Nuances of Undergrounding - Some Considerations for GOPHURRS Teams

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Vision

To be a world leader in advancing science and technology solutions for a clean energy future

Mission

Advancing safe, reliable, affordable, and clean energy for society through global collaboration, science and technology innovation, and applied research.

Together…Shaping the Future of Energy®

Nonprofit

Chartered to serve the public benefit, with guidance from an independent advisory council.

Thought Leadership

Systematically and imaginatively looking ahead to identify issues, technology gaps, and broader needs that can be addressed by the electricity sector.

Independent

Objective, scientific research leading to progress in reliability, efficiency, affordability, health, safety, and the environment.

Scientific and Industry Expertise

Provide expertise in technical disciplines that bring answers and solutions to electricity generation, transmission, distribution, and end use.

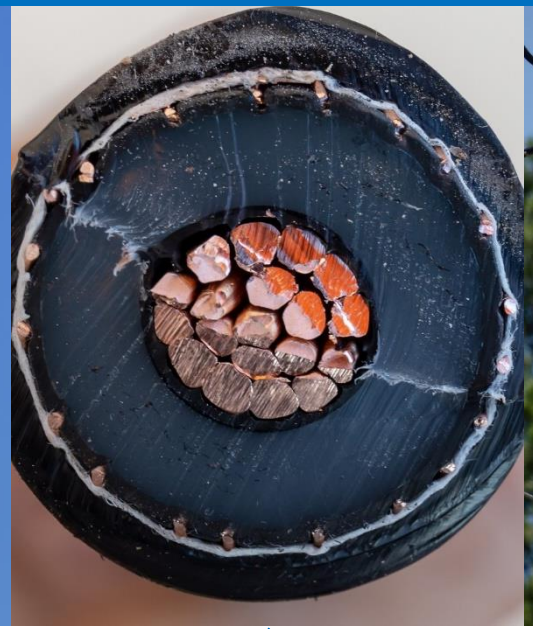
Collaborative Value

Bring together our members and diverse scientific and technical sectors to shape and drive research and development in the electricity sector.

Robust, realistic laboratory testing is critical

Distribution Assets – P180

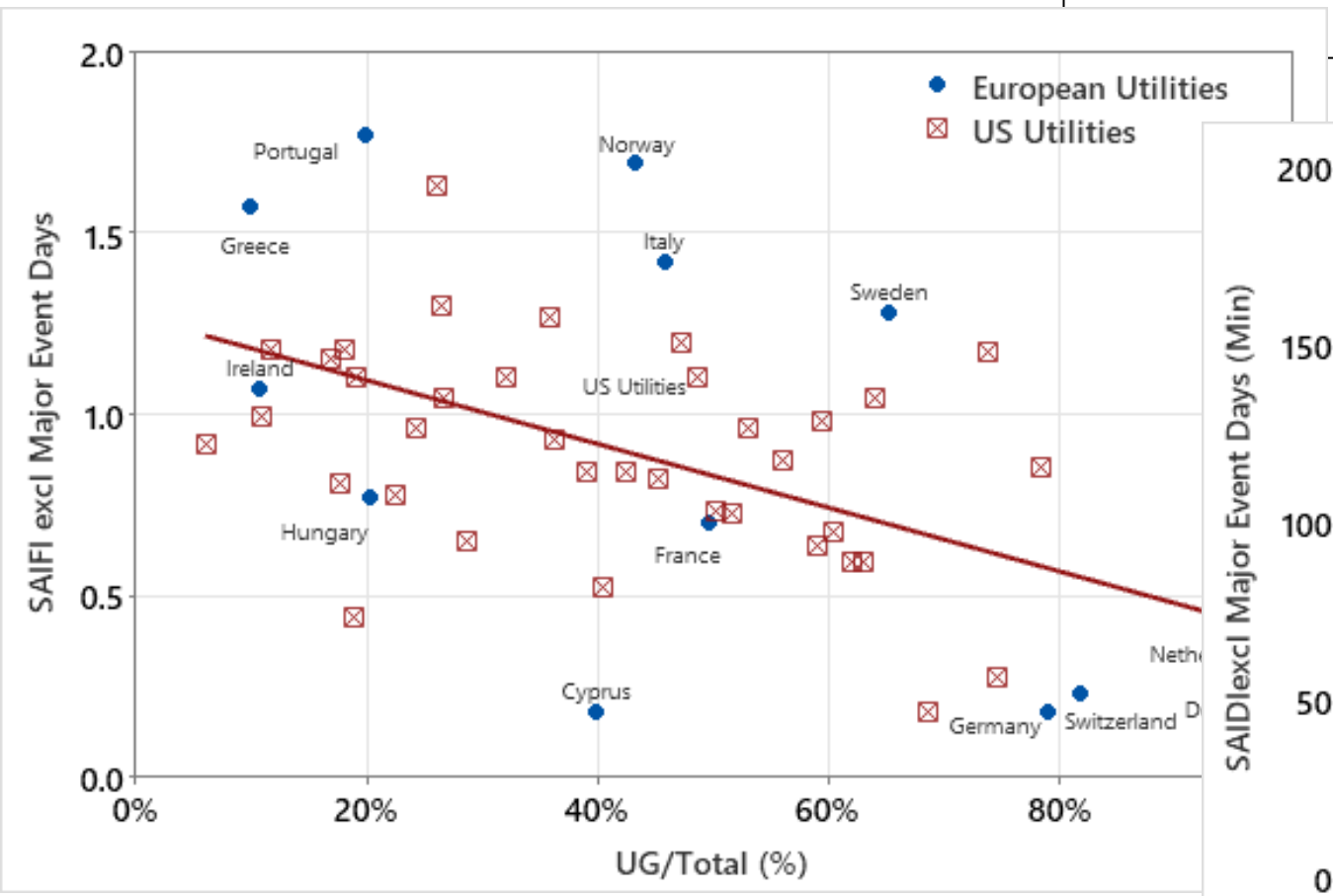
Overhead Assets	Underground Assets	Automation Assets	Distribution Safety	Asset & Reliability Analytics

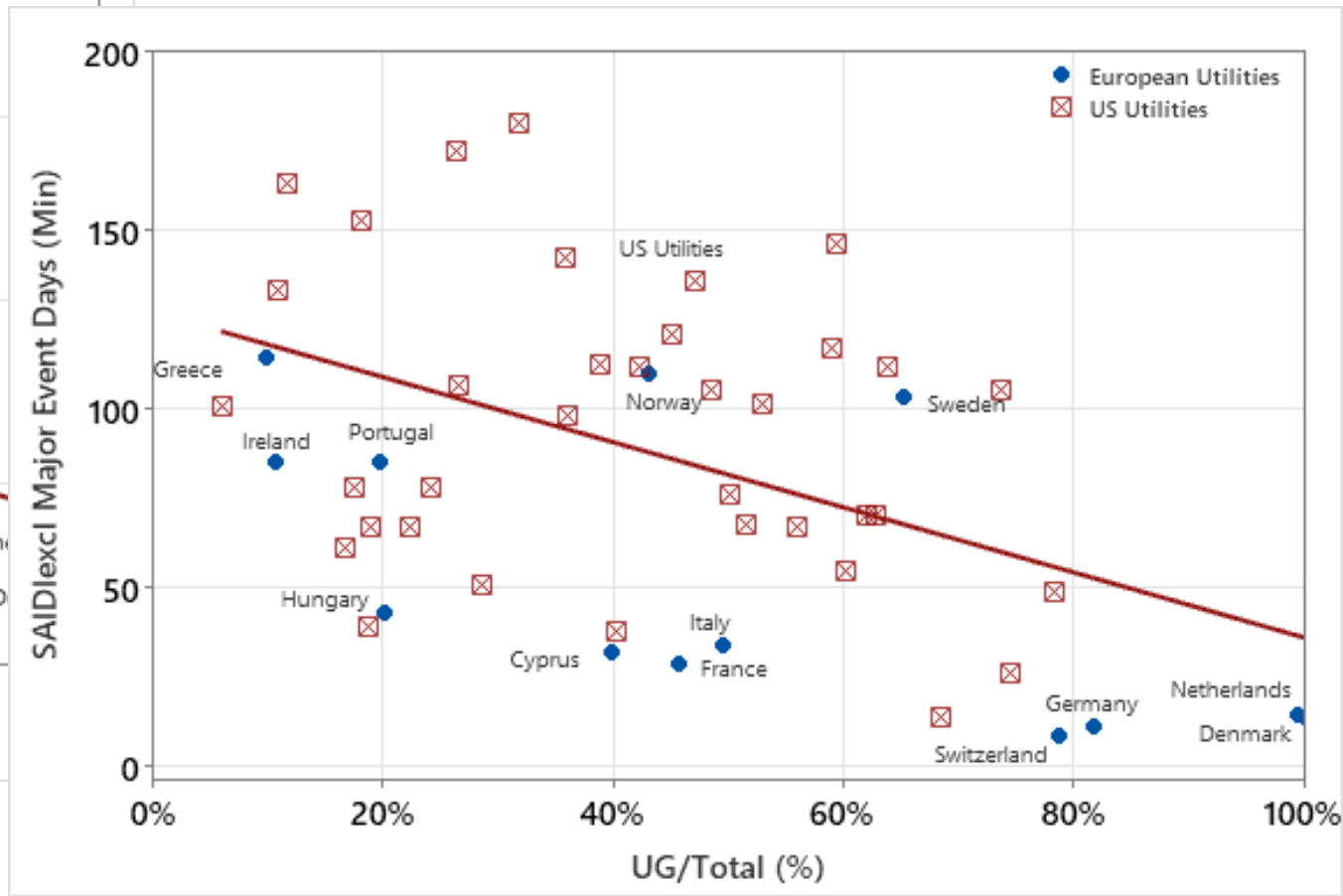




Strategic Collaborative Research
and
Custom One-on-One Research

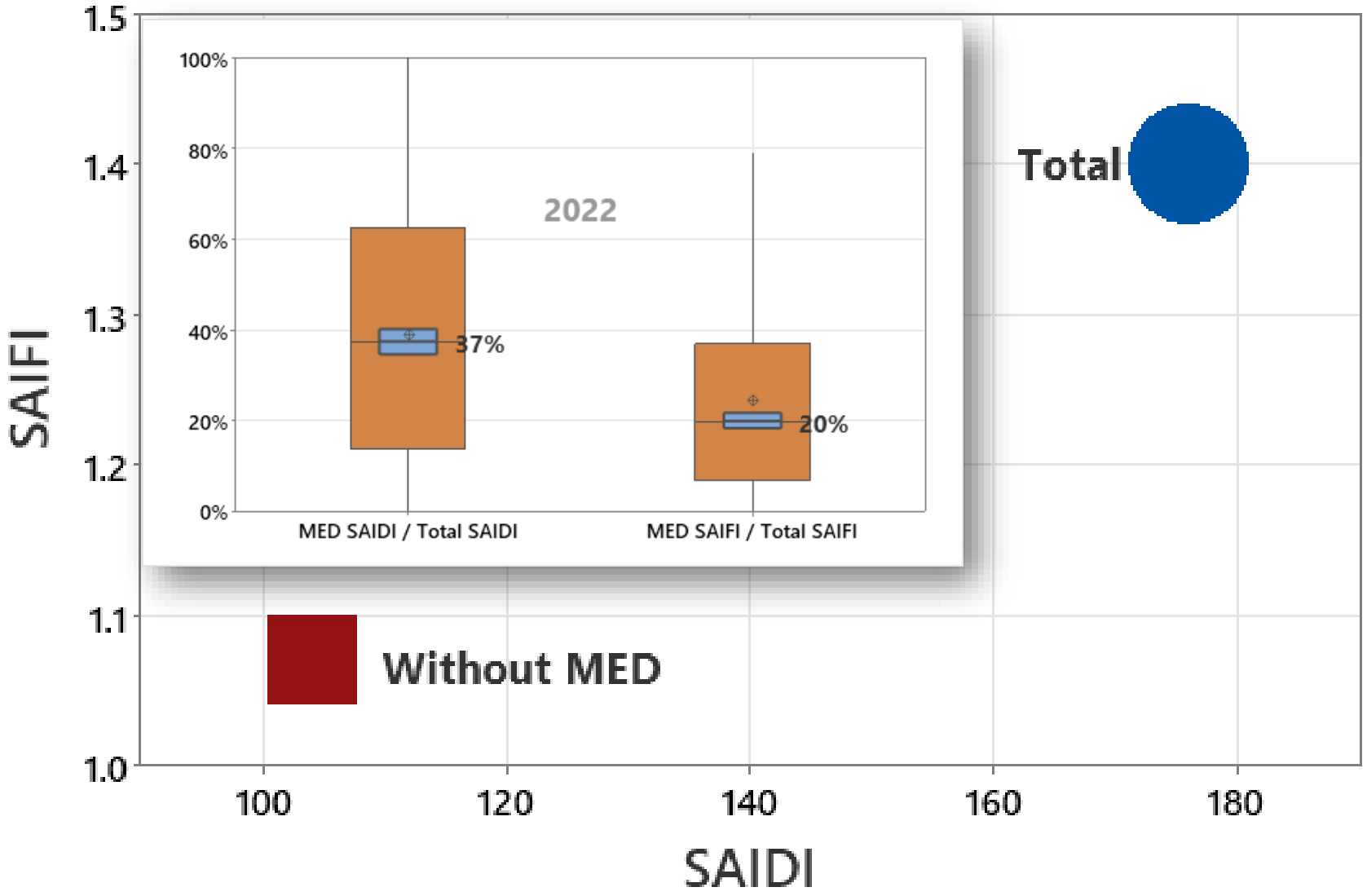
Impact of Distribution Underground Systems on Reliability

SAIFI – System Average Interruption Frequency,
SAIDI – System Average Interruption Duration
MED – Major Event Days





Reliability Indices



SAIFI – System Average Interruption Frequency,
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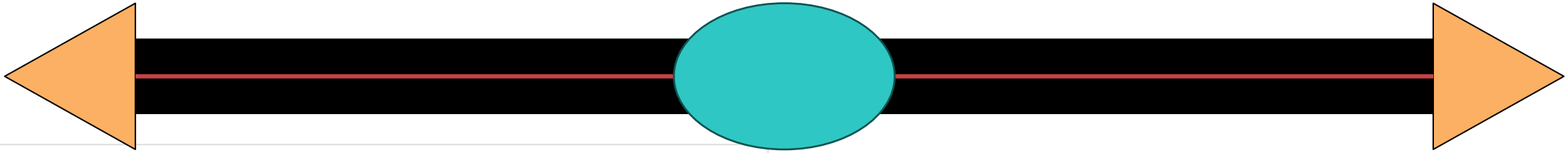
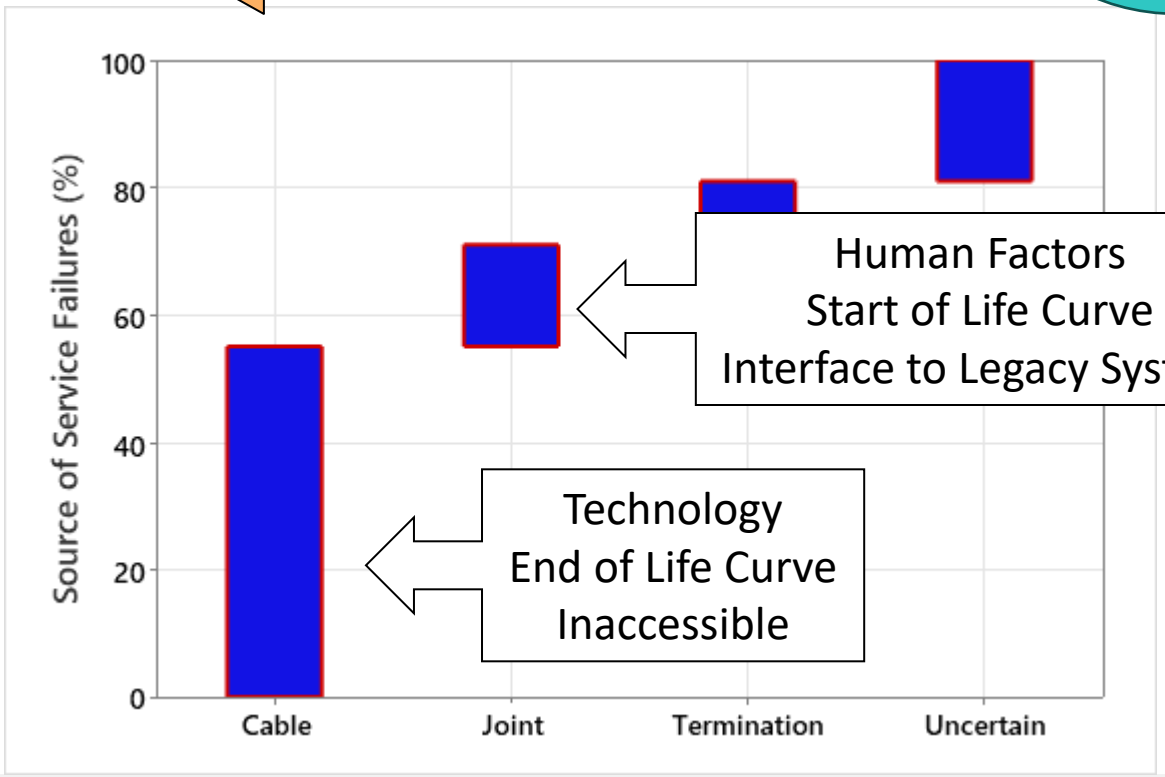
Performance of Distribution Underground Systems

3.1 underground distribution failures / 100 conductor miles / year

Excl third party & transformers Incl accessories & cables



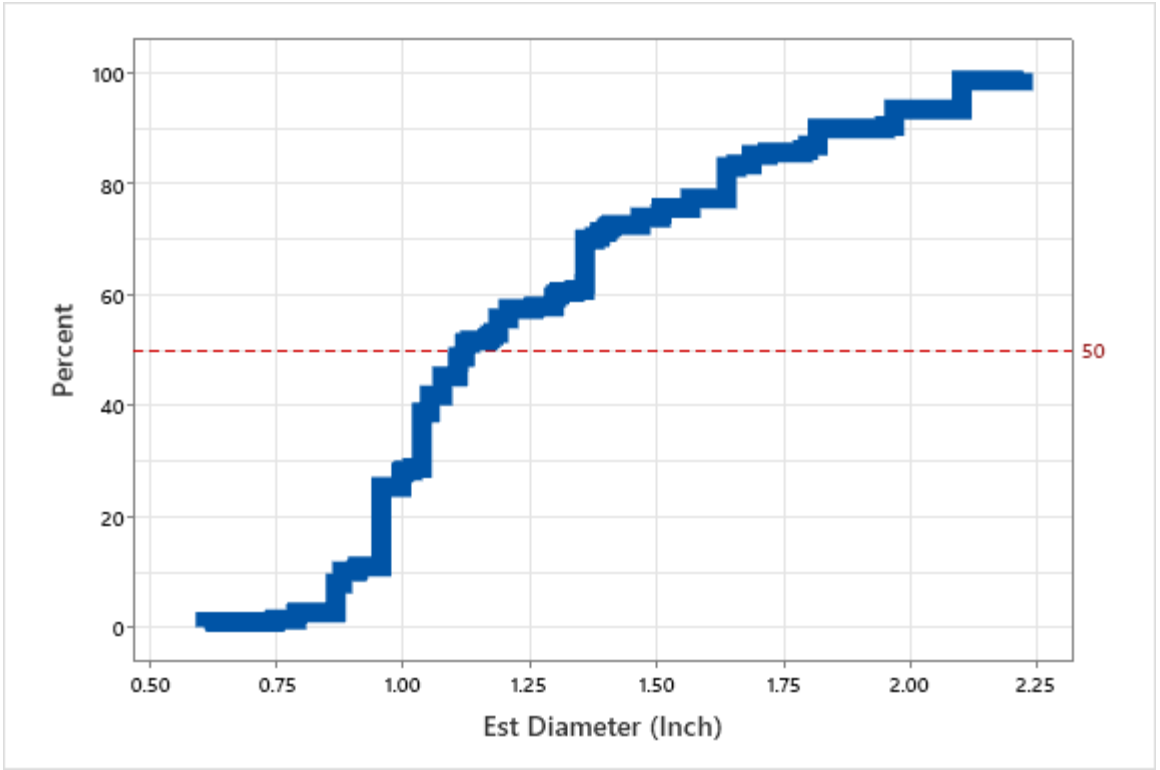


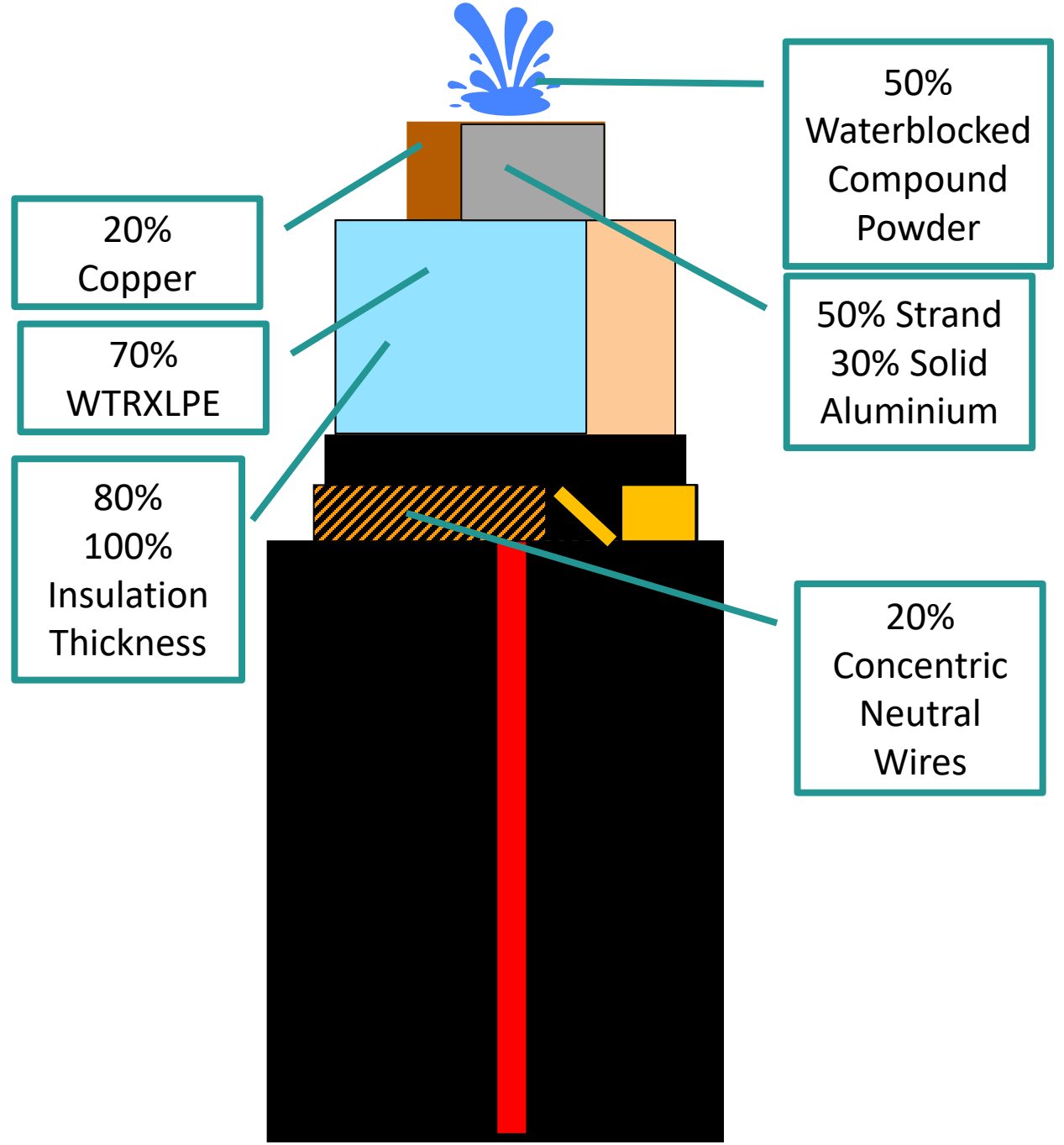
Seasonal Effects - - Summer Failures

>50% of utilities experience,

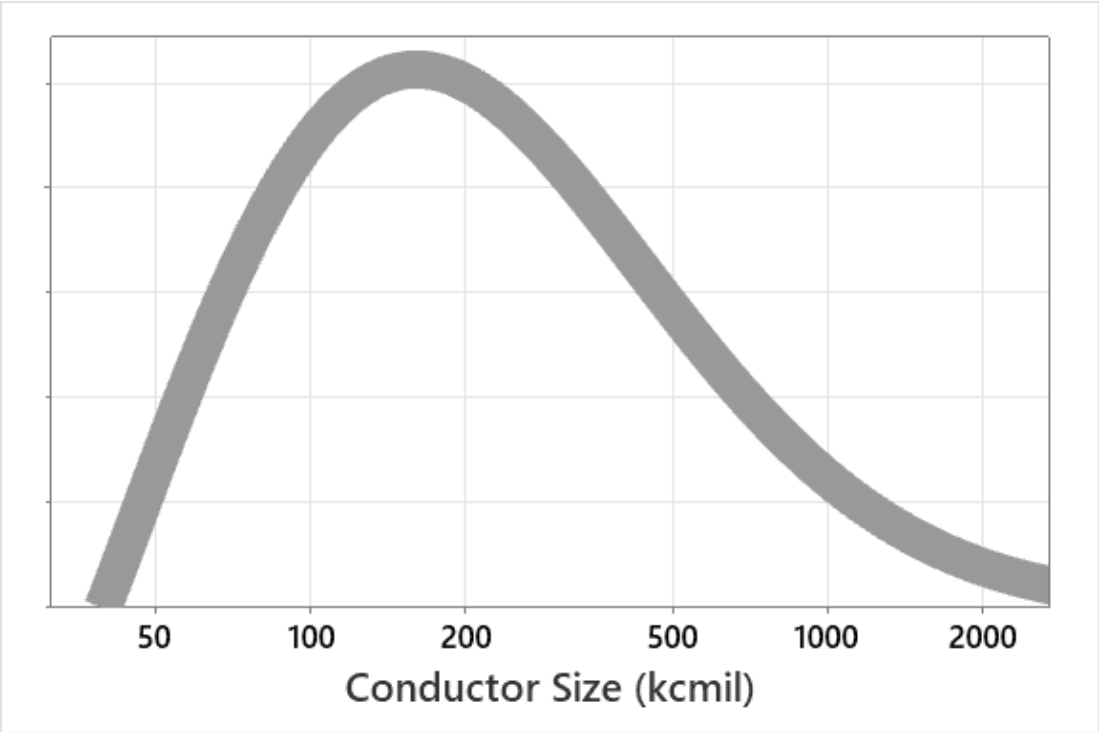
≈ 30 - 40% of annual failures occur over the summer

Diversity in Cable Designs

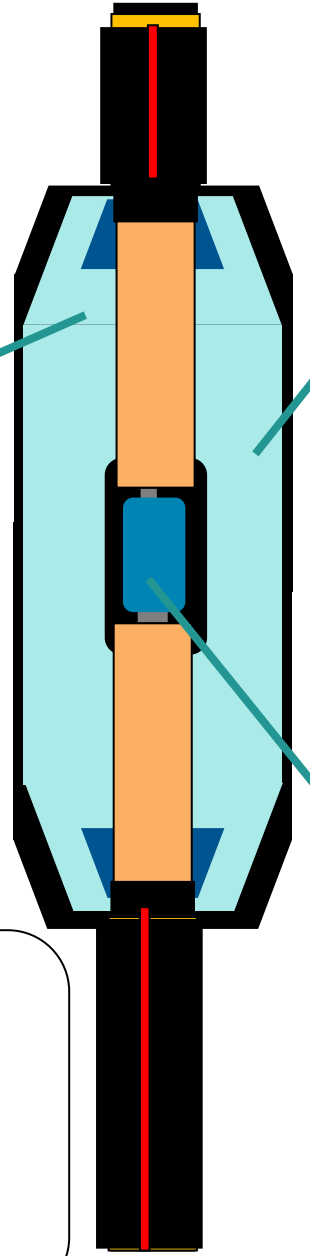




Diversity in Accessories



90% of utilities use more than one joint design



Cold shrink
Heat shrink
Push on
joint design
regularly used

20%
of utilities
only use
crimp
connectors

Metallic connections require specific attention

- Insulating oxides in Aluminium
- Neutral configurations – Concentric, Foil, Straps, Tape
- Legacy cables

Undergrounding for Distribution Interest Group

U-DIG Objectives:

- Expand knowledge for optimizing undergrounding project
- Discussions on new technologies & installation practices
- Identify and prioritize R&D needs
- Repository of information for members
- Sharing of cost reduction strategies

https://distribution.epri.com/u-dig/

Commenced 2021

2024 Events Scheduled

U-DIG

UNDERGROUNDING DISTRIBUTION INTEREST GROUP

U-DIG is focused on all aspects of converting overhead distribution systems to underground from the substation to customer meter base

U-DIG Topics

>400

Utility Participants

>50

Utilities

- Excavation and Burial of UG Components
- Permitting & Easements
- Coordinating with Joint-Use Service Providers
- Customer Interaction
- PUC Regulatory Legislative
- New Equipment & Components
- Supply Chain & Quality
- “No Excavate” Approaches

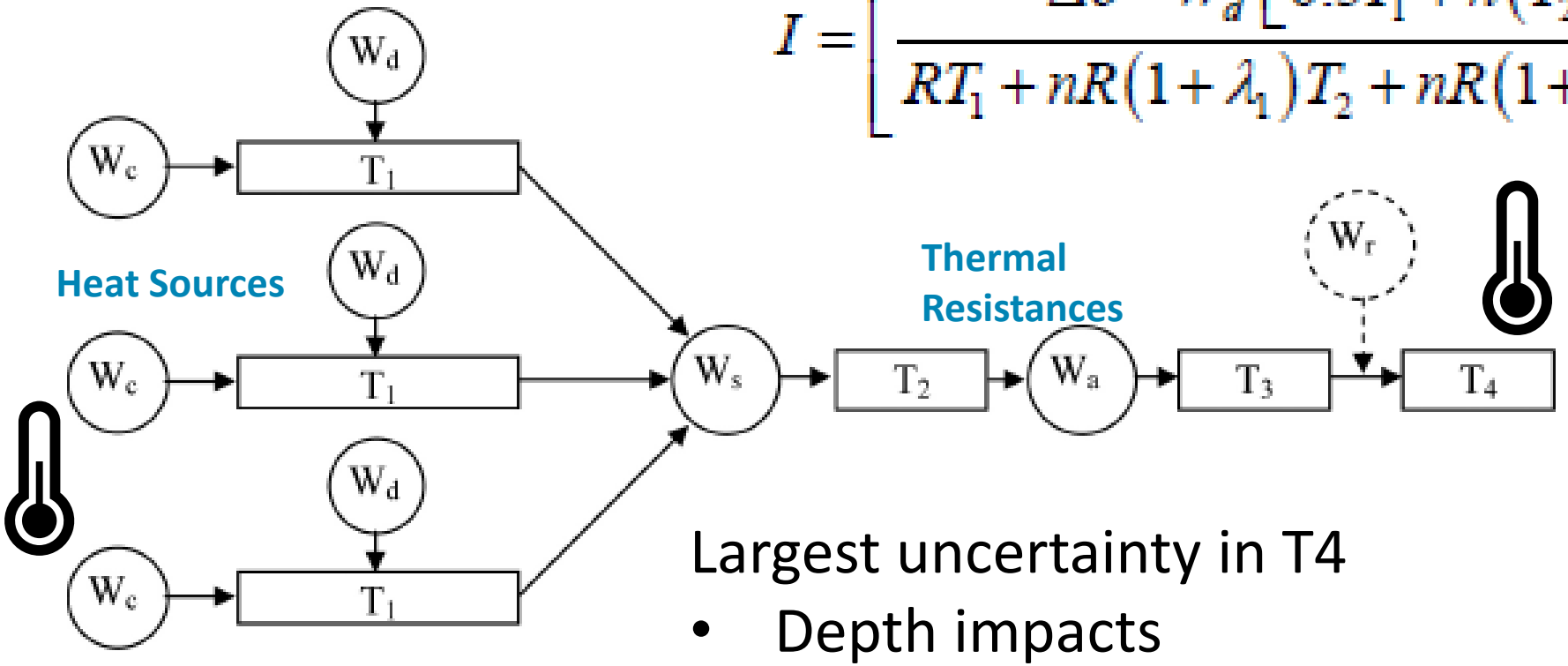
Excavation Challenges

Traditional excavation (trenching and drilling) presents many challenges:

- Rocky geologies make excavation slow and expensive
  - Require special machinery
  - Common in high wildfire-risk areas
- Permitting in archeological and religiously sensitive areas is time consuming
- Excavated material testing, treatment, and disposal is costly
- Striking other equipment or structures halts work

Ampacity

$$I = \left[\frac{\Delta\theta - W_d \left[0.5T_1 + n\left(T_2 + T_3 + T_4\right) \right]}{RT_1 + nR\left(1+\lambda_1\right)T_2 + nR\left(1+\lambda_1+\lambda_2\right)\left(T_3+T_4\right)} \right]^{0.5}$$



Largest uncertainty in T4

- Depth impacts
  - Temperatures
  - Local Thermal Resistance
- Thermal Resistivity – depends upon soil types
- Heat Sources

Considerations for Technologies

- Avoid existing services
  - Water: PE, metal, concrete
  - Electrical: power, secondary, telecom
  - Steam: metal
  - Gas: PE, metal
  - Sewage: PE, metal, concrete
- Accommodate range of diameters & stiffnesses for the cables
- Multiple accessory designs installed in direct buried trenches
- Meet depth specifications & record actual depths
- Provide 3D route map
- Identify sub soil conditions – thermal resistivity

- Be demonstrated as practical at utility scale

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