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CTC Global comments to RETI 2.0

Additional submitted attachment is included below.

CTC Global Comments regarding RETI 2.0

November 18, 2015

California Energy Commission
Dockets Office, MS-4
1516 Ninth Street, MS-34
Sacramento, CA 95814

Dear Commissioners,

CTC Global appreciates the opportunity to comment on the Joint Agency Workshop on the Proposed Organization Structure and Work Plan for the Renewable Energy Transmission 2.0 Initiative. Our primary objective is to point out the importance of transmission line efficiency, capacity and reliability.

Following the Western Energy Crisis of 2000 and the Major East Coast Blackout of 2003 (that was ultimately linked with excessive conductor sag after telemetry errors, computer reboot failures and poor communications set the stage), CTC Global developed and commercialized a bare overhead conductor known as ACCC (Aluminum Conductor Composite Core) to mitigate the thermal sag. The reduced sag characteristic and other properties also allowed utilities to double the capacity of existing corridors to alleviate grid bottlenecks, reduce congestion costs and enable the integration of renewables without the need, in many cases, to build new transmission lines. To date nearly 35,000 km of ACCC conductor has been deployed to approximately 375 projects in more than 35 countries.

The reason that CTC is bringing this to your attention actually relates to this technology's efficiency. Because the ACCC conductor uses a carbon fiber core that is substantially stronger and lighter than steel, it is able to utilize approximately 28% more conductive aluminum. The improved efficiency serves to reduce line losses by 25 to 40% or more compared to any other conductor type of the same diameter and weight.

Though the importance of improved efficiency for generators, transformers and demand side appliances are well known, widely encouraged, and often subsidized, it seems strange that very little consideration is given to the electric wires themselves that connect all of these devices.

Line loss reductions not only serve to reduce fuel consumption - and electrical costs - they also reduce associated emissions and/or improve the economic viability of renewable resources. Additionally, line loss reductions also free-up existing generation capacity that is otherwise wasted.

CTC Global recently met with team members at the CEC and presented a case study. The case study considered an example that closely replicated a 240 circuit mile project nearing completion in Texas by American Electric Power. As an FYI, AEP's project was undertaken while the line remained energized. For simplification, the case study presented to the CEC team by CTC Global considered a 100 mile section of a 345 kV line that used double-bundled ACCC conductor to replace double-bundled ACSR conductor of the same diameter and weight. Not unlike the AEP project, the line considered a 3,200 amp peak load. A load factor of

62% was assumed. The actual capacity of the ACCC conductor in this configuration (with certain ambient assumptions made) is ~3,800 amps, meaning that there would be even more capacity available for emergency conditions.

The case study presented to the CEC staff offered the following findings:

- ACCC increased line capacity over ACSR by 57% (with additional capacity for growth or N-1 emergency conditions).
- ACCC reduced line losses by 30% compared to ACSR which saved ~300,000 MWh per year.
- The value of reduced line losses (@ $0.06/kWh) = $17,745,387 per year.
- The approximate cost of ACCC for this project = $12,672,000.
- If the cost of installation was an additional $20,000,000, the payback would be less than 2 years.
- Emission reduction saving (assuming the national average of all combined sources at 1.372 pounds of CO_2 per kWh) = 184,060 Metric Tons per year. (One car = 3.75 MT per year)
- Improving the efficiency of this 100 mile section of a 345 kV line would have the same impact as taking 49,082 cars off the highway.
- Line loss reductions in this scenario would also free-up ~50 MW of generation that is otherwise wasted supporting line losses.
- Assuming the cost of installing new generation was $1.2 million per MW, this would save ~$60,000,000.

CTC encourages RETI 2.0 stakeholders to consider the importance of leveraging proven conductor technology to further improve the efficiency, capacity and reliability of the grid as RETI 2.0 plans evolve further. A screen shot of the case study analysis is shown below.

Respectfully Submitted,

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CTC GLOBAL

Save Comparison to PDF

100 Mile 345 kV Reconductor Case Study

Conductor Information

Parameter		Base Conductor		Conductor #1		Conductor #2		Conductor #3
Type:		ACCC®		ACSS		ACSS/HS-285		ACSR
Size (kcmil Al - Code Word):	kcmil	1026 - DRAKE	kcmil	795 - DRAKE	kcmil	795 - DRAKE	kcmil	795 - DRAKE
Aluminum Area (kcmil):		1025.6		795.0		795.0		795.0
Diameter (in.):		1.108		1.108		1.108		1.108
Rated Strength (lbf):		41,200.0		25,900.0		32,600.0		31,500.0
Weight (lb/kft):		1,051.8		1,093.4		1,093.4		1,094.0
DC Resistance at 20°C (ohms/kft):		0.0163		0.0208		0.0208		0.0214
AC Resistance at 25°C (ohms/kft):		0.0169		0.0215		0.0215		0.0221
AC Resistance at 75°C (ohms/kft):		0.0202		0.0257		0.0257		0.0263
Conductors per phase:		2		2		2		2
Circuits:		1		1		1		1
Ampacity (A) at Temperature (°C):	100	2,503	100	2,215	100	2,215	100	2,192
Ampacity (A) at Rated Operating Temp (°C):	180	3,611	200	3,380	200	3,380	75	1,721
Ampacity (A) at Maximum Temp (°C):	200	3,826	250	3,810	250	3,810	100	2,192

Line Losses (100 miles, 3200 Peak Amps)

Parameter	Base Conductor	Conductor #1	Conductor #2	Conductor #3
Steady-State Temperature (ºC) at Peak Ampacity:	146	181	181	184
Resistance at Peak Operating Amps (ohm/mile):	0.13093	0.18330	0.18336	0.18770
First Year Line Losses (MWh):	739,474	1,035,231	1,035,566	1,060,067
ACCC® 1026 - DRAKE - Reduces First Year Line Losses by (MWh):	--	295,756	296,092	320,593
ACCC® 1026 - DRAKE - Reduces First Year Line Losses by (%):	--	29%	29%	30%
ACCC® 1026 - DRAKE - Reduces First Year Line Losses by ($/Year):	--	17,745,387	17,765,509	19,235,574
ACCC® 1026 - DRAKE - Line Loss Savings of Conductor ($/ft/Year):	--	5.60	5.61	6.07
ACCC® 1026 - DRAKE - Reduces 30 year line loss by ($):	--	532,361,625	532,965,263	577,067,228
ACCC® 1026 - DRAKE - Reduces First Year CO_2 Generated by (MT):	--	184,060	184,268	199,516
ACCC® 1026 - DRAKE - Reduces 30 year CO_2 generation by (MT):	--	5,521,789	5,528,050	5,985,487

Generation Savings

Parameter	Base Conductor	Conductor #1	Conductor #2	Conductor #3
Generation Capacity Required to Supply Line Losses (MW):	124.69	174.56	174.62	178.75
ACCC®-1026 - DRAKE reduces generation capacity by (MW):	--	49.87	49.93	54.06
ACCC®-1026 - DRAKE reduces cost of Capacity by ($):	--	$59,844,288	$59,912,145	$64,869,773

Initial Sag/Tension at Stringing Temperature (5C):

Parameter	Base Conductor	Conductor #1	Conductor #2	Conductor #3
Ruling Span (ft):	1000.0	1000.0	1000.0	1000.0
% RTS:	15.0%	24.0%	19.0%	20.0%
Sag at Initial Sagging Temperature (ft):	21.30	22.00	22.10	21.70
Total Initial Tension at Tower at Sagging Temperature (lbf):	12,360.0	12,432.0	12,388.0	12,600.0
Total Conductor Weight/phase (lb/kft):	2103.6	2186.8	2186.8	2188.0

Sag/Tension at Above Stringing Temperature:

	Parameter	Base Conductor	Conductor #1	Conductor #2	Conductor #3
Sag at Peak Operating Amps	Temp(ºC):	146	181	181	184
	Sag (ft):	28.10	36.29	36.35	36.45
	Total Tower Tension (lbf):	9,358.0	7,532.0	7,520.0	7,504.0
Sag at Rated Operating Temperature	Temp(ºC):	180	200	200	75
	Sag (ft):	28.33	37.23	37.30	29.65
	Total Tower Tension (lbf):	9,282.0	7,342.0	7,330.0	9,224.0
Sag at Maximum Temperature	Temp(ºC):	200	250	250	100
	Sag (ft):	28.46	39.65	39.71	32.19
	Total Tower Tension (lbf):	9,238.0	6,894.0	6,884.0	8,498.0
Max Temperature at Max Allowable Sag of 34 ft.	Max. Temp(ºC):	201	137	136	101
	Sag (ft):	28.47	34.06	34.08	32.24
	Total Tower Tension (lbf):	9,236.0	8,024.0	8,022.0	8,484.0
Ampacity Cells Turn Red if Max Capacity is not reached	Ampacity (A):	3,836	2,728	2,716	2,208

Wind / Ice or Cold Temperature Sag/Tension

	Parameter	Base Conductor	Conductor #1	Conductor #2	Conductor #3
	Total Sag (ft):	29.90	29.84	29.89	26.60
	Total Tower Tension (lbf):	20,726	21,100	21,062	23,664
% RTS cells turn red when Max. % RTS is exceeded	% RTS:	25.2%	40.7%	32.3%	37.6%

Knee Point Temperature Sag/Tension:

Parameter	Base Conductor	Conductor #1	Conductor #2	Conductor #3
Knee Point Temperature (°C):	60	92	92	101
Sag (ft):	27.54	31.72	31.79	32.24
Total Tower Tension (lbf):	9550.0	8618.0	8600.0	8484.0

Environmental Inputs: Sun Radiation (W/ft²) = 89.9, Ambient Temp. (ºC) = 30, Wind (ft/sec) = 2, Elevation (ft) = 150, Solar Absorptivity = 0.6, Emissivity = 0.6, Wind Angle (deg.) = 90
Load and Generation Cost Assumptions: Line Length (miles) = 100, Voltage (kV) = 345, Peak Operating Amps = 3200 A (1912.1 MW), Load Factor = 62%, Loss Factor = 42%, Phases/Circuit = 3, Cost of Energy Generation ($/MWh) = 60, CO_2 (lb/kWh) = 1.4, Load Increase/Year = 0
Wind / Ice or Cold Temperature Sag/Tension: Temperature (°C)=-20, Windspeed (mph)=40, K-Factor (lb/ft)=0.3,Radial Ice Thickness (in.)=0.5, Ice Density (lb/ft³)=57, Max. % RTS=60

Version	Language	Voltage Type	Select Units
4.0	English	AC	US Units

Environmental Inputs

Input Solar Radiation Parameters

89.9	Sun Radiation (W/ft²)
30.0	Ambient Temp. (ºC)
2.00	Wind (ft/sec)
150	Elevation (ft)
0.60	Solar Absorptivity
0.60	Emissivity
90	Wind Angle (deg.)
0	Azimuth of Line (NS=0, EW=90)
36	Latitude (neg = South)
June	Month
9	Day of Month
15	Time (24 hrs.)
Clear	Atmosphere

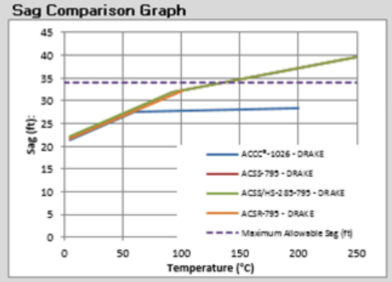
Load and Generation Cost Assumptions

100.0	Line Length (miles)
345	Voltage (kV)
3,200	Peak Operating Amps
62%	Load Factor
42%	Loss Factor
1912	Peak Power per Circuit (MW)
3	Phases/Circuit
60	Cost of Energy Generation ($/MWh)
0%	Load Increase/Year
US Average	Select Generation Fuel Type
1.372	CO_2 (lb/kWh)
$1,200	Installed Generation Cost ($/kW)
-38	Required Generation Reserve (%)

Initial Sag/Tension at Stringing Temperature (5C):

5.0	Initial Sagging Temperature (°C)
34.0	Maximum Allowable Sag (ft)

Sag Comparison Graph



Click to See Larger Sag/Temp. Chart

Click to See Amps/Temp. Chart

Wind / Ice Conditions

NESC HEAVY

-20	Temperature (°C)
40.0	Windspeed (mph)
0.30	K-Factor (lb/ft)
0.50	Radial Ice Thickness (in.)
57.0	Ice Density (lb/ft³)
60.0	Max. % RTS