Viking’s Broken Conductor Protection Technology (“BCPT”)

Software-Based Protection Enhancement for **Transmission & Distribution**

Patented Technology Platform

Viking Protection Systems, LLC

THE CHALLENGE

Broken conductor events can create **significant** operational, safety, and reliability **challenges for electric utilities**. Key points include:

- Broken conductor events are difficult to detect using conventional protection
- Often produce insufficient fault current for reliable detection
- Can result in energized conductor contact with ground or structures
- Increasing regulatory and wildfire mitigation focus
- Existing methods may fail under normal load conditions

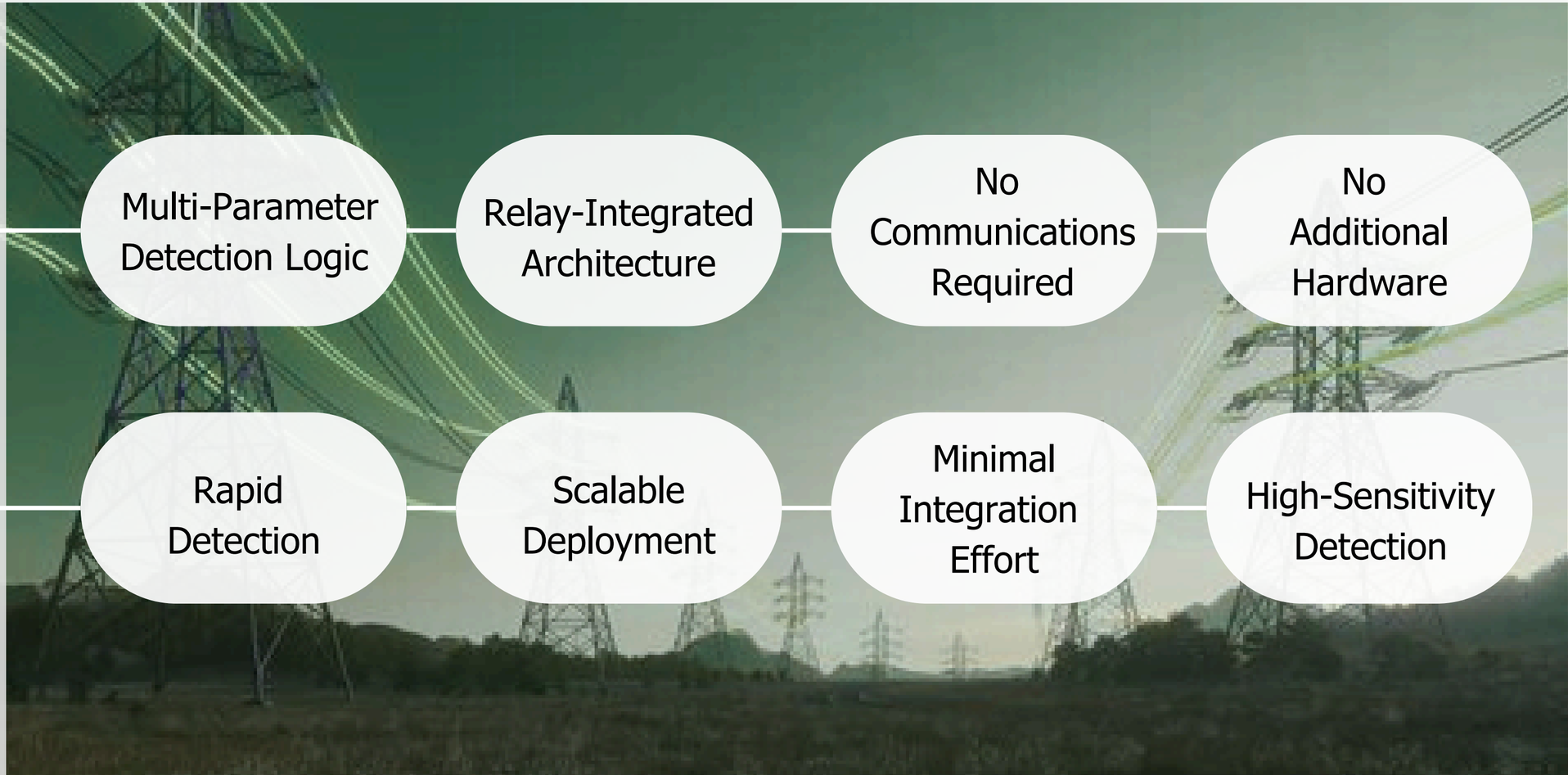
OPPORTUNITY

Utilities are actively seeking improved broken conductor detection capabilities that can be deployed within existing infrastructure, creating a clear opportunity to integrate advanced protection functionality into relay platforms.

- Utilities are actively seeking enhanced detection capabilities
- Preference for solutions deployable within existing infrastructure
- Need for scalable approaches across transmission and distribution
- Opportunity to differentiate relay platforms
- Alignment with safety and wildfire mitigation initiatives

BCPT OVERVIEW (PATENTED)

Viking's BCPT is a patented software-based solution that enhances existing relay platforms with advanced broken conductor detection capabilities, while enabling scalable deployment across transmission and distribution systems, **without reliance on communications-based protection schemes or additional hardware.**



SOFTWARE-BASED SOLUTION

- Multi-Parameter Detection Logic
- Relay-Integrated Architecture
- No Communications Required
- No Additional Hardware

KEY BENEFITS

- Rapid Detection
- Scalable Deployment
- Minimal Integration Effort
- High-Sensitivity Detection

INTELLECTUAL PROPERTY

Protected Technology

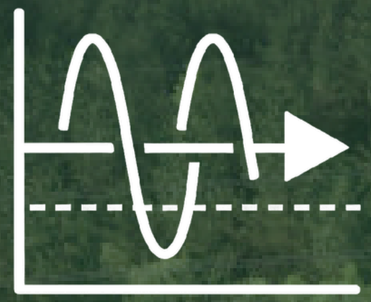
- Viking’s BCPT is protected by multiple patents
- Patents cover high-sensitivity broken conductor detection
- Dual-parameter monitoring methodologies
- Advanced relay-based protection logic
- Separate patented approaches for transmission and distribution
- Additional enhancements and IP under development

DETECTION METHODOLOGY

Advanced Multi-Parameter Detection

Viking’s BCPT applies a multi-parameter detection methodology that analyzes current and voltage behavior to identify broken conductor conditions. The approach leverages fundamental transmission line behavior under open-conductor conditions, where capacitive effects and resulting current characteristics create distinct, detectable signatures.

Viking’s BCPT combines several complementary analytical checks to ensure reliable detection while maintaining stable operation during normal system conditions and minimizing the risk of false trips.



Undercurrent Magnitude & Rate-of-Change Analysis

Negative Sequence Current Variation Monitoring

Phase Imbalance Detection

Voltage-Based Validation

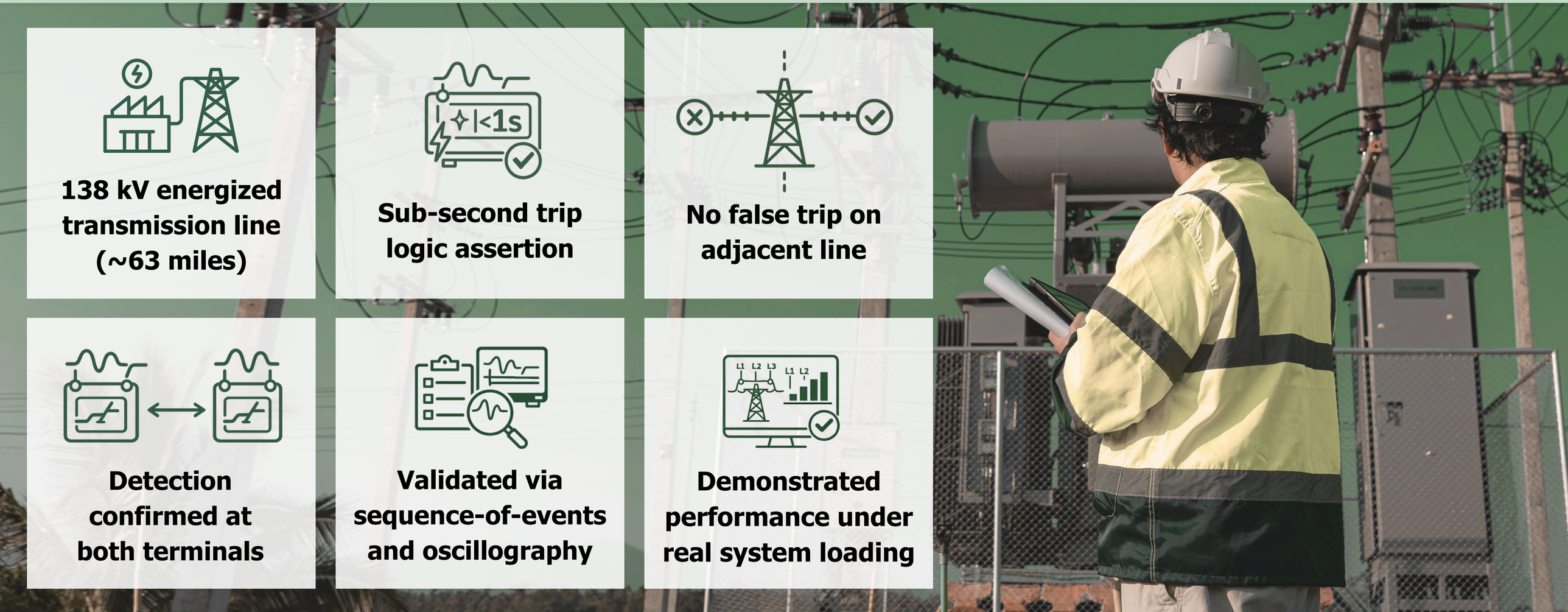
Multi-Stage Filtering for Stability

False Trip Prevention

TRANSMISSION VALIDATION

LIVE SYSTEM TESTING

Demonstrated across a wide range of voltage levels, system configurations, and loading conditions.



138 kV energized transmission line (~63 miles)

Sub-second trip logic assertion

No false trip on adjacent line

Detection confirmed at both terminals

Validated via sequence-of-events and oscillography

Demonstrated performance under real system loading

DISTRIBUTION APPLICATION

Extends BCPT capability from transmission to distribution-level protection environments.

Technical Adaptation

Patented approach adapted for distribution systems

Feeder-level detection capability

Deployment Path

Integration into reclosers and distribution relays

Scalable across large circuit populations

Utility Engagement

Extensive modeling conducted to evaluate distribution system application

Under evaluation by a major U.S. utility

RELAY-INTEGRATION & OPERATION

Integration Model

- Embedded firmware logic within relay platforms
- Configurable protection element
- Optional advanced protection module
- No external communications dependency
- No hardware retrofit requirements

Operational Workflow

Substation relay continuously monitors line conditions

BCPT algorithm evaluates current and sequence parameters

Detection occurs during open-conductor conditions

Trip logic asserted by the relay

Protection action initiated per utility configuration

COMMERCIAL VALUE

PRODUCT ENHANCEMENT

- Expanded Protection Capability
- Competitive Differentiation
- Aligns with Utility Protection Needs
- Access to Patented Technology

BUSINESS MODEL FLEXIBILITY

- Per Device Licensing
- Per Circuit Licensing
- Enterprise Agreement

PARTNERING WITH VIKING

APPROACH

Viking and its affiliated entities develop advanced protection technologies designed to enhance grid safety, reliability, and operational performance across transmission and distribution systems.

Viking's patented BCPT solutions are purpose-built for **seamless integration into OEM relay** platforms and utility protection environments.

EXPERIENCE

Core technology developed by **Bob Stuart**, a recognized protection systems expert with **50+ years of experience** across generation, transmission, and distribution, including 35 years with PG&E leading system protection, operations engineering, and reliability initiatives.

Proven track record in advanced protection design, remedial action schemes, and grid reliability innovation.

CONTACT

For partnership discussions or technical engagement:

James A. Doris
President
jdoris@vikingenergygroup.com
(281) 404-4387

Enabling next-generation protection capabilities through relay-integrated innovation!