PJM Winter Operations and Market Performance

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FERC Winter Operations Panel
October 19, 2017

Agenda

- Winter 2017/18 System Projections
- Winter Preparedness
- Gas Electric Coordination
- Resilience – Gas Pipeline Initiatives
- Market Performance

Winter 2017/18 System Projections

50/50 Non-diversified Peak Load Base Case	
LAS Load Forecast	135,526 MW
RTO Net Interchange	3,950 MW** (Importing)
PJM RTO Installed Capacity	184,926 MW (preliminary as of 8/02/2017)
Discrete Generator Outages	16,586 MW

** 3,950 MW of net interchange is modeled in the OATF base case and accounted for in the total RTO installed capacity

PEAK LOAD ANALYSIS

- No reliability issues identified.
- Re-dispatch and switching required to control local thermal or voltage violations in some areas.
- All networked transmission voltage violations were controlled by capacitors. All other voltage violations were caused by radial load.

IN PROGRESS

- Sensitivity Studies - Results expected early October

PJM Winter Preparations

PJM Studies, Data Requests & Drills

- PJM Operating Analysis Task Force (OATF) Winter Operations Study (November 2017)
- Resource Winter Testing Exercise (December 2017)
- PJM Emergency Procedures Drill (November 7, 2017)
- Fuel Inventory Survey (October 13, 2017)
- Generation owner Cold Weather Resource Preparedness Checklist (Nov. 1 - Dec. 15, 2017)

Reliability Coordinator Winter Preparation Meetings

- PJM / DEP / VACAR (November/December, 2017)
- SERC Operating Committee / SERC RCS / VACAR (October 3-4, 2017)
- Reliability First (September 20, 2017)
- Joint NPCC/PJM/MISO (November 9, 2017)
- NYISO / PJM (October 24, 2017)
- TVA / PJM (November, 2017)

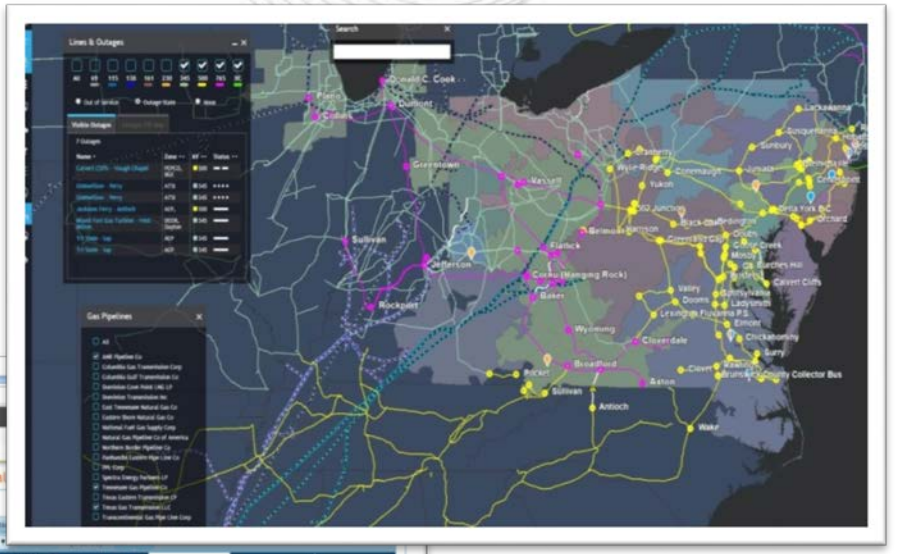
Gas / Electric Coordination

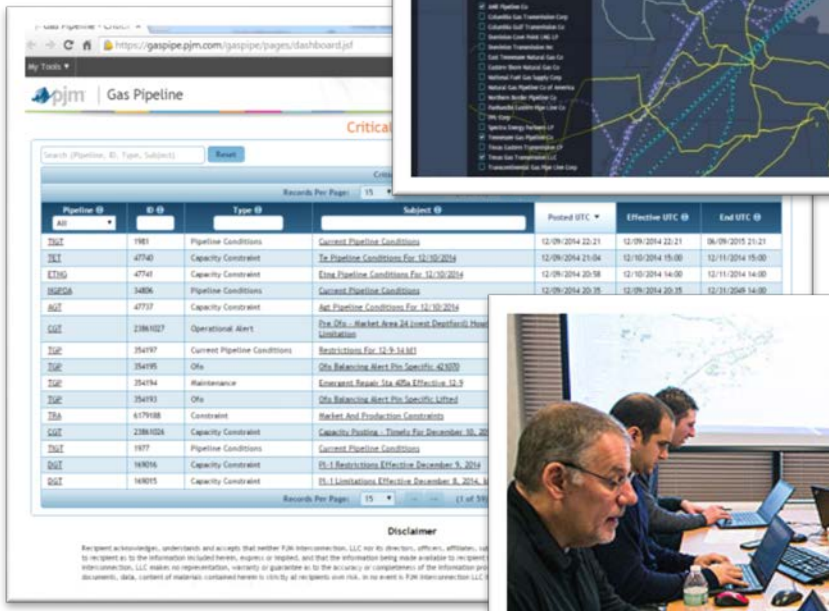
- Joint INGAA – Inter-RTO Council Meeting (October 19, 2017)
- Daily, Weekly, Monthly, and Seasonal Communications with Pipelines in PJM footprint
- Data Sharing Agreements and Communication Protocols with key Local Distribution Companies
- Resilience efforts to:
  - Operationalize Gas Infrastructure Contingencies
  - Develop gas pipeline model in conjunction with Argonne Labs
- Increase transparency though enhancements to tools/visualization

Gas – Electric Coordination

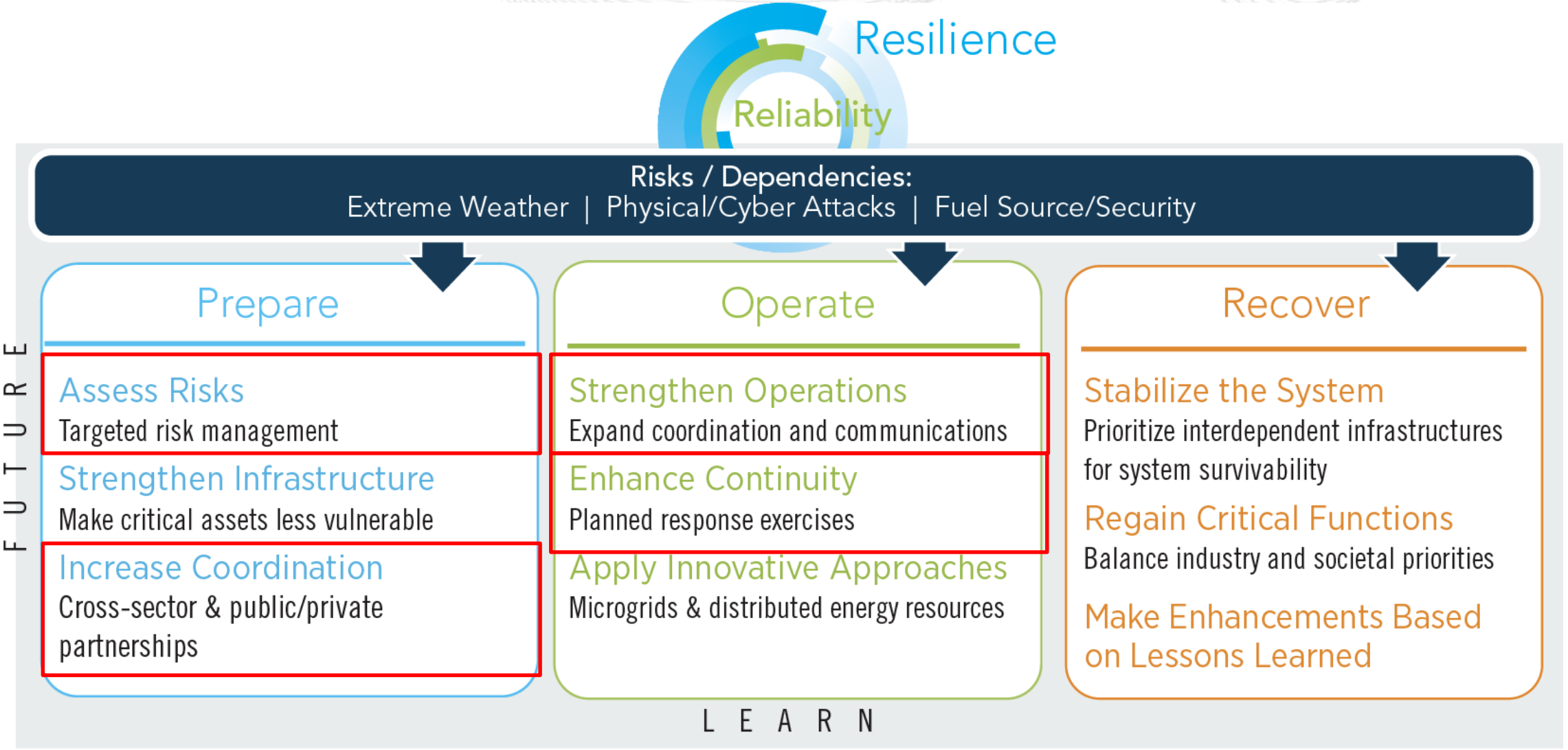
PJM team

- Analyze data related to gas delivery to units
- Provide operational info that allows operators to make better decisions
- Improve coordination with pipelines and LDCs
- Develop tools to support processes

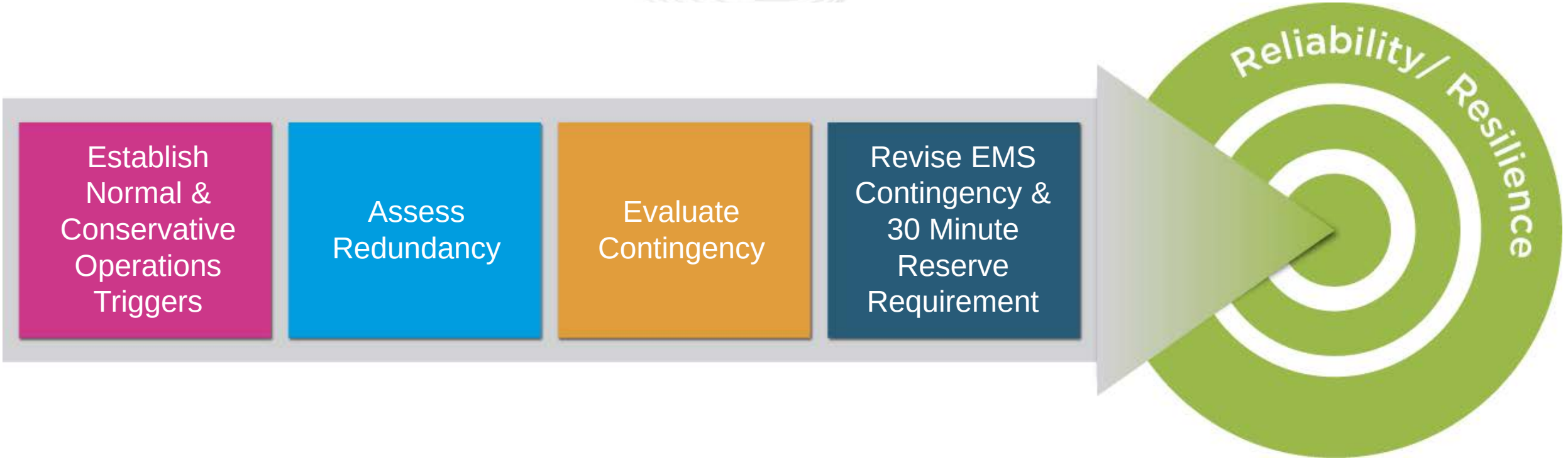




Reliability . . Resilience



Resilience - Gas Pipeline Contingencies



Resilience - Gas Pipeline Modeling

MODEL FRAMEWORK AND PLATFORM

- Model framework based on "node-link" representation:
  - Nodes → compressor stations, receipt/ delivery points, etc.
  - Links → pipeline segments
- Gas networks will be modeled using Argonne's PLASMO (Platform for Scalable Modeling and Optimization)

Natural Gas Networks

We can easily model a network of pipelines by defining sets of nodes (junctions) and links (pipelines).

- $\mathcal{N}$: Set of nodes (junctions)
- $\mathcal{L}$: Set of links (pipelines)
- $\mathcal{S}$: Set of gas supply flows
- $\mathcal{D}$: Set of gas demand flows
- $\mathcal{L}_a \subseteq \mathcal{L}$: Set of active links (pipelines with compressors)
- $\mathcal{L}_p \subseteq \mathcal{L}$: Set of passive links (pipelines without compressors)

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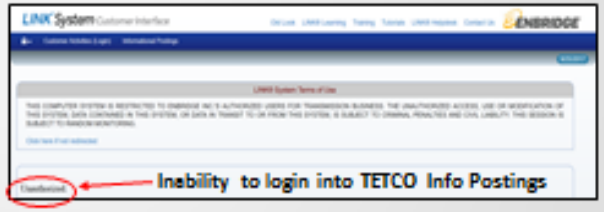
- Pilot model with Texas Eastern pipeline under development
  - December 2017 target completion
- Run model on pre-identified critical areas on all other pipelines
  - Q2, 2018 target completion
- Continue seeking cooperation from interstate pipelines for model result review/ validation

GAS-ELECTRIC SCENARIO – CYBER EVENT

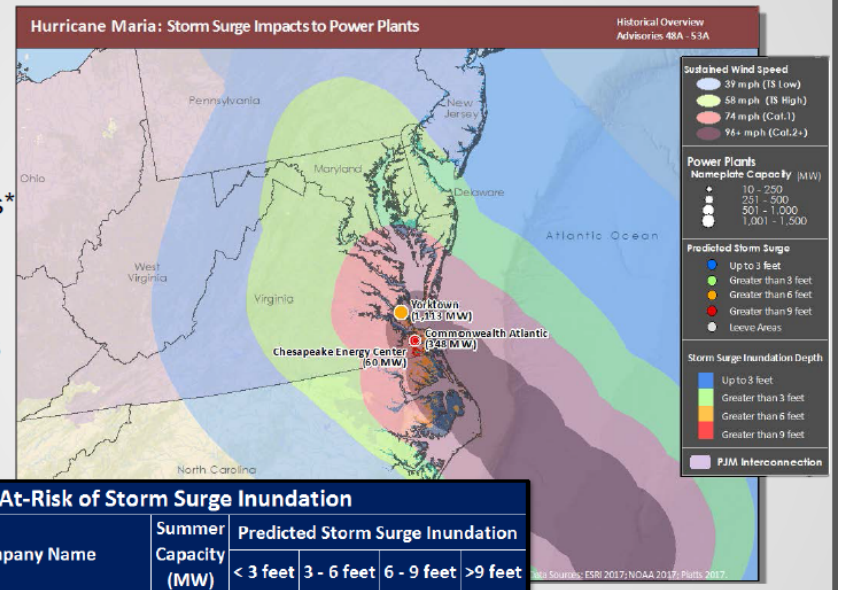
- Major news organizations reporting delivery problems for multiple natural gas interstate pipelines in the U.S.:
  - *Issues with natural gas deliveries to customers.*
  - *Unconfirmed reports of natural gas being released to the atmosphere via relief valves.*
- News report indicate that Texas Eastern Gas Transmission (TETCO) may be affected:
  - *Company Informational Posting web site down.*
  - *Natural gas supply to interruptible electric power plants abruptly halted over multi-state region.*
- Source of the disruptions is unknown; unsubstantiated reports indicate disruptions were intentional.



- Conjecture that the incidents could be cyber-related (but not certain).
- U.S. government investigating to determine whether incidents are intentional.

STORM SURGE IMPACTS ON ELECTRIC SECTOR: POWER PLANTS

- NOAA projects that the storm surge from Hurricane Maria could extend into Virginia and North Carolina:
  - Three power plants* projected to be completely inundated.
  - Other power plants may be subject to localized flooding (not determined).



Power Plants At-Risk of Storm Surge Inundation

Plant Name	Company Name	Summer Capacity (MW)	Predicted Storm Surge Inundation			
			< 3 feet	3 - 6 feet	6 - 9 feet	>9 feet
Yorktown	Virginia Electric & Power Co.	1,113			X	
Commonwealth Atlantic	Virginia Electric & Power Co.	348				X
Chesapeake Energy Center	Virginia Electric & Power Co.	60				X

** Summer capacity > 50 MW*

Market Changes

Recently Implemented

Hourly Offers

Shortage Pricing

Initiatives

Energy Price Formation

Load Following