

The Composite Conductor

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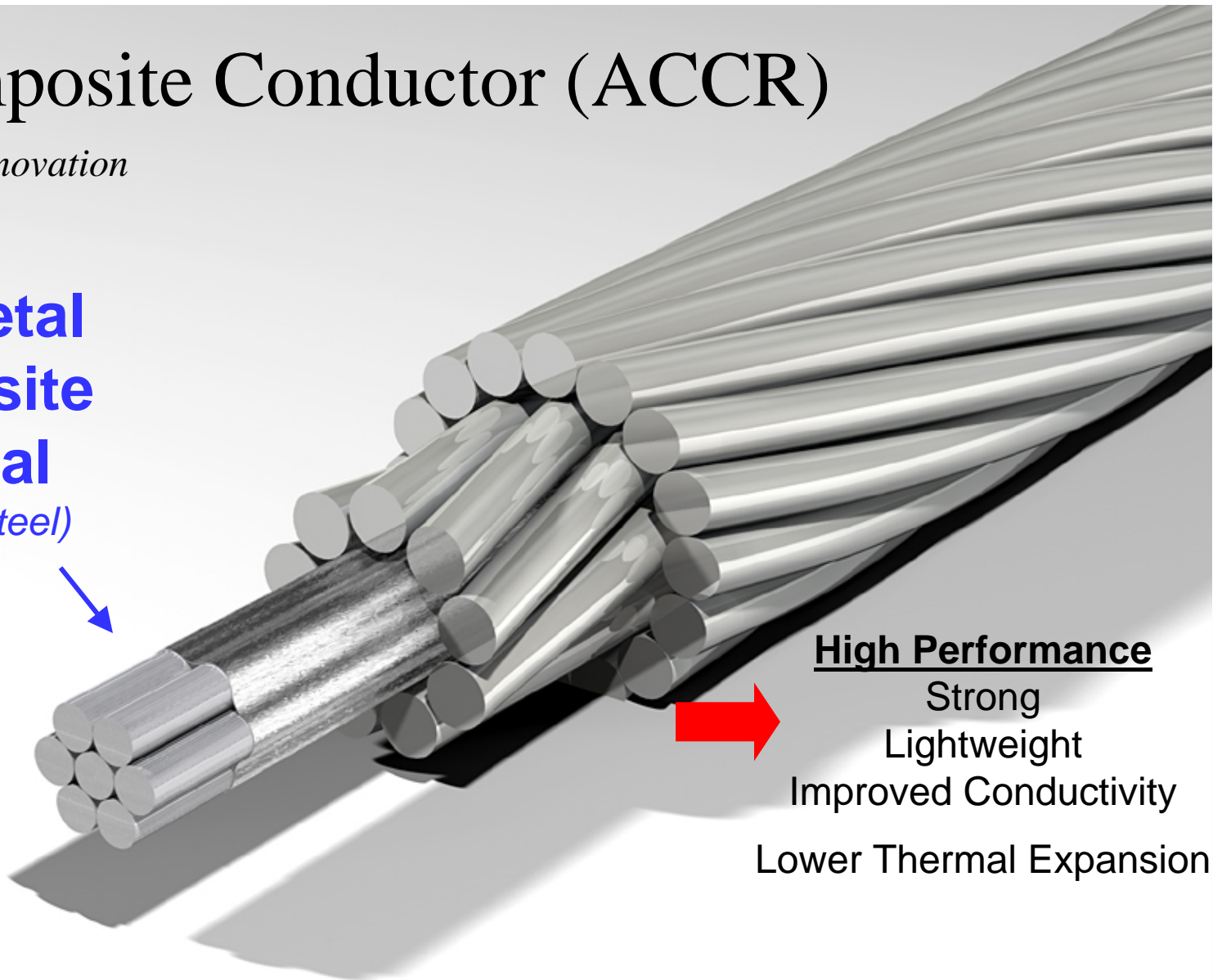
3M *Innovation*

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3M Composite Conductor (ACCR)

A Materials Innovation

**New Metal
Composite
Material**
(replaces steel)

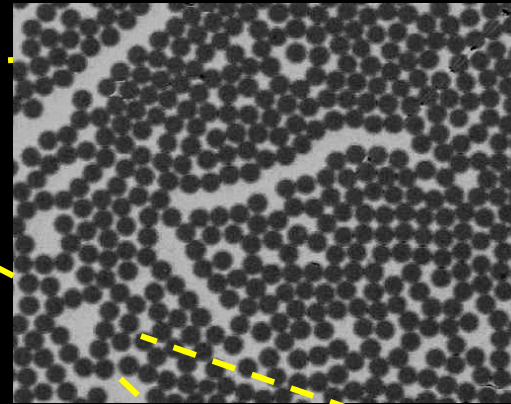


High Performance
Strong
Lightweight
Improved Conductivity
Lower Thermal Expansion

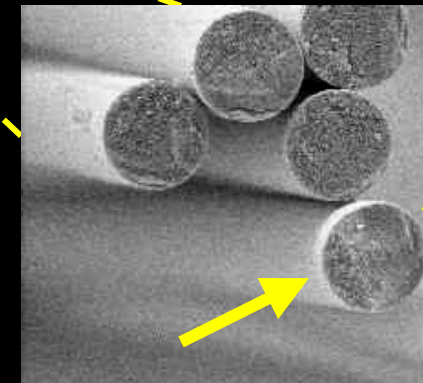
**Quick solution to increase capacity of existing
transmission lines without need for new towers or a
visual change to line**

Developed for Performance and Reliability

*Continuous Fibers
Embedded in Pure Aluminum*



**Metal
Matrix
Composite**



12 micron

Aluminum-Oxide Fibers

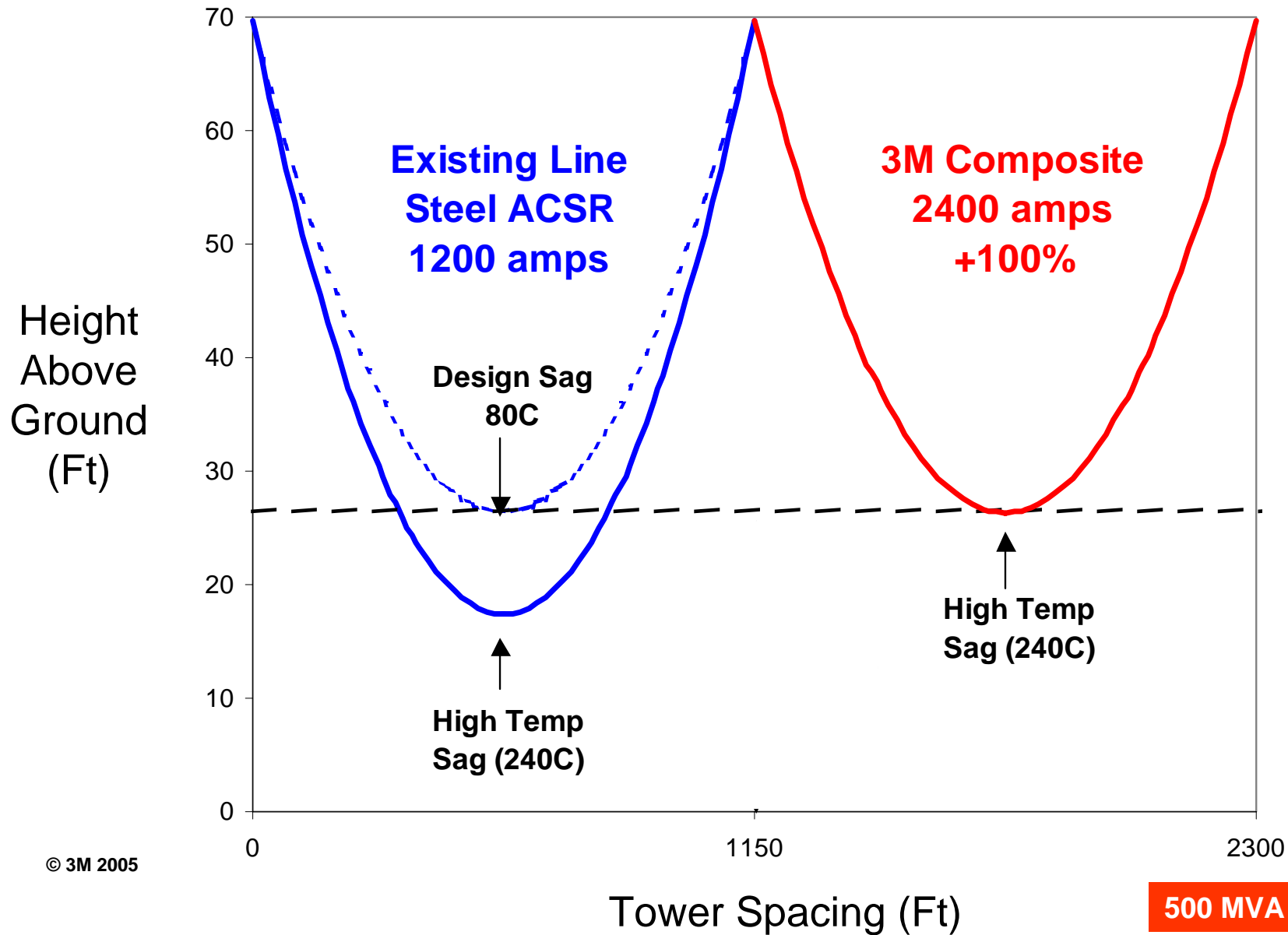
Primary Application is Thermal Upgrades

- 2X to 3X gain in ampacity
- Existing structures
- Quick and simple solution
- Minimal environmental impact
- No visual change
- Cost competitive vs. rebuild



3M Conductor Sags Less at High Temperature

(Allows for simple replacement on existing structures)



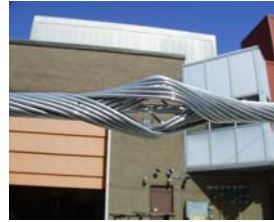
Extensively Tested



Strength



Thermal Expansion



Short Circuit



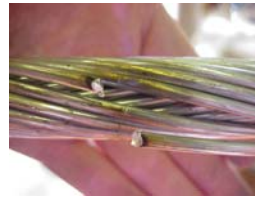
Torsional Ductility



Test Span



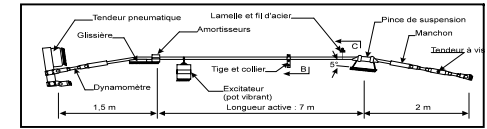
Creep (rt/et)



Lightning



Drop Test



Vibration Fatigue



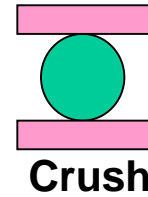
Axial Impact



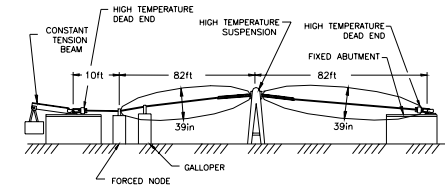
Sheave



Shotgun

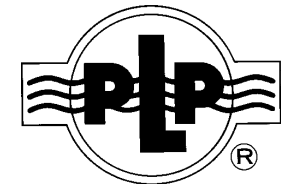


Crush



Galloping

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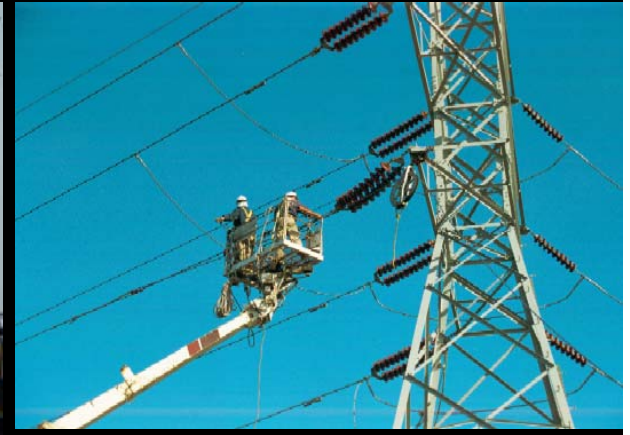
Field Trials Confirm Lab Tests



46kV Hawaii
2002



230kV North Dakota
2002



115kV Minnesota
2001



ORNL Tennessee
2002

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230 kV Phoenix 2004

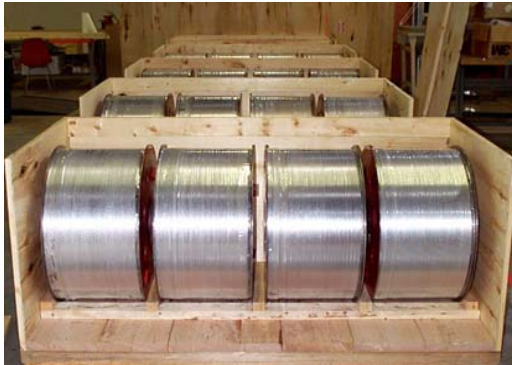


69kV Phoenix 2004



115kV Columbia River
2004

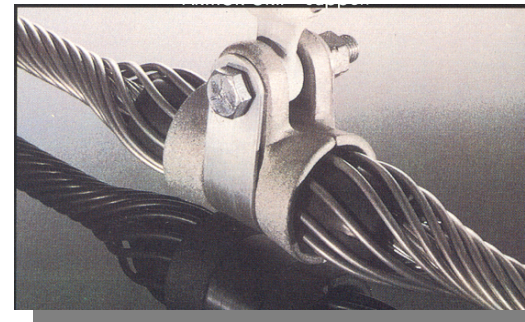
3M Aligned with Industry Leaders



3M



Nexans



- Conductor & Accessories
- Installation Guidelines
- Laboratory Test Results
- Technical Support

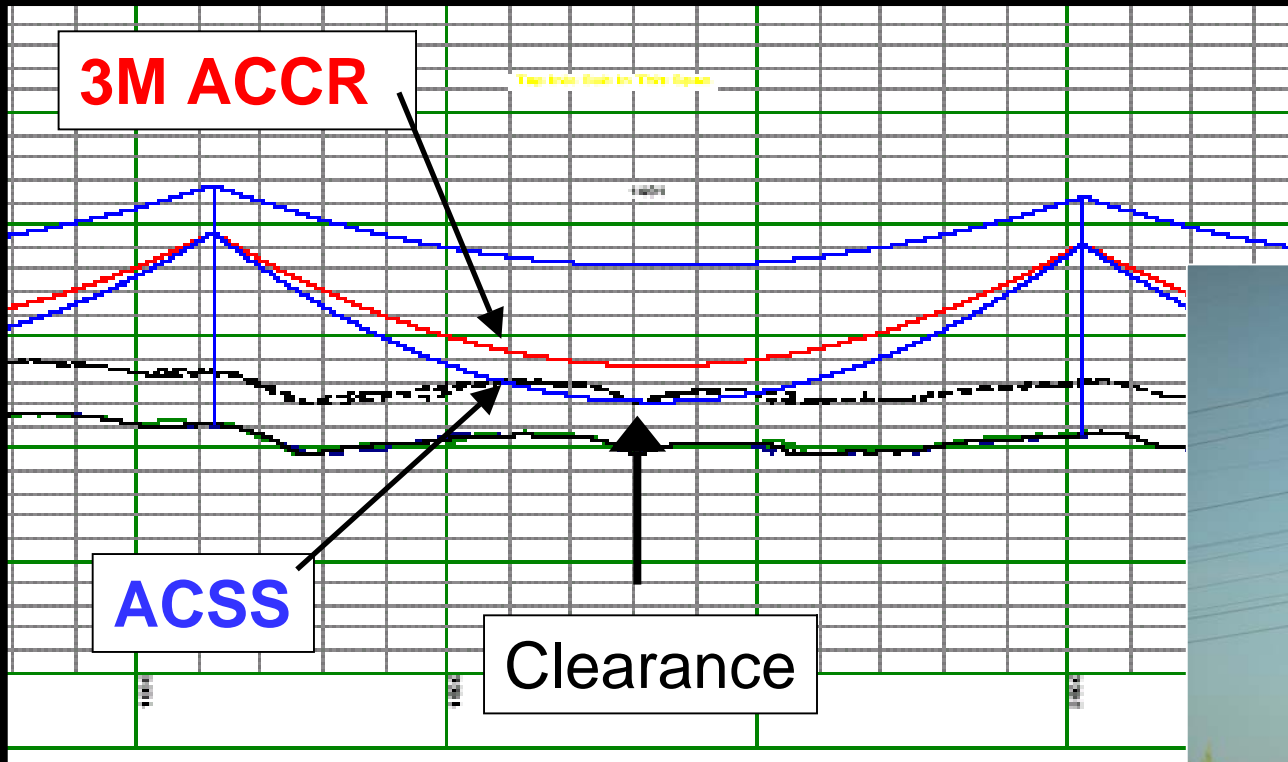
Xcel Commercial Installation

(Completed in 11 months)

- Plant expansion was \$100M investment
- Wetlands
- Challenging timelines



3M Solution Avoided Tower Replacement



Saved the towers in sensitive wetland areas



Supplied 33 Miles
Of ACCR 795



Simpler and Faster Than Rebuilding

(Eight week installation)



No bucket truck access

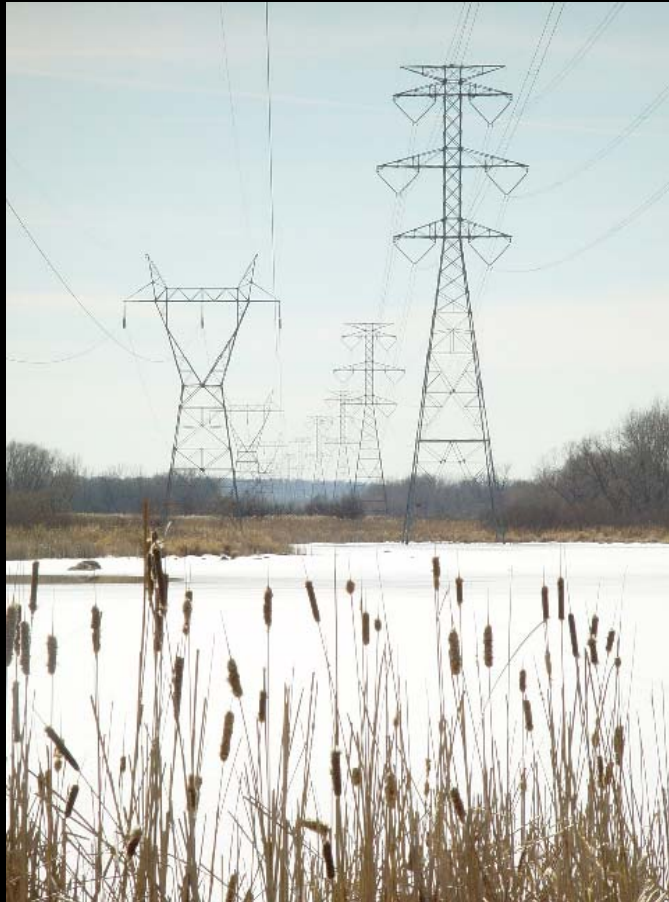


ATV access
only

Lake Crossing



Result – Increased Capacity Without Visual Change to the Line



Before



**After Installing 3M ACCR
(80% capacity increase)**

Commercial Applications



Xcel Energy (10 cir-mi)



WAPA (20 cir-mi/80 cir-mi)



Alabama Power (10 cir-mi)

California Installations



PG&E Santa Clara, CA

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SDG&E Oceanside, CA