Leveraging Federal Funding for Transmission Technologies and Renewable Energy Integration

August 22, 2023

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Providing states with information, tailored guidance, and opportunities for collaboration to capitalize on billions of dollars in federal clean energy opportunities.

www.cesa.org/projects/ira-bil-implementation
Webinar
Speakers

Mike Razanousky
Senior Project Manager, NYSERDA

Joseph Lookup
Director of Asset Management, PPL Corporation

Julia Selker
Executive Director, the Working for Advanced Transmission Technologies (WATT) Coalition

Bentham Paulos
Senior Research Associate, Clean Energy States Alliance

Leveraging Federal Funding for Transmission Technologies and Renewable Energy Integration | August 22, 2023
An Equitable Solar Access Pilot Project in Minnesota benefitting Manufactured (Mobile) Home Residents (8/31)


Predevelopment Funding for LMI Solar and Storage Projects: A Case Study from New York (9/19)

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Dynamic Line Rating Systems

- **Contact** – (Tension, Temperature)
  - Ampacimon
- **Weather**
  - Wind Sim
- **Lidar**
  - Line Vision
Dynamic Line Rating Projects

**Avangrid**
- Line Vision & Wind Sim Démonstrations

**National Grid**
- Maintenance – Line Vision

**Contact**
- Other state utilities have demonstrated in past

Demonstrations in NY – Building on FERC 881 Order (Ambient Air)
Power Flow Controls

- Phase Shifting Transformers (PST)
- Series Reactors
- Distributed Series Compensators (DSC)
- Series Capacitors
- Unified Power Flow Controllers (UPFC)
- High Voltage Direct Current (HVDC)
- Energy Storage (ES)
Power Flow Controls
Demonstrations in NY

- Static Var Compensator - ABB
  - Marcy - NYPA
- PST
  - Linden Generator – Con Edison
- DSC - Smart Wires
  - Mobile Unit – Avangrid
  - Permanent – CHG&E

Controlled voltage 345 kV SVC rating 300 Mvar inductive to 270 Mvar capacitive Control system Three-phase voltage control by means of a voltage regulator Thyristor valves Water/glycol cooled three-phase valves with indirect firing
Energy Storage – Transmission & Distribution Applications

NY BEST SATA Study - Use Cases in NY

**Use Case 1:**
**N-1 Security Constraint Management**
- Under summer and winter peak conditions, Y-50 will be 119% and 117% overloaded, respectively.
- Study shows that SATA can increase the transfer limit by approximately 200 MW.
- Implementation of SATA can increase the utilization of the interface between Zones I & J and Zone K by 1,547 GWh over 1 year.

**Use Case 2:**
**Voltage Support Services**
- In a scenario where up to 3 generators go down, SATA has increased the utilization of the Central East interface from 22,000 GWh to 23,000 GWh.
- Without the SATA, the Central East interface is congested for 3,037 hours, and the congestion cost is $142M;
- With the SATA, the total congestion drops to 2,028 hours, and the congestion cost is $91M.

**Use Case 3:**
**Example of Reduced Local Capacity Requirement**
- In the case of a double outage (M51 and M52), the transfer limit without SATA was 2,645 MW, while the transfer limit with SATA was 2,974 MW.
- With the incremental 329.5 MW in the TSL, Zone J can purchase an additional 329.5 MW capacity from upstate New York and reduce the LCR requirement by 329.5 MW, which is by around 2.9%.
Energy Storage – Potential Study

Examines energy storage as an alternative solution to address specific grid needs, which can defer investment in costly traditional wire solutions.

- The use cases in this paper rely on identifying potential bottlenecks or specific locations on the grid that are prone to failure (i.e. identifying a specific grid need that energy storage can address).
- The additional capacity needed to address the grid need will inform the optimal sizing of the storage system.
- Production cost modeling with 8,760 hours of operation may inform project costs and benefits, once optimal size of battery is identified.

Further consideration is needed to understand and model energy storage for long-term planning purposes.

- Alongside thinking about how storage can address certain problems, we need to model the characteristics and behavior of energy storage technologies so that they reflect the capabilities of these resources in long-term planning studies.
- How do we model energy storage such that we can be confident that the power system models are correctly simulating the operations (individually and in coordination) of numerous storage resources?
  - What criteria are important and must be included to model the storage resource?
  - Capacity, duration, round-trip efficiency, depth of discharge, charge/discharge speed, operating temperature, degradation, response time, etc.
Additional Information

➢ New York Advanced Technologies Working Group – Task Forces (ES, DLR, & PFC)
https://jointutilitiesofny.org/advanced-technologies-working-group

➢ New York Power Authority’s Agile Lab
https://www.nypa.gov/innovation/digital-utility/agile-lab

➢ NYSERDA Funding Opportunities - PON 4393 – Future Grid- GETs
https://www.nyserda.ny.gov/All-Programs/Grid-Modernization-Program
Thank You
Michael Razanousky
Clean Energy States Alliance (CESA) Grid Enhancing Technologies Webinar

Joseph Lookup – Director of Asset Management
What is DLR

DLR is a system of installed line sensors used to measure conductor and environmental real time data to determine a real time rating instead of assumed condition values.

**Traditional Line Ratings (Existing)**

**Assumes:**
- Wind speed
- Ambient Temperature
- Solar Radiation

**Ratings:**
- Seasonal ratings – Planning limitations
- Ambient Adjusted (Operations)
  - Conservatively Calculates Ratings

**Dynamic Line Ratings**

**Measures:**
- Wind speed
- Ambient Temperature
- Conductor Temperature
- Conductor Sag

**Ratings:**
- Provides accurate Real-Time Ratings
- Allows forecasted ratings

**Asset Health:**
- Measures conductor health
Our Roadmap So Far....

- **DLR sensors installed for three lines**
- **Validated data and projected benefits**
- **DLR Vendor Assessments**
- **Implemented a DLR TEST system from vendor cloud**
- **Planned implementation into real-time operations**
- **Built on-premise DLR System in DEV**
- **TMS operational development and modeling**
- **GO-Live 10/6/2022**
- **Working with PJM on operational implementation requirements**
- **Determine compliance program impacts and developing plans**
- **Implementing compliance plans**
Transmission Planning – Congestion Solution

Step 1: Identified need(s) on transmission lines
Step 2: Alternative Analysis
Step 3: Asset management/economic analysis
Step 4: Submitted in PJM market efficiency window
Step 5: Full study with our RTO to confirm

Result:
Awarded PJM in market efficiency project
Ratings Data Flow

- Sensor 1
  - Vibration Frequencies
  - Line Current
  - Other Sensor Data

- Sensor 2

- Sensor 3

- Sensor 4

- Sensor 5

- Sensor 6

DLR Computation Applications (Ampacimon)

- DLR Computation Applications
  - Vibration Frequencies
  - Line Current
  - Other Sensor Data

PPL Transmission Management System (GE)

- PPL Transmission Management System
  - Real-Time Ratings
  - Quality & System Flags

PJM Real-Time Operations

- PJM Real-Time Operations
  - Managed Real-Time Ratings

PJM Market Operations

- PJM Market Operations
  - Day-Ahead Ratings through EDART

PPL Forecasted Ratings Processor

- PPL Forecasted Ratings Processor
  - 24-48 hour Forecasted Ratings

F(x) to cap values to next limiting component

F(x) to cap values to next limiting component
Juniata –Cumberland Results

• Live Since October 2022
• Increase in Ratings:
  • ~18% Average Normal Rating
  • ~10% Average Emergency Rating
• Saved customers over $60 million in Congestion generation costs
PPL leads the way in Dynamic Line Ratings (DLR)

- To resolve market efficiency and congestion issues non-wired solution
- Utilized into real-time operations in our Transmission Management System (TMS)
- Integrated DLR into Regional Transmission Organization (RTO) real-time energy market, during October 2022

Estimated to save customers over $23 million in congested generation costs annually
Challenges: Solved and Ongoing

• NERC standards impacts and processes
• Ratings management:
  • Failure contingency
  • Honoring next most limiting component
• Regional transmission operator and stakeholder coordination
• Best practices for ratings validation
• Ratings methodologies industry best practices:
  • Real-time
  • Long-term forecasts
• Large scale system considerations, risks and mitigations
Thank you
Targets Span Identification

1. **Critical Span Distribution From DLR Simulation**

   ![Graph showing critical span distribution]

   *Period: from 2019-01-01 to 2019-12-31. Degraded mode to normal samples: 104832 (~100% of total samples: 104832)*

2. **Required Span Selection Rules**

   - Orientation between spans changes more than 15°
   - To capture variability in wind direction
   - Distance is greater than 6.2 miles (10 km)
   - Conductor or number of sub-conductor change
   - Span safety concerns
   - Utility span data identifies high risk span(s)

3. **Final Span Selection**

   ![Image of transmission towers]

4. **Installation**

   - One phase per identified span
   - Sensor mounted 5 – 10% of the total span length from either tower
   - Live Line Installation Via Helicopter and from ground
   - Mounting procedure is 5 - 10 minutes per sensor
A duplicated line facility is created when DLR is applied to a line. The line conductor ratings are removed in this facility since the line conductor’s rating will be dynamic.

These are used as next most limiting component ratings to limit any ratings received from DLR.
TMS Operator Display

<table>
<thead>
<tr>
<th>Line Name</th>
<th>Mode</th>
<th>DLR Sensor</th>
<th>TELEMETRY_VALID 0 minutes failed</th>
<th>Indication Points</th>
<th>Validation Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>JUNI-CUMB_1</td>
<td></td>
<td>DLR_SENSOR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>463.2 MVA</td>
<td></td>
<td></td>
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<tr>
<td>SUSQ HARW_1</td>
<td></td>
<td>DLR_SENSOR</td>
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<tr>
<td>354.3 MVA</td>
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</tr>
<tr>
<td>SUSQ HARW_2</td>
<td></td>
<td>DLR_SENSOR</td>
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<tr>
<td>355.6 MVA</td>
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</tbody>
</table>

Current line loading

Current real-time ratings

Rating Zone if DLR goes down

Various DLR indication, validation, and quality points for situational awareness
Federal Funding for Grid Enhancing Technologies

Julia Selker, Executive Director
Working for Advanced Transmission Technologies (WATT) Coalition

8.22.2023
Mission: The Working for Advanced Transmission Technologies (WATT) Coalition advocates for policy that supports wide deployment of Grid Enhancing Technologies (GETs) to accelerate the clean energy transition and lower energy costs.
DOE programs for GETs deployments - $14B total

- Preventing Outages and Enhancing the Resilience of the Electric Grid Grants
  - Matching grants for industry - 40101(c)
  - State and tribal formula grants - 40101(d)
- Smart Grid Investment Grants – 40107
- Grid Innovation Program - 40103(b)
- Energy Improvement in Rural & Remote Areas Program (ERA) - 40103(c)

First round awards expected Q3/4 2023, new opportunities Q1 2024
Groundwork for Grants

States are grantees in 40101(d), Smart Grid, Grid Innovation, ERA

• Partner with technology vendors
• Partner with your utilities

Utilities are grantees in 40101(c), Smart Grid, ERA (nonprofits only)

• Push utilities to pursue funding – open dockets, write letters
Other state leverage on grid optimization

• FERC Order 881, Order 2023 implementation
  – 881: Upgrade systems to use DLR in addition to AAR
  – 2023: Utilities have full discretion on how to evaluate and implement transmission technologies
  – And beyond: MISO Congestion Reconfiguration Process, ERCOT economic transmission planning

• Pursue funding for studies that utilities will use to deploy GETs
  – A study of the KS and OK grids found $90m in GETs deployments would unlock 2,500 MW of renewable development - $175m/year in benefits
Working for Advanced Transmission Technologies

For more information contact
Julia Selker / jselker@gridstrategiesllc.com
www.watt-transmission.org
Appendix
Grid-Enhancing Technologies (GETs): hardware or software that increases the capacity, efficiency, and/or reliability of transmission facilities

- **Dynamic Line Ratings**: Measure the true capacity of transmission lines based on ambient conditions.
- **Advanced Power Flow Control**: Reroutes power from congested to underutilized lines.
- **Advanced Topology Control**: Identifies grid reconfigurations to reroute flows around bottlenecks.
Deployments in the UK by National Grid unlocked capacity for 1.5 GW of new renewable energy saving UK ratepayers over $500 million.
Topology optimization reduced curtailment of one wind farm by 77%
Dynamic Line Ratings

Results from 2021 deployment in 3 states:

DLR exceeded static reference ratings by
- 9-33% in winter
- 26-36% in summer

DLR exceeded static ratings over 85% of the time

From *A Guide to Case Studies of Grid Enhancing Technologies*
GETs going mainstream:

- MISO reconfiguration process to reduce congestion costs
  
- PPL wins 95th Edison Award for DLR integration

- ERCOT evaluates DLR in economic transmission planning to resolve congestion
Benefits of Grid Enhancing Technologies (GETs)

Economic, Reliability and Clean Energy Benefits

Cost Savings
- Decreased congestion costs – estimated savings of $2-4 billion per year
- Lowest cost increase in transmission capacity – often >20% average increase
- GETs are very low cost: roughly $0.5k - $25m per installation
- Increased capacity enables lower-cost renewable generation

Cleaner energy, faster
- GETs can double the integration of new renewable energy capacity of a transmission system, without any new lines
- GETs deploy in months for rapid energy transition

Reliability through flexibility and awareness
- Data-driven decisions, real-time visibility, and enhanced control over the system support reliable grid operation
Barriers to Adoption

Why are these beneficial technologies not being used?

Awareness

• Many planners, utility executives, regulators, and stakeholders are unfamiliar with advanced transmission technologies and their benefits

No Incentive to Innovate

• Can’t be blamed for doing things the same way as usual
• Lower returns on lower capital cost expenditures
Advanced Power Flow Control

Meets current flexibility needs
— A set of technologies that effectively pushes or pulls power away from overloaded lines and onto underutilized corridors within the existing transmission network
— Serves as a “valve” to control power flow

Technological benefits
— Quickly deployed
— Easily scaled to meet the size of the need
— Able to be redeployed to new parts of the grid when no longer needed in current location

See a deployment in UK, saving customers more than £300 million and adding 1.5 GW of capacity
Dynamic Line Rating

Increases capacity on existing transmission lines
— Calculates ratings based on actual monitored conditions rather than fixed worst-case assumptions
— Even a relatively low amount of wind can cool the line, significantly increasing its rating and reducing curtailments and congestion

Improves reliability
— Provides forecasted ratings up to 48 hours ahead, and improves reliability by alerting operators to conditions such as clearance violations
— Estimates of increased capacity have been 40 percent, 30 to 70 percent, and 30 to 44 percent on three different tests


Belgium has been managing its transmission system with widespread use of Dynamic Line Ratings for over a decade.
Advanced Topology Control

Evenly distributes flow over the network

— A software technology that automatically identifies reconfigurations of the grid to route power flow around congested or overloaded transmission elements
— Reconfigurations are implemented through switching on/off existing high voltage circuit breakers
— Optimization increases the transfer capacity of the grid

Congestion and curtailment reduction

— Can reduce congestion by up to 50 percent and improve response to contingencies
— Can reduce renewable energy curtailment by up to 40 percent

See the potential impact of topology optimization in MISO as presented to FERC.