Asset Management Strategy Transmission Sustain Steel

Final

May 13, 2010

Situation Assessment

- Sixty percent of our 10,800 circuit miles of steel lines are 40 years or older and many still have the original hardware in place.
- Theoretical life expectancy of the most critical active components is 40 years.
- In the 5 year period between 2005 through 2009, we experienced 37outages in excess of 240 minutes that were likely due to material failure.
- The advanced age of components is assumed to increase their likelihood of failure during severe weather.
- We are experiencing material failures that indicate that active components (connectors, insulators, dampers, spacers, airway warnings) have a finite lifespan and are approaching that limit; reliability and availability of the operating line will decrease as a result.
- Failing components could result in extended line outages and possibly a multiple line outage if a span crossing over other lines fails.
- We need to be proactive in addressing these aging assets and avoid putting ourselves in a reactive mode with regard to material failure on our transmission lines.
- Maintenance costs to repair or replace failing components in a piece meal fashion will be less cost effective than a proactive whole line component replacement approach.

What equipment and facilities are covered?

What performance objectives, measures and targets should be set?

What is the health of the assets, and what risks must be managed?

What strategies should we undertake?

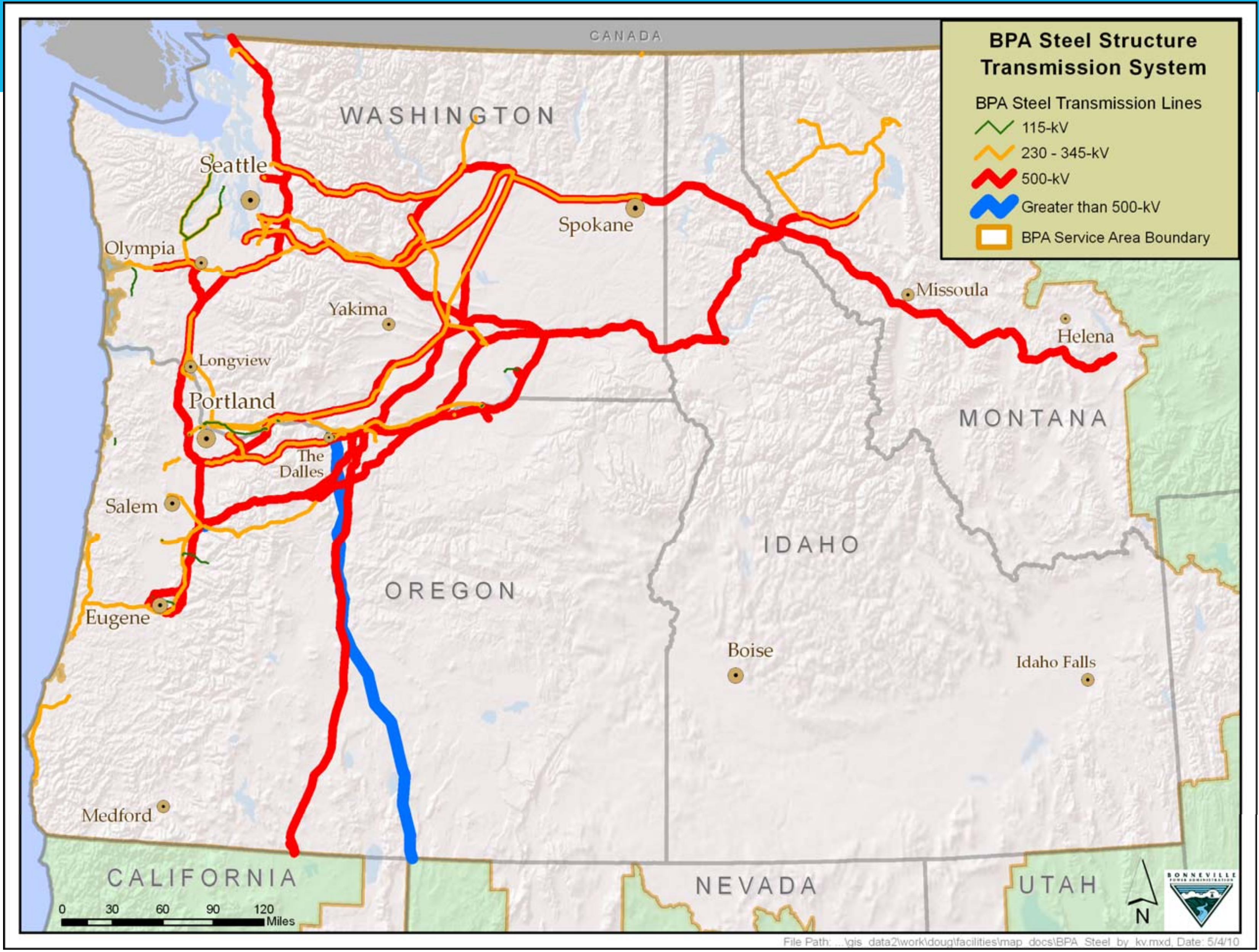
What will it cost?

Assets and asset systems

Our Steel transmission lines consists of about 10,800 circuit miles on approximately 43,200 steel lattice towers, steel lattice poles and engineered steel poles. This includes the DC intertie (~260 circuit miles,) all of the 500kV grid (~4500 circuit miles including the AC interties,) along with about 80 percent of the 230- 345kV system (~5200 circuit miles) and about 13 percent of the 115kV system (~900 circuit miles.)

- Assets consist of:
  - Lattice Towers
  - Lattice Poles
  - Engineered Steel Poles
  - Footings: Concrete Pier, Rock, Grillage, Plate, Pile
  - Guying Systems: Guy anchors, Rods, Guy Strands, Guy Insulators
  - Conductor: AAC, AACTW, ACSR, ACSRTW, Copper, Specials
  - Conductor Insulators assemblies and associated hardware: Insulator string (Ceramic, glass, NCI), Suspension shoes, Armor rod, Vibration dampers, Jumpers and jumper attachment hardware, Shunts
  - Spacers and Spacer Dampers
  - Ground Wire and Associated Hardware
  - Fiber Optic Cables and Associated Hardware (maintenance currently managed by TLM)
  - Airway Warning: Lighting, Marker Balls

- Asset systems consist of:
  - Network critical transmission lines
  - Interties
  - Key points of interconnection with many of our load serving wholesale full and partial requirements customers



BPA Steel Structure Transmission System
BPA Steel Transmission Lines
115-kV
230 - 345-kV
500-kV
Greater than 500-kV
BPA Service Area Boundary
CANADA
WASHINGTON
OREGON
IDAHO
MONTANA
CALIFORNIA
NEVADA
UTAH
Seattle
Olympia
Spokane
Yakima
Longview
Portland
The Dalles
Salem
Eugene
Medford
Missoula
Helena
Boise
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What equipment and facilities are covered?

What performance objectives, measures and targets should be set?

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What performance targets drive this strategy?

- Long term goals and initiatives relevant to the sustain steel program

Goals for sustaining transmission

Goals	Strategic initiatives
G9 Information on asset attributes (condition, performance, and costs) is complete, accurate, and readily accessible	I-1. Ensure nameplate, condition assessment, outage history, maintenance costs and other asset information is accurate, complete, and readily accessible via the Transmission Asset System (TAS) (Go-live by [date]) (G9)
	I-2. Maintain or replace existing communications, control and operations infrastructure on a timely basis to ensure reliable, efficient, secure, and safe operation of the power system (G10, G11) • Develop and implement policies, guidelines, and standards that ensure communications, control and operations infrastructure will comply with regulatory standards and requirements
G10 Assets are proactively maintained and replaced • Maintenance, replacements and sparing planning is integrated • Priority is given to critical assets at greatest risk of failure or noncompliance • Reliability, availability, and other standards are met at least life-cycle cost	I-3. Prioritize and manage maintenance and replacement backlogs to sustainable levels (target dates set in life-cycle strategies for each sustain program) (G10, G11) I-4. Ensure that replacement and maintenance actions result in no more than X% of critical assets at high risk of failure or noncompliance (target percents and target dates set in life-cycle strategies for each sustain program) (G10, G11)
G11 Maintenance is reliability-centered (condition-based)	I-5. Develop and implement sparing strategies to assure a supply of critical spare parts is geographically situated to enable timely restoration of service (G10) I-6. Implement an integrated rights of way program that (1) controls vegetation to avoid unplanned outages, (2) maintains roads to minimize response time, increase reliability, and avoid environmental damage, and (3) considers public impacts. (G10, G11) I-7. Establish condition-based maintenance standards and implement reliability-centered maintenance as each asset class is added to TAS (G11)

What performance targets drive this strategy? (continued)

- Transmission system performance measures for Reliability and Availability

System performance metrics and targets

Reliability - SAIDI: Zero control chart violations for line categories 1-2, and no more than 1 violation per year for line categories 3-4

Reliability - SAIFI: Zero control chart violations for line categories 1-2, and no more than 1 violation per year for line categories 3-4

Availability: 98 percent per year for line categories 1-2, and XX percent for line categories 3-4

- Safety: The lost-time accident frequency rate is ≤1.5. No fatalities occur to BPA employees or contract employees working on BPA facilities.

Performance Objectives and Targets

- **Transmission Line Reliability**
  - **Performance Objective**: Reduce or avoid unplanned outages on BPA’s most important steel transmission lines (category 1 and 2) due to equipment condition or age related failures.
  - **Measures**: Outage frequency (SAIFI) and duration (SAIDI) due to equipment condition or age related failure
  - **End-stage Targets**:

    Maintain SAIDI and SAIFI at or below historic averages:
    - Zero Control Chart Violations for SAIDI and SAIFI for category 1 & 2 lines
    - No more than one control chart violation per year for line categories 3 & 4

- **Transmission Line Availability**
  - **Performance Objective**: Ensure BPA’s steel transmission lines meet availability targets.
  - **Measures**: Duration of planned outages for maintenance
  - **End-stage Target**: BPA's most important transmission lines (Category 1 and 2) are available for service at least 98.0% of the time.

Performance Objectives and Targets (continued)

- **Safety**
  - **Performance Objective**: BPA transmission lines are maintained and operated in a way that limits risk to health and safety of employees working on the lines and to the public
  - **Measures**: Frequency of lost-time accidents and near misses
  - **End-Stage Target**: Lost-time accident frequency rate ≤ 1.5 per 100,000 hours worked, No fatalities occur to BPA employees or contract employees working on BPA facilities

- **NERC/WECC Maintenance & Inspection Compliance Criteria**
  - **Performance Objective**: We are adequately inspecting, assessing, documenting and maintaining our transmission lines in accordance to WECC Standard PRC-STD-005-1 (A Regional Reliability Standard to ensure the Transmission Operator or Owner of a WECC transmission path performs maintenance and inspection on identified paths as described by its transmission maintenance plan)
  - **Measures** (this is what NERC/WECC requires we do)
    - Transmission Maintenance & Inspection Plan (TMIP) is developed, documented and reviewed annually
    - Maintenance is performed in accordance with the TMIP
    - Maintenance records are maintained as required by this Standard (documentation exists that the Transmission Lines have been regularly inspected, conditions have been noted and corrected in a timely fashion)
  - **End-Stage Target**: There are no violations to NERC/WECC maintenance and inspection standards

Performance Objectives and Targets (continued)

- **Transmission Asset Data Adequacy and Availability (G9)**
  - **Performance Objective**: As lines are inspected on a scheduled basis, information on active and passive component attributes and condition is complete, accurate and readily accessible in TAS.
  - **Measures**:
    - Extent to which a framework for collecting and retaining program critical component condition data is provided for in TAS
    - Availability of complete, accurate and readily accessible asset attribute information in TAS
  - **End-Stage Target**:
    - 95% of program critical asset data have a place in TAS by end of FY2011
    - 90% asset attribute data for 99% of steel line assets inspected since the inception of TAS is available in TAS.

Performance Objectives and Targets (continued)

- **Assets are proactively assessed, maintained and replaced (G10 & G11)**
  - **Performance Objective**: Assets are proactively assessed, maintained and replaced
    - Priority is given to critical assets at greatest risk of failure
    - Reliability, availability, and other standards are met at least life cycle cost
    - Maintenance is reliability-centered and condition-based
    - Maintenance, replacements and sparing planning is integrated
    - Reduce the risk of unplanned outages
  - **Measures**:
    - Percent of critical assets at high risk of failure (G10, G11)
    - Percent of asset classes that have condition-based maintenance standards (G11)
    - Extent to which sparing strategies are in place to assure that a supply of critical spare parts is geographically situated to enable timely restoration of service (G10)
  - **End-Stage Target**:
    - Risk assessments are updated every 5 years
    - The number of circuit miles for active components in the high risk category has decreased by 20 percent from the last update period
    - Condition-based standards are in place for 80% of asset classes by the end of 2011
    - Sparing strategies are in place for our most critical assets by the end of 2011

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What performance objectives, measures and targets should be set?

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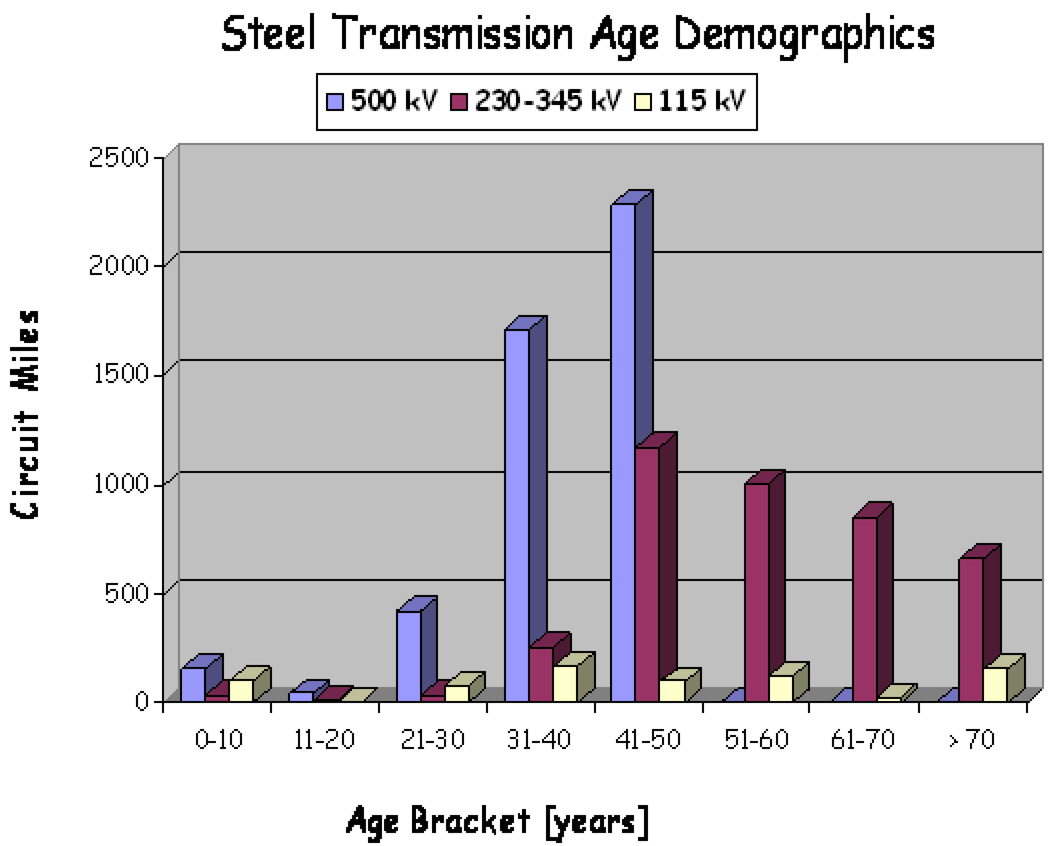
What will it cost?

Transmission line age

- Much of the primary loop and significant portions of the Southern Intertie exceed 40 years of service life
- With the median age of all 10,800 circuit miles being 45 years, the 2007 Aging Asset Report concluded key components were approaching theoretical end-of-life on 60% of BPA's installed asset



Steel line health assessment

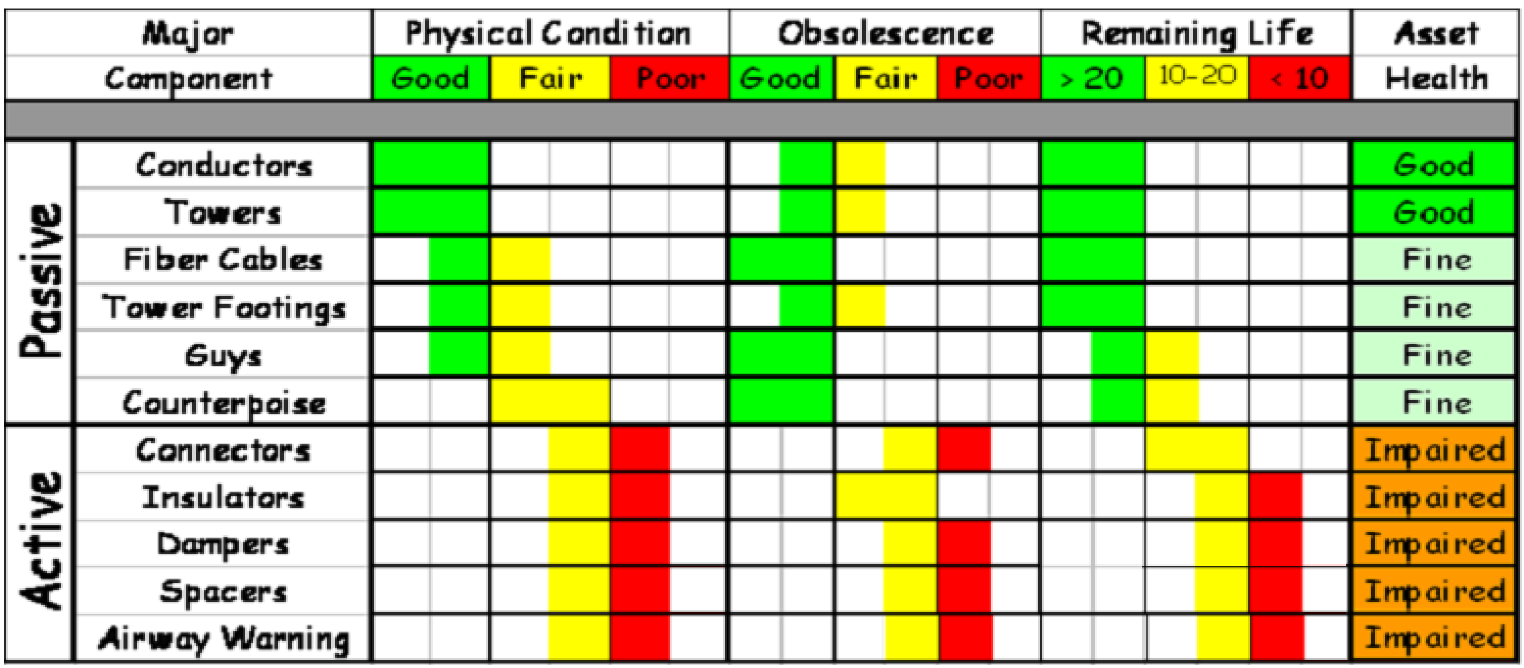
- Overhead steel lines make up a vast and complex physical and electrical system, and is difficult to characterize as a population. To build a quantitative evaluation of the asset's overall health, the steel transmission system was separated into 11 major components organized by common, age-related attributes.

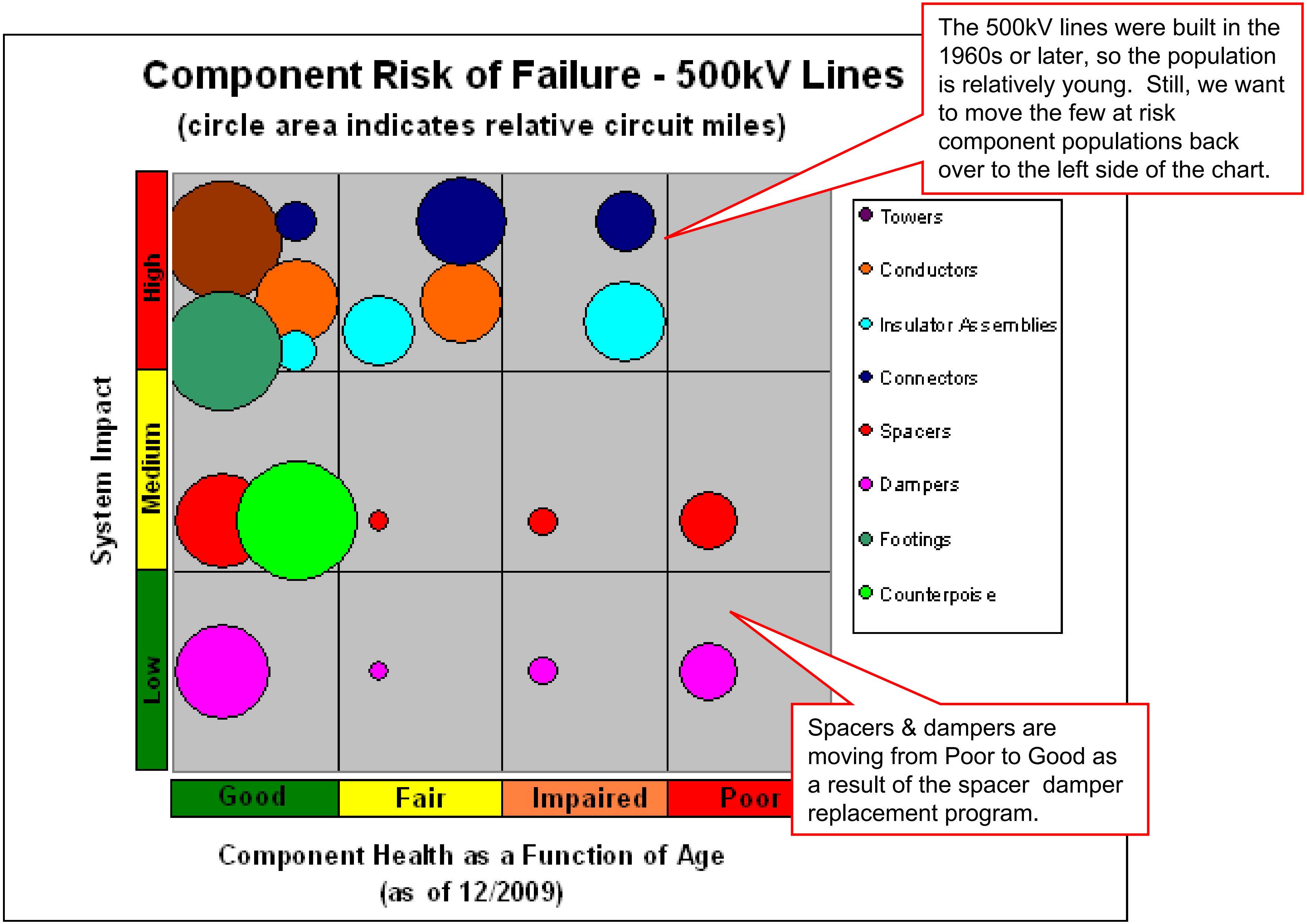
- Currently the only overhead asset component for which condition has been consistently assessed and documented over time is wood poles. Data on steel line component health is sparse, making the data documenting efforts presently underway crucial to the success of this sustain program. Three key elements necessary to adequately document our transmission asset and it's condition are:
  - TLDD- Transmission Line Design Data
    - To understand a specific line's design parameters
    - To analyze line physical/structural capacities
    - For line rating
  - TAS – Transmission Asset System (for asset health data)
    - For recording, retaining and managing comprehensive asset health assessment data in order to properly manage, assess and analyze the overhead asset
  - Comprehensive metrics for regularly and consistently collecting and retaining asset condition data
    - To identify trends
    - To assist in targeting and timing replacement programs
    - To facilitate effective management over time
    - To assist in refining predictions on component service life as impacted by site conditions

- Recognizing that major line components will age at different rates, we have grouped and identified these 11 components as populations that facilitate efficient health and risk assessments
  - Active Components
    - Age faster
    - Low replacement cost
    - Critical or Protective function
  - Passive Components
    - Last longer
    - High Replacement Costs
    - Assessment more difficult

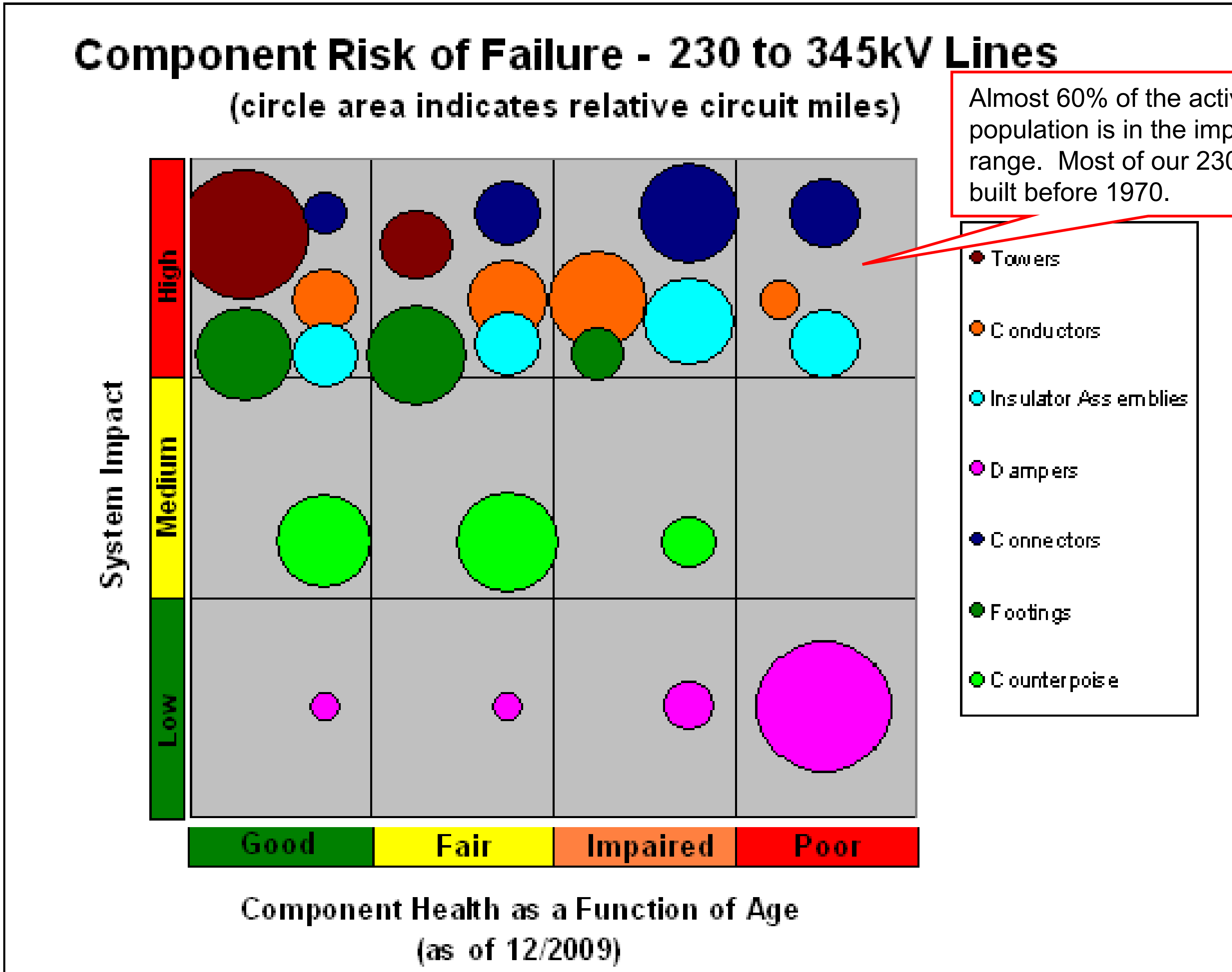
Steel line health assessment

- For the purposes of this 2010 strategy, line health is generally based on 2007 “Aging Overhead Transmission Asset: Condition and Risk Assessment” report. The health of specific lines is based on line age, field observed and reported condition, and engineering judgment.
- The chart below is the population based assessment from the Aging Asset Report, with some modifications based on work done in the last two years on Spacer dampers and airway warning.

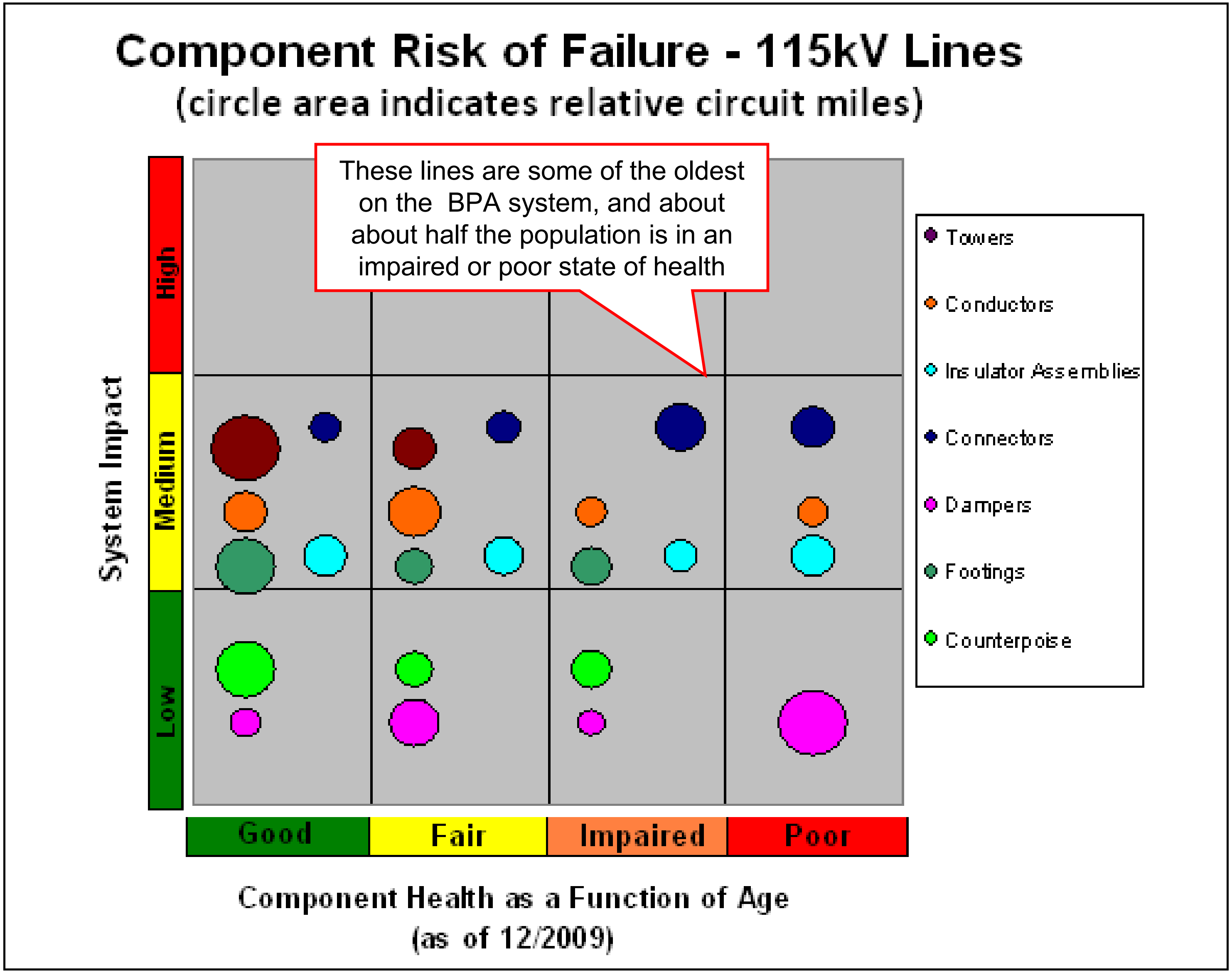




Component Risk of Failure - 500kV Lines
(circle area indicates relative circuit miles)
System Impact
High
Medium
Low
Good
Fair
Impaired
Poor
Component Health as a Function of Age
(as of 12/2009)
Towers
Conductors
Insulator Assemblies
Connectors
Spacers
Dampers
Footings
Counterpoise
The 500kV lines were built in the 1960s or later, so the population is relatively young. Still, we want to move the few at risk component populations back over to the left side of the chart.
Spacers & dampers are moving from Poor to Good as a result of the spacer damper replacement program.



Almost 60% of the active component population is in the impaired to poor range. Most of our 230kV lines were built before 1970.


Component Risk of Failure - 115kV Lines
(circle area indicates relative circuit miles)
These lines are some of the oldest on the BPA system, and about about half the population is in an impaired or poor state of health
System Impact
High
Medium
Low
Good
Fair
Impaired
Poor
Component Health as a Function of Age
(as of 12/2009)
Towers
Conductors
Insulator Assemblies
Connectors
Dampers
Footings
Counterpoise

Performance history

- In the 5 year period between 2005 through 2009, we experienced 37 outages in excess of 240 minutes that were likely due to material failure.
- As a proxy for deteriorating condition, the increasingly advanced age of components is assumed to increase their likelihood of failure during severe weather.
- Our steel lines are not crumbling to the ground, although we are experiencing material failures that clearly indicate that active components have a finite lifespan and are approaching that limit.
  - Recent ground wire failures on Fairview-Rogue
  - Recent insulator failures on Olympia-Grand Coulee
  - TLM observations on North Bonneville-Troutdale and Bonneville-Hood River that tower attachment points for suspension insulators have worn thin.
  - Engineering's concerns about fittings on copper and 2.5" expanded experiencing thermal failure

Cost history

- Capital cost for replacement projects (last 3 years)
  - Spacer Damper Replacement: $23 million FY08-10
  - Insulator Replacement: $418,630 FY08-10
- Annual maintenance costs
  - A major component of this cost is labor hours, to inspect and maintain these lines. Costs exclude right-of-way maintenance, access roads and non-line specific vegetation management.

What risks must be managed?

- **Transmission Reliability**

Performance Objective: Reduce or avoid unplanned outages on BPA's most important steel transmission lines (category 1 and 2) due to equipment condition or age related failures

- **Risk:** Components which are approaching or have reached their end-of-life begin to fail and continue to fail in increasing numbers, resulting in an increased likelihood of unplanned outages.

- **Likelihood:** Very likely. Line components that experience mechanical load cycles have a finite lifespan; eventual failure is inevitable, even more so for those components considered to be a high risk of failure.

- **Consequence:** Significant
  - Reliability of the operating line will decrease
  - SAIFI and SAIDI end-stage targets will increasingly not be met
  - Failing components could result in extended line outages
  - Maintenance costs to repair or replace failing components in a piece meal fashion will be less cost effective than a proactive whole line component replacement approach
  - Station equipment will experience increased duty with increasing automatic outages
  - Staff will be diverted from implementing planned program work

What risks must be managed? (continued)

- **Transmission Availability**

Performance Objective: Ensure BPA's steel transmission lines meet availability targets.

- **Risk:** The anticipated increase of replacement work will lead to an increasing frequency of planned outages resulting in decreased transmission line availability.

- **Likelihood:** Likely. Line components that experience mechanical load cycles have a finite life expectancy; eventual failure is inevitable and without a systematic approach to preemptive replacement, the failure rate will likely be unmanageable from a maintenance perspective.

- **Consequence:** Significant
  - Maintenance backlog will increase to an unsustainable level.
  - Maintenance costs to repair or replace failing components in a piece meal fashion will be less cost effective than a proactive whole line component replacement approach.
  - Availability of the operating line will decrease overtime, until enough hardware has been replaced to move the line out of a high maintenance category.

What risks must be managed? (continued)

- ## Safety

  Performance Objective: BPA transmission lines are maintained and operated in a way that limits risk to health and safety of maintenance employees and the public.

  - **Risk:** Age-related deterioration of line components results in component failure during maintenance activities, storm events, etc, leading to injury or death.
  - **Likelihood:** Low. Depending on the failure mechanism, it may be difficult for field personnel to readily identify materials, like insulators, that have severely deteriorated strength capacity.
  - **Consequence:** Significant – Potential injury or loss of human life

- ## NERC/WECC Management and Compliance Criteria

  Performance Objective: We are inspecting, assessing, documenting and maintaining our transmission lines in accordance to WECC Standard PRC-STD-005-1

  - **Risk:** Being found not in compliance with NERC/WECC standard PRC-STD-005-1 through self report or during NERC/WECC audit leads to mandatory emergency remediation with possible financial penalties that results in increased expense costs and loss of reputation.
  - **Likelihood:** Low
    - We currently have a TMIP in place,
    - Maintenance is performed in accordance with the TMIP
    - Maintenance records are maintained as required by this Standard
  - **Consequence:** Moderate – There are possible fines for non-compliance and we could be ordered to take expensive corrective actions within a short time frame.

What risks must be managed? (continued)

- **Transmission Asset Data Adequacy and Availability**

  Performance Objective: As lines are inspected on a scheduled basis, information on active and passive component attributes and condition is complete, accurate and readily accessible in TAS

  - **Risk**: We do not have the information available to help us identify condition trends or to predict service life, making it difficult to effectively target, pace and manage replacement and maintenance programs.
  - **Likelihood:** Moderate
    - It is not yet clear what resources will be available to systematically and scientifically test and assess a statistically significant sampling of aging component populations, which is a critical part of this strategy's success.
    - TAS development may not meet it's current schedule.
  - **Consequence:** Significant
    - Replacement and maintenance decisions based on inadequate asset condition information can potentially lead to significant over or under spending within the program and inefficient program targeting and pacing.

What risks must be managed? (continued)

- **Assets are proactively assessed, maintained and replaced**

  Performance Objective: Processes are developed to ensure that assets are proactively assessed, maintained and replaced

  - **Risk:** Maintenance cannot overcome the anticipated backlog of work, material for restoring service is not readily available or we are not gathering and tracking adequate data to make well informed maintenance decisions.
  - **Likelihood:** Low
  - **Consequence:** Significant – Decreased reliability due to increasing frequency of unplanned outages. Reactionary replacement efforts to keep up with failures results in increased overall program costs.

What equipment and facilities are covered?

What performance objectives, measures and targets should be set?

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Strategy Considerations

- **Load growth and long term reliability**
  - In targeting lines for refurbishment, a feedback loop with expansion planning needs to be established to ensure a thoughtful and coordinated line specific strategy that is long-term, proactive, and regional in scope

- **Determining Asset Condition**
  - In order to accurately assess and appropriately target and pace our steel line component replacement efforts, we must have in place a systematic approach to track and document the condition of our assets over time
  - TAS is the future of asset maintenance tracking and documentation
    - The goal is systematic accounting of what's out there, what's wearing and breaking and what's being fixed
    - Ease of reporting recurring issues on the system that will feed into program development
    - TAS implementation for this program begins early to mid FY2011
  - A resource strategy must be developed for managing and orchestrating on-gong component evaluation: sampling, testing, assessment and reporting

Strategy Considerations (continued)

- **Component Population Condition Assessment**
  - While 500kV lines are most critical they are younger and tend to be in better condition
  - Whereas the 115kV and some 230kV lines are less critical, they are older and appear to be at greater risk of failure. Effort needs to be put toward restoring the health of these lower voltage lines
  - Proper management of the overhead asset is critically dependent on the reliability and availability of condition assessment data, related analysis, and timing of replacement efforts

- **QA/QC Requirements**
  - Must have increased emphasis on QA/QC due to increased off-the-shelf purchasing
  - BPA cannot have successful partnerships with material suppliers without a robust internal QA program
  - QA/QC should be a strategic initiative that goes across transmission expansion and sustain

- **Maintenance strategies for steel lines need to be refined to address issues of an aging population**
  - Robust maintenance standards and procedures for aging steel lines must be in place, integrated with TAS and reviewed annually.
  - Forecast costs necessary to perform adequate maintenance on our aging steel lines.
  - Share information with other utilities on approaches for maintaining an aging system.

Strategy Considerations (continued)

- **Staffing Constraints**
  - The level of man-power resources necessary to adequately accomplish transmission system refurbishment significantly exceeds those of routine maintenance and will require the use of internal and external resources.

- **Outage Constraints**
  - Refurbish work involving conductor hardware is most efficiently performed while the line is not energized.
  - Extended outages are difficult, if not impossible, to get on some lines; we need to continue to develop our hotline resources

- **Evolving Regulatory Standards**
  - To meet NERC/WECC requirements, a Transmission Maintenance & Inspection Plan (TMIP) must be in place so that assets are proactively maintained and replaced
  - NESC – replacement components must meet current standards for quality and electrical functionality
  - Business Continuity: the agency’s business continuity objectives must be met

Steel Sustain Program Strategies

- **Asset Vision:** BPA has restored the health of all overhead transmission system components to a state of long-term functionality and reliability and has instituted a proactive, economical, and dynamic strategy for tracking, assessing and mitigating its aging overhead asset over time. In doing this, BPA continues to fulfill its commitment to the region to provide an adequate, efficient, economical and reliable power supply.

- **Process Goals**
  - A Proactive plan to replace vital overhead system components nearing end of life
  - Standard metrics for collecting and retaining asset condition data, with enough granularity to 1) identify condition trends 2) target and pace replacement efforts 3) manage components over time and 4) better predict remaining service life
  - A standardized process for sampling and testing retired components, analyzing results and drawing conclusions that will assist us in pacing and targeting the replacement strategies
  - Long term strategy for evaluating and mitigating our continuously aging asset
  - Data quality and reporting is adequate in TAS (transmission Asset System) and TLDD (Transmission Line Design Data) to serve us in effectively tracking and evaluating our overhead asset
  - Standardized components and technology innovations appropriately incorporated into replacement efforts
  - Documented lessons learned available so that every cost-effective effort is made to ensure that new projects are assembled with the best chance for a long and reliable service life

Steel Sustain Program Strategies (continued)

- **Insulator Assemblies and Associated Hardware (planned to start 2011) Capital**
  Replace the entire insulator assembly and associated hardware. Shunt deadend and jumper connections.

  Background: Unlike with the spacer damper replacement program where there were obvious physical indicators of components having reached the end of their service life, the condition of the insulator assemblies and associated hardware is not always obvious and can be difficult to ascertain by field observation alone. An on-going strategy for testing retired components will give us the data necessary to appropriately target and pace the program.

  - Phase One
    - Replace the full insulator assembly and any associated hardware on discrete line sections.
    - Shunt compression fittings at deadends
    - Based on age of asset, field observation of condition, weather exposure, frequency of material caused outages, line criticality and outage availability, a group of line sections is targeted for the first three years of the program, this list will evolve as new information becomes available.
    - Determine construction resources available and skill enhancement necessary to address hard to take out lines, which are often our most critical.
    - Replacement assemblies will have been reviewed and revised as necessary to meet our current policy to standardize hardware components when ever possible.
    - As insulator assemblies and associated hardware are replaced, a statistically significant sampling of the retired population must be evaluated to determine actual component condition, help refine service life predictions and identify predictors of urgency
    - These evaluations will give us the data necessary to determine the pace at which this effort should move forward over the long term.
    - TAS Implementation will likely begin in early to mid FY 2011; effective implementation is critical to the sustain programs

Steel Sustain Program Strategies (continued)

- **Insulator Assemblies and Associated Hardware** (continued)
  - Phase Two (on-going:)
    - Reevaluate the strategy for insulator assembly and associated hardware replacement for the next multi-year program period based on retired component analysis and other phase one program lessons learned.
    - Structure the next three to five year program according to urgency and critical indicators uncovered in phase one.
    - Continue to refine condition data collection efforts to best meet asset management needs

- **Airway Marking (currently underway) <u>Expense</u>**
  - Program started in 2004
  - Theoretical lifespan is 10 years for the fixture and 2-4 years for the flashtube.
  - Region expense budgets may allow between two and six towers per year (between $5K and $60K)
  - Program cost to date is about $3 million
  - Replacements prioritized based on criticality, condition and maintenance frequency and complexity
  - Standardizing around low maintenance, self-contained fixtures
  - Replace marker balls in conjunction with spacer replacement when possible
  - Program tracking is currently done by the PM on a locally maintained list, TAS will be taking over this function eventually.

- **Steel Tower Components (strategy development to begin 2011) <u>Expense/Capital</u>**
  - A steel transmission tower has a theoretical lifespan of 100 years, and footings up to 80 years.
  - Underground components may have corrosion issues that shorten this lifespan
  - Points of interface between the tower and the insulator string may experience accelerated wear.
  - Develop a systematic way to assess document and track over time the condition of these passive components and their more vulnerable subparts. The expectation is that TAS will provide the means for collecting, storing and tracking this information.

Steel Sustain Program Strategies (continued)

- **Other Components of the Steel Sustain Program:**
  - **Developing and Implementing assessment strategies for all transmission line components**.
    - Working with our utility partners to share information, the entire industry is facing this issue
    - Developing and validating testing and assessment methods
    - Determining what parameters should be documented by TLM in TAS
    - Determining condition thresholds that will guide program schedule.
    - Component testing, assessment and tracking
  - **Other replacement and maintenance activities**
    - Tower steel repair
    - Footing repair and protection
    - Guying repair or replacement
    - Conductor splice reinforcement – shunting
    - Premature spacer replacement due to material quality issues

Alternative Strategies Considered

- **Alternative Strategies for steel lines**:
  - Status Quo – Continue with the philosophy that steel lines don't require much more than occasional insulator bell or string replacement and address other material failures as they come up.
    - Not sustainable, higher cost for piecemeal approach
    - Does not address growing backlog of lines well beyond expected service life
    - Increasing risk of unplanned outages due to component failures
  - Aggressive Age-Based Replacement of Active Components - Aggressive replacement of active components based on predicted life expectancy. 500kV insulators would be replaced at 40 years, for example.
    - Challenge to implement and strains resources
    - Outages necessary to complete the work would be very difficult
    - Improves long-term reliability but would adversely impact short-term availability
    - Likely that many line components would be replaced before end of service life
  - Proactive Condition Based Replacement of Active Components – **PREFERRED** - Beginning with an age-based approach, discrete line segments will be targeted for replacement. A sampling of retired components will be evaluated and results will be documented along with factors like age, manufacturer, geographic location, weather exposure etc. in order to refine life expectancy predictions, better target high risk lines and appropriately pace the program.
    - Starts with what we do know about the lines
    - Refines the approach base on actual component condition

What equipment and facilities are covered?

What performance objectives, measures and targets should be set?

What is the health of the assets, and what risks must be managed?

What strategies should we set?

What will it cost?

Forecast Planning Levels

- **Summary and forecast logic**
  - Contractor estimates are coming in at $89,000 per mile for labor and $22,000 per mile for materials.
  - The target for 2011 is about 45 miles ($5 million), for 2012 is about 80 miles ($9 million) and for 2013 100 miles ($11.5 million.) For the next program period we've planned for an annual budget of $27.8 million.
  - The 2014 budget level of $27.8 million is held through 2018
  - Roads and associated environmental work will be programmed by the Access Road PM
  - Over the course of the program, analysis on a sampling of retired components will be on-going and will inform how the program will evolve over time.
  - BPA's steel transmission system consists of about 10,800 circuit miles of line. At a refurbish rate of between 225 and 290 per year, it will take about 40 years to refurbish the system. Although we are approaching theoretical end of life for between 40 and 60 percent of our system, we will be relying on asset assessment and retired component analysis to reinforce or refine that assumption.
  - What remains to be determined is the longevity of the steel towers and footings themselves. At this time, towers are predicted to have a lifespan of 100 years and footings are predicted to have a lifespan of 80 years. The wholesale replacement of these passive assets will require a much greater capital investment than the active components.
  - Expense dollars should be earmarked for sustain activities and those dollars should be controlled at the program level
  - Decisions will have to be made within the next 20 years about next steps for maintaining the aging transmission system as passive components begin to reach the end of their service life. This will warrant close examination of our long term capacity and network needs for specific corridors as we're faced with decisions on replacing passive components, like towers, footing and conductor.

Capital Forecast Planning Levels

- Our first contractor bids have come in. Low bid for labor was around $89,000 per mile for full insulator assembly replacement.

Line Name	Op kV	FY11-18 Line Miles	Typical Estimate Cost Per Mile $ Labor Direct	Typical Estimate Cost Per Mile $ Materials Direct	FY11-18 Total Direct Cost (Millions 2009 $)	Estimated Year Completed	(not included) Estimate FY 2010	*Estimate FY2011*	*Estimate FY2012*	*Estimate FY2013*	*Estimate FY2014*	*Estimate FY2015*	*Estimate FY2016*	*Estimate FY2017*	*Estimate FY2018*
CONDUCTOR ASSEMBLY AND ASSOCIATED HARDWARE REPLACEMENT (WHOLE LINE)															
Mileage Forecasts (not including FY10)							45.0	45.0	80.0	100.0	250.0	250.0	250.0	250.0	250.0
Budget Forecast (not including FY10)		1475.0	89,000	22,000	$164.5	ON-GOING	$5.0	$5.0	$9.0	$11.5	$27.8	$27.8	$27.8	$27.8	$27.8

(In 2009 dollars)

Expense Forecast Planning Levels

- This is a very rough estimate that is intended to bring attention to the expense component of this program and not to imply that additional expense dollars need to be added to the IPR.
- It is assumed that expense dollars related to minor unit component replacements have already been accounted for in the expense IPR.
- Resources to carry out component testing and data analysis will have to be planned for, by the organization under which this activity will take place. It is likely that sustain programs will consolidate this function across programs.

(In 2009 dollars)

EXPENSE										
	Description	Estimate FY 2010	*Estimate FY2011*	*Estimate FY2012*	*Estimate FY2013*	*Estimate FY2014*	*Estimate FY2015*	*Estimate FY2016*	*Estimate FY2017*	*Estimate FY2018*
Expense Budget Forecast	Replacement of expense components (minor unit) covered in the sustain steel strategy.		50,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
	Resources for orchestrating and performing retired component testing and data analysis		100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000

FAS 71 Planned Expenditures in 2010 for Projects Underway
Spacer Damper Replacement Program

Line Name	Op kV	Line Miles	Typical Estimate Cost Per Mile $ Direct		Total Direct Cost (Millions 2009 $)	Estimated Year Completed	Estimate FY 2010	*Estimate FY2011*
							2010	2011
SPACER PROJECTS CURRENTLY PLANNED FOR 2010 CONSTRUCTION SEASON								
Coyote Springs-Slatt No 1	525	28.1	20,000		$0.6	2010	$0.6	
Echo Lake-Monroe No 1	525	30.0	20,000		$0.6	2010	$0.6	
Garrison-Taft No 1	525	159.4	20,000		$3.2	2010	$3.2	
Grizzly-Captain Jack No. 1	525	113.1	20,000		$2.3	2010	$2.3	
Hanford-Wautoma No 1	525	18.1	20,000		$0.4	2010	$0.4	
Hanford-Wautoma No 2	525	18.1	20,000		$0.4	2010	$0.4	
John Day-Big Eddy No 2	525	16.0	20,000		$0.3	2010	$0.3	
John Day-Grizzly No 2	525	85.0	20,000		$1.7	2010	$1.7	
McNary-Coyote Springs No 1	525	19.4	20,000		$0.4	2010	$0.4	
Napavine-Allston No 1	525	34.9	20,000		$0.7	2010	$0.7	
Rock Creek-John Day No. 1	525	8.7	20,000		$0.2	2010	$0.2	
Schultz-Raver No. 4	525	50.8	20,000		$1.0	2010	$1.0	
Taft-Bell No. 1	525	0.9	20,000		$0.0	2010	$0.0	
Taft-Hot Springs No. 1	525	4.0	20,000		$0.1	2010	$0.1	
Wautoma-Rock Creek No. 1	525	65.1	20,000		$1.3	2010	$1.3	
Dworshak PH-Dworshak No. 1	525	3.7	20,000		$0.1	2011		$0.1
Raver-Paul No 1	525	69.3	20,000		$1.4	2011		$1.4
Slatt-John Day No. 1	525	30.3	20,000		$0.6	2011		$0.6
Vantage-Hanford No 1	525	23.5	20,000		$0.5	2011		$0.5
Wautoma-Ostrander No. 1	525	56.2	20,000		$1.1	2011		$1.1
TOTAL		834.6					$13.0	$3.7

Next Steps

- Communicate and share strategy
  - Share within Transmission Executives to get feedback
- Develop the Business Case
- Develop Asset Management Plan
  - Identifies specific projects and initiatives
  - Assigns accountability
  - Delivery date
- Other Steps
  - Determine funding options for on-going component assessment
  - Determine personnel resources for on-going component assessment
  - Participate in TAS architecture development

BPA's Financial Disclosure Information

- All FY 2010 – FY 2018 information has been made publicly available by BPA on May 14th, 2010 and does not contain Agency-approved Financial Information.
- This information is being released externally by BPA on May 14th, 2010 as an ad hoc report or analysis generated for a specific purpose. The information provided is based upon data found in Agency Financial Information but may not be found verbatim in an External Standard Financial Report or other Agency Financial Information release.