Example of Information for EOL Projects

American Municipal Power ***October 19, 2017***

Transmission Owner, PJM region, Zone, Area,

Baseline Project: Description of Project

Problem Statement: PJM/NERC/TO Criteria violation and description

Criteria Violated: NERC or PJM or TO

XXXXX, list of all criteria violations and contingencies

XXXXX, Description of facilities, And first, second, third review, etc.. Reviewed date by previous subregional meeting(s)

Proposed Solution:

- Describe proposed solution for first presentation of the violation. . Provide the following details for line projects:
  - Current line rating: XXXMVA New line rating: XXXMVA
  - Current line conductor: XXXX, New line conductor: XXXX
  - Line loading percent for when new line is required by PJM to be in-service using worst contingency on transmission syst
  - Provide normal loading for new line
    - In-service loading: XX% [best guess on date if no firm date for first review]
    - 10 year loading: XX% [same here, best guess if firm date is not known]
  - Loading % "Deltas" changes on ALL facilities impacted by project.
    - Delta Loading Increase = MVA after projects – MVA before project
    - Delta Loading Decrease = MVA before project – MVA after project
  - Asset Class: Identify if overloaded facility is distribution or transmission based upon current owners accounting records,

Estimated Project Cost: $XX.X M [only show transmission costs that will be paid for under FERC rate]

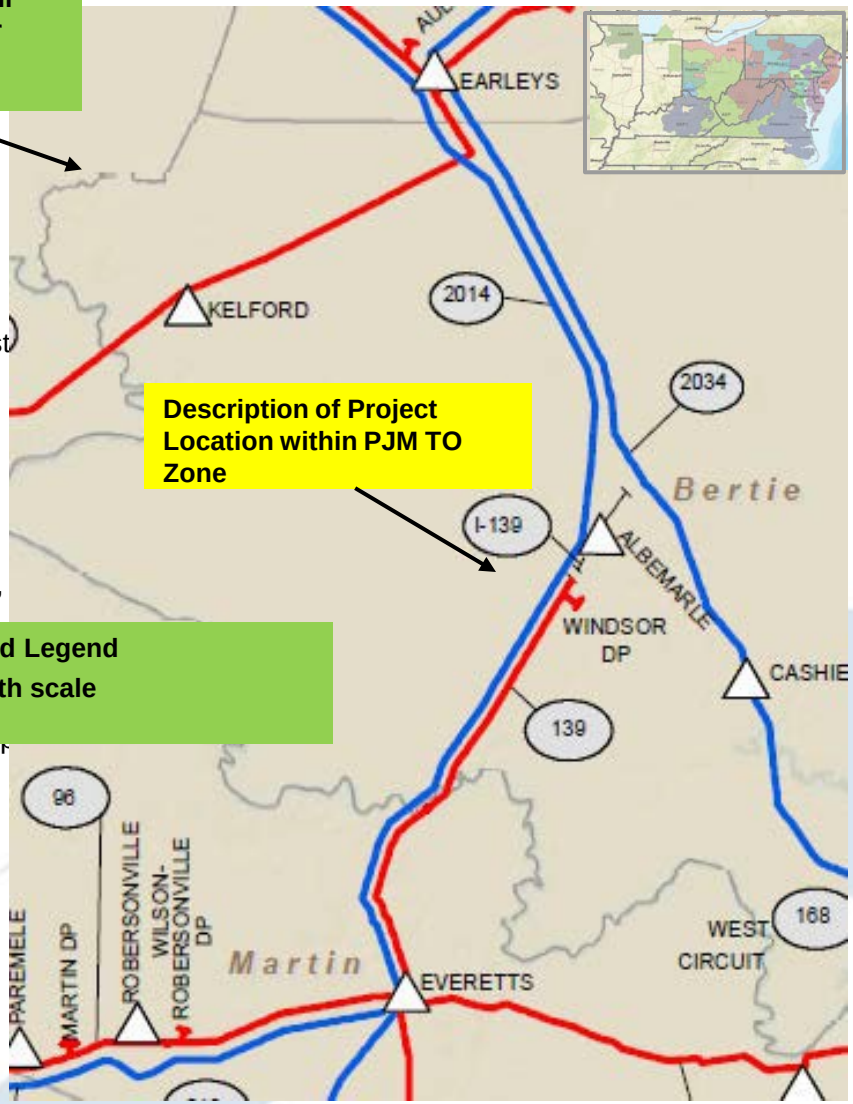
Alternative Solutions:

- Description of Alternatives. Include a description of all options that can solve this type of problem such as a new line, li
  eliminated and the details on there feasibility & cost
- Provide line ratings, conductor and both loadings as above.

  Estimated Project Cost: $XX M (Estimate Class, Class 1-5)

Possible IS Date Submitted by Designated Entity or Transmission Owner: XX/XX/XXXX
Required IS Date Identified by PJM: XX/XX/XXXX
PJM Determined Project Status: Conceptual, Engineering, Under Construction, Completed or whatever the categories are.
Associated Projects: list any other approved or proposed connected with these facilities or nearby (same line)

Add detailed map for all facilities mentioned for project with locational PJM map as shown.



Transmission Owner, PJM region, Zone, Area,

Supplemental Project:

Problem Statement: Operational Performance/Reliability/Risk etc. Value used to determine

Criteria Violated: Local Utility Planning Guide reference, detailed description of primary driver's for project, detailed description of all other project drivers

Date Project Presented Previously at: XX/XX/XXXX Southern/Mid-Atlantic/Western RTEP

- Description of Project, ratings current and new, conductors, equipment, any contingency loadings or in-service loadings for lines and transformers.
- Any comments, data requests or action items resulting from first review of project at stakeholder meetings

Recommended Solution:

Description of solution and justification and decisions made by TO to determine this solution. Whether we use Potential Solution or Recommended Solution is up for discussion. Guess it would be Potential for first review, Recommended for second or other review.

Alternatives: Description or None. Include a description of all options that can solve this type of problem such as a new line, line upgrade, capacitor bank, then let us know why some of these were eliminated and the details of the feasible solutions, include cost break down, and one-line diagrams of alternative proposal.

Estimated Project Cost: $XX M

Projected IS Date: XX/XX/XXXX

Project Status: Current status options.

Associated Projects: list any other approved or proposed connected with these facilities or nearby (same line), list of any other assets or facilities in the sounding? and their rehab/condition/performance/risk issues

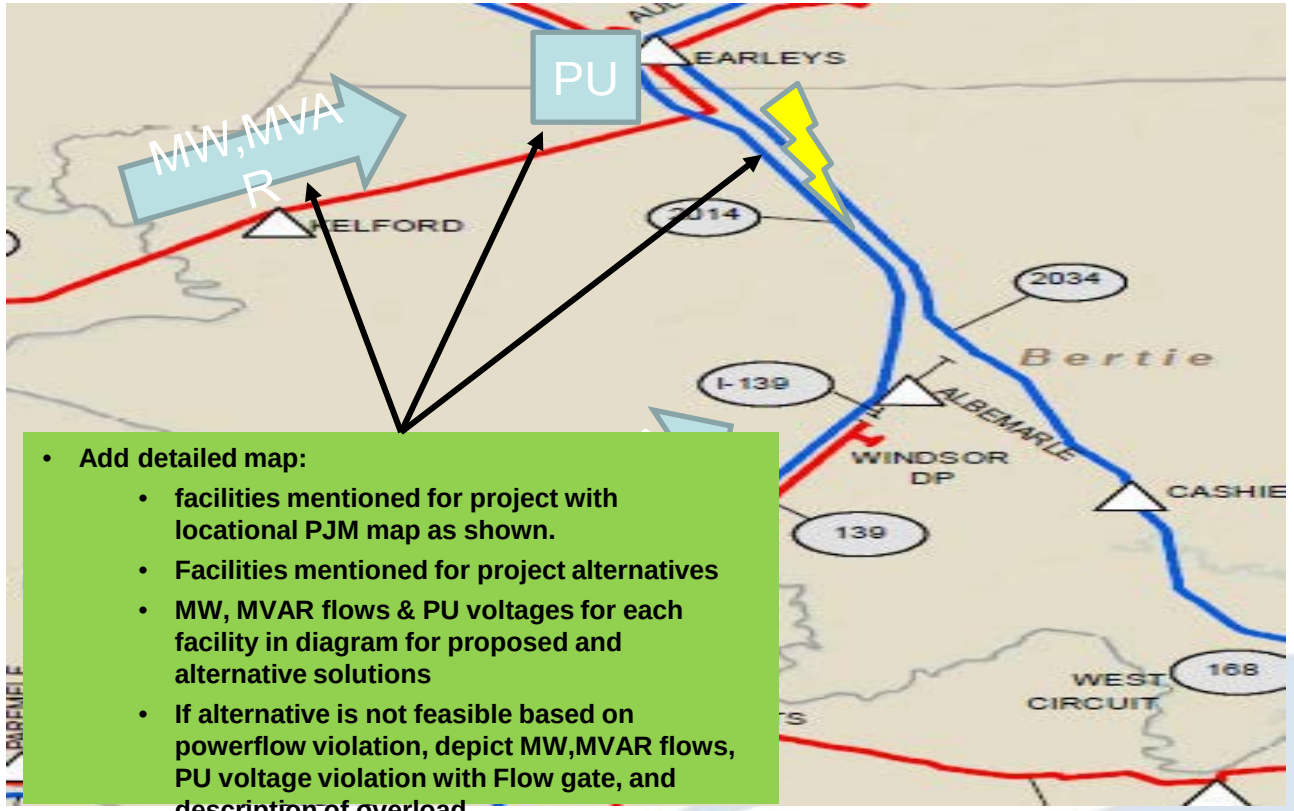
Show current and proposed substation one lines so stakeholders can understand the reasoning behind the need for the re-design. Show substation location on TO map and PJM location map as typical. Show legend as needed to understand one-lines.

Transmission Owner, PJM region, Zone, Area,

Project Title	
Problem Statement	
Transmission Owner or Designated entity	
Supplemental/TO Baseline/ PJM Baseline	
Zone (Southern/Mid-Atlantic/Western, TEAC)	
Date Project Was Previously Presented	
Primary Project Driver (Description)	For Rehab Driven (Tlines See Tline Section) (Station See Station Section)
Description of impacted facilities	
Description of load delivery points served by impacted facilities and their ownership	
Drivers Accounting Class (Distribution, Transmission)	
Proposal Cost	
Proposal Need Date	
Proposal Targeted In-service Date	

"Individual" Stakeholder Comments	Comment	Organization	Date	Documented Response

Power Flow Criteria	Criteria Description	Criteria Measure	Criteria Threshold	Simulated Value
Bus, Branch, Facility, Equipment in Violation and/or Driver (PSSE bus Number, Branch Identifier)				
Contingency or Contingency Causing violation				
PJM's Verification of TO results				



- **Add detailed map:**
  - **facilities mentioned for project with locational PJM map as shown.**
  - **Facilities mentioned for project alternatives**
  - **MW, MVAR flows & PU voltages for each facility in diagram for proposed and alternative solutions**
  - **If alternative is not feasible based on powerflow violation, depict MW,MVAR flows, PU voltage violation with Flow gate, and description of overload.**

	Justification Driver										
Criteria Threshold	Probability of Failure Description	Impact of Failure Description	Risk of Failure Description	Age	Criticality Measure	Equipment Health Value	Historical Reliability Impacts	Historical Performance Measure	Maintenance (O&M)	Spare Part Availability, Software Compatibility, Vendor Support (Description)	Environmental and/or Safety Descriptions
Threshold	P(x)	I(x)	P(x) * I(x) = R(x)	Years	Peak Flow MWh Delivered Load Served Transformation	H(x)	CMI CI SAIDI SAIFI CAIDI Loss of Load	List of Outages Momentary Outage, Initiating Cause, Sustained Cause, Date List of Outages Permanent Outage, Initiating Cause, Sustained Cause, Date, Duration System Averages (T-SAIDI, T-SAIFI, T-SAIFI-S, T-MAIFI)	Maintenance Completed and Cost Maintenance Findings and Estimated Cost	Spares in inventory Number of similar assets on system	Description of Issue Number of these issues on the system
	Written Description of All Area Issues and Needs										

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CEII Version (One-Line Diagrams)

Photo Of Transmission Line Or Station

Description of Proposed Solution			
Description of Proposed Project and Reasoning for Selecting Solution	Component Description	Estimated Component Cost	Component In-Service Date

Was Retirement Considered Why or Why not?	
Was rebuild considered: Why or Why not	

Proposed Facility Details		
Current Overloaded Line's Rate "A" Normal (MVA) , Rate "B" Emergency (MVA)	Rate A	Rate B
"Proposed" Line's Rate "A" Normal (MVA), Rate "B" Emergency (MVA)	Rate A	Rate B

Proposed & Impacted Facilities Analysis		
Description	Loading % Rate A	Loading % Rate B
"Proposed" Line's "%" Loading System Normal (N-0)		

Analysis For: 5 Year Forward 10 Year Forward

Proposed Facility	N-1 Thermal Overload	Generation Deliverability Thermal Overload	Load Deliverability Thermal Overload	N-1-1 Thermal Overload	N-1 Voltage Drop	N-1 Voltage Magnitude	N-1-1 Voltage Magnitude	Any TO specific analysis and criteria
"Proposed" Line's/stations Highest "%" Loading, lowest voltage, or largest voltage deviation for all study scenarios								

Impacted Facilities	Branch 1.....N								
	Facility Name, To Bus, From Bus, ID	N-1 Thermal Overload	Generation Deliverability Thermal Overload	Load Deliverability Thermal Overload	N-1-1 Thermal Overload	N-1 Voltage Drop	N-1 Voltage Magnitude	N-1-1 Voltage Magnitude	Any TO specific analysis and criteria
Existing Line's & Transformers with "%" Changes greater than +- 40% for (N-0)									
Existing Line's & Transformers crossing the 80% loading threshold for (N-0)									
Existing Line's & Transformers crossing the 80% loading threshold for all study scenarios									
Existing Line's & Transformers crossing the 80% loading threshold for all study scenarios									
Existing station's PU change of more than 2%, or within 2% of TO criteria threshold									

*N/A for all none applicable fields

**Request Same Detail Above for Alternative Project Review

Transmission Owner, PJM region, Zone, Area,

Station
Performance Driven Projects

Transmission Owner, PJM region, Zone, Area,

Performance Driven Projects Stations:

- Number of Forced Permanent Outage
  - Causes of each outage (Initiating cause and sustained cause)
  - Duration of each outage
- Number of Momentary Outages
  - Causes of each outage (Initiating cause)
- List of the Equipment Outages caused by each event
- Individual event details including number of customers impacted (CI) by each event
- Amount of recorded customer minutes of interruption (CMI) for each event
- Amount of load impacted by each event
- Amount of consequential generation loss due to outage (Generation served by the station)
- Event date & event time
- Calculated System (All voltage classes & each kV class) Average Availability Rate for, Assets Availability Rate
- System (All voltage classes & each kV class) Average values (TSAIDI, TSAIFI, TMAIFI, TSAIFI-S, IEEE SAIDI, IEEE SAIFI, IEEE CAIDI, Number of customers used to calculate SAIDI,SAIFI,CAIDI)
  - References: https://www9.nationalgridus.com/non_html/transmission_ntwk_perf_rpt2008.pdf
  - References: http://grouper.ieee.org/groups/td/dist/sd/doc/Benchmarking-Results-2015.pdf
  - Reference:http://www.pjm.com/~/media/committees-groups/committees/srrtep-w/20170124/20170124-aep-transmission-owner-needs-guidelines.ashx
- Station's performance ranking and overall ranking relative to all other station/Tlines in system
- Any and all other referenced inputs including but not limited to: Table #1 and Table #2
- Detailed description of how TO applies the data noted above, or any other data not included to determine EOL

*For each item listed use multiple sheets or (.xls) spreadsheet if required

Transmission Owner, PJM region, Zone, Area,

Station and Station Asset Condition Driven Projects

http://assets.fiercemarkets.net/public/smartgridnews/End_to_end_asset_health.pdf

https://www.satcs.co.za/Transformer_Oil_Analysis.pdf

Transmission Owner, PJM region, Zone, Area,

Station Condition Inspection Details: Station & Station Structures

- Date of last inspection
- Date condition was first identified and action taken when identified
- List of conditions identified (example: cracked foundations, rusted steel, damaged conductor terminations, missing grounds, broken insulators, cap-N-pin insulators, damaged capacitor cans, flooding/drainage issues)
  - Foundation conditions, number of foundation conditions and severity of conditions
  - Structural conditions, number of conditions, and severity of conditions (rusted, bent, rotten, cracked, split)
  - Grounding conditions, number of conditions, and severity of conditions
  - Insulation conditions, number of conditions, and severity of conditions (insulation type, crack, broken, deteriorated, failed)
- List of operational constraints associated with station
  - Abnormal conditions, date first identified
  - Known failed/Un-operable equipment, date first identified
  - Non-Functioning equipment, date first identified
  - Non-standard Electrical configurations, date configurations was installed
  - Site constraints (clearance issues, drive island concerns, known flooding issues, site access)
- List of safety issues at station
- Station obsolesce items
- Station vandalism reports (stolen grounds, break-ins, gun shots, etc.)
- Station ground assessment details.
- Station shielding
- Telecommunication, RTU needs (Mode of communications, bandwidth, fiber, cable, RTU type and maker, channel available, channels used, RTU install date)
- Relaying needs (relay type, electromechanical, static, microprocessor)
- List of all known conditions at a station and the station's relative condition ranking to all station on the system

*For each item listed use multiple sheets or (.xls) spreadsheet if required

https://www.satcs.co.za/Transformer_Oil_Analysis.pdf

http://assets.fiercemarkets.net/public/smartgridnews/End_to_end_asset_health.pdf

Transmission Owner, PJM region, Zone, Area,

Condition Driven Projects: Station Equipment "Transformers, Series & Shunt Reactors"

- **Transformers** (Values if used to assess transformers health or EOL or life expectancy)
  - All recorded test dates and their corresponding data listed below:
  - Date when recorded data first exceeded TO thresholds, action taken prior or date threshold exceeded
  - Past electrical test results if conducted
  - Core ground test result
  - Total combustible gas
  - Gas concentration levels and trending, (IEC 567)
    - Hydrogen (H2) ppm, system average ppm
    - Methane (CH4) ppm, system average ppm
    - Ethane (C2H6) ppm, system average ppm
    - Ethylene (C2H4) ppm, system average ppm
    - Acetylene (C2H2) ppm, system average ppm
    - Carbon Monoxide (CO) ppm, system average ppm
    - Carbon Dioxide (CO2) ppm, system average ppm
  - Water concentration levels and trending (IEC 814)
  - Oil Dielectric Strength and trending (IEC 156)
  - Oil Acidity or Neutralization Numbers and trends (ATSM D971)
  - Interfacial Tension and trends (ASTM D971)
  - Calculated Likelihood of failure, risk of failure, and asset criticality, system averages for each of previously stated items
  - Health score and/or replacement score and/or remaining useful life
  - Recommend solutions and time lines provided by assessment software
  - Asset Age
  - O&M tasks completed on unit, date completed

Show photo of each TF being replaced including name plate details

*For each item listed use multiple sheets or (.xls) spreadsheet if required

http://assets.fiercemarkets.net/public/smartgridnews/End_to_end_asset_health.pdf

Transmission Owner, PJM region, Zone, Area,

Condition Driven Projects: Station Equipment "Circuit Breakers"

- Breaker "Accessories"
  - Function of cabinet, mechanism, and tank heaters
  - Number of hydraulic pump starts
  - Total accumulated run hours of the air compressor
  - Total accumulated run hours of the SF6 compressor
- Breaker "Dielectric"
  - Insulating oil dielectric strength
  - Rated voltage vs. applied voltage
  - Rated current vs. applied current
  - SF6, or oil moisture content, pressure, and purity
  - High-pressure SF6 moisture content, pressure, and purity
  - SF6 Density
- Breaker "Mechanical"
  - Closing time, velocity and acceptable limits
  - Trip time, velocity, trip coil currents and acceptable limits
  - Interpole close time, trip time deltas and acceptable limits
  - Resistor preinsertion time and acceptable limits
  - Total interrupter travel and acceptable limits

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https://static.selinc.com/assets/Literature/Publications/Technical%20Papers/6772_RealTime_RS_20170130_Web.pdf?v=20170404-145043

- Breaker "Wear"
  - Contact wear (switch operations) and acceptable limits
  - Main nozzle wear and acceptable limits
  - Auxiliary nozzle wear and acceptable limits
  - Contact resistance and acceptable levels
  - Interrupter wear and acceptable levels
- Breaker "Other"
  - Mechanism stored energy state
  - Motor current and run time
  - Time elapsed since last inspection, maintenance and overhaul
  - Breaker age
  - Breaker test or switch operations and acceptable limits
  - Breaker event operations "fault" interruptions
  - Breaker nameplate arc times
- Additional Values if used to make replacement decision
  - Risk of Failure and acceptable levels
  - Asset Criticality Values
  - Probability of failure and acceptable levels
  - Replacement score and maintenance score
  - Asset Health score, Remaining useful life
  - Forecasted Maintenance
  - Priority of asset replacement
  - List of all circuit breakers and their associated scores and rankings

Show photo of each CB being replaced

Transmission Owner, PJM region, Zone, Area,

Risk Driven Projects: Stations

- **Transmission Lines or Substation** (Values if used to assess transmission lines risk, EOL or life expectancy, only if used in TO's assessment)
  - Calculated probability of failure with detailed inputs
  - Associated impact values used to calculate risk
    - Customers impacted
    - Load Impacted
    - System impacts
    - Generation Impacts (Per Planning Model)
    - Expected energy not delivered
    - Dynamic reactive devices impacted and their MVA
    - Number of stations with voltage sags
    - Number of tie line interconnections interrupted
    - Arming of SPS scheme's due to stability or thermal constraints
    - Number of real time operational constraints resulting in load drop warnings
    - Any impacts not listed above
  - List of all stations and their associated Risk scores and risk rankings

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Transmission Owner, PJM region, Zone, Area,

Transmission Line Rehab Driven Projects

Transmission Owner, PJM region, Zone, Area,

Performance Driven Projects Transmission Lines:

- Number of Forced Permanent Outage
  - Causes of each outage (Initiating cause and sustained cause)
  - Duration of each outage
- Number of Momentary Outages
  - Causes of each outage (Initiating cause)
- List of the Equipment Outages caused by each event
- Individual event details including number of customers impacted (CI) by each event
- Amount of recorded customer minutes of interruption (CMI) for each event
- Amount of load impacted by each event
- Amount of generation impacted
- Event date & event time
- Calculated System (All voltage classes & each kV class) Average Availability Rate for, Assets Availability Rate
- System (All voltage classes & each kV class) Average values (TSAIDI, TSAIFI, TMAIFI, TSAIFI-S, IEEE SAIDI, IEEE SAIFI, IEEE CAIDI, Number of customers used to calculate SAIDI,SAIFI,CAIDI)
  - References: https://www9.nationalgridus.com/non_html/transmission_ntwk_perf_rpt2008.pdf
  - References: http://grouper.ieee.org/groups/td/dist/sd/doc/Benchmarking-Results-2015.pdf
  - Reference:http://www.pjm.com/~/media/committees-groups/committees/srrtep-w/20170124/20170124-aep-transmission-owner-needs-guidelines.ashx
- Tline's performance ranking and overall ranking relative to all other Tlines in system
- Any and all other referenced inputs including but not limited to: Table #1 and Table 2

*For each item listed use multiple sheets or (.xls) spreadsheet if required

Transmission Owner, PJM region, Zone, Area,

Condition Driven Projects: Transmission Lines

- Date maintenance was last perform (per structure basis, and on entire asset)
- Asset Age
  - List of each structure's age associated
  - Total count of all structure
  - Conductor used on each span and conductor age
  - Identified data gaps and/or missing data
- Asset Design
  - Material comprising structure (Steel, Aluminum, Wood, Concrete, Composite, Underground)
  - Structure design (Monopole, H frame, Lattice)
  - Cross arm material (Wood, Steel: if applicable)
  - Insulators (Glass, Porcelain, composite)
  - Shielding features of each structure (Double/single shield wire, OPGW, structure grounded Y/N)
  - Grounding status of each structure and ground resistance
- Condition List
  - Detailed description of each condition including component and condition
  - structure or span associated with each condition
  - geographic location of condition
  - severity of condition, date that condition was first identified, date of last inspection
  - Any additional known defects with structure design or components comprising structure
- Asset's condition ranking and asset's ranking overall as compared to the all other T-line in the system

*For each item listed use multiple sheets or (.xls) spreadsheet if required

https://www.satcs.co.za/Transformer_Oil_Analysis.pdf

http://assets.fiercemarkets.net/public/smartgridnews/End_to_end_asset_health.pdf

Show photo of each condition being addressed Including pole/structure tag

Transmission Owner, PJM region, Zone, Area,

Risk Driven Projects: Transmission Line and Stations

- **Transmission Lines or Substation** (Values if used to assess transmission lines risk, EOL or life expectancy only if used in TO's assessment)
  - Calculated probability of failure with detailed inputs
  - Associated impact values used to calculate risk
    - Customers impacted
    - Load Impacted
    - System impacts
    - Generation Impacts
    - Expected energy not delivered
    - Dynamic reactive devices impacted and their MVA
    - Number of stations with voltage sags
    - Number of tie line interconnections interrupted
    - Arming of SPS scheme's due to stability or thermal constraints
    - Number of real time operational constraints resulting in load drop warnings
    - Any impacts not listed above
  - List of all stations or tines and their associated Risk scores and risk rankings

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