

# The Valley Group

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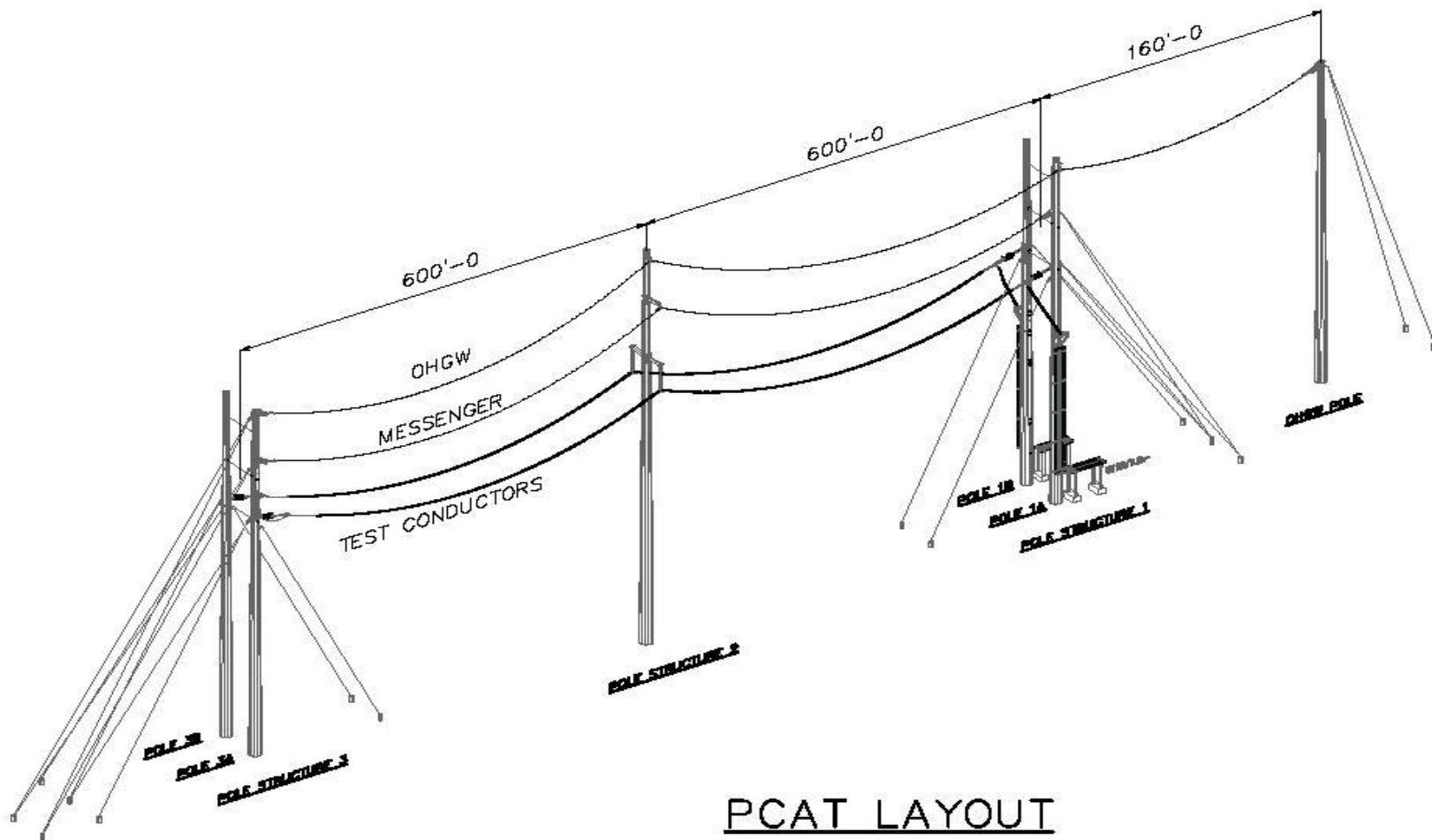
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## **High Temperature Sag Measurements at ORNL Test Line, June 2010 and their Implications re. Monitor Calibration**

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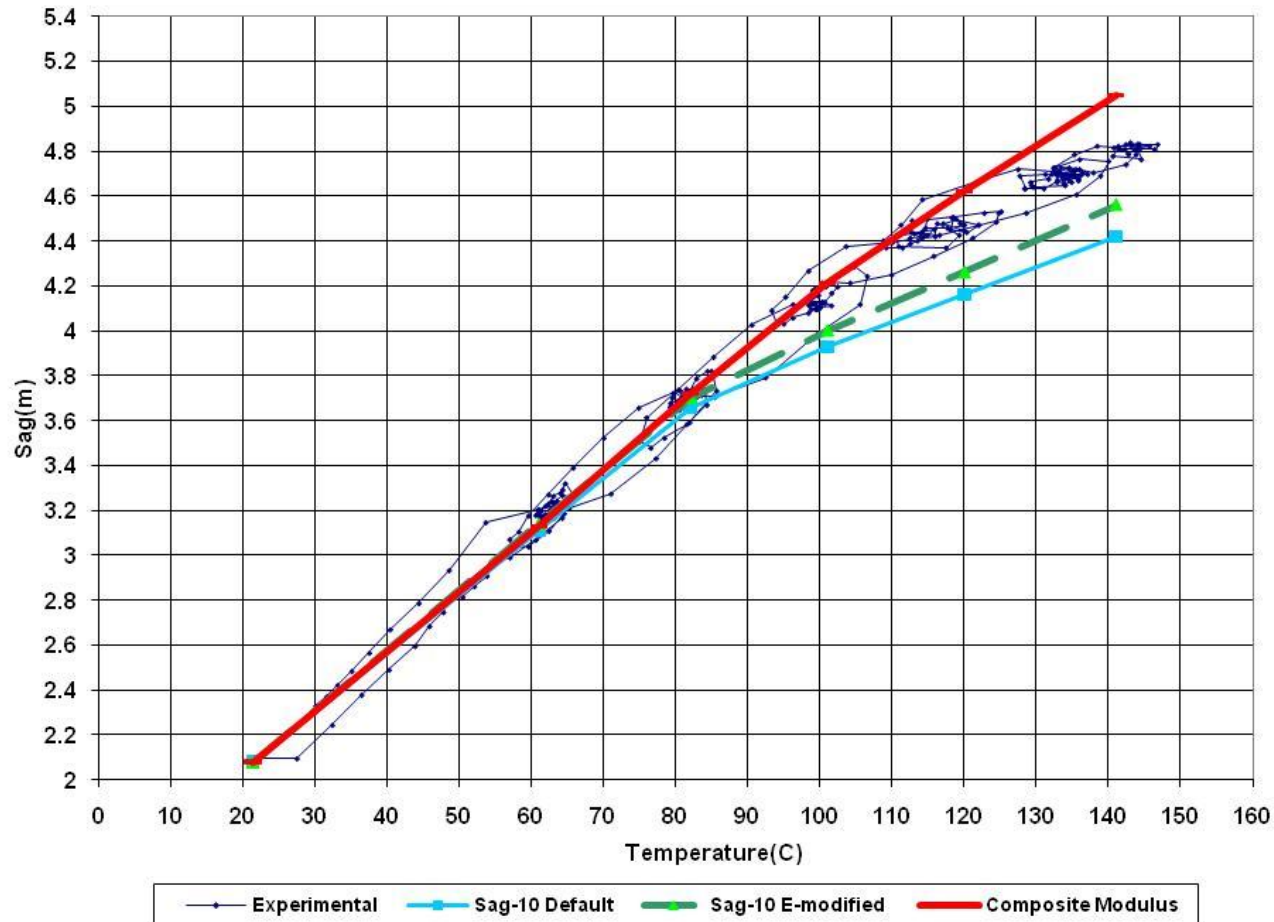
**Dean Stoddart**

Presentation at CIGRE TAG B2-04, August 23, 2010



- Drake conductor had been prestressed to eliminate creep during tests (38% of RBS overnight at 18 C)
- Final tension 31.6 kN (22.6% of RBS at 21 C)
- The average temperature of the line is measured with thermocouples at ends, midpoints and quarter-points of spans.
- In this test, temperature is increased in steps to 60, 80, 100, 120, 140 and 150 C and held at each level for 60 minutes, then reduced with same steps.
- Conductor tension and sags are measured at 5 minute intervals.

## ORNL - ACSR "DRAKE" Sag vs Temperature, 180m R.S. Port 1 - Roadside, June 18, 2010



- Knee region is much higher than anticipated by graphic method and sag calculation programs based on it (100-120 C vs. 75-80 C)
- Above knee region the sags appear to increase more than that calculated using properties of steel core only.
- This means that present line design programs are likely to underestimate high temperature ACSR sags, even if corrected with proper high temperature elastic modulus.
- Real-time rating methods based on temperature measurement will also seriously underestimate actual high temperature sags.
- There is significant hysteresis, sags with increasing temperatures are less than sags with decreasing temperatures.
- Possible explanation could be gravity effects ignored by graphic method and its derivatives; aluminum and steel components remain interlocked until the relative stress in the aluminum-steel interface exceeds the weight of aluminum times friction coefficient.
- More details later in a full report of tests.

- If real time monitoring is based on temperature measurement, the sag or tension criteria to determine the line safety should be based on composite modulus and composite thermal elongation. Otherwise, line sags may violate assumed clearances and the calculated ratings will be overly optimistic.
- If real time monitoring is based on tension or sag, the kneepoint temperature must be shifted upwards from that assumed by graphic method and its derivatives. Otherwise, calculated real time ratings will be overly conservative.
- Sag/temperature relationship has a hysteresis of 10-15°C. This will limit the confidence level of clearance calculations based on temperature measurements.
- Note that static and other ratings calculated using graphic method and its derivatives may be overly optimistic if lines are templated above the kneepoint. In such cases, real time sag or tension monitoring should be applied, as temperature monitoring provides no clearance assurance.