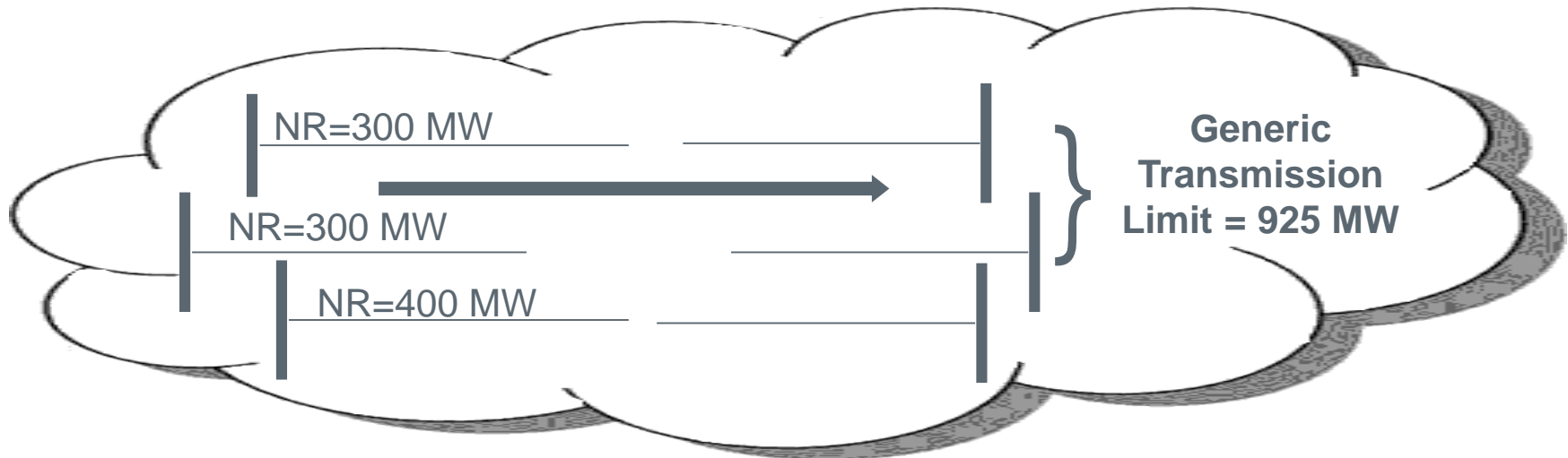
Not all constraints can be directly modeled in ERCOT's Powerflow and Contingency Analysis applications

- To enforce stability and voltage constraints, Generic Transmission Limits can be used
- These limits are more constraining than the sum of the associated Transmission Elements Normal Ratings (NR)



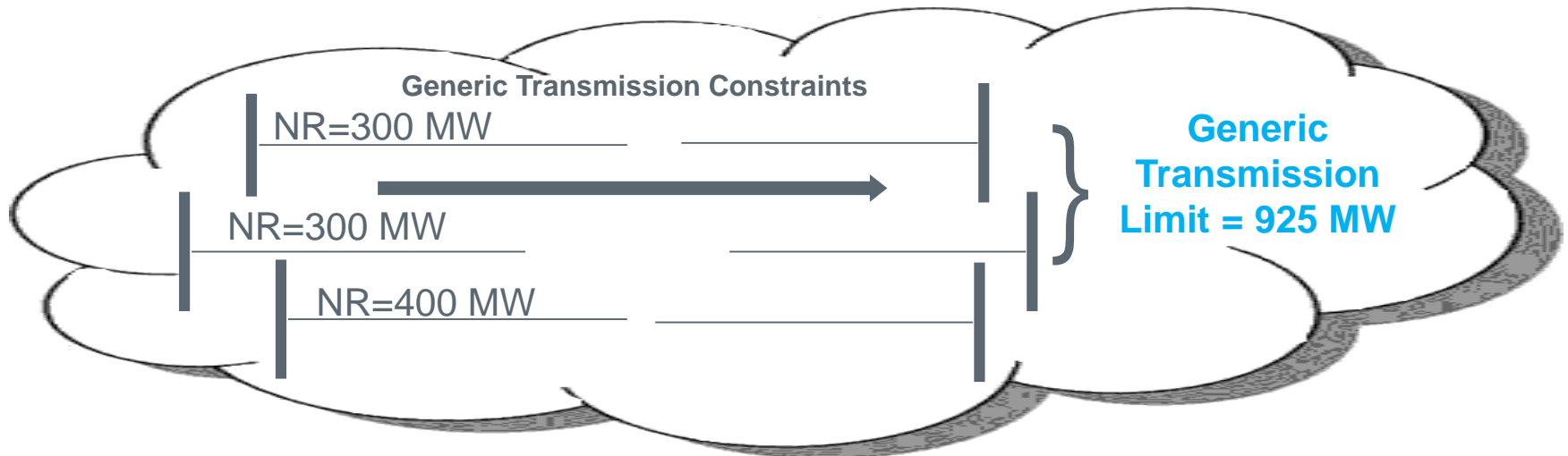
## Defining: Generic Transmission Constraints

- Involves one or more grouped Transmission Elements
- Used to constrain flows between geographic areas
- Protects ERCOT Transmission Grid against transient instability, dynamic instability or voltage collapse.



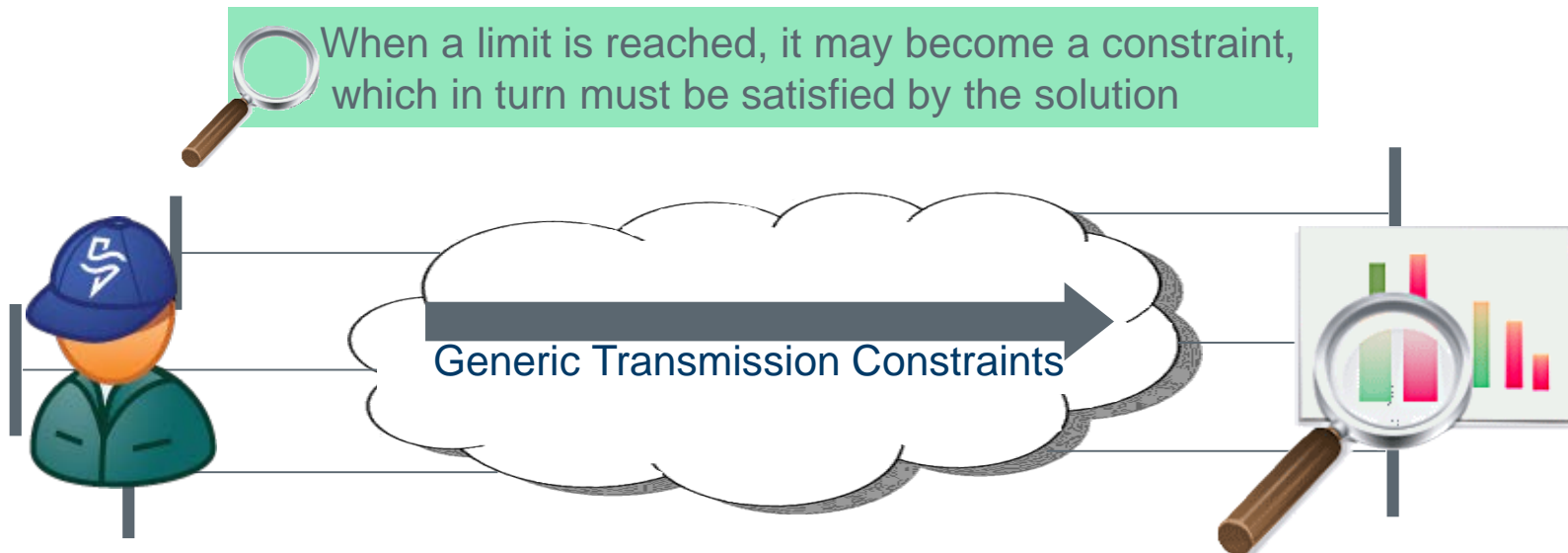
## Defining: Generic Transmission Limits (GTL)

- The value of the transmission flow limit associated with a Generic Transmission Constraint
  - Will always be less than the sum of the Normal Ratings of the associated transmission elements



## Managing Generic Constraints and Limits

- ERCOT is responsible for the development and application of GTCs and GTLs.
- ERCOT monitors the use of GTCs and GTLs in its applications to ensure postings are made in accordance with protocols



## Managing Generic Constraints and Limits

Specific processes using Generic Transmission Constraints and Limits:

- Powerflow and Contingency Analysis
- Day-Ahead Operations
  - Day-Ahead Market (DAM)
  - Day-Ahead Security Analysis
  - Day-Ahead Reliability Unit Commitment
- Hour Ahead Operations
  - Hour-Ahead Security Analysis
  - Hour-Ahead Reliability Unit Commitment
- Real-Time Operations
  - Real-Time Network Security Analysis
  - Security Constrained Economic Dispatch (SCED)

## TSP Responsibilities

- New or modified Generic Transmission Constraints and their associated Limits are not “pushed out”.
- TSPs must access the Secured MIS daily to monitor new or modified GTCs and GTLs

ercot.com  
ERCOT.com  
Market Information System

Contact Us | Help

Search >

Markets Grid Reports Applications Groups and Rules Services Notices

Transmission Generation Forecasts Long-Term Planning Regional Planning Resource Integration

**Voltage and Dynamic Ratings** S

Title  
Dynamic Ratings Submission Exceptions  
Forecasted Temperature Adjusted Dynamic Ratings  
Monthly Average Dynamic Ratings Report  
Real-Time Dynamic Rating Data  
Transmission Elements Recommended for Dynamic Ratings  
Voltage Profiles

**Generic Transmission Limits** S

Title  
Generic Transmission Limits  
Generic Transmission Limits Market Comments  
Generic Transmission Limits Methodology

**Competitive Constraints** S

Title  
Long-Term Approved Competitive Constraints

**Real-Time Prices** P

Title  
SCED Shift Schedules and Binding

**Transmission Outages** S

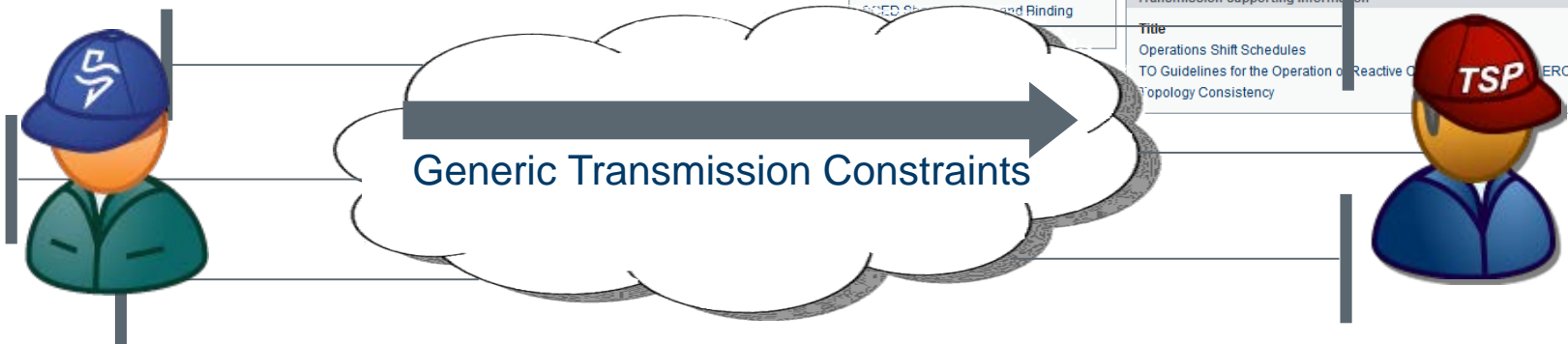
Title  
Consolidated Transmission Outage Report  
Daily Transmission Outage Comments Report  
Transmission Outage Schedule Statistics

**Real-Time Operations** S

Title  
Assessment of Chronic Congestion  
Daily Real-Time Congestion Report - Exceeded Constraints Not Activated  
ICCP Link Availability Statistics Report  
Monthly Average Dynamic Ratings Report  
Monthly Real-Time Congestion Report - Chronic or Severe Constraints  
Monthly Telemetry Point Availability Statistics Report  
NSA Active Constraints  
NSA Inactive Constraints  
Quarterly Important Telemetry Availability Report  
Quarterly Telemetry Point Availability Statistics Report  
Real-Time Dynamic Ratings Data  
Reversal of Base Point Instructions to Generation Resources  
SCED Shift Factors  
State Estimator Reports  
System Ancillary Service Capacity Monitor  
Temporarily Removed Contingencies  
Total Amount of Regulation Service Deployed  
TSP Temporary Equipment Limitation Notifications

**Transmission Supporting Information** S

Title  
Operations Shift Schedules  
TO Guidelines for the Operation of Reactive Compensation  
Topology Consistency



If unexpected changes require a new or modified GTC not previously posted, ERCOT will:

- Issue an Operating Condition Notice (OCN)
- Post the new GTC on the MIS Secure Area
- Explain why it did not post the limit change on the previous day





GTCs and GTLs are typically posted two days prior to the actual operating day.

- Identity of constrained transmission elements
- New flow limits
- Modified flow limits
- Effective date
- Explanation of change







## Posting methodology:

- Includes data and studies used for determination of each GTC
- Market Participant may review and comment on new or modified GTCs



ERCOT posts any comments that Market Participants may have about the GTC methodology within seven days following receipt of comments.

## ERCOT runs stability applications

- Identifies constraints that can be enforced in ERCOT market and reliability analyses
- Establishes new transmission flow limits more constraining than a Transmission Element's Normal Limit
- Enforces stability and voltage constraints not modeled directly in ERCOT's transmission security analysis applications
- All changes and methodologies are posted to the MIS Secure Area

## In Summary - You should now be able to:

- Discuss the Three “C’s” of Transmission Security
- Differentiate between the different types of Constraint Management Plans
- Describe the use of Remedial Action Schemes
- Summarize ERCOT’s use of calculate Generic Transmission Constraints

