



Transmission & Substations New Components & Materials Research Roadmap

Richard Ord

Transmission & Substations Area

Overhead Transmission Lines (P35)



Underground Transmission Lines (P36)



Substations (P37)



HVDC (P162)

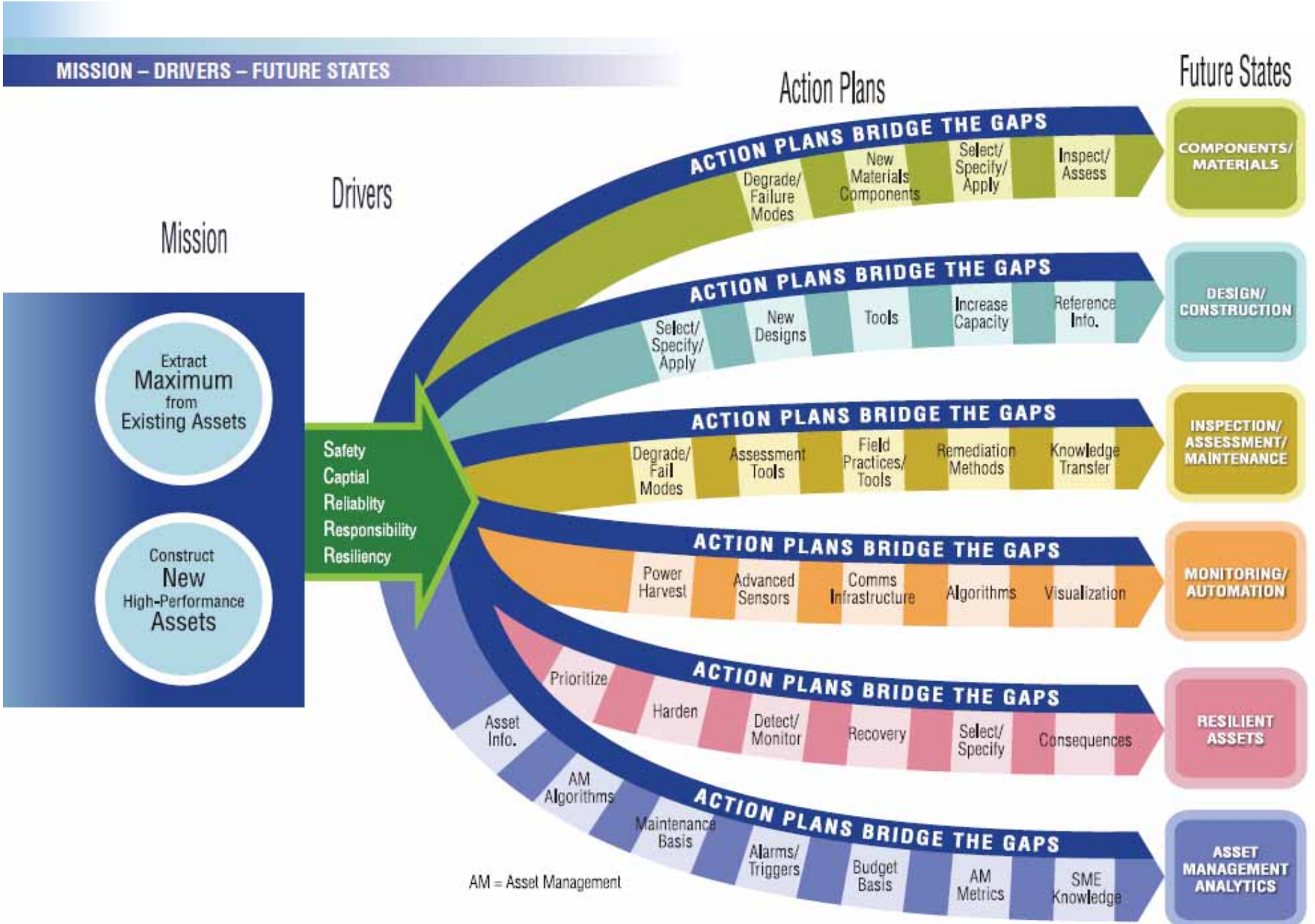


Asset Related Research

EPRI's Mission

Advancing safe, reliable, affordable and environmentally responsible electricity for society through global collaboration, thought leadership and science & technology innovation





Action Plans to Address Gaps: By Issue





COMPONENTS OF THE FUTURE STATE

New components and materials promise higher performance, increased reliability, longer life expectancy, and lower costs, but knowledge gaps need to be addressed before utilities can specify and apply them with confidence.

1. Utilities will have the tools to specify and assess new and existing materials and component designs for failure modes, reliability, and life expectancy in a rapidly changing manufacturing environment.
2. New materials will be developed that are easier to apply, reliable, and cost-effective and enable real-time in-service assessment (predictive) of material condition and risk.
3. Materials and components will have a minimal impact on the environment.
4. Tools and techniques will enable the confident selection, specification, installation, and maintenance of new component technologies.
5. Components will be safe and friendly to work practices.

GAPS**1. Understanding of Degradation and Failure Modes**

A fundamental understanding of how new and emerging components and materials degrade and fail is vital when selecting, applying and installing them for maximum reliability.

2. Development of New Materials and Components

More cost-effective reliable materials and components with equivalent or higher performance and life expectancy are required. One key feature of new material/component designs is the ability to enable increased powerflow in existing rights of way (ROW) and assets.

3. Effective Selection, Specification, and Application

Utilities need the ability to select, specify, and apply existing and new technologies confidently under a wide range of conditions ensuring optimal performance and appropriate life expectancy. Historically it was possible to rely on high-quality products from vendors that meet the application. As utilities procure new technologies with unknown long-term performance, and vendors are more globally diverse, the importance of relevant tests and specifications has become paramount.

4. Effective Inspection and Remediation

As new materials and components reach end of life, inspection and monitoring technologies are needed to identify high-risk units, manage the fleet and perform remediation. In addition it needs to ensure that these new materials and components do not pose a barrier to live working techniques.

VALUE AND RISK

The value of developing and comprehensively evaluating new components and materials as well as addressing application, operation, inspection, and assessment includes:

- Access to lower-cost and more reliable assets which will have a longer life expectancy, and in turn will reduce capital and maintenance budgets.
- More environmentally compatible new materials and components.
- Increased power flow through existing rights of way (ROW) and assets.
- Materials and components that can potentially be applied to existing aging assets that will either increase performance or extend life.
- Access to new components that can potentially reduce capital and O&M costs.

Risks that may emerge if new materials and components are not developed or fully evaluated prior to being applied include:

- The power flow through existing rights of way will be limited to present levels.
- New materials and components *may* be applied that have not been fully evaluated, which may result in a reduction in the reliability, safety, and life expectancy of the transmission system.
- New materials and components that have not been fully evaluated may result in increased maintenance expenditures due to unforeseen challenges.



**Understand
Degradation
& Failure
Modes**

**Develop New
Materials &
Components**

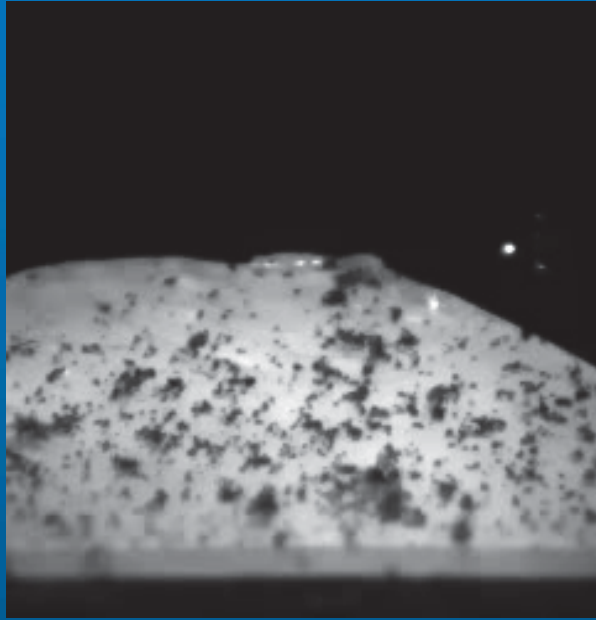
**NEW
Components
and
Materials**

**Effective
Selection,
Specification
& Application**

**Effective
Inspection &
Remediation**

APPLY NEW MATERIALS & COMPONENTS WITH CONFIDENCE

Example: Approach to Advanced Coatings for Conductors and Insulators



Self Cleaning

Courtesy John Simpson



Icephobicity

Courtesy NEI

PROPERTIES OF INTEREST

Opportunities for Power Delivery Applications



**Contaminated
Insulation**



Iced Insulation

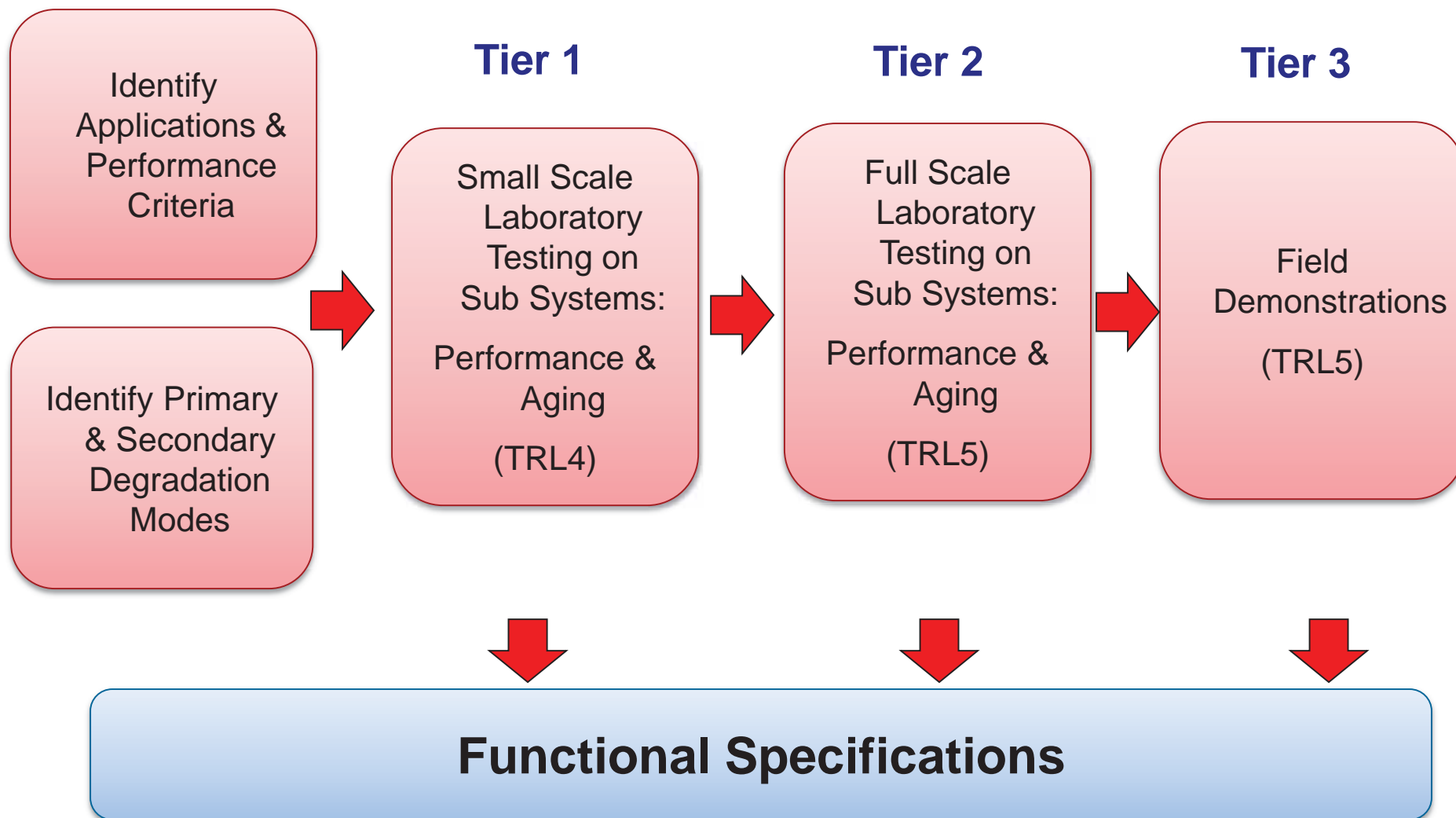


Iced Conductors

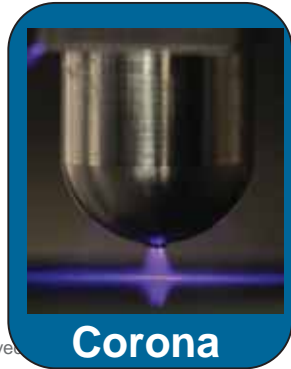
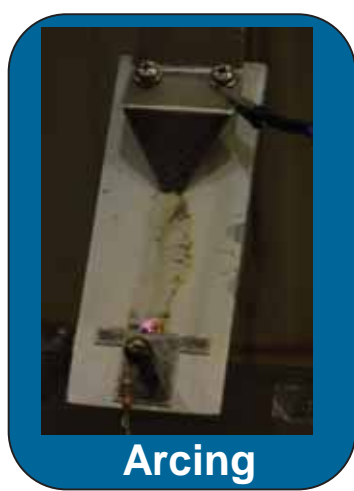
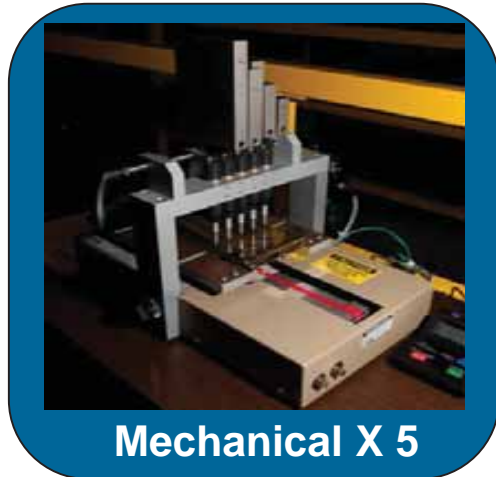
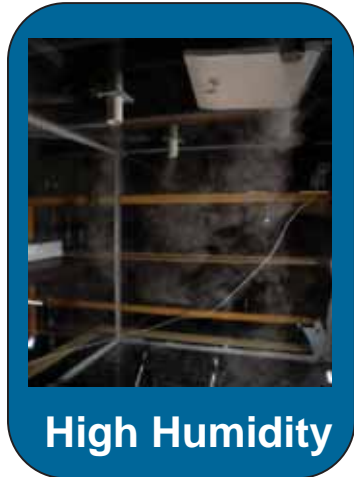
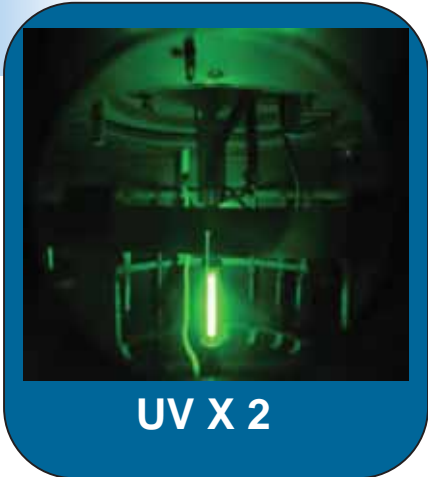


Iced Structures

EPRI Research Approach



Examples of Tier 1 Testing



Examples of Tier 2 Testing



Contamination Accumulation



Raptor Excretion



Corona Cage

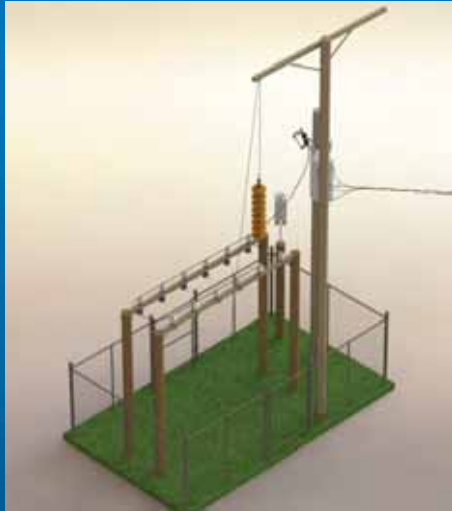


Conductor Icing



Energized Salt Fog

3 Field Tests in Planning



Contamination



Conductor Icing



Roadsalt Contamination



Together...Shaping the Future of Electricity