Sterlite Technologies Limited

Increasing demand for Electrical power generation and transmission, but.....

- Very high cost to install new Power Lines
- Difficulty in acquiring Tower sites- Right of Way
- Time involved in constructing new Power Lines
- Provision for future contingencies

Usage of High Temperature – Low Sag(HTLS) Conductors

Addressing Key industry challenges

INSUFFIFICENT CAPACITY

TOWER TENSION

REQUIREMENT OF NEW LINES

T&D LOSSES AND CDM

Need to develop & use specialty materials in power transmission lines

Shift from ACSR to HTLS

HTLS Conductors

- **Ampacity** — *High Current Carrying Capacity*
- **Sag tension** — *Low Sag-Tension Property*
- **Installation** — *Easy and Rapid Installation*
- **Reliability** — *Equally Reliable*
- **Economics** — *Low Line loss*

HTLS Conductors – New Generation Conductors

RECONDUCTORING

- Enhanced Current Carrying Capacity for the same diameter/weight.
- No modification/reinforcement to the existing towers.

NEW LINES

- Enhanced Current Carrying Capacity.
- Reduction in per unit transmission cost.
- Higher Corrosion Resistance.
- Shorter Project Duration.
- Additional capacity of ~ 100% is reserved for future demand

GREEN SOLUTIONS

- Low loss leading to lower carbon emissions.
- Run at lower temperature for the same current.

STERLITE'S PORTFOLIO

NEW LINES

TACSR

ACSS

STERLITE ECO™

ACCC®

RECONDUCTORING

STACIR

GAP

ACCC®

GREEN SOLUTIONS

STERLITE ECO™

ACCC®

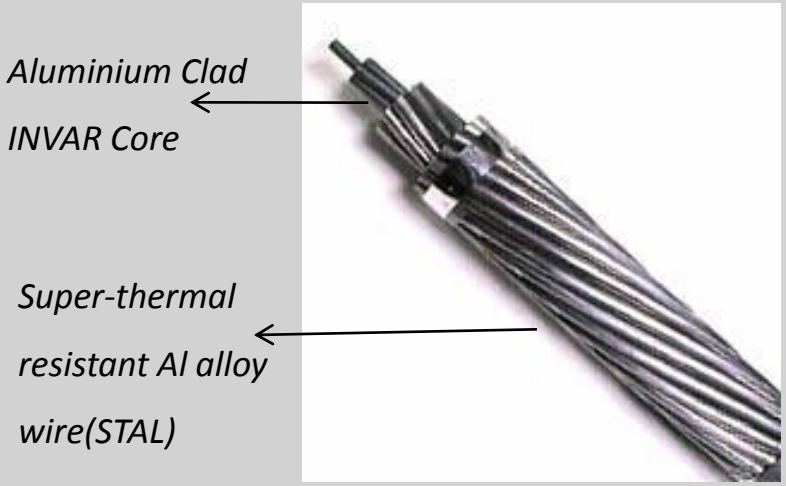
STACIR

SUPER THEMAL ALUMINIUM CONDUCTOR INVAR REINFORCED

This low sag conductor is manufactured from Al-Zr(Aluminium Zirconium) alloy rods. The conductor comprises of an strong inner Invar steel core and concentrically arranged STAL strands forming the outer layer of conductors.

BENEFITS:

- Preffered for reconductoring applications.
- No modification/reinforcement is required to the existing towers.
- Can carry 100% more current as that of ACSR of the same size,while maximum sag and maximum working tension remains the same as that of ACSR.



STACIR

Application case : Sterlite STACIR

- **Application:** Replacing the installed ACSR/AAAC conductor by STACIR equivalent conductor. STACIR is a solution to **up rate existing transmission lines in a short time frame**. Modification or reinforcement of the towers is not required.

- **Performance:** With the same tower loadings a STACIR conductor can **carry up to two times the rating** of a conductor with the same diameter it would replace.

- **Sterlite's experience:** In India Sterlite has supplied approximately 200 Km of STACIR conductor equivalent of ACSR Panther for the increase of the transmission capacity of the 132kV Shapurnagar – Chinthal, 132kV Ghanapur – Bandhlaguda & 132kV Bootpur to Balanagar lines of Andhra Pradesh Transmission Corporation, India.

Re-conductoring solution: STACIR

Benefits

- Possibility to increase the capacity of existing lines by 100%
- Excellent Sag properties due to INVAR core
- Modification or reinforcement of the towers is very limited or not required.

	STACIR Wolf 30/7/2.59 mm	ACSR Wolf 30/7/2.59 mm
Ampacity (amperes)	843	362
Sag (m)	4.83	5.42
Tension (Kg)	3723	3723

Condition: Span 275m, Tension 36°C 100% wind, Ambient 55°C, Operating Temp: ACSR Panther – 75°C & STACIR - 210°C

Re-conductoring solution for 132kV lines of APTRANSCO

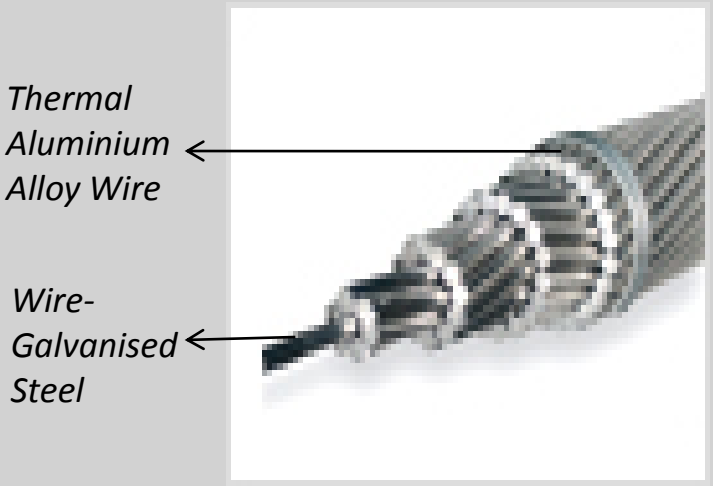
TACSR

THERMAL ALLOY CONDUCTOR STEEL REINFORCED

TACSR conductors are the conductors wherein the inner core is composed of galvanised steel and outer layers are composed of thermal-resistant aluminium alloy.

BENEFITS:

- Ampacity is almost 50% more – Higher Power Transfer Capacity.
- Higher capacities line built can cater to future increased demand of power.
- Can be used with existing tower designs.



TACSR

New lines solution: TACSR

Benefits

- Ampacity is almost 50% more – Higher Power Transfer Capacity.
- Higher capacities line built can cater to future increased demand of power.
- Can be used with existing tower designs.

	TACSR	ACSR Moose
Ampacity (amperes)	1509	764
Sag (m)	13.91	12.86
Tension (Kg)	7392	7392

Condition: Span 400m, Tension 32°C 100% wind, Ambient 45°C, Operating Temp: ACSR Moose – 75°C & ACSS - 210°C. Quad configuration

New line solution for different voltage levels

Inner core – TACSR & STACIR

- STACIR is designed with Al clad INVAR having low thermal co-efficient expansion at 210^0 C which enables it to maintain the SAG equal to equivalent ACSR.

- TACSR can be designed with STC 6 core to maintain the sag equal to ACSR, even when while it operate at 150^0 C.

Properties	Galvanised Steel	Galvanised Steel (ST6 C)	Aluminium Clad Invar
Tensile Strength (MPa)	1226	1700	1184
Conductivity(% IACS)	8	8	14
Linear Co-efficient of Expansion	11.5×10^{-6}	11.5×10^{-6}	3.7×10^{-6}
Young's Modulus(Kg/mm^2)	21000	21000	15500

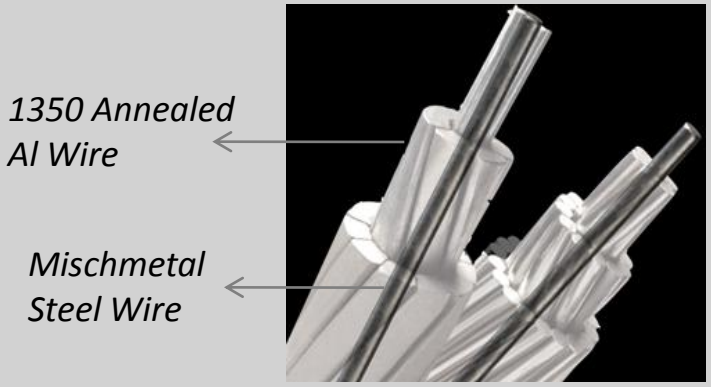
ACSS

ALUMINIUM CONDUCTOR STEEL SUPPORTED

ACSS conductors are manufactured from Annealed Aluminium 1350 wires and an inner high tensile strength core of Galfan(Zn 5% Al Mischmetal) coated steel wires.

BENEFITS:

- Preffered for reconductoring as well as new line applications.
- Offers low sag, even when operating at upto 250^0 C.
- Alumnium wires of ACSS have an increased conductivity of 63% IACS.



ACSS/TW and ACSS

Application case : Sterlite ACSS

- **Application:** ACSS for new lines in order to **reduce losses/transfer more than double power**, replacing conventional conductors like ACSR/AAAC.

- **Performance:** With the same tower loadings an ACSS conductor can **carry up to two times the rating** of a conductor with the same diameter it would replace.

- **Sterlite's experience:** In India, Sterlite has supplied 235 Km of ACSS conductor equivalent of ACSR Moose for the increase of the transmission capacity of the 400kV LILO of D/C Korba – Birsingpur line of Bharat Aluminium Company Limited. Sterlite ACSS will be the first HTLS to be deployed in upgradation of bus bar of 220kV S/S of Maharashtra State Electricity Transmission Co. Ltd.

STER – ECO™

STER ECO™

- **Trapezoidal shaped special aluminium alloy containing magnesium, silicon and copper stranded with round core which provides compactness to the extent of 96%.**
- **Innovative, efficient, low loss and an economical solution for re-conductoring power lines and constructing new lines.**
- **Higher efficiency enables significant savings when substituted in grid systems for normal ACSR or AAAC conductors.**

BENEFITS:

- Up to 30% less I^2R losses for same sized conductor
- For same output runs cooler by 5-10^{O}C, hence lower carbon emissions
- Contributing to greenhouse gases
- Can be deployed with existing structural designs

	ACSR Dog	Sterlite Eco Cond.
Ampacity (amperes)	284	284
Temp ^{0}C	75	68.5
I^2R Losses (kw/km)	80.74	57.89

GAP TYPE CONDUCTOR

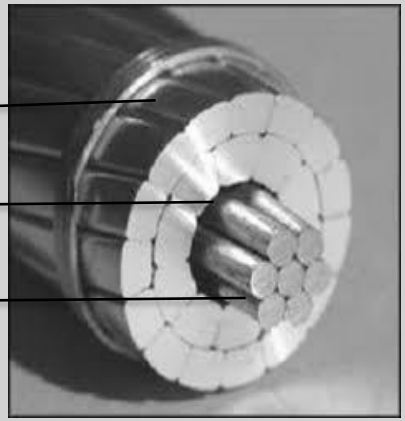
SUPER THEMAL ALUMINIUM CONDUCTOR INVAR REINFORCED

GAP conductors are manufactured from (super) thermal-resistant aluminium alloy wire and the high strength steel core. There is a small annular gap filled with grease between the high-strength steel core and the first layer of trapezoidal-shaped aluminum strands. The principle of the Gap-type conductor is that it can be tensioned on the steel core alone during erection.

(Super) Thermal resistant aluminium alloy wire

Gap filled with grease

High Strength Steel Wire



GAP

Re-conductoring solution: GAP

Benefits

- Possibility to increase the capacity of existing lines by 50 to 100%
- Excellent Sag properties
- Modification or reinforcement of the towers is very limited or not required.

	GAP	ACSR Moose
Ampacity (amperes)	1574	797
Sag (m)	13.06	13.25
Tension (Kg)	9421	9421

Condition: Span 400m, Tension 9421 kg, 32°C no wind, Ambient 45°C, Operating Temp: ACSR Moose – 75°C & GAP - 210°C ;

Excellent option for re-conductoring of old lines

DULL CONDUCTOR

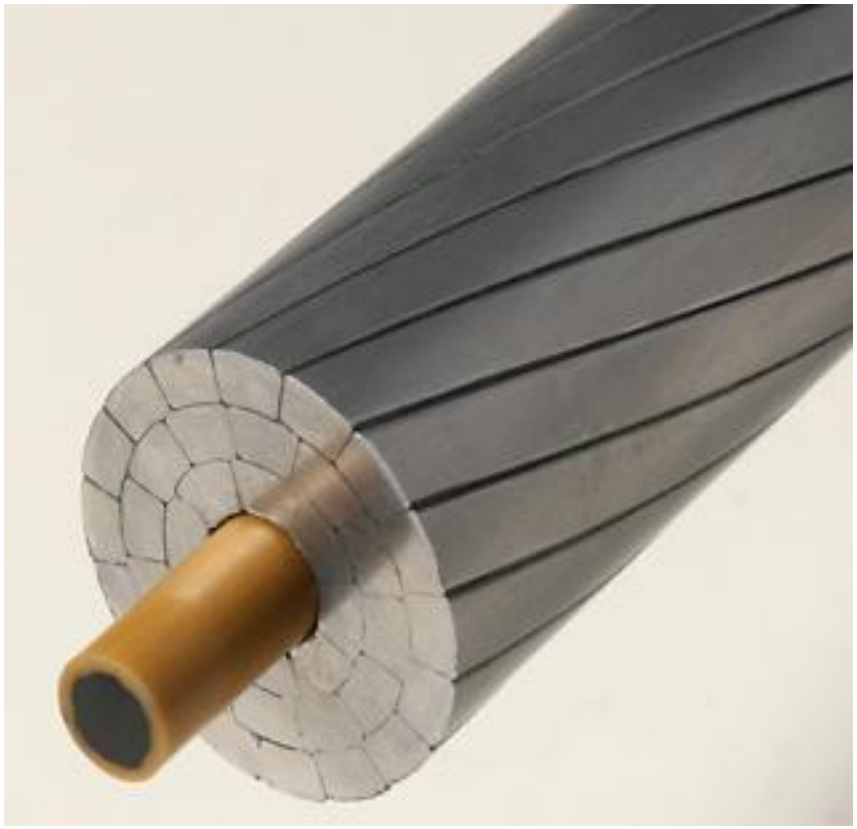
DULL CONDUCTORS

Dull conductors are either mechanically or chemically treated to produce reduced reflectivity. The finished conductor surface is blasted with a very fine mild abrasive grit producing a dull matte gray finish.

BENEFITS:

- Increase in current carrying capacity in the range of 5% due to increase in emissivity of the conductor.
- Aesthetic Appeal

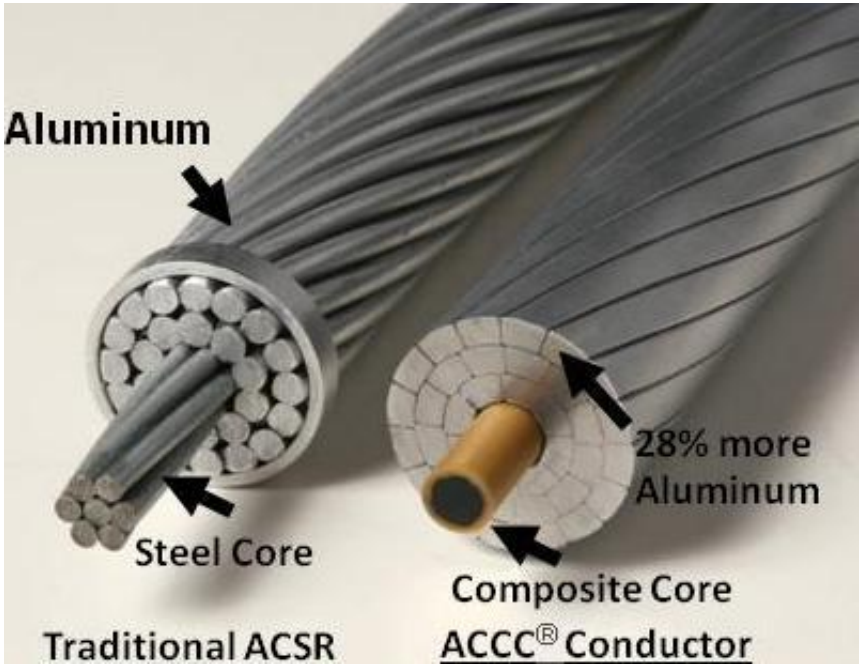
ACCC® conductors



- These are high ampacity, low loss hybrid conductors
- Composition: Carbon, glass fiber and trapezoidal shaped aluminum, that are resistant to environmental degradation.
- These conductors can reduce line losses up to 40% compared with conventional conductors of the same diameter and weight.

Technology patented by CTC Cable Corporation, USA and under license to Sterlite Technologies.

ACCC® conductors

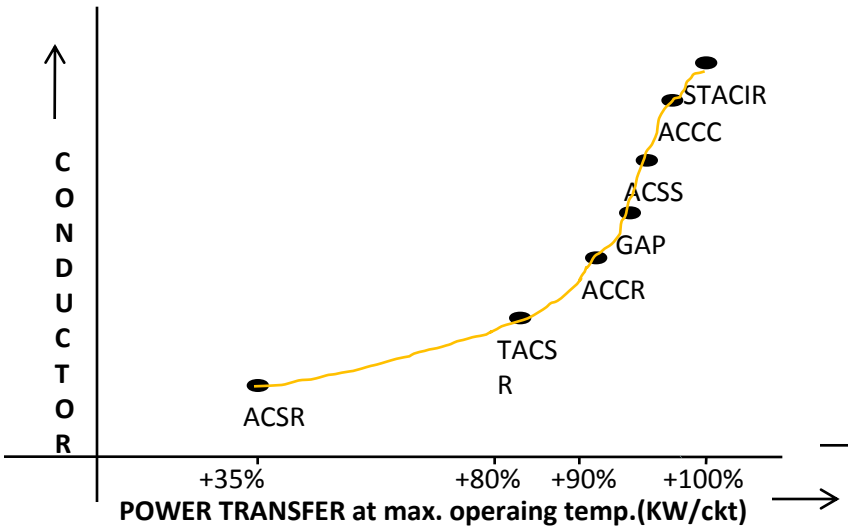


- 28% More Aluminum = Greater Capacity, Reduced Losses, & Cooler Temperatures
- 25% stronger & 60% lighter vs. traditional steel core = fewer or lower structures
- Lower Coefficient of Thermal Expansion = Less Sag at Higher Temperatures

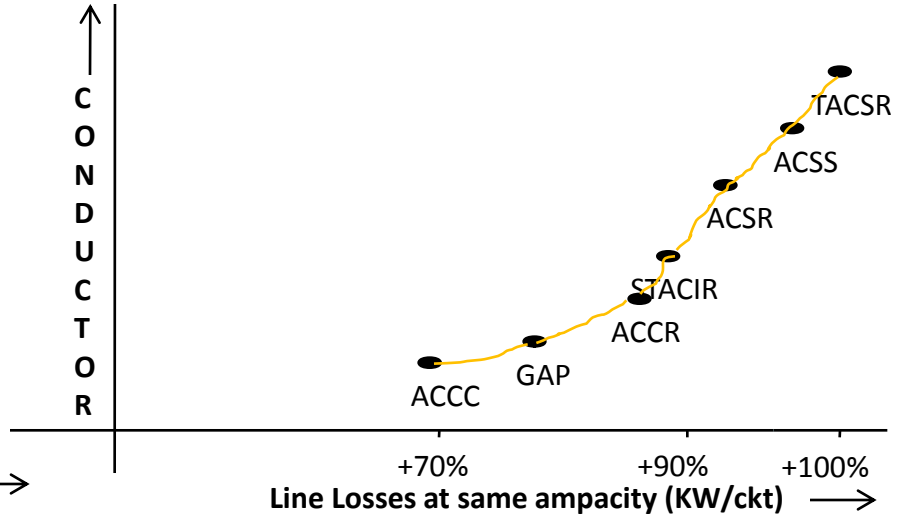
These conductors find use in new line installations and re-conductoring applications.

COMPARISION OF DIFFERENT HTLS CONDUCTORS

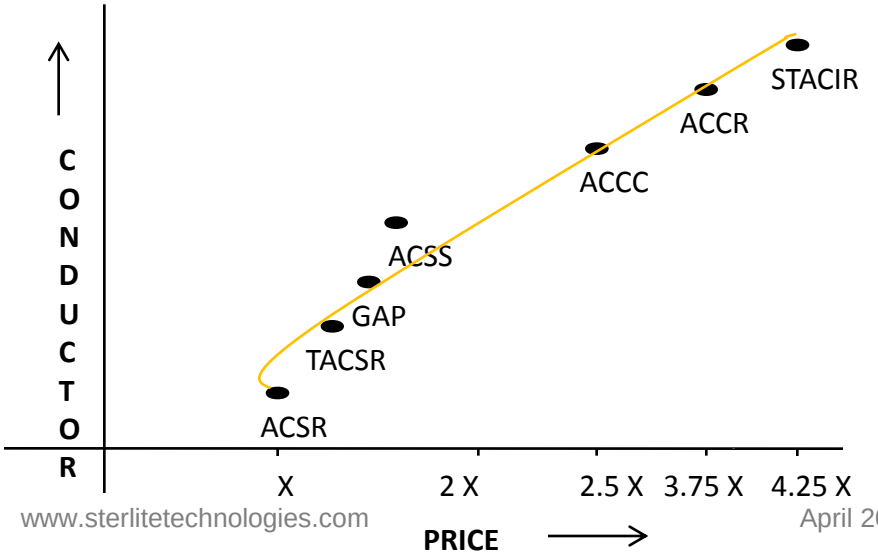
Conductor Performance(Power Transfer)



Conductor Performance(Line Loss)



Conductor Price



INFERENCE:

• ACCC will give us lowest line losses at the same amperage but considering the price also, GAP serves as the most economical & efficient conductor.

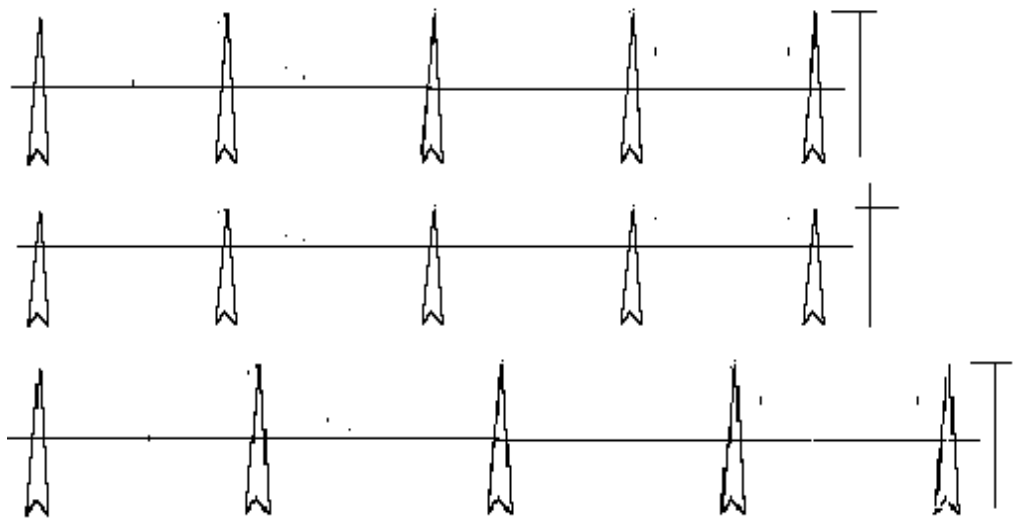
•To draw maximum power STACIR is the best option but again its price limits economic feasibility. ACSS can be a economical option. Only problem is its sag which is more than eq. ACSR.

Summary: Comparison of Conductors

Properties	ACSR Moose	TACSR	Al59	ACCC Delhi	ACSS/TW	STACIR	GTACSR
Cross Sectional Area (Sqmm)	597.0	597.0	594.0	738.4	614.6	597.0	672.0
Conductor Dia (mm)	31.77	31.77	31.70	31.4	28.62	31.77	31.50
Weight (kg/km)	2004.0	2004.0	1640.0	1996.0	1985.3	1956.0	2179.0
UTS (kgf)	16432	16557.6	14545	17166.6	11462.8	15549	18175.3
DC Resistance @ 20° C Temp (ohms/km)	0.05595	0.05564	0.05026	0.04260	0.05140	0.05409	0.04780
Maxiumum Operating Temperature (˚C)	75	150	95	175	210	210	210
Current Carrying Capacity (Amps) at 75 °C	764	766	806	896	775	777	822
Current Carrying Capacity (Amps) at Maximum operating Temperature	764	1511	1103	1950	1846	1869	1979
Sag (Span = 400m) at Maximum operating Temperature	13.25	14.00	13.55	13.04	13.95	12.30	13.06

Optimisation-New line with HTLS Conductors

- Current requirement is known = optimal resistance
- Focus on tower loading: height & length of span
- HTLS's lower sags = lower towers or longer spans
- This translates into capital expense savings



- ACSR Conductor plan
- HTLS lower tension = same spans but lower towers
- HTLS lower tension = longer spans with same towers

THANK YOU