The Nip/Tuck Method
A Solution to Providing Additional Conductor-to-Ground Clearances for Transmission Lines

46th Annual TSDOS Conference
September 11-13th, 2013
Addison, TX

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SUMMARY

- Why the interest in clearances?
- What is Nip / Tuck Method?
- What are its uses?
- How does it compare to other methods?
- How do I do it?
- Case study
Why the Interest in Clearances?

- NERC Alert of October 2010
- Review current facility ratings methodology / clearances
- Result: Comprehensive review of transmission lines.
What is the Nip/Tuck Method?

- The Nip/Tuck Method is a method of removing or adjusting slack in a span to improve clearances.

**The Nip:** Removes a section of conductor in order to shorten the length of conductor in a given span. This increases the tension in the span which improves the conductor-to-ground clearance in the given span.

**The Tuck:** Slides a length of conductor from one span to another. This shifts the amount of slack from one span to another. Improves clearance in one span at the sacrifice of another span.
Pros and Cons

- Works well for long spans
- Creates longitudinal loads
- Outages can be much shorter as compared to other methods
- Requires a precise survey of the line and using state-of-the art analysis programs
Nip/Tuck Method Requirements

Needed:
- Residual Capacity
- Accurate Survey (LiDAR)
- 3D Finite Element Software (PLS-CADD)
  - SAPS Module

Recommended:
- PLS-Pole models of the structures (Method 4)
- Separate conductors strung for each phase
Traditional Clearance Fixes

- Re-tensioning
- Re-grading
- Nip / Tuck
- Floating Deadend
- Full-Strain Conversion
- Intermediate Structure
- Structure Replacement Modification
Considerations When Improving Clearances

- Costs
- Client Criteria
- Constructability Issues
- Accessibility Issues
- Design Considerations
  - Clearances
  - Uplift
  - Insulator Swing
  - Structure Usage
Case Study – 765 kV line

- Span – 1250 ft
- Lattice towers – 130 ft tall
- Clearance issue of 0.5 ft

- Solution – Remove 3 ft of conductor

Check of:
Insulator swing: Change of 1 to 2.5 degrees
Unbalanced load: Change of 300lbs to 1000lbs
Tracking the Analysis

» Find a Method That Works for You:
   > Stay Consistent … Outline Changes… Simplify QAQC

<table>
<thead>
<tr>
<th>Violation Information</th>
<th>Structure From</th>
<th>Structure To</th>
<th>Span (ft)</th>
<th>Extent of Clearance Violation (ft)</th>
<th>Wire to be Removed (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4/3</td>
<td>4/4</td>
<td>1550</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>18(4/4)</td>
<td>5/1</td>
<td>1250</td>
<td>0.5</td>
<td>3</td>
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<tr>
<td></td>
<td>5/1</td>
<td>5/2</td>
<td>1060</td>
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<td></td>
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</tbody>
</table>

**Str 4/4 to 5/1**

(Left Phase)

<table>
<thead>
<tr>
<th>Structure Type</th>
<th>Existing Imbalance (lbs)</th>
<th>Existing Long. Insulator Swing (deg)</th>
<th>New Imbalance (lbs)</th>
<th>New Long. Insulator Swing (deg)</th>
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</thead>
<tbody>
<tr>
<td>4/3</td>
<td>HS1</td>
<td>129</td>
<td>0.25</td>
<td>937</td>
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<tr>
<td>18(4/4)</td>
<td>HSA1</td>
<td>334</td>
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<td>-73</td>
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<td>5/1</td>
<td>HS1</td>
<td>274</td>
<td>0.1</td>
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<td>5/2</td>
<td>HS1</td>
<td>-120</td>
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<td>-570</td>
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(Middle Phase)

<table>
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<th>Structure Type</th>
<th>Existing Imbalance (lbs)</th>
<th>Existing Long. Insulator Swing (deg)</th>
<th>New Imbalance (lbs)</th>
<th>New Long. Insulator Swing (deg)</th>
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<td>969</td>
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<td>-161</td>
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<td>HS1</td>
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<td>HS1</td>
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(Right Phase)

<table>
<thead>
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<th>Structure Type</th>
<th>Existing Imbalance (lbs)</th>
<th>Existing Long. Insulator Swing (deg)</th>
<th>New Imbalance (lbs)</th>
<th>New Long. Insulator Swing (deg)</th>
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<td>-501</td>
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TRC
Case Study – 345kV line

- Span – 1360 ft
- Lattice towers – 120 ft tall
- Clearance issue of 1.0 to 2.5 ft

- Solution – Remove 3.5 ft of conductor

Check of:
Insulator swing: Change of 4 to 7 degrees
Unbalanced load: Change of 250lbs to 700lbs
## Tracking the Analysis

### Violation Information

<table>
<thead>
<tr>
<th>Structure From</th>
<th>Structure To</th>
<th>Span (ft)</th>
<th>Extent of Clearance Violation (ft)</th>
<th>Wire to be Removed (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/1</td>
<td>6/2</td>
<td>830</td>
<td>2.5</td>
<td>3.5</td>
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<td>6/2</td>
<td>6/3</td>
<td>1360</td>
<td>1</td>
<td></td>
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<tr>
<td>6/3</td>
<td>6/4</td>
<td>1180</td>
<td>1</td>
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</tbody>
</table>

### Existing Structure Information

<table>
<thead>
<tr>
<th>Structure</th>
<th>Structure Type</th>
<th>Existing Imbalance (lbs)</th>
<th>Existing Long Insulator Swing (deg)</th>
<th>New Imbalance (lbs)</th>
<th>New Long Insulator Swing (deg)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>GS2</td>
<td>-171</td>
<td>1.15</td>
<td>404</td>
<td>-2.9</td>
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<td>GS2</td>
<td>254</td>
<td>1.15</td>
<td>182</td>
<td>-0.56</td>
</tr>
<tr>
<td>6/3</td>
<td>GS2</td>
<td>-63</td>
<td>0.34</td>
<td>76</td>
<td>-0.74</td>
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<td>GS2</td>
<td>130</td>
<td>1.6</td>
<td>-506</td>
<td>7.03</td>
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</tbody>
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### Notes

1. These calculations are based on the assumption that the insulator strings on either side of the Nip will be placed in blocks. Insulators will be plumbed vertically after the piece of conductor is removed.
2. Conductor tensions are based on the NESC Heavy Loading (initial). Insulator swings are based on a 60°F, no wind, final condition.
Demonstration in PLS-CADD
Steps of the Nip/Tuck Method

→ Iterative Process to Satisfy Requirements:
  - “Clip” the conductor
    ◦ Fixes the conductor at the insulator attachment points
  - “Sag” the conductor
    ◦ Graphically sag to survey temperature
  - “Nip” the conductor (if required)
    ◦ Specify the unstressed length to remove from the ahead span
  - “Tuck” the conductor (if required)
    ◦ Move a specified unstressed length from one span to an adjacent span
  - “Check” the conductor
    ◦ Verify the correct length was removed
    ◦ Verify the weather and load state of the conductor and structure
    ◦ Check clearance, insulator swing, and structure stability
  - “Adjust” the conductor
    ◦ Repeat any Nip/Tuck adjustments in order to further improve clearance, re-plumb insulators, or redistribute loads
Recap

- Adjustment or removal of slack
- A means of raising the conductor
- Great tool for long spans
- Pros and Cons
Thank You!

Questions?

» For further information please don’t hesitate to contact:

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