BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Develop a Risk-Based Decision-Making Framework to Evaluate Safety and Reliability Improvements and Revise the General Rate Case Plan for Energy Utilities.	Rulemaking 13-11-006 (Filed November 14, 2013)

OPENING COMMENTS OF THE ENERGY PRODUCERS AND USERS COALITION ON THE REFINED STRAW PROPOSAL

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Pursuant to the Administrative Law Judge's Ruling Regarding Refined Straw Proposal filed April 17, 2014 and the Scoping Memo issued May 15, 2014 in the above-captioned Rulemaking, the Energy Producers and Users Coalition (EPUC)[1] hereby provides its opening comments.

I. INTRODUCTION

The Commission opened R.13-11-006 largely to "*prioritize safety and reliability issues in [General Rate Case] applications of energy utilities…..*" The Rulemaking will integrate into the General Rate Case (GRC) an evaluation of utility risk management methodologies to increase the safety and reliability of Investor Owned Utilities (IOU) infrastructure. The Refined Straw Proposal (RSP) outlines a framework for this evaluation, reflecting constructive improvements and growing stakeholder consensus, but requires additional refinement to

[1] EPUC is an ad hoc group representing the electric end use and customer generation interests of the following companies: Aera Energy LLC, Chevron U.S.A. Inc., ExxonMobil Power and Gas Services Inc., Phillips 66 Company, Shell Oil Products US, Tesoro Refining & Marketing Company LLC, THUMS Long Beach Company, and Occidental Elk Hills, Inc.

achieve the Commission's stated goals. The refinements proposed in these Comments support implementation of a Final Framework that will achieve safety and reliability goals at the greatest overall benefit per dollar spent: an asset-based, uniform risk-management program.

An *asset-based* methodology should be the centerpiece of the risk management program outlined in the Final Framework. The methodology should not be a "black-box," but instead should be analytically rigorous and clear in its data, assumptions, and calculations. The proper focus of a risk-based decision-making methodology is the condition of utility assets; the safety and reliability of utility infrastructure is a direct result of the condition of the utility's assets. Assets maintained in good condition are more likely to operate in a safe and reliable manner and are less likely to suffer damage as a result of outside events including fires and earthquakes. The Commission does not need to look any further than the 2010 San Bruno incident to understand the importance of an asset-focused approach.

Another central focus of the Commission's efforts should be ensuring that the Final Framework results in a *uniform* approach by the utilities, with commonality in organizational management, strategic and operational asset management and management of the risks of uncontrollable events. The adoption of uniform methodologies will best address safety and reliability risks and will streamline the GRC process. Uniformity also encourages administrative efficiency and stakeholder participation. The Final Framework should direct the

IOUs, the Commission and stakeholders to work together to adopt uniform framework decision-making procedures.

In implementing these central principles, the Final Framework must ensure that the utility programs improve reliability of delivery services to its customers. The benefits of improving infrastructure reliability – reducing the frequency, severity and duration of outages -- go beyond mitigating economic impacts on customers. Infrastructure reliability improvements can mitigate outage-related safety risks that arise on customer premises when utility delivery services fail. The OIR strives to achieve both "*safety and reliability improvements*," and the Final Framework should not overlook infrastructure reliability.

The RSP takes important steps toward these principles, proposing:

- Overall implementation of procedures that should improve transparency and accountability and encourage stakeholder participation;
- Focus on asset condition;
- Adoption of the Safety Mitigation Assessment Proceeding (S-MAP), a process that will move towards uniform decision-making;
- Implementation of annual reporting and review of utility risk management activities and improvements; and
- Establishment of a risk lexicon.

Additional refinements are required, however, to realize the desired impact on safety and reliability results and encourage stakeholder participation in the future. The proposal should be enhanced to:

- Focus on infrastructure reliability as well as safety;

- Provide additional direction for the S-MAP and the adoption of uniform procedures;
- Clarify the interaction between Risk Assessment and Mitigation Phase (RAMP) review and the Commission's responsibility to ensure just and reasonable rates in the GRC;
- Consider all asset-based projects in the RAMP;
- Expand the risk lexicon; and
- Provide useful information in the Risk Mitigation Accountability Report.

The RCP should be modified as necessary to account for these changes.

These refinements to the RSP will result in an inclusive, participatory and transparent approach to managing both safety and reliability through prudent asset stewardship. The adoption of a uniform risk-based decision-making methodology will provide the Commission an efficient means of determining that the utilities are addressing safety and reliability in the most cost-effective manner. The Commission should encourage stakeholder participation and empower the utilities to make sound, analytical decisions that maximize the efficient use of resources and improve safety and infrastructure reliability with the greatest overall benefit per dollar spent.

II. THE RSP SETS OUT NEW PROCEDURES AND IOU REQUIREMENTS IN ORDER TO MEET THE GOALS OF THE RULEMAKING.

The Rulemaking aims to provide a means by which the Commission and intervenors can evaluate utility spending on safety and reliability and ensure that the IOUs will achieve results cost effectively.[2] The Rulemaking also seeks to efficiently manage the complexity and duration of the GRC.[3] Beyond these primary goals, the RSP identifies three procedural principles for the reformed process: transparency, participatory inclusivity and accountability.[4]

In service of these goals, the RSP adopts new procedures both within and outside of the GRC:

- The Commission will initiate a periodic S-MAP in order to educate parties on the use of utility decision-making models and establish standards and requirements for these models.[5] As part of the initial S-MAP, stakeholders will develop a risk lexicon.[6]

- Each utility will file a RAMP application as the initial phase of its GRC. Focusing on assets, the RAMP will present the IOU's risk profile and proposed mitigation plan. After a workshop and stakeholder comments, Commission staff will present a report on the RAMP filing.[7]

- Every year the utility will file a Risk Mitigation Accountability Report and a Risk Spending Accountability Report. These reports provide verification that the utility's mitigation projects are serving their identified purposes and that utility spending matches projected spending on projects.[8]

The RSP makes significant strides towards achieving the goals identified in the OIR. Unless there are further refinements, however, the result will be an overly

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2 R.13-11-006, *Order Instituting Rulemaking to Develop a Risk-Based Decision-Making framework to Evaluate Safety and Reliability Improvements and Revise the General Rate Case for Energy Utilities*, November 14, 2013 at 1 [hereinafter OIR].

3 *Id*. at 1

4 R.13-11-006, Refined Staff Proposal, *Administrative Law Judge's Ruling Regarding Refined Straw Proposal*, April 17, 2014 at 1 [hereinafter RSP].

5 *Id*. at 1.

6 *Id*. at 10.

7 *Id*. at 2.

8 *Id*. at 2.

burdensome GRC with reduced stakeholder participation and sub-optimal resource management.

III. THE RSP REFLECTS POSITIVE DEVELOPMENTS ACHIEVED THROUGH STAKEHOLDER PARTICIPATION AND CONSENSUS.

The Commission has solicited the input and feedback of interested stakeholders in the form of comments, straw proposals and participation in the workshop. The RSP reflects this collaboration and consensus building, and includes many elements of a successful, asset-based decision-making framework.

A. The RSP Implements Procedures That Will Result in Transparent Risk Management Practices And Ensure Improvements to Utility Safety Records.

In general, the RSP adopts procedures and requirements that will result in additional transparency for IOU decision-making and increased safety and reliability of the IOU infrastructure. The S-MAP is proposed, in part, to educate stakeholders and "*allow the Commission and parties to examine, understand and comment*" on the utility decision-making models.[9] Additionally, the S-MAP will adopt "*guidelines and standards for these models*" moving the utility decision-making methodologies included in the RAMP filing towards uniformity.[10]

Both the S-MAP discussion of the methodology and the repeated application of the methodology will develop better intervenor understanding of the methodologies. This will improve intervenor ability to identify potential IOU failures and oversights in application of the methodology. Comparisons between

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9 *Id*. at 2-3.
10 *Id*. at 3.

the IOUs will be facilitated, and intervenors and IOUs will be able to observe the successes and failures of the others when implementing safety and reliability programs.

B. The RSP Moves towards More Detailed Standards and Guidelines for Utility Risk Assessment Models.

While the RSP does not require fully uniform methodologies (discussed further below), the RSP states that the Commission should have a goal that the "*utility models [are] as uniform as possible*."[11] The adoption of more uniform decision-making methodologies and models reduces barriers to intervenor participation and further simplifies the RAMP process. The adoption of uniform models will alleviate the current burden on intervenors having to learn different models and methodologies for each of the utilities.[12] This encourages participation since intervenors will not have to dedicate scarce resources in each GRC to challenge the propriety of the model.

C. The RSP Bases RAMP Assessment on Asset Condition.

The focus of the proposed RAMP assessment is "*asset condition*."[13] Asset condition is the proper focus since assets maintained in good condition are less likely to fail. Focusing on "risks" may result in more resources spent on low probability events at a higher overall cost, rather than on the maintenance of a safe and reliable infrastructure. Focusing on asset conditions instead maximizes safety and reliability in the face of constrained resources.

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11 *Id*. at 4.
12 *Id*. at 4.
13 *Id*. at 6.

The United States Environmental Protection Agency supports the use of asset management systems for the water infrastructure, since:

> *This approach has gained recognition all across the world—and across all infrastructure heavy sectors—for its effectiveness in maximizing the value of capital as well as operations and maintenance expenditures.*[14]

A proper asset management plan "*maintain[s] a desired level of service…at the lowest life cycle cost*."[15] An asset management program enables more informed asset maintenance and replacement decisions and encourages sound operational and financial planning. Benefits of asset management include a budget focused on "*meeting service expectations*" and "*improving security and safety of assets.*"[16]

D. The RSP Adopts a Useful Verification Report Examining Utility Spending on Programs.

The RSP adopts a "Risk Spending Accountability Report" comparing projected spending on risk mitigation measures with actual spending on those measures.[17] This annual report encourages utility compliance with the risk management program approved in the GRC, but still allows flexibility and deviation from approved plans provided the IOU can justify its decision. The annual reporting requirement will result in increased transparency and additional information on IOU spending between GRCs.

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[14] EPA, Asset Management at http://water.epa.gov/infrastructure/sustain/asset_management.cfm

[15] EPA, *Asset Management: A Best Practices Guide* at 1, available at: http://water.epa.gov/type/watersheds/wastewater/upload/guide_smallsystems_assetmanagement_bestpractices.pdf.

[16] *Id*.

[17] RSP at 9.

E. The RSP Adopts a Common Risk Lexicon Enabling Better Intervenor Communication and Debate.

The RSP adopts a risk lexicon and identifies the terms to be included in the lexicon, directing the parties to further develop the lexicon in the first S-MAP.[18] A common risk lexicon enables the Commission, utilities and intervenors to communicate using the same language, and encourages meaningful intervenor participation. The development of the lexicon will also educate parties on risk management as they come to common agreement on the definition of words. Additional education on risk management and related methodologies will improve intervenor confidence and ability to participate in the RAMP and GRC.

IV. THE RSP REQUIRES ADDITIONAL REFINEMENTS TO BEST SERVE THE COMMISSION'S GOAL OF INCREASED SAFETY AND INFRASTRUCTURE RELIABILITY.

While the RSP reflects positive improvements, in order for the Commission to meet its goals of improved safety and reliability and increased participation, transparency and accountability further refinements are required. The Final Framework adopted should focus on reliability as well as safety, set a clear goal of a uniform methodology and clearly identify the proper scope of newly adopted procedures.

A. The RSP Should More Deliberately Integrate the Goal of Infrastructure Reliability.

The OIR sets out a goal of improving safety and reliability of the IOU infrastructures, and states that the "*goal is to prioritize* ***safety and reliability***

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18 *Id*. at 10.

issues in GRC applications."[19] The language of the RSP suggests, however, that the focus of Commission staff is narrowly on safety: "*the key goal of this proceeding is to modify the current [GRC] process to ensure that the utilities are focusing on* ***safety***."[20] This focus on safety, rather than safety *and* reliability, pervades the RSP. Reliability and safety are complementary, and the Final Framework should integrate both concepts.

By separating the ideas of safety and reliability, the OIR suggests that they are distinct concepts. Despite the OIR's direction to pursue both safety and reliability improvements, the Draft Straw Proposal released by staff focused on safety and "resiliency,"[21] which captured the key components of reliability. The RSP, however, focuses on safety, largely omitting reliability and resiliency.[22] Unless the Final Framework reintroduces the idea of reliability, it will fail to comply with the direction and intent of the OIR.

The Commission should distinguish its reliability goal in this proceeding from the goals in other ongoing Commission proceedings. Other Commission proceedings refer to "reliability" as the procurement of sufficient generation to meet demand requirements on the grid. The goal in this proceeding, reduced outages on the IOU infrastructure, should be distinguished as "infrastructure reliability." The risk lexicon should define infrastructure reliability as "the ability of

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19 OIR at 1 (emphasis added).

20 RSP at 1 (emphasis added).

21 *See* Draft Straw Proposal at 1.

22 The RSP mentions resiliency only twice in passing. In the discussion of the RAMP, the RSP states that the utility should address the top 10 assets that pose a risk to "*a safe, resilient and reliable*" system. RSP at 6. The second mention is in support of adopting a risk lexicon. RSP at 10.

the asset to perform its required function without compromised performance or outright failure."

Focusing on infrastructure reliability will support the Commission's safety goals, not distract from them. Assets that are maintained in the condition required to provide reliable service will also provide safe service. Failures in reliability at the grid level have clear implications for customers. Residential customers will be inconvenienced and commercial and industrial customers will experience economic losses and lost profits. In the face of a severe reliability incident, the state could see environmental impacts, supply disruptions and higher prices.

Maintaining a reliable infrastructure will impact the safety of customers beyond the grid since delivery outages can have significant safety implications. Power outages can impact the operation of critical medical, heating and cooling devices for residential customers. Public transit systems and regional traffic grids cannot function safely or efficiently without near-100% reliability. Power outages can also raise safety and environmental implications for complex industrial sites and otherwise detrimentally impact the safety and security of customer premises and property. If assets are maintained in good condition, however, they are less likely to fail, and the result will be a decrease in customer safety incidents.

B. The S-MAP Should Develop in Greater Detail the Elements of a Successful Risk Management Program and the Required Inputs, Outputs and Principles.

The RSP identifies as a long-term goal of the S-MAP the adoption of utility models that are "*as uniform as possible*."[23] Uniform methodology will "*reduc[e] burdens…to learn models and …increase the comparability of risk priority and mitigation analyses among the utilities*," and encourage increased intervenor participation.[24] The RSP fails to explain what it means by "*as uniform as possible,"* give clear parameters for uniformity or set a goal date for adoption of a fully uniform methodology. Unless the Final Framework requires a uniform methodology, the S-MAP could result in extraneous complexity, requiring excessive intervenor resources.

The Final Framework should direct the parties to adopt uniform methodology in the S-MAP and provide clear requirements for the final methodology. Uniformity should be reflected in the methodologies for organizational management, strategic and operational asset management and the management of the risk of uncontrollable events as further described below. A common RAMP process and a lexicon will further these objectives.

1. The Commission Should Adopt a Uniform Risk Management Methodology for All IOUs.

The goal of the S-MAP should be to adopt a risk management program that includes uniform methodologies that will be applied in the same way by each

23 *Id*. at 4.
24 *Id*. at 4.

IOU in its RAMP phase. Uniform methodology serves the Rulemaking's goals of accountability, participation and transparency.

- Accountability: A uniform methodology is easily tested and verified, and it is relatively simple to demonstrate that the IOUs have correctly used the methodology.
- Participation: Early adoption of a uniform methodology will reduce the number of potential proceedings and maximize the impact of intervenor participation. If intervenors cannot see that the S-MAP will result in an effective, uniform methodology, they may see no clear benefit to participation and will focus scarce resources elsewhere.
- Transparency: Development of a uniform methodology by interested parties will open the black box of utility decision-making and create a collaborative process for achieving the desired results.

Adoption of uniform methodologies will streamline the GRC process and result in administrative efficiency. This reduced burden should minimize the amount of time required to review IOU plans in the RAMP and GRC litigation. Rather than litigating methodological issues, the RAMP can simply determine if the IOU has correctly deployed the methodology.

2. The Final Framework Should Outline the Outputs, Inputs and Design Principles for the Uniform Methodology.

The Final Framework should provide the S-MAP with specific direction for the development of the uniform methodology. The RSP identifies "*models that* *may be evaluated in the S-MAP phase,*" in a chart that identifies not just models, but also potential inputs, methodologies and vocabulary.[25] The chart should be refined to provide more clear direction for issues for consideration in the S-MAP.

The S-MAP should develop a comprehensive risk management strategy including:

- Organizational Management Systems;
- Strategic Asset Management Methodology;
- Operational Asset Management Methodology; and
- Management of the Risks of Uncontrollable Events.

Beyond common strategies and methodologies, parties in the S-MAP should agree upon an acceptable:

- RAMP Filing Outline; and
- Risk Lexicon.

Appendix A presents an updated chart of issues for consideration that further describes these items.

Primary among the S-MAP considerations is the development of the Strategic and Operational Asset Management Methodologies.[26] These two methodologies will form the core of each IOU's risk management plan. The Commission can and should seek the IOU's proposals for implementing these methodologies, but the Final Framework should identify the inputs, outputs and

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25 *Id*. at 4.

26 Attached as Appendix B is an article titled "Opening the Black Box" which appeared in Public Utilities Fortnightly. The article describes "*a dynamic optimization methodology to determine asset strategy*."

design principles of a properly designed methodology. Appendix A also outlines these requirements.

After the initiation of S-MAP, each utility should submit a proposal addressing each of the components of a comprehensive risk management strategy outlined above. The Commission and intervenors will have an opportunity to study the proposals, ask questions and suggest refinements. Using an iterative process similar to the one in this Rulemaking, the parties will work together to refine the methodology. The Commission should consider hiring a consultant to assist with the development of the methodology. After a final, uniform methodology is decided, the S-MAP should turn to and adopt RAMP filing requirements and a risk lexicon.

C. The Final Framework Should Clarify the Interaction Between the RAMP Filing and Its Responsibility To Ensure Just and Reasonable Rates

As proposed in the RSP, the RAMP will result in a Staff Report that makes a judgment on the IOU's plans to mitigate its key risks which could impact the ability of parties to litigate the traditional GRC Phase 1. If the outcome of the RAMP and its relationship with the traditional GRC litigation is not clarified, there is a risk that the RAMP report could prejudge the results of Phase 1. Both the RAMP itself and the resulting Staff Report should be limited to evaluating whether the IOU has correctly utilized the methodologies adopted in the S-MAP.

The RSP directs the IOUs to make a RAMP filing including a prioritized list of risks, controls in place, costs, a prioritized list of mitigation alternatives, a risk mitigation plan and two mitigation plan alternatives considered.[27] After a workshop and an iterative drafting process, Commission staff will produce a report that addresses:

- Whether the IOU proposal is complete and addresses the utility's top risks;
- If significant risks or reasonable mitigation options have been overlooked;
- If the proposed mitigation plan is an efficient means of addressing the risks, is realistic and if an alternative mitigation plan would be preferable; and
- Whether the proposed plan is in line with stakeholder preferences.[28]

The RAMP proposed is estimated to take a year from the RAMP filing by the utility to the final staff report.

The RAMP report, as described in the RSP, requires Commission staff to make a number of judgments on the merits of the IOU's proposed program including whether the IOU has:

- Addressed its "*top risks*." [29] This conclusion requires Commission staff to consider all utility risks and judge whether the IOU has properly identified its top risks. The RSP does not require the Commission to rely on stakeholder input to make this determination.
- Overlooked mitigation options and chosen the best mitigation alternative. The comparison and resulting approval of mitigation alternatives encourages Staff to substitute its judgment and values for a properly designed methodology.[30]

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27 *Id*. at 5-6.
28 *Id*. at 6-7.
29 *Id*. at 6
30 *Id*. at 6-7.

- Identified a mitigation plan that is "*an efficient allocation for the risks that the utility faces*."[31] This conclusion presents a direct judgment regarding the proper budget for an IOU program. Judgments regarding the proper allocation of utility budgets are properly the focus of GRC Phase 1 litigation.

In each of the above cases, Commission staff is making a judgment on the merits of the IOU plan. These judgments could be viewed as giving the IOU project the imprimatur of Commission approval, which could foreclose or limit discussion on the cost recovery sought by the utility.

It is important to limit judgments on the cost of specific projects outside of traditional phase 1 GRC litigation. The RAMP should primarily serve as an opportunity for the IOU to present and explain its risk management program, and as a forum for stakeholders to examine the process and ask questions. If the Final Framework determines that the RAMP phase should result in a report, the evaluation parameters of the report should be limited to a simple audit and evaluation.[32] The report should audit whether the IOU has correctly deployed the methodology identified in the S-MAP. The report should also evaluate whether the IOU has presented mitigation solutions that would address the identified risks. The report should not, however, make any judgment regarding the preferred mitigation plan or the cost of these plans.

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31 *Id*. at 6.

32 The importance of limiting any report resulting from the RAMP proceeding is further exacerbated by FERC jurisdiction over transmission cost recovery and rates for the electric utilities. While it is proper and necessary for the utilities to present risk management programs that address all assets, the Final Framework should adopt an SED report that could serve as supporting evidence of the utilities' rate transmission rate applications before FERC.

D. The Final Framework Should Eliminate the "Top 10 Asset" Limitation for the First RAMP.

In order for the RAMP and the resulting report to be effective the RAMP filing must be complete, and address all risks rather than be limited to the "*top 10 assets.*"[33] The RSP intends that this limitation will simplify analysis as the IOUs and intervenors engage in the RAMP for the first time, but the actual impact will be to severely limit the effectiveness of the first RAMP.

As an initial matter, it is unclear how Staff intends for the IOUs to determine the top 10 assets: by dollars, by size of program, by the intensity of the risk or some other measure. If a probability-times-magnitude approach is taken, it may suffice for radial systems but becomes less robust when applied to highly-networked systems with a myriad of interdependencies. Regardless of the measure chosen, limiting the first RAMP will result in the presentation of an incomplete view of the IOU's risk management program. Rather than pursuing an optimized plan, the IOUs may be encouraged to pursue and present a strategy that maximizes spending on a limited number of projects.

The S-MAP, as refined by these comments, will result in a uniform methodology and finalize the RAMP filing requirements. This direction should sufficiently simplify the RAMP filing required, making the "top 10 assets" limitation unnecessary. Simplifying the review process, rather than narrowing the scope of review, will ultimately yield a greater impact on the overall safety and infrastructure reliability of the system.

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33 *Id*. at 6

E. The Purpose and Requirements of the Risk Mitigation Accountability Report Should be Clarified.

The purpose and usefulness of the Risk Mitigation Accountability Report, a verification tool required by the RSP, requires additional clarification and refinement. The Risk Mitigation Accountability Report compares the projections of the costs and benefits of the mitigation program against its actual benefits.[34] As drafted, however, this report looks at each mitigation program and its impact in a vacuum rather than as a part of an optimized strategy.

This narrow presentation of a program and its impact may fail to capture the long term benefits of a program. Accordingly, this may encourage the IOUs to focus on only those projects and programs that have a clear short term impact, rather than benefits that will be seen in the long term or are difficult to quantify. The IOUs could be discouraged from pursuing projects that are of central importance to maintaining assets in good condition because it may be difficult to later demonstrate its benefits.

The Final Framework should either clarify the role of these reports or eliminate the requirement altogether. For example, rather than focusing on a cost-benefit analysis or the impact of individual projects, the IOU could report on progress made towards safety and infrastructure reliability goals or overall asset condition improvements. Alternatively or additionally, the IOUs should be required to include in their filing, all incident reports submitted to the Commission pursuant to other requirements over the course of the year.

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[34] *Id*. at 9.

F. The Risk Lexicon Should Be Expanded to Enable Enhanced Communication on Basic Concepts During the S-MAP.

While it is encouraging that the RSP adopts a Risk Lexicon, it must be expanded in order to enable productive discussion in the first S-MAP. Terms including risk and infrastructure reliability are absent from the proposed lexicon. It is important to adopt common vocabulary early since "*[a] key challenge is that risk … [is] not well or consistently defined*."[35]

The Final Framework should adopt definitions for infrastructure reliability, risk and additional terms in advance of the S-MAP to provide focus, scope and increase efficiency of that proceeding. Refinements and additional terms are attached as Appendix C. In addition to these refinements, the Final Framework should direct parties to the S-MAP to further develop the Risk Lexicon as a risk management program is adopted in the S-MAP.

V. IMPLEMENTATION OF SAFETY AND INFRASTRUCTURE RELIABILITY RISK MANAGEMENT CHANGES NECESSITATE CHANGES TO THE RATE CASE PLAN.

The adoption of the risk management structure outlined above will serve the Commission's stated goals of improving safety and reliability of the system and will increase transparency, accountability and participation. Adoption of the changes, however, requires that the Commission make revisions to the rate case plan to accommodate the new procedures and streamline the GRC.

35 OIR at 8.

A. With the Adoption of the RAMP, the Notice of Intent Should Be Eliminated.

The Rate Case Plan directs each utility to provide a Notice of Intent (NOI) to ORA approximately 4-6 months before filing its GRC Application. ORA studies the NOI and provides the utilities with a list of deficiencies which the utility should address in its Application. The usefulness of the NOI is limited and the requirement should be eliminated. Intervenors beyond ORA tend not to rely on the NOI and in workshops the IOUs have expressed a willingness to forego the deficiencies process and assume the risk that they have addressed all issues. The time created by eliminating the NOI will provide the additional time required to complete the RAMP proceeding.

B. The Commission Should Maintain a Three Year GRC Cycle.

The Commission should maintain the current three-year GRC cycle. The current schedule allows for the staggering of cases and the regular consideration of the utility revenue requirement. Under the current system, little attention is paid to attrition year ratemaking and with the added complexity of the RAMP it is unlikely that this issue will receive more attention. In order to mitigate the impact of inaccurate attrition year ratemaking, the Commission should decline to further extend the GRC cycle.

C. With Refinement, the Proposed Schedule Provides Sufficient Time for Adopted Procedures.

With the refinements suggested in these comments, the proposed S-MAP, RAMP, and GRC schedule provides sufficient time for the consideration of all issues. The impact of focusing the S-MAP should reduce its potential burden on stakeholders. Adoption of a uniform risk management program and RAMP filing requirements should alleviate the burden on the IOUs in making the RAMP filing. The limited report required on the RAMP filing will relax the burden on Commission staff and the time required for the RAMP. Overall, limiting the number and complexity of the proceedings will encourage transparency, accountability and participation within the current schedule allowed for rate cases.

D. The Commission Should Convene a Workshop on S-MAP Considerations at the Outset of the S-MAP.

The implementation of any new procedure is likely to include a learning curve for all active participants. A key tool for encouraging participation and enabling valuable contribution in the S-MAP is educating all parties on the potential for the risk management system as well as its components. A workshop provides a more informal atmosphere in which parties can ask questions and share information off of the record. This education process will result in more robust feedback within the formal proceeding.

VI. CONCLUSION

For all of the foregoing reasons, EPUC requests that the Commission consider the recommendations herein to ensure safety and reliability of the utility systems and make revisions to the Refined Straw Proposal accordingly.

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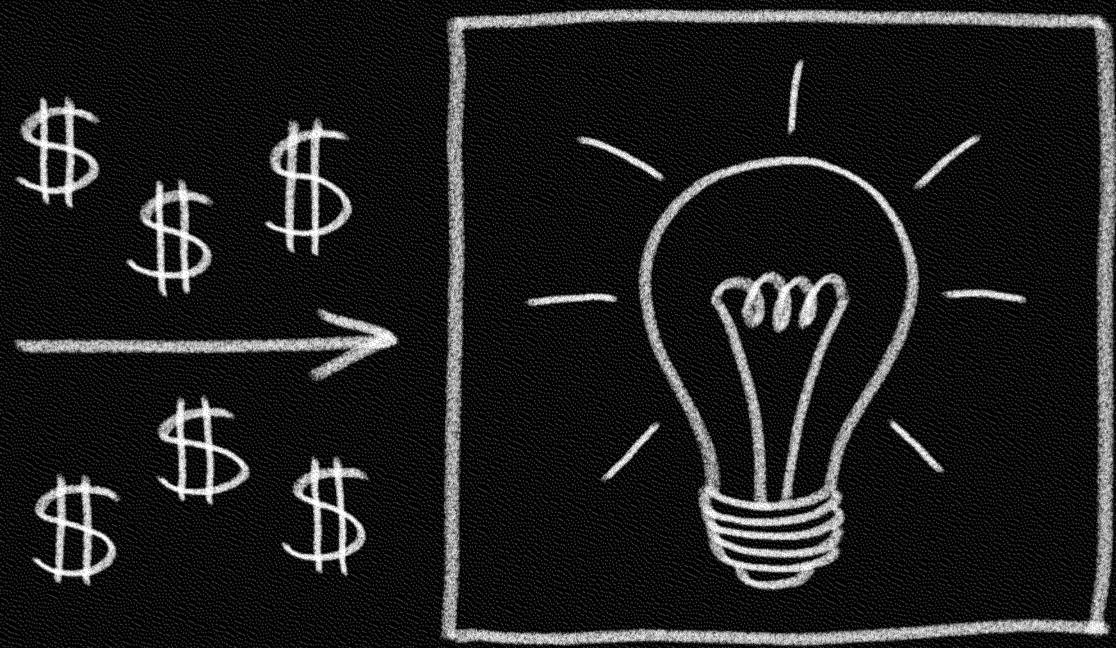
Appendix A

Program Component	Description	
Organizational Management	The utilities should adopt an organizational structure that values safety and infrastructure reliability. Potential organizational structures include PAS 55 or ISO 31000.	
Strategic Asset Management Methodology	The utilities should adopt a methodology to specify a plan, over a long time horizon, for replacing, repairing, maintaining and testing the utility's asset inventory. A properly designed plan will maintain desired service levels with the greatest overall benefit per dollar spent.	
	Inputs	• <u>Asset inventory</u>: what are the assets and where are they located • <u>Asset condition definitions and dynamics</u>: definitions provide a means of converting attributes into measures of condition and dynamics describe how the asset changes over time • <u>Asset hazard rates</u>: condition-dependent hazard rates measuring the likelihood of asset failure as condition worsens • <u>Asset test specifications</u>: the frequency, requirements and focus of asset testing procedures • <u>Asset management alternatives</u>: repair, replace, maintain and do nothing; other measures that improve safety without directly impacting the asset • <u>Costs</u>: of alternatives and failure
	Outputs	• <u>Optimal strategy</u>: actions, when to take them and under what conditions • <u>Optimal test strategy</u>: when to test assets and how to respond to test results • <u>Inventory and cash flow forecasts</u>: future behavior of assets and costs
	Design Principles	• <u>Quantitative</u> • <u>Optimal</u> • <u>Grounded</u> in engineering and economic analysis • <u>Repeatable</u> • <u>Transparent</u> • <u>Responsive</u>

		• Flexible • Modeling Quality: verified, validated and accredited • Fairness
Operational Asset Management Methodology	How to implement the strategy identified above in the Strategic Asset Management Methodology in the short term. The underlying design principles are the same as above.	
Management of the Risk of Uncontrollable Events	Means for estimating and addressing the risk from outside events and natural disasters by determining arrival rates and strategic and operational methods.	
RAMP Filing Outline	Identification of the requirements of the RAMP filing and establish a format for the RAMP filing.	
Risk Lexicon	Identify and define language commonly used when developing and discussing asset management.	

Appendix B

Opening the Black Box



A new approach to utility asset management.

By Charles D. Feinstein and Jonathan A. Lesser

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Natural gas and electric utilities have always been concerned about reliability and safety, and each year spend billions of dollars repairing and replacing transmission and distribution assets. However, unlike the commodities they sell, there are no markets to value safety and reliability. Utilities can't purchase these attributes directly, but instead must determine the best targets for each, while constrained by available resources. There are no guarantees. No system is 100 percent safe or reliable. No amount of planning or investment can completely eliminate sudden, unplanned equipment failures.

In fact, reliability and safety share characteristics of public goods. Customers along a specific distribution line, for example, can't choose different levels of reliability; it's the same for all of them. Thus, utilities must somehow determine how best to provide needed safety and reliability at the lowest possible cost. And state utility regulators must be able to evaluate those determinations accurately and independently.

Many utilities have developed their own methods to address the inevitability of equipment failure and evaluate the tradeoffs between replacing and repairing aging assets. Others rely on methods developed by consultants. Some of these methods are simply *ad hoc* – *e.g.*, "replace utility poles that are 30 years old" or "test underground distribution lines every five years." And these *ad hoc* rules can, in some cases, appear to work well. Yet they aren't based on sound engineering and economic principles. Utilities that employ such rules can't know whether they provide a least-cost strategy. Furthermore, such rules are less likely to pass the heightened regulatory scrutiny that comes when budgets are stretched. In other cases, utilities rely on flawed analytical tools. These tools, while not *ad hoc*, can lead to worse decisions, if flaws appear in underlying assumptions or analytical approaches.

Although the comprehensiveness of these methods varies, they all lead to inefficient or, worse, incorrect, decisions. In other words, utilities can end up spending more money than needed to achieve desired levels of safety and reliability. Or, they obtain less reliability and safety than their methodologies claim to provide. In either case, both ratepayers and utility shareholders lose: with ratepayers paying more and investors seeing lower returns if certain investments are disallowed by regulators.

Some methods are *ad hoc:* test underground lines every five years, replace utility poles after 30 years.

With natural gas and electric utilities spending billions each year on transmission and distribution systems, both for new equipment and repairs to the old, even small improvements in asset management strategies can yield significant savings for consumers, while maintaining or improving overall reliability and safety. Here we introduce an approach that avoids errors common to other asset management approaches. Our methodology combines advanced statistical and mathematical optimization techniques. It recognizes the interdependence between asset management strategies and testing regimes. It also recognizes interdependencies among assets themselves and avoids the errors common to other asset management approaches.

For utilities and their shareholders, our methodology can provide greater assurance that asset management decisions are prudent, so that the costs can be recovered from ratepayers, thus reducing uncertainty. For utility regulators, the methodology provides greater assurance that utilities are providing required levels of safety and reliability at the lowest cost, thus benefitting ratepayers. Moreover, the methodology can also provide regulators with an objective ability to independently verify utility asset management strategies, rather than accept black-box approaches they can't assess independently.

First, we describe six common errors in models used to make asset management decisions for transmission and distribution (T&D), and how these errors lead to inferior decisions about equipment repair and replacement. Second, we explain the four uncertainties that increase the complexity of asset management strategies. Third, we describe the analytical method we developed that addresses these uncertainties in a statistically and mathematically correct way. We conclude with a real-world application of the methodology, showing how it's been used by one regional transmission organization (RTO) to evaluate optimal numbers and locations of spare transformers.

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The Cost-Risk Tradeoff

Decisions regarding whether to repair or replace specific assets, or simply leave them in place, share common characteristics and

FIG. 1 PRESENT VALUE COSTS VS. ASSET RETIREMENT AGE

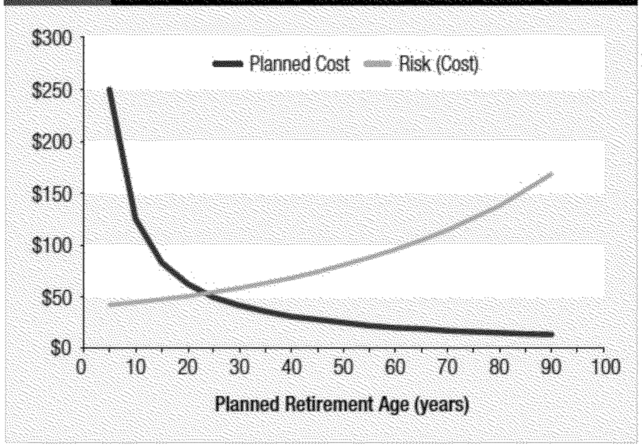
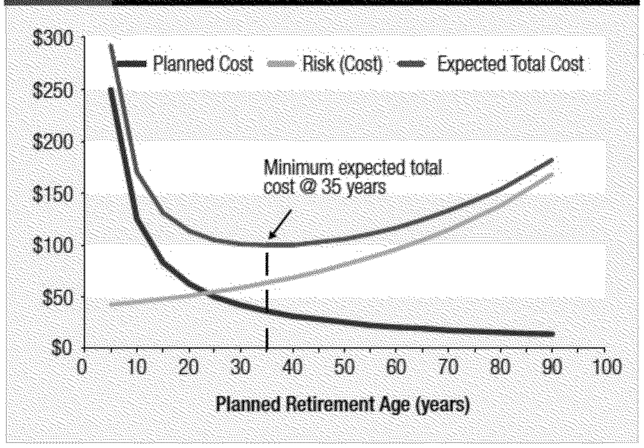


FIG. 2 OPTIMAL RETIREMENT STRATEGY



tradeoffs. The basic tradeoff is well-known to anyone who owns a car: putting off replacement to postpone the cost of buying a new one must be tempered against the increasing cost of likely repairs. For utilities, which operate assets over the indefinite future, an asset management strategy based on extending the life of an asset reduces the present value of the cost of asset replacement over the indefinite and foreseeable future. However, as assets age, they tend to require more expensive and more frequent repairs. Further, taken to its logical conclusion, extending the life of an asset tends to provide a "run-to-failure" asset management strategy. Therefore, evaluation of life extension or run-to-failure strategies must address the cost of unplanned failures. These concepts are illustrated in Figure 1.

Figure 1 illustrates the decreasing present value cost associated with planned asset replacements as a function of asset retirement age: the greater the age at which an asset is retired, the lower the present value cost of a timed sequence of asset replacements over the indefinite future. However, as an asset's retirement age increases, the higher the risk (and unplanned costs) associated with repairs or asset failure that could occur in each increasingly large replacement cycle. The costs shown are only expected values, because when (or if) an asset fails is uncertain. The likelihood of an asset's failure sometime in the future is called the asset's "hazard rate."[1]

The optimal retirement age is defined as the one for which the expected total cost is minimized. This is shown in Figure 2. The expected total cost is the sum of the planned replacement costs and the expected cost of asset failures (risk). In the example presented in Figure 2, the minimum expected cost occurs at a planned retirement age of 35 years for this type of asset.[2]

Defining and identifying the optimal replacement strategy is conceptually straightforward, as shown in Figure 2. However, it turns out that Figure 2 illustrates the flaws of commonly applied methods. The reason is that Figures 1 and 2 can't be used in practice to find the optimal retirement age for an asset. In other words, one can't simply construct the two curves and read off the optimal retirement age. Yet, this is commonly done, based on four incorrect assumptions: 1) the time interval between replacements is always the same; 2) all replacement life-cycles cost the same; 3) the actual timing of asset replacements within each replacement life cycle is always the same; and 4) the actual capital costs of asset replacement due to unplanned failures aren't considered, leading to underestimates of actual capital costs.

For one RTO, a key problem was step-down transformers: Refurbish? Replace? Deploy spares?

Some Common Mistakes

We have also identified at least six common types of errors present in many commonly applied asset management methodologies (sometimes also called "repair or replace") that lead to inferior solutions. These common errors include: 1) ignoring or wrongly defining the initial conditions of assets being evaluated; 2) using a misleading concept of "asset health" to lump different classes of assets together; 3) applying a static method (*i.e.,* one that doesn't recognize how the condition of an asset changes over time), based on asset health, to determine how to treat an asset; 4) conflating asset condition with the

1. The hazard rate, $h(t)$, measures the probability that an asset will fail shortly after time t, given that it's survived until time t. The hazard rate can be found empirically by estimating the survivor rate, $S(t)$, which is the probability that an asset survives until at least time t. Mathematically, for some small interval Δt that begins at time t, the probability of failure during this small interval of time = $h(t)\Delta t$, where $h(t) = [dS(t)/dt]/S(t)$.

2. At the optimal retirement age, the expected present value marginal cost from higher risk equals the expected present value marginal benefit from fewer replacements; i.e., the slopes of the curves are equal in magnitude and opposite in sign. Note that the optimal replacement age generally isn't where the planned cost and risk cost curves cross.

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consequences of asset failure; 5) failing to account for all of the costs of asset failure; and 6) failing to integrate testing policies into an overall asset management strategy.

Any method that fails to assess the initial condition of assets, or assesses them incorrectly, can't possibly identify an appropriate management strategy and, as a consequence, will be *ad hoc*.

Consider, for example, wooden utility poles. Unless a pole has fallen over or is leaning precipitously, it's difficult to determine its condition. A pole might look fine on the outside, but be rotten inside, awaiting the next windstorm or errant automobile to knock it over. A pole replacement strategy based on whether the pole looks "good" on the outside, regardless of its true internal condition, will lead to excessive pole failures, more outages, and higher costs.

And a wooden utility pole tested and found rotten is far more likely to fail at any given time. That is, asset condition determines the likelihood of future failure. This likelihood is known as a "condition-dependent hazard rate." Although a common-sense way to characterize the so-called "health" of an asset is to measure its remaining life, this straightforward idea has been expanded to include many other aspects of an asset into a single measure called "asset health." However, it turns out that the optimal repair-replace strategies for assets having the same health can be quite different.

Typically, asset health measures combine several distinct attributes, such as age and near-term failure likelihood, into a single measure. However, such a single measure can be misleading because different assets with different attributes could have the same asset health. For example, an older, well-maintained transformer, for example, might have a much lower hazard rate than a younger, poorly-maintained one. Thus, these assets determined to have the same overall health might, in fact, need to be treated very differently.

In some cases, the asset health measurement conflates both the likelihood of near-term failure and the consequences of failure. But that can lead to incorrect conclusions. Consider, for example, a car's tires. Most of us would agree that replacing worn tires before they fail is a better strategy than waiting for a blowout, which can have severe consequences. However, keeping a worn spare tire can be a reasonable strategy because the consequences of tire failure can be managed as well with a worn spare as a brand new spare because both enable one to drive to the nearest tire store. Thus, the asset management policy associated with a tire's condition depends on the tire's intended use, not just the immediate failure rate and the consequences of failure.

Yet another problem is that asset health measures typically fail to account for the dynamics of asset condition; *i.e.,* how an asset's condition changes over time. The condition of an asset changes not only naturally as it ages, but also because of how it's operated and maintained. Again, a car engine is a good example: its condition depends not only on its age, but on how much it's run, whether the car is driven in stop-and-go traffic or primarily on the highway, how frequently the oil is changed, and so forth. Therefore, the asset's hazard rate will change over time as the asset's condition changes. An asset management strategy that assumes the hazard rate doesn't change over time won't be least-cost.[3]

Nor should asset health standing alone dictate asset-management strategy. For example, in some cases, utilities will rank T&D assets by their health and replace those assets in order until the utility reaches a predetermined budget amount. Thus, asset health is treated as if it were a benefit-cost ratio. However, ranking alternatives based on benefit-cost ratios is itself generally inaccurate.[4]

Utilities also might fail to consider all failure costs. For example, widespread power outages can garner negative publicity and additional regulatory scrutiny of a utility's actions. In other cases, such as with the gas pipeline explosion at San Bruno, California, regulators can levy multi-million dollar fines, as the California Public Utilities Commission levied against PG&E.

One can't simply add up the value of spares at each location to determine the value of locating spare transformers at every location.

Finally, asset testing is also crucial to asset management. It's impossible to determine a least-cost asset strategy without also determining the optimal asset testing regime. In other words, asset strategy and testing strategy are interdependent. We have found, for example, that utilities often test too frequently or rely on the wrong kinds of tests. An optimal asset management strategy must account for the outcomes of tests because those outcomes provide information about the true condition of the assets. That's another reason for rejecting a static method of asset management, such as ranking assets by asset health, in favor of a dynamic one that reflects changing conditions over time.

A Dynamic Alternative

These problems lead us to propose an alternative approach – which we call a dynamic optimization methodology to determine asset

3. For those who are mathematically inclined, finding the least-cost strategy over time is known as an "optimal control problem."
4. For a brief discussion, see Leonardo R. Giacchino and Jonathan A. Lesser, *Principles of Utility Corporate Finance*, chapter 17, Public Utilities Reports, Inc., 2011.

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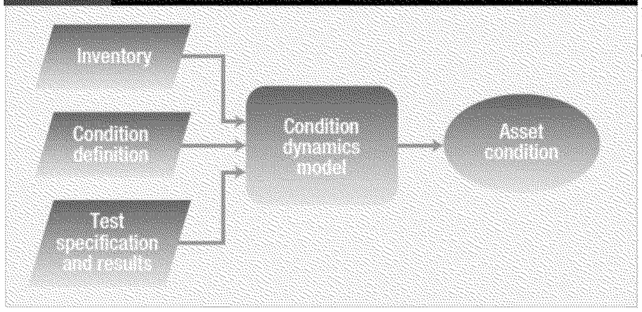
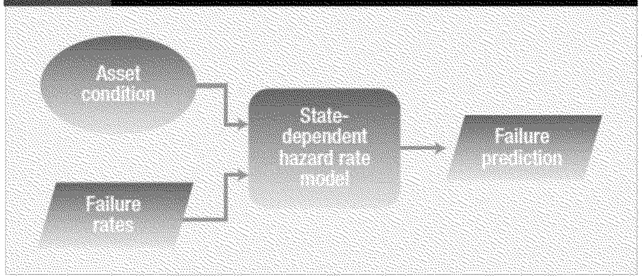
FIG. 3 ASSET CONDITION DYNAMICS



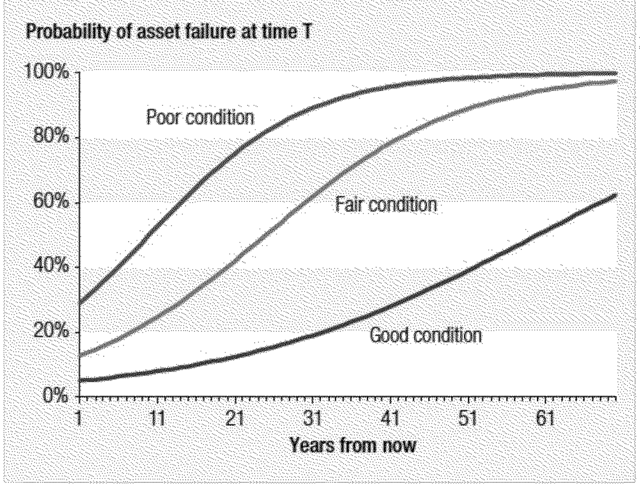
Source: Authors' analysis

FIG. 4 ESTIMATING ASSET FAILURE RATES



Source: Authors' analysis

FIG. 5 STATE-DEPENDENT PROBABILITY OF ASSET FAILURE

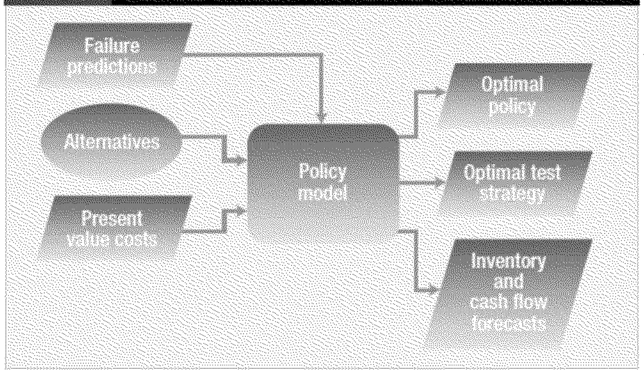


Source: Authors' analysis

strategy.[5] This type of dynamic strategy addresses four types of uncertainty: 1) uncertainty regarding an asset's current condition and how that condition changes over time; 2) uncertainty regarding the accuracy of tests of an asset's condition; 3) uncertainty regarding an asset's remaining life; and 4) uncertainty regarding the effects of repairs on an asset's condition and, therefore, its remaining life.[6]

As we discussed previously, determining an optimal asset management strategy requires that we determine how an asset's condition changes over time, because the condition of an asset at

FIG. 6 POLICY MODEL



Source: Authors' analysis

any time *t* determines the probability of failure thereafter. To do this, we combine condition definitions (e.g., what does it mean for an asset to be in good condition today?) with tests that can evaluate the asset's condition. These are combined to establish what we call a "condition dynamics model (CDM)." The CDM determines how an asset's condition is likely to change over time, given its current condition.[7] (*See Figure 3*).

However, knowing an asset's condition today – unless it's already failed – and the forecast of asset condition given by the CDM won't provide enough information to make asset management (repair, replace, test, do nothing) decisions. That requires a model that estimates the likelihood of asset failure tomorrow, given an asset's condition today. Such models are called State-Dependent Hazard Rate Models, as shown in Figure 4.

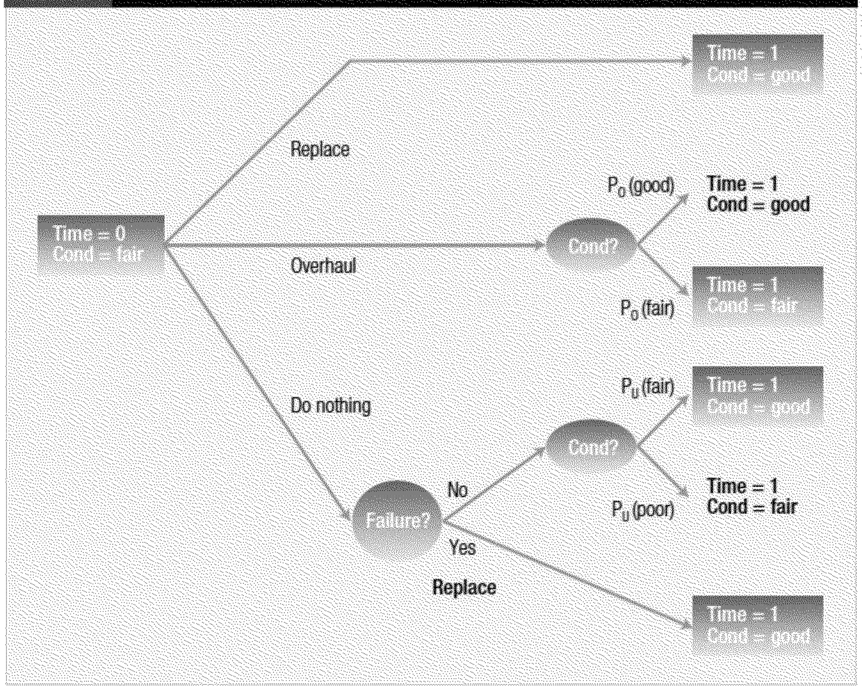
Figure 5 illustrates three hazard rates for a class of assets in different condition today.[8] Although it's straightforward to determine a repair-replacement strategy along a single hazard function, that strategy won't be least-cost because we further recognize that repairing an asset can also *change* its condition and thus change the appropriate hazard rate. Depending on the type of repair made, however, there will also be uncertainty as to what is that new post-repair condition.[9]

For example, suppose your car is running poorly and you ask the mechanic to change the car engine's oil. Changing the oil will improve the engine's condition because old oil has various contaminants that can increase wear on the various moving parts. However, if the engine has leaking rings or a blown gasket, changing the oil will do little to improve its condition.

5. The Appendix to this article provides a formal mathematical description of the modeling structure. http://www.fortnightly.com/appendix-opening-black-box
6. For further discussion, see Charles D. Feinstein and Peter A. Morris, "The Role of Uncertainty in Managing Aging Assets In Electric Utility Systems," IEEE PES Transmission and Distribution, New Orleans, April 2010. A copy of this presentation is available from the authors.
7. Technically, the CDM establishes a Markov-chain type of probability model, in which we estimate the probability of moving from state A to state B. For example, the probability of a transformer in good condition today being in fair condition next year might be 20 percent, the probability of its being in poor condition next year 5 percent, and the probability of it remaining in good condition 75 percent.
8. The hazard functions are similar in concept to survivor curves used by utilities for depreciation analysis.
9. The post-repair conditions are estimated using a statistical concept called "Bayesian revision." Using the analogy of depreciation survivor curves, repairs can move an asset from one survivor curve to another.

Thus, a simple repair can still leave a high level of uncertainty as to the engine's true condition. If, on the other hand, you ask the mechanic to completely rebuild your car's engine, the engine will be in good condition with no uncertainty (assuming the mechanic has rebuilt it correctly). The optimal engine repair strategy, therefore, depends on the type of repair made and the effect of that repair on the engine's condition. Moreover, an optimal strategy must evaluate the tradeoffs between the cost of the repair made and the (uncertain) impact on the engine's post-repair condition.[10]

FIG. 7 SIMPLIFIED DECISION TREE: TRANSFORMER STRATEGY



Source: Authors' analysis

Developing an optimal policy for each class of assets requires additional information, including: 1) the available types of repairs (*e.g.*, major? minor?); 2) the type of replacement asset (*e.g.*, the same asset type? an improved asset?); 3) the costs of the different alternatives; and 4) the probability distribution of the cost of failure. Moreover, the optimal policy includes determining the optimal testing policy, based on the accuracy and the cost of alternative testing regimes. Thus, the Policy Model, shown in Figure 6, can determine the optimal policy as well as the expected benefit of alternative testing regimes. The Policy Model also forecasts the behavior of the asset inventory and the cash flows associated with implementing the optimal policy.

The Policy Model can be envisioned as a type of decision tree. For example, suppose we have a high-voltage transformer, which we believe is in fair condition today (Time =0). The transformer can be replaced, overhauled, or simply left alone (the "Do Nothing" alternative), as shown in Figure 7.

In the figure, after overhauling or doing nothing, there will remain uncertainty as to the transformer's actual condition at Time = 1. Specifically, if the transformer is overhauled, its condition either will be good with probability PO (good) or fair with probability PO (fair).[11] However, if the transformer is left alone and doesn't fail, next period it will be either in fair condition with probability PN (fair) or poor condition with probability PN (poor). The relative likelihoods of the resulting conditions in the Do-Nothing case are determined by the Condition Dynamics Model. The relative likelihoods associated with the overhauling procedure are based on utility-specific or industry-wide knowledge of the outcomes of overhauling

In actuality, of course, we are dealing with multiple uncertainties, including whether to test the transformer's condition and, if so, what type of test to undertake. Moreover, the time horizon used by the model is infinite. The actual model uses dynamic optimization techniques to solve the model for each asset class and develop a recommended strategy, including a testing strategy. Moreover, the model can estimate the value of different testing regimes.

Spare Transformer Inventory Analysis

One aspect of ensuring a reliable electric system is quick restoration from forced outages. This type of repair-replace decision involves the value of spare equipment, similar to the spare tire example discussed above, with an additional geographical component.

For one RTO, a key issue was the best management policy for the step-down transformers on its system, which reduce voltages from 500 kV to 230 kV. Specifically, the RTO had four questions: 1) how often should these transformers be tested? 2) when should they be overhauled (refurbished)? 3) when should they be replaced? and 4) where should spare transformers be deployed to mitigate the consequences of transformer failures?

The expected value of a spare at a given location within the RTO is based on several factors. Not surprisingly, the first factor is the expected value of reduced outage duration. Thus, if the cost of a forced outage at location X is $\$O_X$ per hour, then the expected value of the spare, $E(V_{S,X})$, equals the probability of failure, $P_X(f)$, times the expected reduction in outage time because of locating the spare at X, ΔT_X, times the outage value, *i.e.*, $E(V_{S,X}) = Px\,(f) \bullet \Delta T_X \bullet \$0_X$.

10. From a technical standpoint, these impacts are dealt with by the CDM.

11. In this example, P_O (fair) = 1 – P_O (good).

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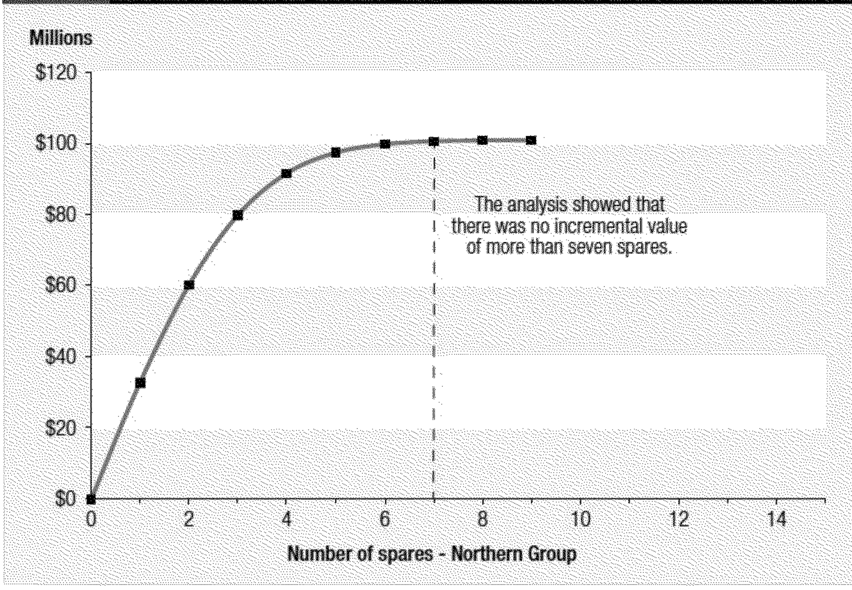
FIG. 8 SPARES VALUATION: PJM NORTHERN GROUP



Source: Authors' analysis

In addition to this value, however, a spare will have additional incremental value in one area if it can mitigate the consequences of transformer failure elsewhere. This means one can't simply add up the expected value of spares at each location to determine the overall expected value of locating spare transformers at every location. For example, if a transformer at location X fails, but transformers in nearby locations A, B, and C can handle the additional loads, then the value of a spare transformer at X will be reduced if there are already spares located at A, B, and C.

For the RTO analysis, step-down transformers were grouped into geographic areas. For example, the "Northern Group" consisted of transformers at 18 separate substations. To mitigate failure risk, the RTO had located one spare transformer at each of the substations.

The value of locating a first spare at each location was then calculated. The analysis showed that locating a spare at "Lovell"[12] had a net expected value of $29.5 million,[13] larger than the incremental values at any other location. Moreover, the analysis showed that, because siting a first spare at Lovell also provided additional risk mitigation benefits in the event of transformer failures at other locations, the overall expected net benefit of siting the first spare at Lovell was $32.8 million.

Next, the analysis determined the optimal location of siting a second spare, given that the first spare was already sited at Lovell. This analysis showed that siting a second spare at "Elgin" had an expected value of $27.4 million. The process continued, each time calculating the incremental expected value provided by the next spare, given the spares that had been sited. In total, the analysis showed that there was no incremental benefit to siting more than seven spares in the entire group, as shown in Figure 8. Moreover, the analysis determined that locating a second spare at Elgin had greater value than siting a first spare at many other locations in the Northern Group. Thus, rather than using 18 spares, one at each location, the analysis freed up 11 spares, which the RTO then relocated. In fact, approximately two weeks after the RTO relocated one of the redundant spares to a location in a different transformer group, as recommended by a subsequent analysis, the existing transformer at that substation failed. Because of the location recommendation, the RTO was able to restore service far more quickly and minimize the consequences of the transformer's failure. ◼

Any method that fails to assess the initial condition of assets, or assesses them incorrectly, can't possibly identify an appropriate management strategy.

12. The names of the locations, as well as the characterization of the "Northern Group," are for convention only. The actual substation locations are confidential.

13. This value includes the cost of locating the spare at Lovell.

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Appendix C

Risk Lexicon

New Terms:

Infrastructure Reliability: the ability of the asset to perform its required function without compromised performance or outright failure

Qualitative Risk Assessment Methodology: set of methods, principles, or rules for assessing risk based on non-numerical descriptions of events and the consequences of events

Quantitative Risk Assessment Methodology: set of methods, principles, or rules for assessing risks based on the use of analytic descriptions of the occurrence of events and the consequences of those events

Risk: possible occurrence of one or more unwanted outcomes resulting from an incident with the implication that there is value in avoiding the unwanted outcome; if there is no value in avoiding the unwanted outcome or if the unwanted outcome is certain to occur, then there is no risk

Risk Management Methodology: set of methods, principles, or rules used to identify, analyze, assess, and communicate risk, and accept, avoid, transfer, or control it to an acceptable level considering associated costs and benefits of any actions taken

Modifications of Proposed Risk Lexicon:

Asset: a component of utility infrastructure with an independent physical and functional identity and age

Incident: an event, caused by human action, natural phenomena, or both, that may cause harm and that may require action to address