

*Low-Cost, Non-Contact, High Accuracy Sensor for the Simultaneous,  
Reliable, Real-time Determination and Monitoring of HV  
Transmission Line Sag, Temperature, Current, and Ampacity*

*Promethean Devices, LLC.*

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Prepared by: **Mr. Steven J. Syracuse**  
**Principal Investigator**

DOE Phase I Contract: DE-FG02-05ER84159  
**DOE Project Manager/Officer: Mr. Gil Bindewald**

**2006 DOE Visualization & Controls Peer Review**  
**October 18 – 19, 2006**

# ***HVTL-STAC Sensor System***

Simultaneous, real-time determination, monitoring, and wireless communication of:

- **Conductor Sag**
- **Phase Current**
- **Conductor Temperature**
- **Ampacity**

# ***HVTL-STAC Sensor System***

**HV Transmission Line- Sag, Temperature, Ampacity, & Current**

- **Non-contact, Non-invasive System**
- **Real-time Wireless Monitoring & Reporting**
- **Reliable, Long-lived Field Operation**
- **High Accuracy, Precision, & Resolution**

# ***HVTL-STAC Sensor System***

**HV Transmission Line- Sag, Temperature, Ampacity, & Current**

- Fully passive, Ground-based system
- NOT affected by snow, rain, sleet, ice, & hail
- NOT affected by fog, dust, or smoke
- Very Low Maintenance: field-and-forget

# HVTL-STAC Sensor System

## Costs

- Lower total installed cost than existing systems
- Fully autonomous operation
- *LESS expensive to Procure*
- *LESS expensive to Install*
- *LESS expensive to Calibrate*
- LOW cost to Operate
- LOW cost of Maintenance

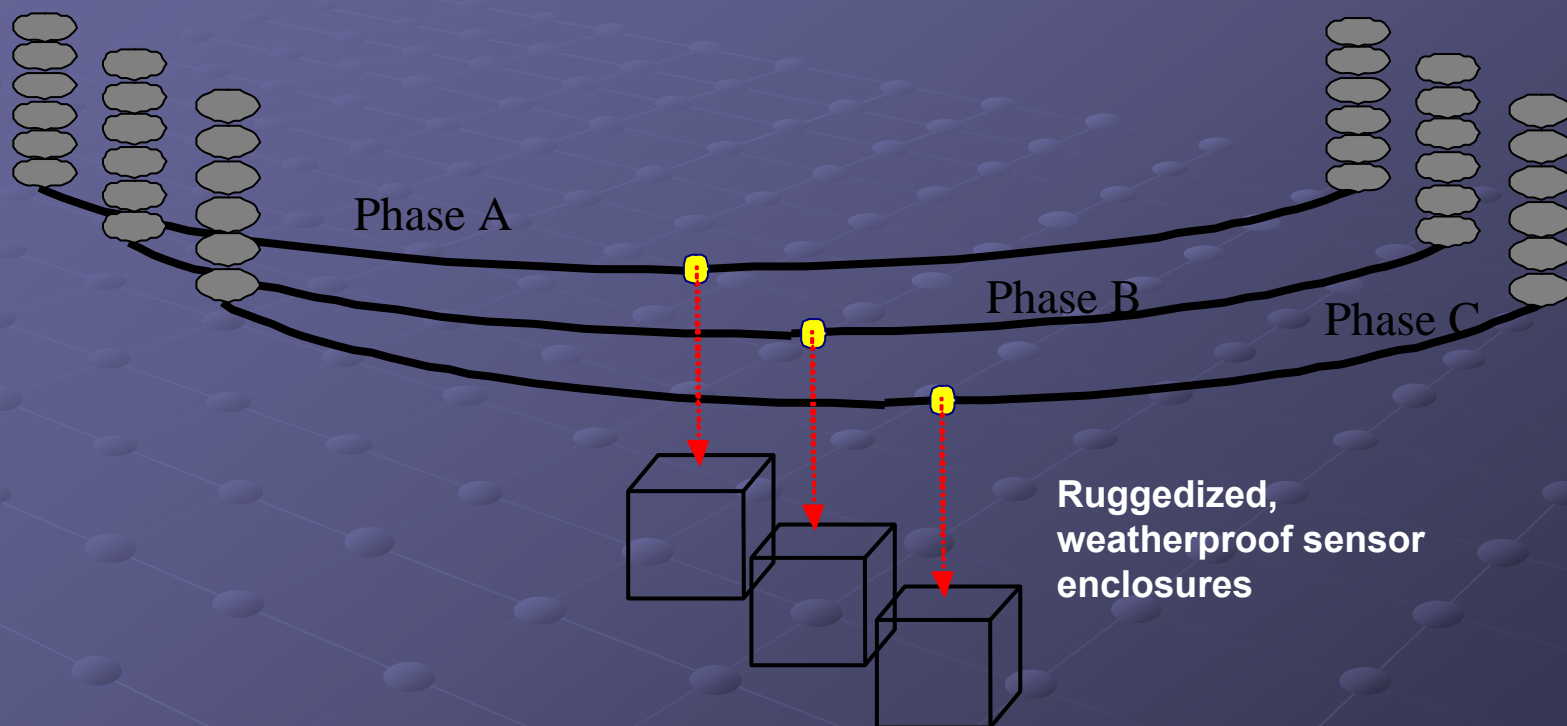
# HVTL-STAC Sensor System

## Installation & Calibration

- Designed for rapid, simple, low-cost field installation: no pedestals required
- Located in ROWs under phase conductors
- Does not require specialized equipment
- Does not require utility field crew participation
- *Does not require outage for installation*
- *Does not require outage for calibration*

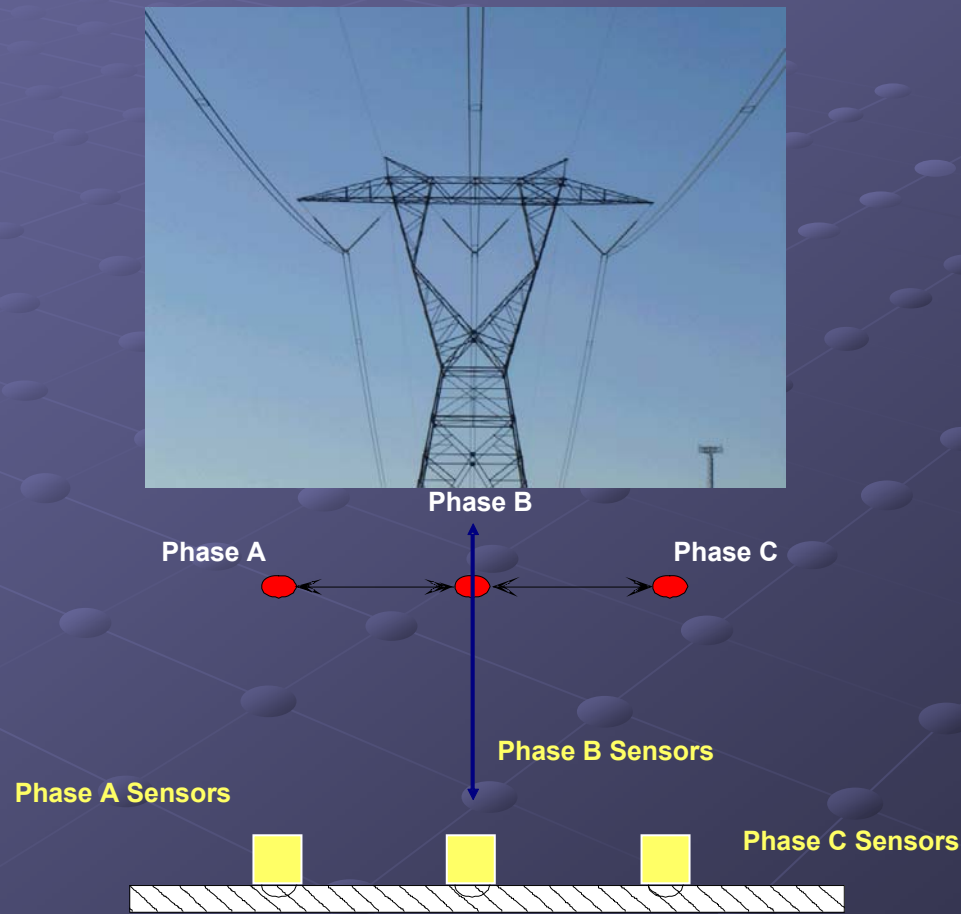


# General Field Layout: HVTL-STAC System



**General field layout of the transducers and the overhead HV phase conductors (drawing not to scale). The transducers are located at ground level, or, if desired, just below.**

# Field Layout & Field Test Site



500 kV Field Test Site and the ground positions of the sensors under the phases (not to scale).



# HVTL-STAC Sensor System

## Hardware & Software

- Laptop-based, Labview-driven system
- Real-time acquisition, processing, and display
- High-reliability combined solar-battery power
- Long-range wireless communications system
- Real-time data logging

# Preliminary System Performance: Phase I Field Prototype

## ● Conductor Sag:

- 3 cm resolution
- 21 cm accuracy
- 5 cm precision

## ● Phase Current:

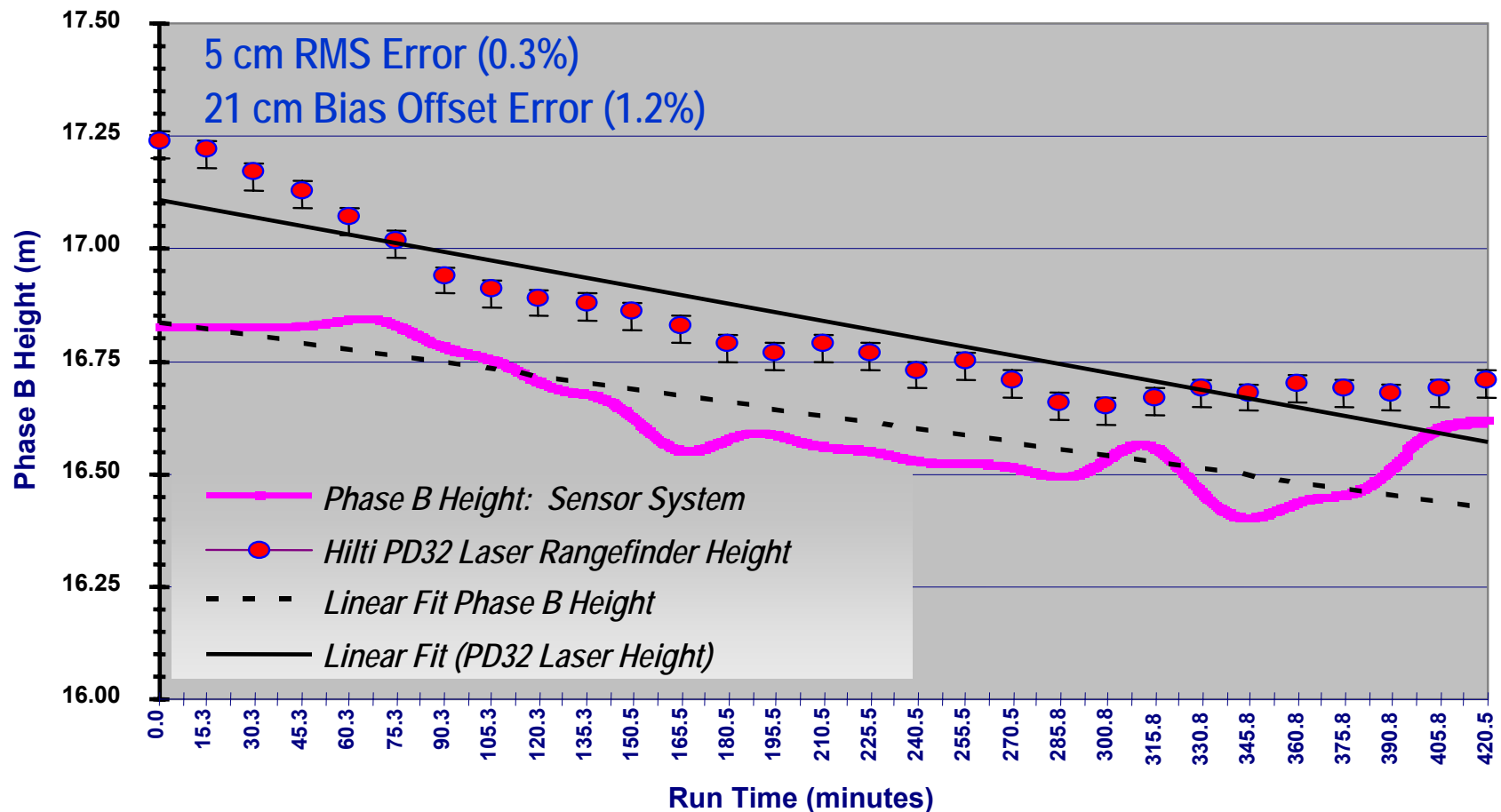
- 9 Amp resolution
- 30 Amp accuracy
- 14 Amp precision

# Phase I Field Prototype Data & Results

## Conductor Sag I: 7 Hour Tracking & Accuracy

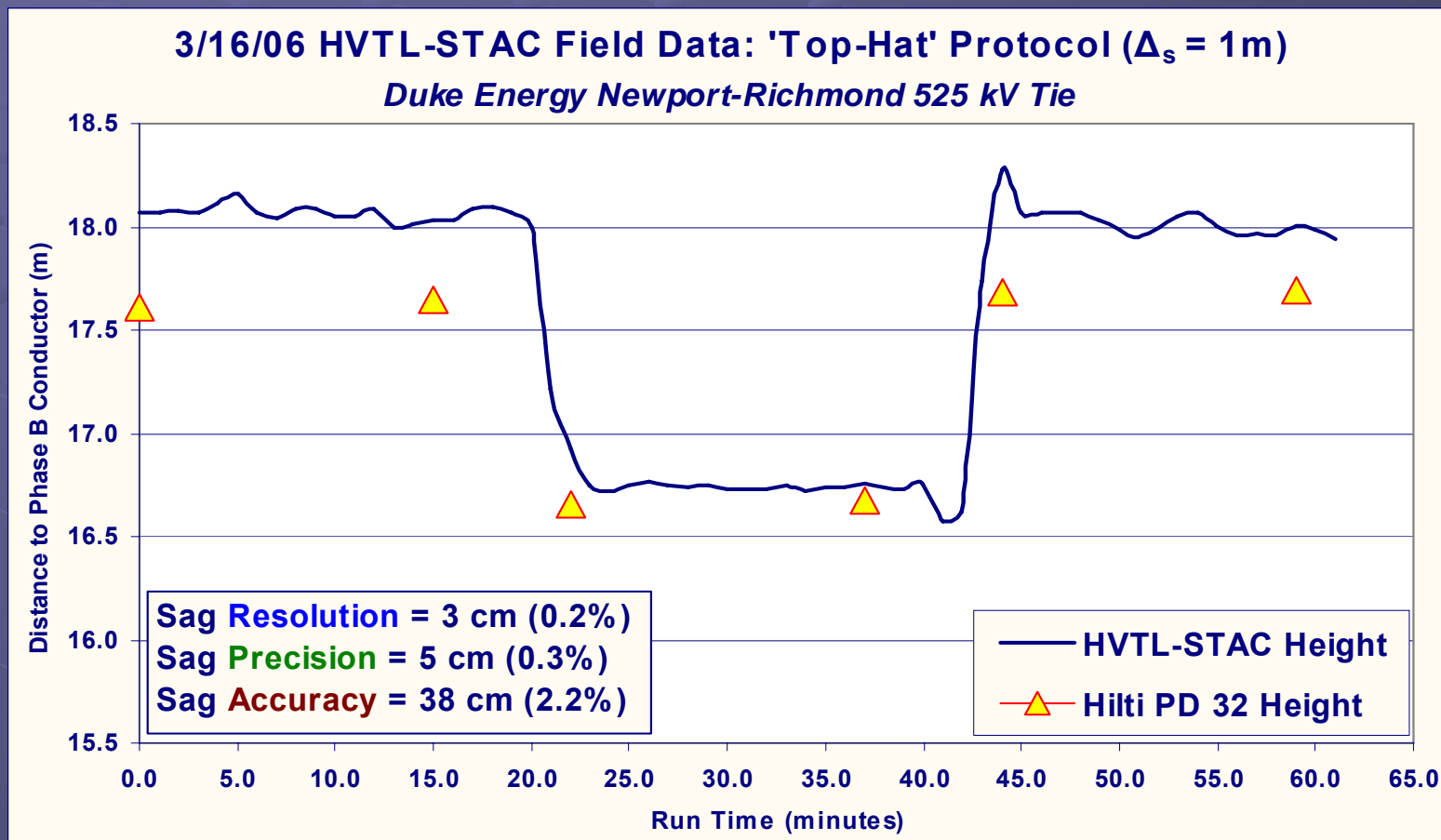
Field Test Data: HVTL-STAC Sensor System; February 24 2006.

Duke Energy Newport-Richmond 525 kV Tie



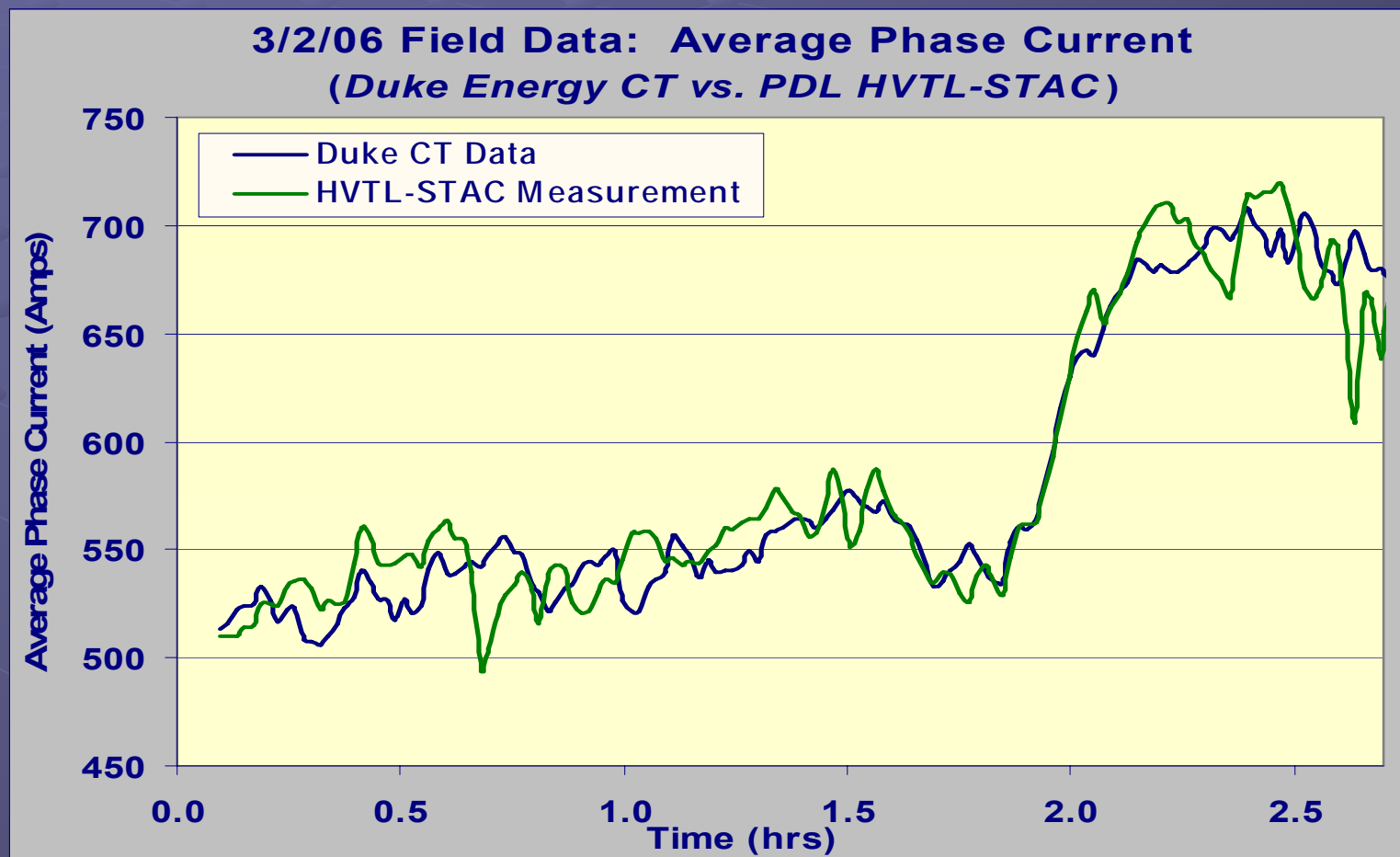
# Phase I Field Prototype Data & Results

## ● Conductor Sag II: Precision and Resolution



# Phase I Field Prototype Data & Results

## ● Conductor Phase Current



# Summary & Conclusions

- Constructed, deployed, demonstrated, and extensively field-tested a new, real-time, non-contact/invasive, wireless overhead HV transmission line sensor system.
- Unambiguously demonstrated that overhead phase conductor sag and current can be determined directly, and in real-time, with our ground-based sensor system.
- Conductor sag and phase current field data demonstrated clear consistency with actual conductor sag (laser rangefinder data) and actual phase current (utility CT data).



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