2019 PLS-CADD Advanced Training and User Group

69KV Project Replacing w/ HTLS Conductors

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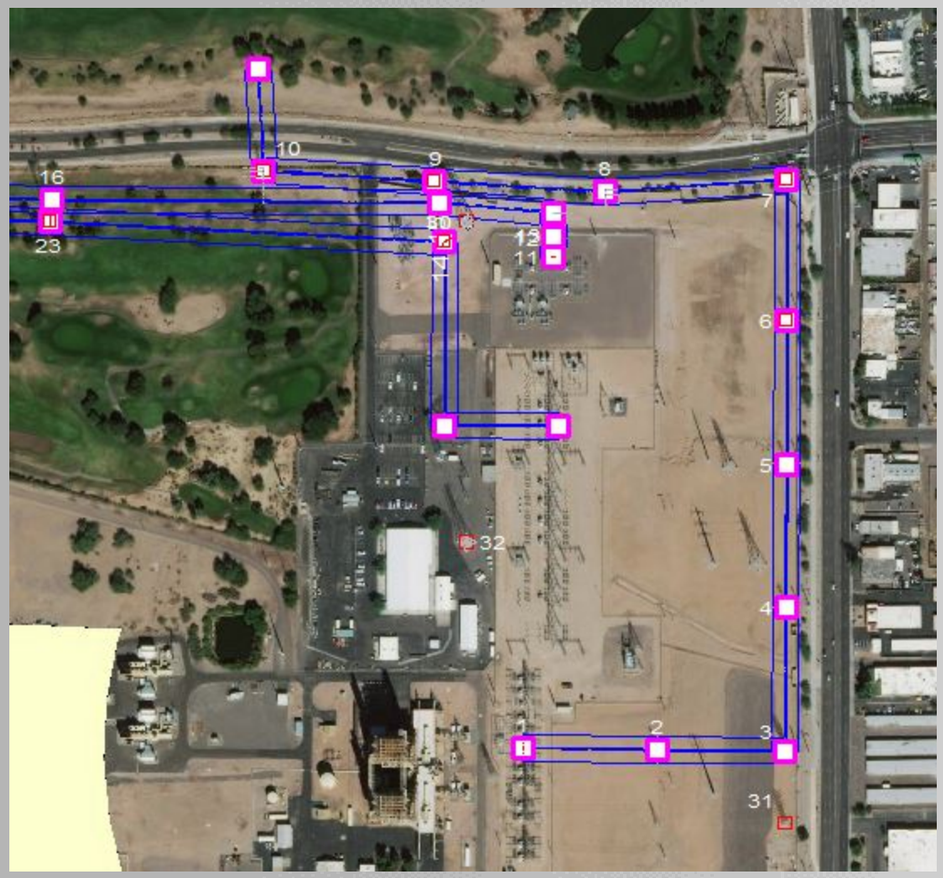
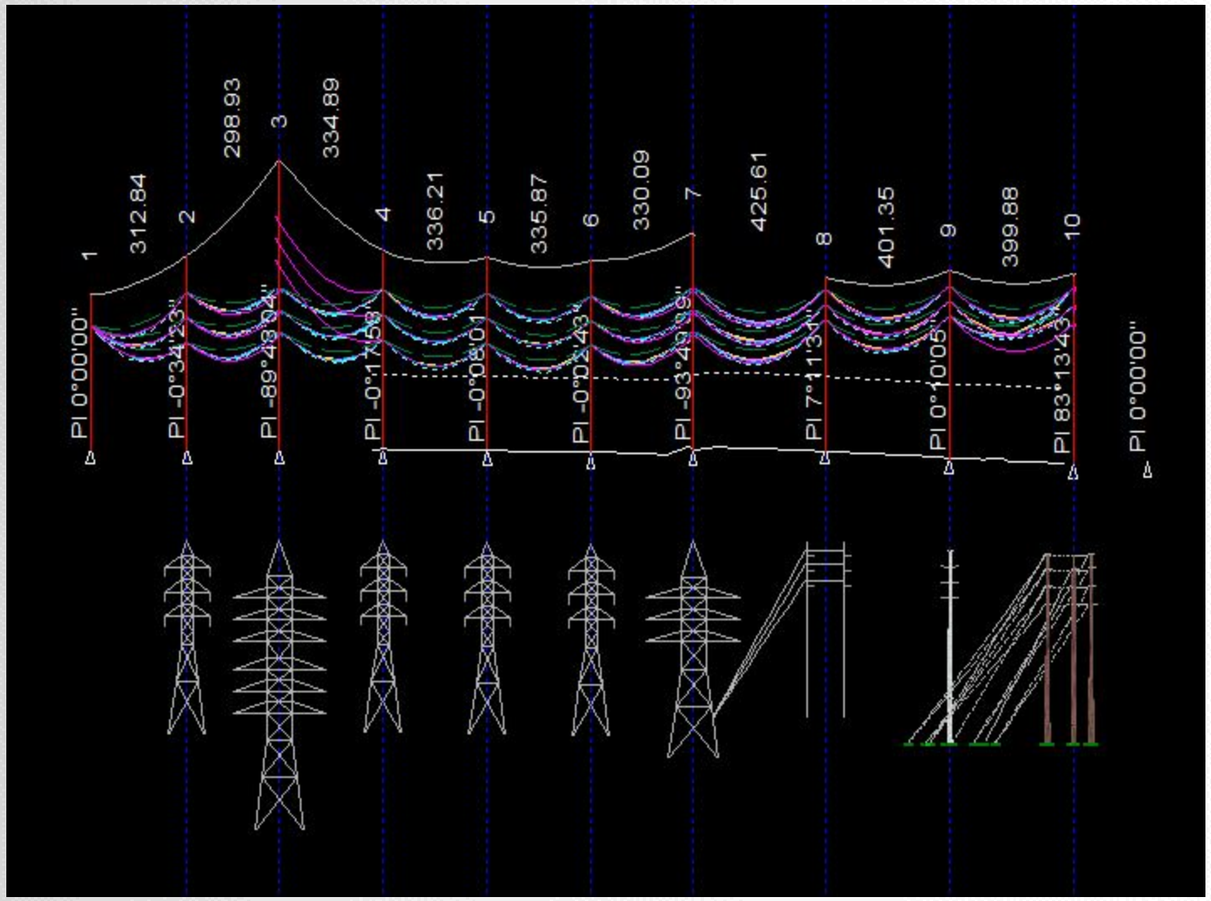
69kV Conductor Upgrade Project (AA → ACSS "ish")

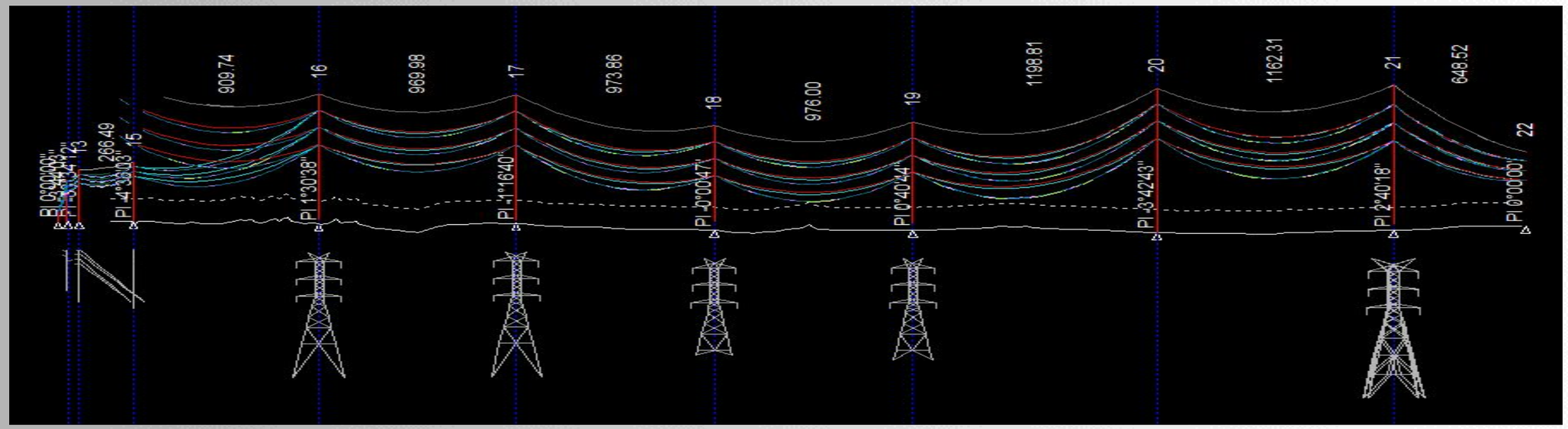
- 2 miles of double circuit 69kV for upgrade
  - No structures are to be replaced...???
  - Only conductor to be replaced for upgrade
  - OPGW installation requested also...

EAST Section



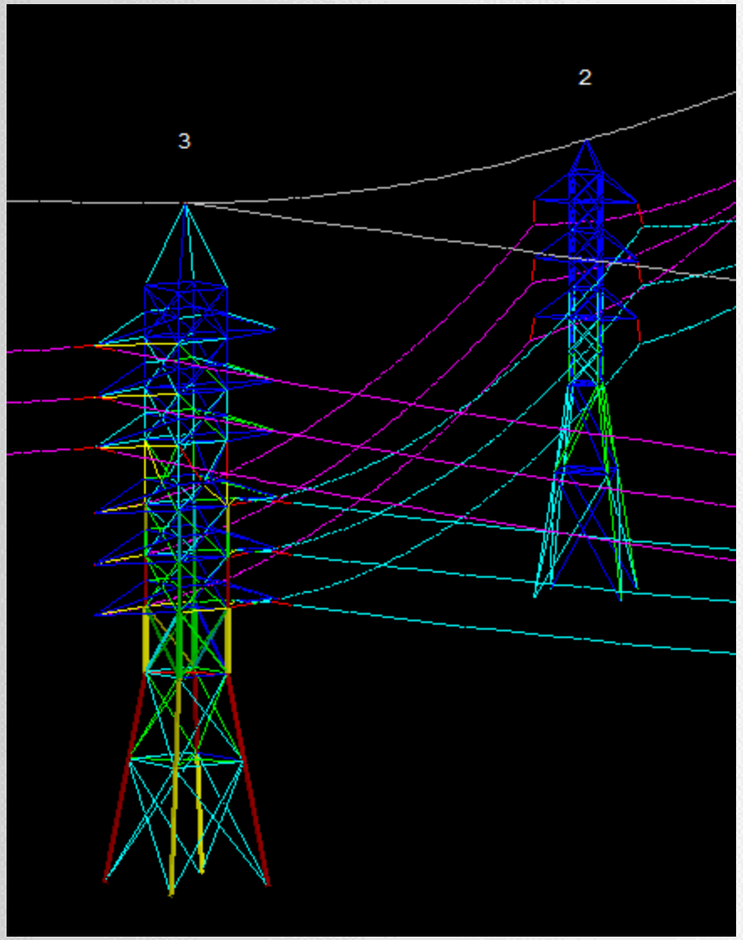


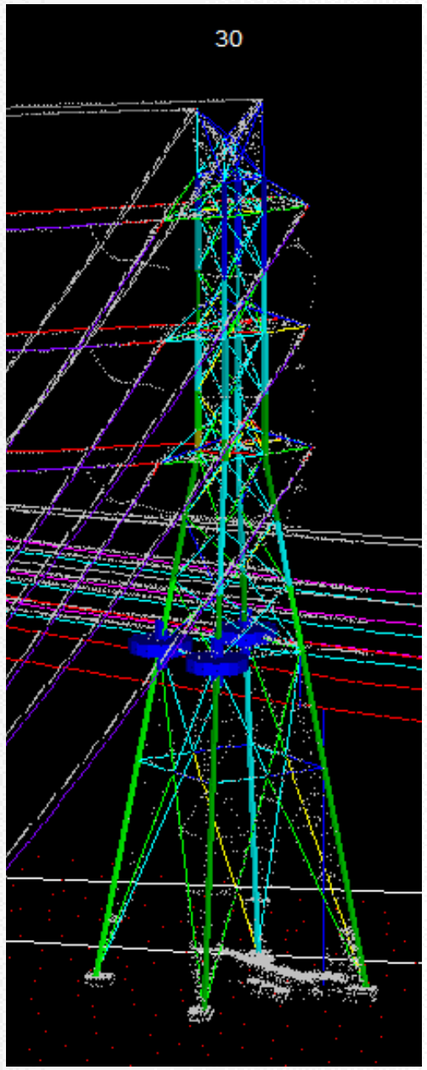
WEST Section



Structure Modeling

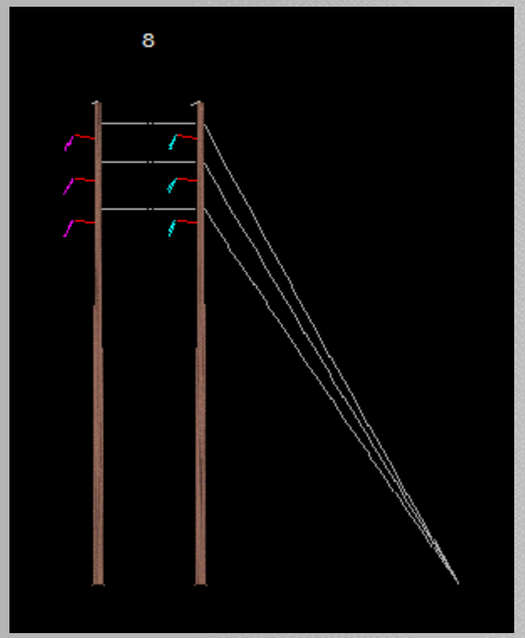
- Towers
  - 1960's vintage Generation Station Towers
  - 1970's vintage Tangent and DE Towers
    - Tower drawings difficult to find and limited in model detailing
- PJ Ford
  - Tower modeling support
    - Ongoing engineering support for remediation activities...

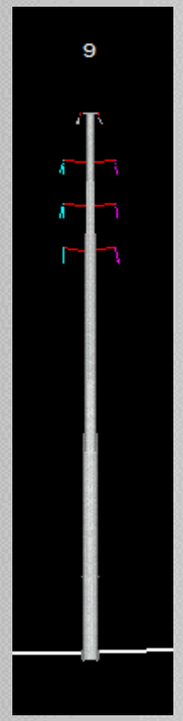


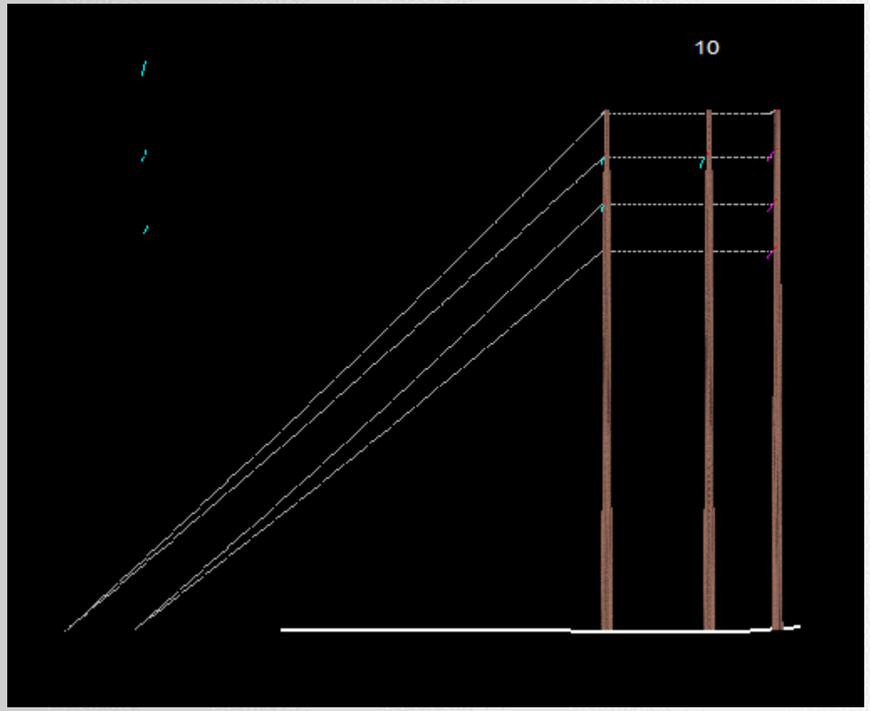


Structure Modeling

- Poles
  - Existing Steel and wood pole structures

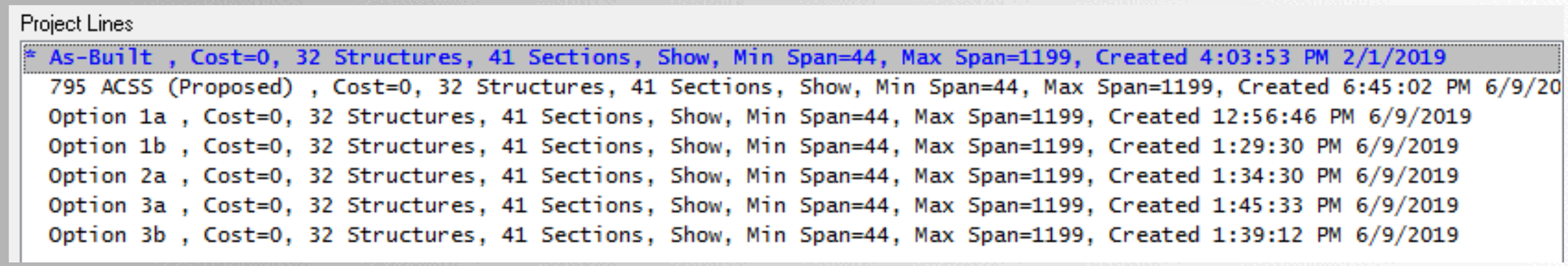






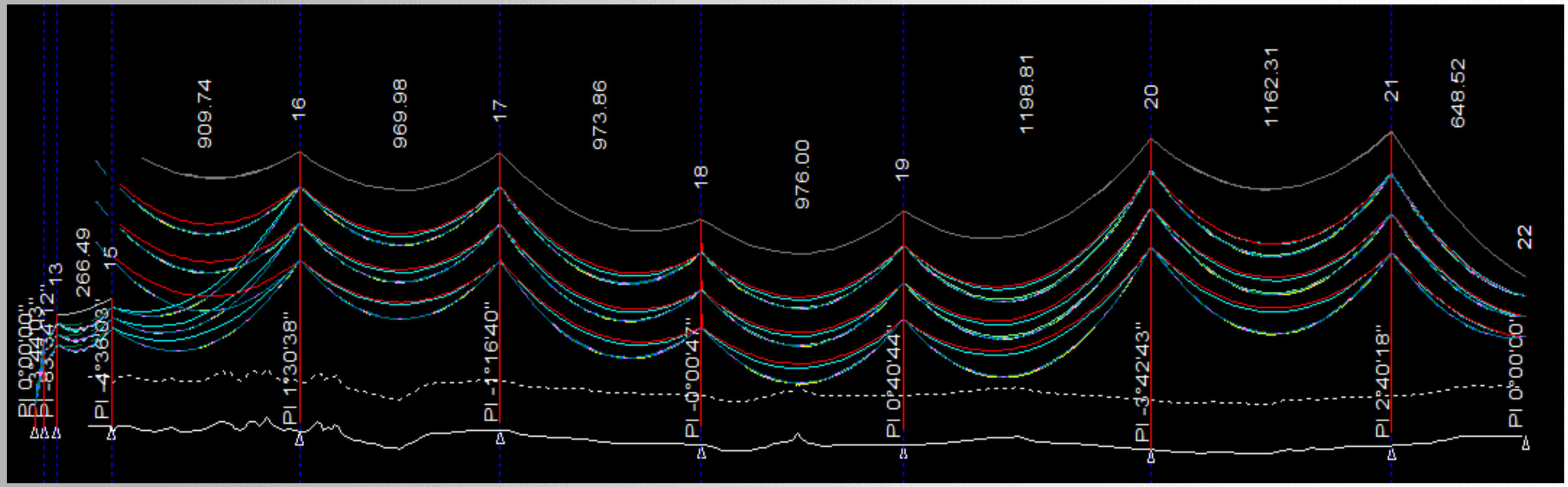
Conductor Type Selection

- Normal upgrade conductor = 795 “Tern” ACSS
  - does not work due to sag / clearance and structure loading issues
- Multiple Manufactures for Specialized Conductor selection
  - Need to follow specs for Arbutus (existing conductor) but also need to support 1600 amp ratings (AZ Summer environment)
  - Need to maintain or reduce loading on existing structures
  - Need to be installed at same or reduced tension compared to Arbutus

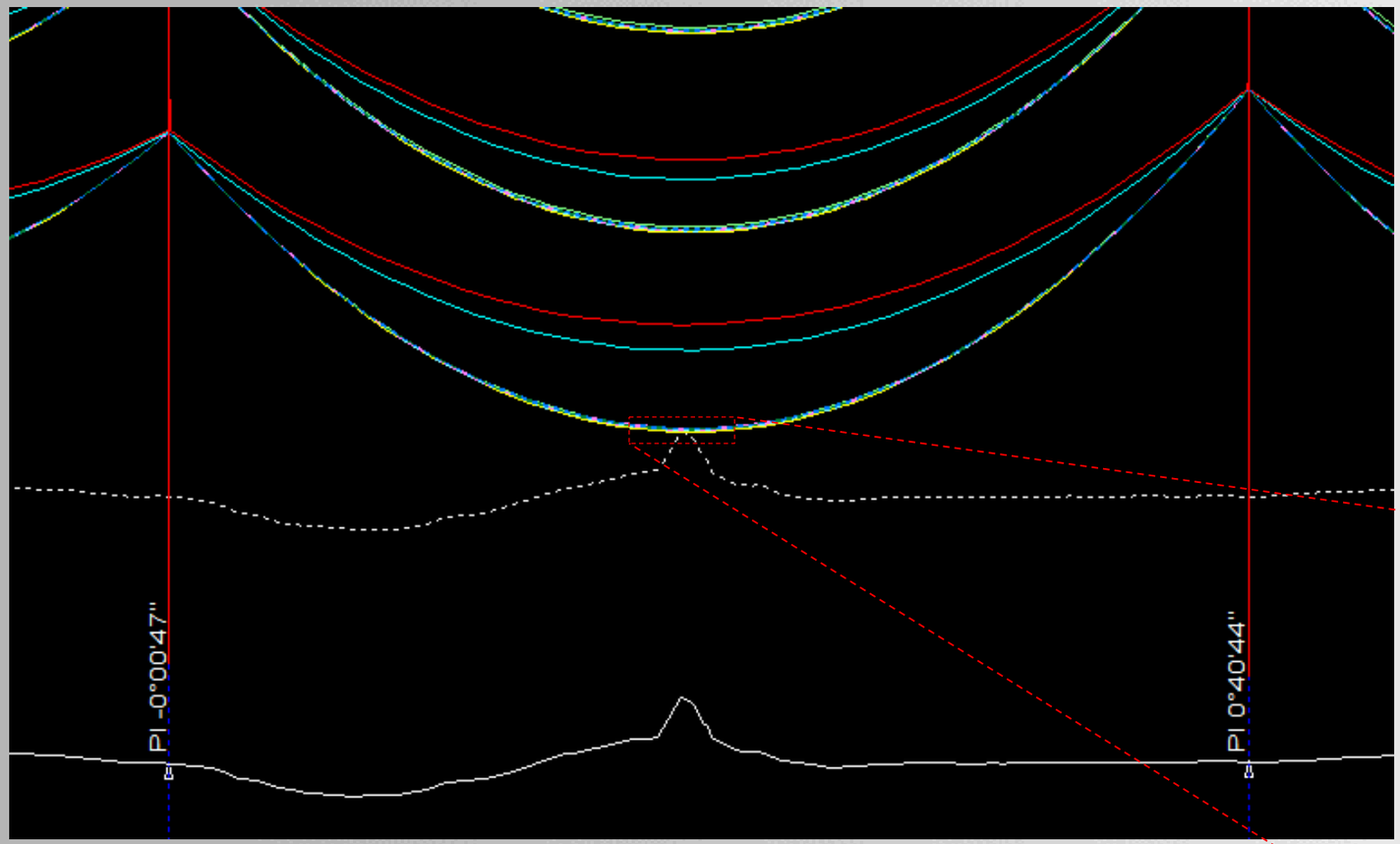


Clearances vs. Tension

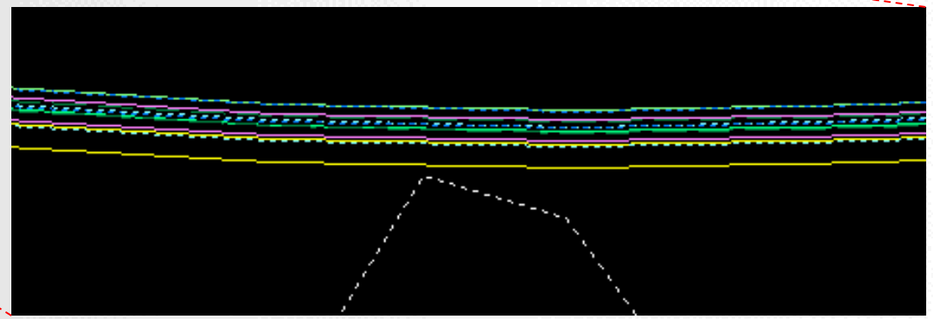
- Due to span lengths and existing structures... Graphical Sagging was used for fitting conductor(s) to the existing terrain.



Clearances vs. Tension with Graphical Sagging



- All specialized conductors were “fit” to the terrain allowing a 2 ft buffer for additional clearance.
- 4” vertical deviation



Structure Remediation – per Conductor Type

– Tower member over-stress based on Conductor Selection

167DegF

As-Built Arbutus	
% of RBS @ 60 Deg F Initial FE	22.5

Row Labels	Max of Maximum Usage %
2-pole tangent str sd guy dn guys.pol	164.03
3pole_DblCkt_DDE.pol	224.99
Angle Dead End With PCS+00BE+35LE.tow	159.74
20	159.74
27	127.86
28	155.36
E-17801 230 DCT.tow	115.48
E-17801 230 DCT+00BE+LE-10-10-10-10.tow	167.99
E-17801 230 DCT+00BE+LE-35-35-35-35.tow	306.29
E-18604 230 DCA-1.TOW	128.65
E-18610 0°-90° Angle Dead End Family.tow	136.06
G-13910 90° Turn Tower - 4 Circuit-96.5.TOW	140.85
Grand Total	306.29

392DegF

Requested 795 "Tern" ACSS	
% of RBS @ 60 Deg F Initial FE	55.6

Row Labels	Max of Maximum Usage %
2-pole tangent str sd guy dn guys.pol	164.03
3pole_DblCkt_DDE.pol	224.98
Angle Dead End With PCS+00BE+35LE.tow	164.06
20	155.98
28	164.06
27	134.31
E-17801 230 DCT.tow	107.64
E-17801 230 DCT+00BE+LE-10-10-10-10.tow	122.25
E-17801 230 DCT+00BE+LE-35-35-35-35.tow	135.64
E-18610 0°-90° Angle Dead End Family.tow	136.06
G-13910 90° Turn Tower - 4 Circuit-96.5.TOW	128.27
RioSalado TangentDropPole.pol	229.68
RioSaladoSub DE Drop Pole.pol	300.51
Grand Total	300.51

392DegF

Option 1A	
% of RBS @ 60 Deg F Initial FE	26.7

Row Labels	Max of Maximum Usage %
2-pole tangent str sd guy dn guys.pol	164.03
3pole_DblCkt_DDE.pol	224.99
Angle Dead End With PCS+00BE+35LE.tow	144.66
28	129.32
27	113.76
28	144.66
E-17801 230 DCT.tow	102.1
E-17801 230 DCT+00BE+LE-10-10-10-10.tow	114.14
E-17801 230 DCT+00BE+LE-35-35-35-35.tow	125.53
E-18610 0°-90° Angle Dead End Family.tow	136.06
G-13910 90° Turn Tower - 4 Circuit-96.5.TOW	136.87
Grand Total	224.99

Excessive Tension

392DegF

Option 1B	
% of RBS @ 60 Deg F Initial FE	21.8

Row Labels	Max of Maximum Usage %
2-pole tangent str sd guy dn guys.pol	164.03
3pole_DblCkt_DDE.pol	224.99
Angle Dead End With PCS+00BE+35LE.tow	150.47
20	138.54
27	116.44
28	150.47
E-17801 230 DCT.tow	106.08
E-17801 230 DCT+00BE+LE-10-10-10-10.tow	119.82
E-17801 230 DCT+00BE+LE-35-35-35-35.tow	131.77
E-18610 0°-90° Angle Dead End Family.tow	136.06
G-13910 90° Turn Tower - 4 Circuit-96.5.TOW	140.47
Grand Total	224.99

392DegF

Option 2A	
% of RBS @ 60 Deg F Initial FE	14.2

Row Labels	Max of Maximum Usage %
2-pole tangent str sd guy dn guys.pol	164.03
3pole_DblCkt_DDE.pol	224.97
Angle Dead End With PCS+00BE+35LE.tow	127.58
20	127.58
27	102.85
28	121.59
E-17801 230 DCT+00BE+LE-10-10-10-10.tow	111.3
E-17801 230 DCT+00BE+LE-35-35-35-35.tow	119.37
E-18610 0°-90° Angle Dead End Family.tow	136.06
G-13910 90° Turn Tower - 4 Circuit-96.5.TOW	128.24
Grand Total	224.97

Excessive Tension
Blow Out

392DegF

Option 2A	
% of RBS @ 60 Deg F Initial FE	25

Row Labels	Max of Max
2-pole tangent str sd guy dn guys.pol	164.03
3pole_DblCkt_DDE.pol	224.97
Angle Dead End With PCS+00BE+35LE.tow	153.37
20	140.48
27	116.36
28	153.37
E-17801 230 DCT+00BE+LE-10-10-10-10.tow	112.54
E-17801 230 DCT+00BE+LE-35-35-35-35.tow	124.78
E-18610 0°-90° Angle Dead End Family.tow	136.06
G-13910 90° Turn Tower - 4 Circuit-96.5.TOW	128.24
Grand Total	224.97

392DegF

Option 3A	
% of RBS @ 60 Deg F Initial FE	32.6

Row Labels	Max of Maximum Usage %
2-pole tangent str sd guy dn guys.pol	164.03
3pole_DblCkt_DDE.pol	224.97
Angle Dead End With PCS+00BE+35LE.tow	127.58
20	127.58
27	112.18
28	116.3
E-17801 230 DCT.tow	102.75
E-17801 230 DCT+00BE+LE-10-10-10-10.tow	114.47
E-17801 230 DCT+00BE+LE-35-35-35-35.tow	125.04
E-18610 0°-90° Angle Dead End Family.tow	136.06
G-13910 90° Turn Tower - 4 Circuit-96.5.TOW	128.25
Grand Total	224.97

Excessive Tension

392DegF

Option 3B	
% of RBS @ 60 Deg F Initial FE	36.5

Row Labels	Max of Maximum Usage %
2-pole tangent str sd guy dn guys.pol	164.03
3pole_DblCkt_DDE.pol	224.98
Angle Dead End With PCS+00BE+35LE.tow	149.12
20	135.28
27	115.56
28	149.12
E-17801 230 DCT.tow	103.26
E-17801 230 DCT+00BE+LE-10-10-10-10.tow	116.58
E-17801 230 DCT+00BE+LE-35-35-35-35.tow	128.26
E-18610 0°-90° Angle Dead End Family.tow	136.06
G-13910 90° Turn Tower - 4 Circuit-96.5.TOW	128.25
Grand Total	224.98

Excessive Tension

Conclusion

- Model Towers – don’t take short cuts
  - Modeling the towers shows that the as-built conditions produce overloaded members, not expected...
  - Also allows the user to identify unknown capacities that may be used if needed
- Conductor Manufacturers
  - Using multiple WIR files from various manufacturers was helpful to better refine the potential installation solutions (alternate tensions, etc.)
- Specialized Conductors vs. Traditional Upgrade Methods
  - Evaluating a range of specialized conductor options could and some times will be less expensive than doing a full rebuild

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