Highly Constrained Elements Within ATC Footprint

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Solutions to Market Constraints

Constraints are ranked by the annual total (year 2007) of the shadow price for the constraint – see handout titled “ATCLLC 2007 Market Constraints Report.”

Potential solutions have been identified for many of the more severe market constraints in the ATC footprint.

Many of the solutions identified in this report were not specifically designed to address the constraints listed and therefore may not fully resolve the constraints in question.

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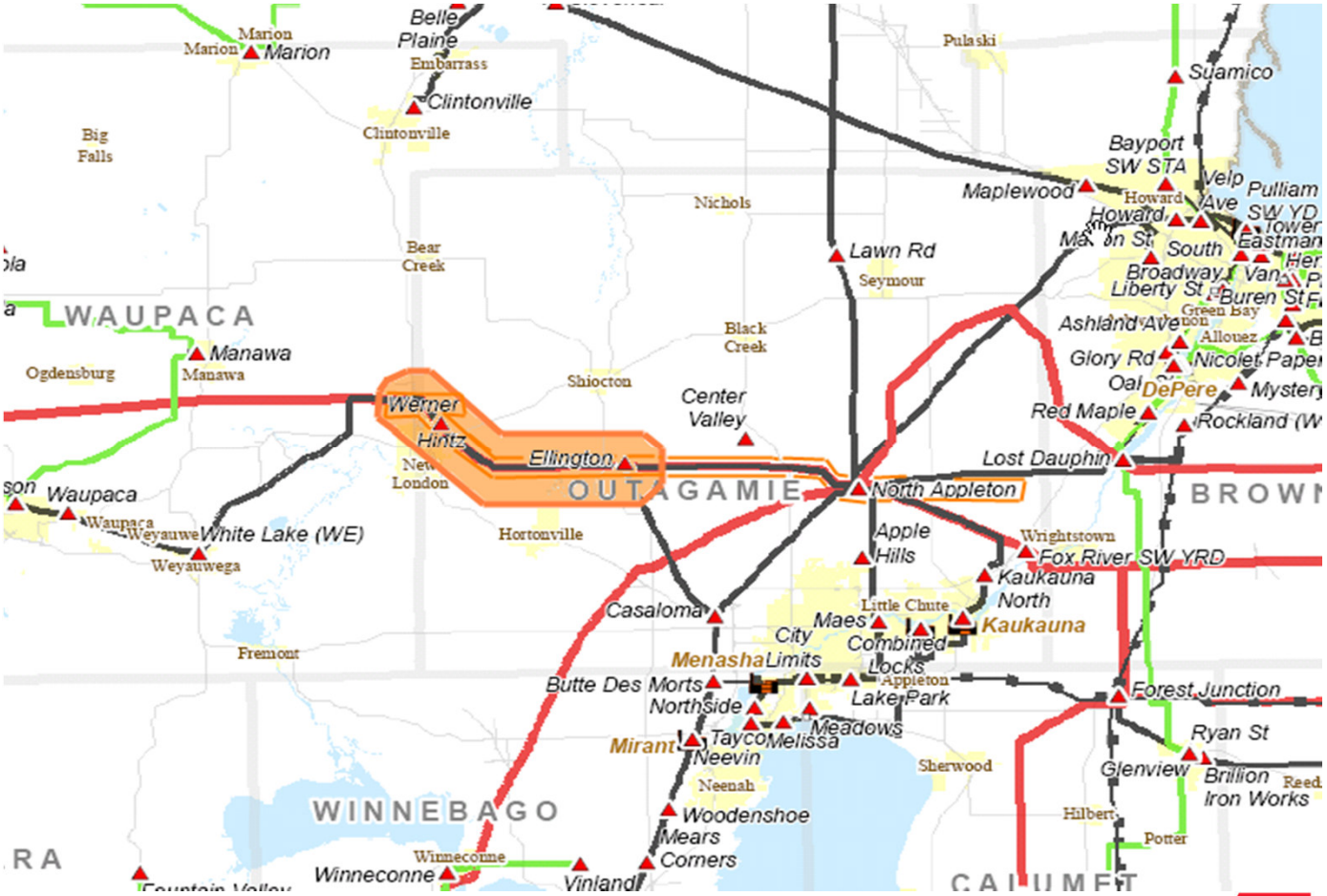
Ellington – Hintz – Werner 138 kV flo
N. Appleton – Werner West 345 kV



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Constraints 1 & 5

Ellington – Hintz 138 kV
Hintz – Werner 138 kV

- Constraints normally occur in the east-to-west direction
- Line clearance / terminal equipment upgrades (completed August 2007) increased ratings significantly.
  - Constraint binding in late 2007 due to abnormal system conditions was much less severe thanks to these upgrades.
- Weston Unit 4 (expected 2008) will provide relief.
- Highway 22, with 345 kV lines to Morgan, Werner West, and Gardner Park (Planned, 2009) will provide additional relief.

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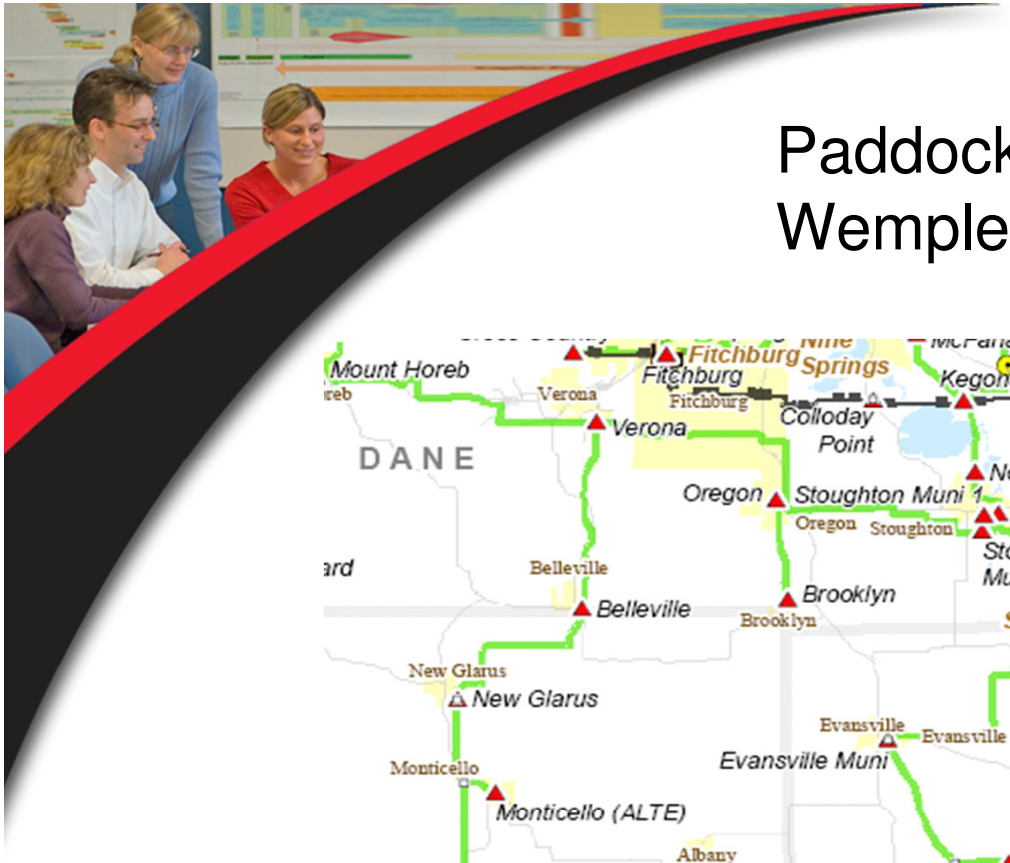

Paddock 345/138 kV transformer flo
Wempletown – Rockdale 345 kV

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Constraint 2

Paddock 345/138 kV transformer

- Constraint is caused by ATC imports from south.
- New Paddock – Rockdale 345 kV line (planned, 2010) will significantly reduce constraint frequency and severity.

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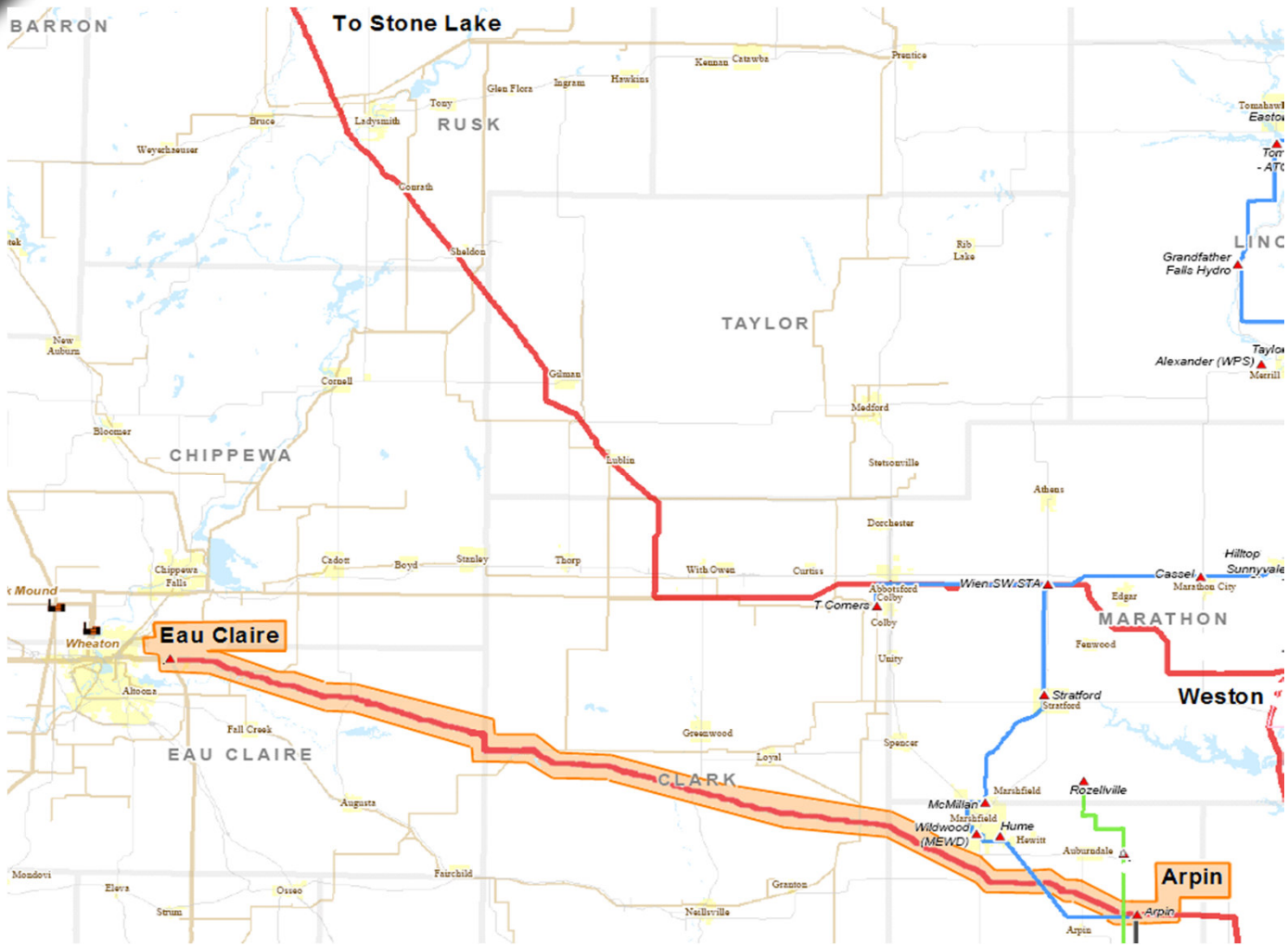
Eau Claire – Arpin 345 kV



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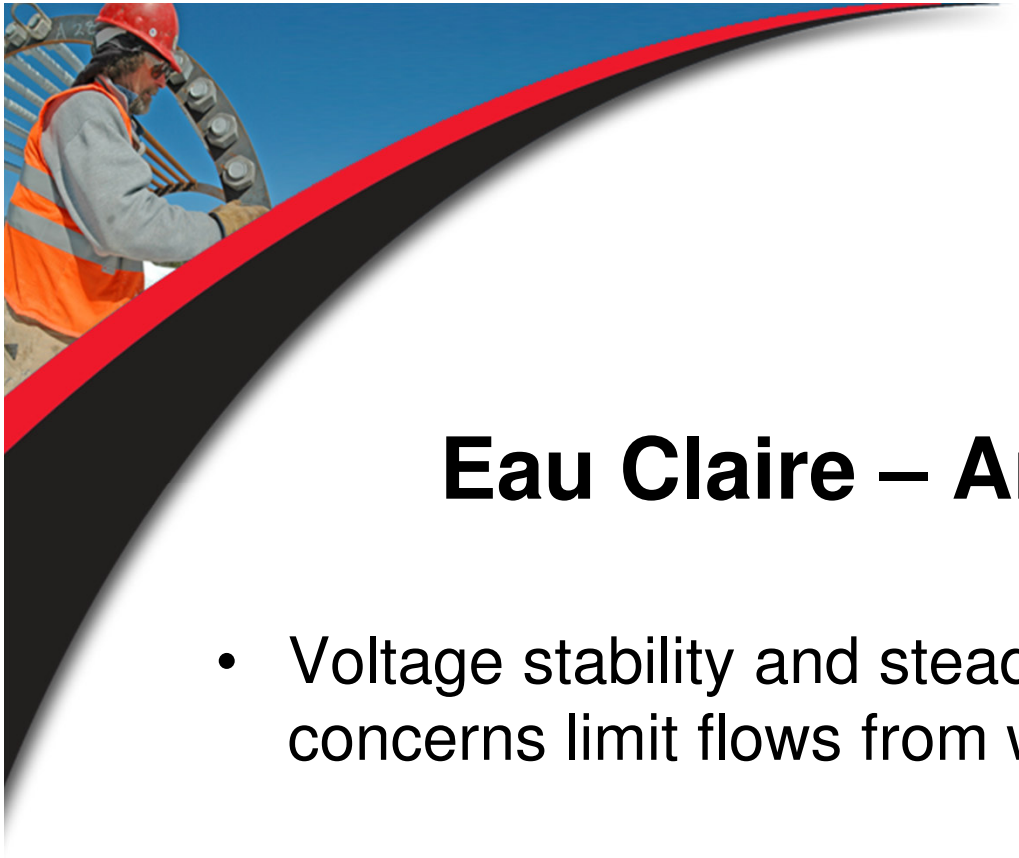

Constraint 3

Eau Claire – Arpin 345-kV

- Voltage stability and steady-state voltage security concerns limit flows from west to east to 790 MVA.

- The Arrowhead – Stone Lake – Weston line, placed in service in January 2008, will result in reduced frequency and severity of this constraint.

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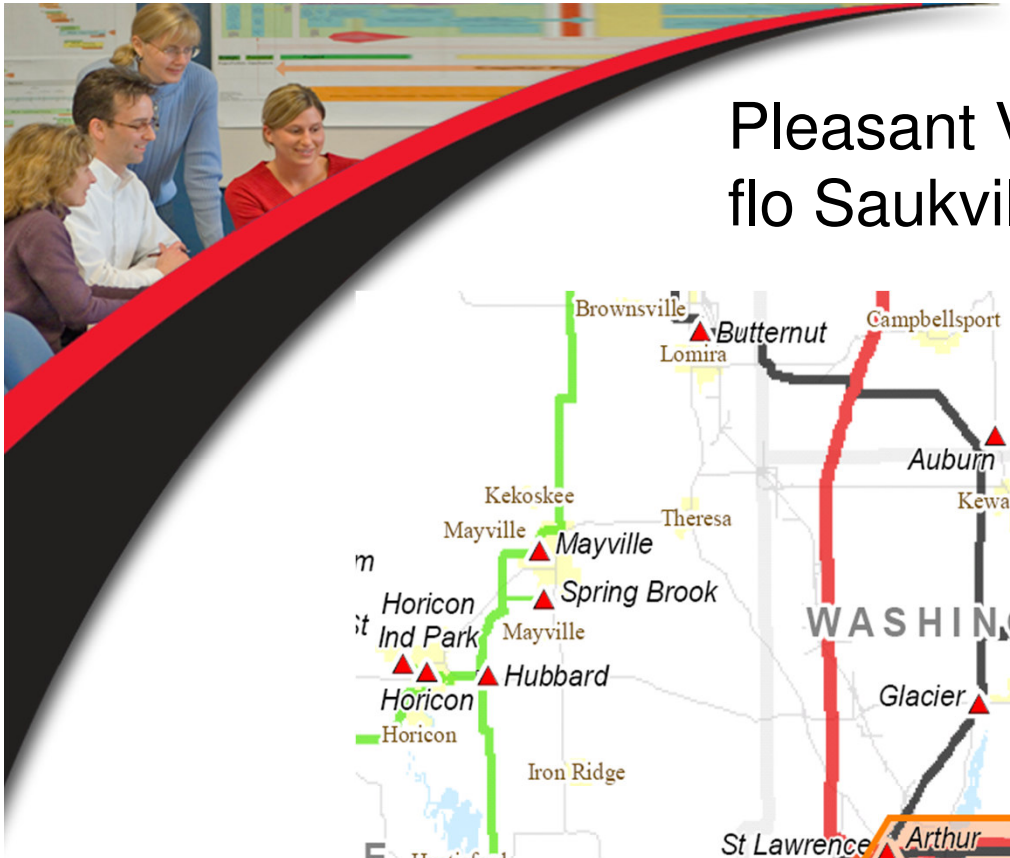

Pleasant Valley – Arthur Rd. 138 kV flo Saukville – Barton 138 kV

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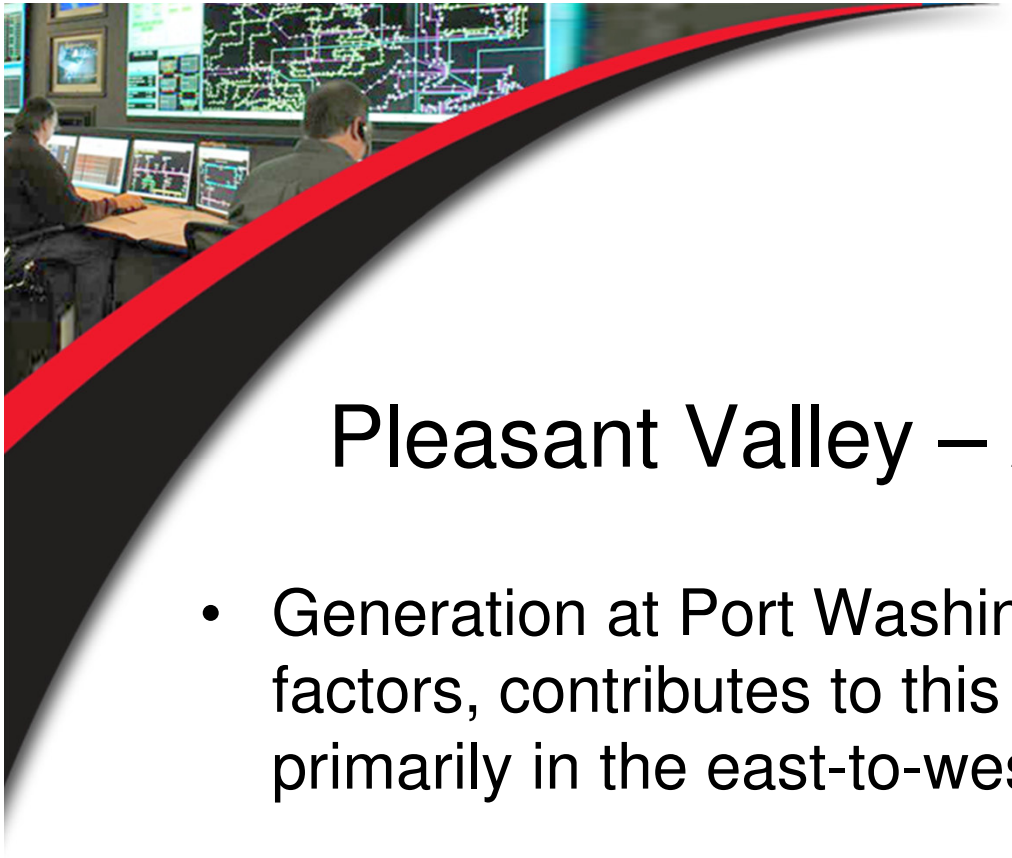

Pleasant Valley – Arthur Rd. 138 kV

- Generation at Port Washington, in addition to other factors, contributes to this constraint, which occurs primarily in the east-to-west direction.

- Saukville – Pleasant Valley – Arthur Rd – St Lawrence 138 kV line reconductor will relieve this constraint.
  - Project to be completed in May 2008

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Constraints 6, 7, 8, & 19 – Green Bay Area

Highway V – Preble 138 kV

Stiles – Pulliam 138 kV ckt. 64441

Stiles – Pulliam 138 kV ckt. 64451

- New Highway 22 substation with 345-kV lines to Morgan, Werner West, and Gardner park (Planned, 2009) provides additional low impedance paths to the north and west and should reduce congestion through the Green Bay area.

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Constraint 9 – 115 kV tie between Green Bay and Wausau areas

Badger – Belle Plaine – Caroline – Whitcomb

- Constraint occurs mostly in the east-to-west direction.
- Operation of Weston Unit 4 will help reduce east-to-west congestion.
- Highway 22, with 345 kV lines to Morgan, Werner West, and Gardner Park (Planned, 2009) will relieve this constraint.

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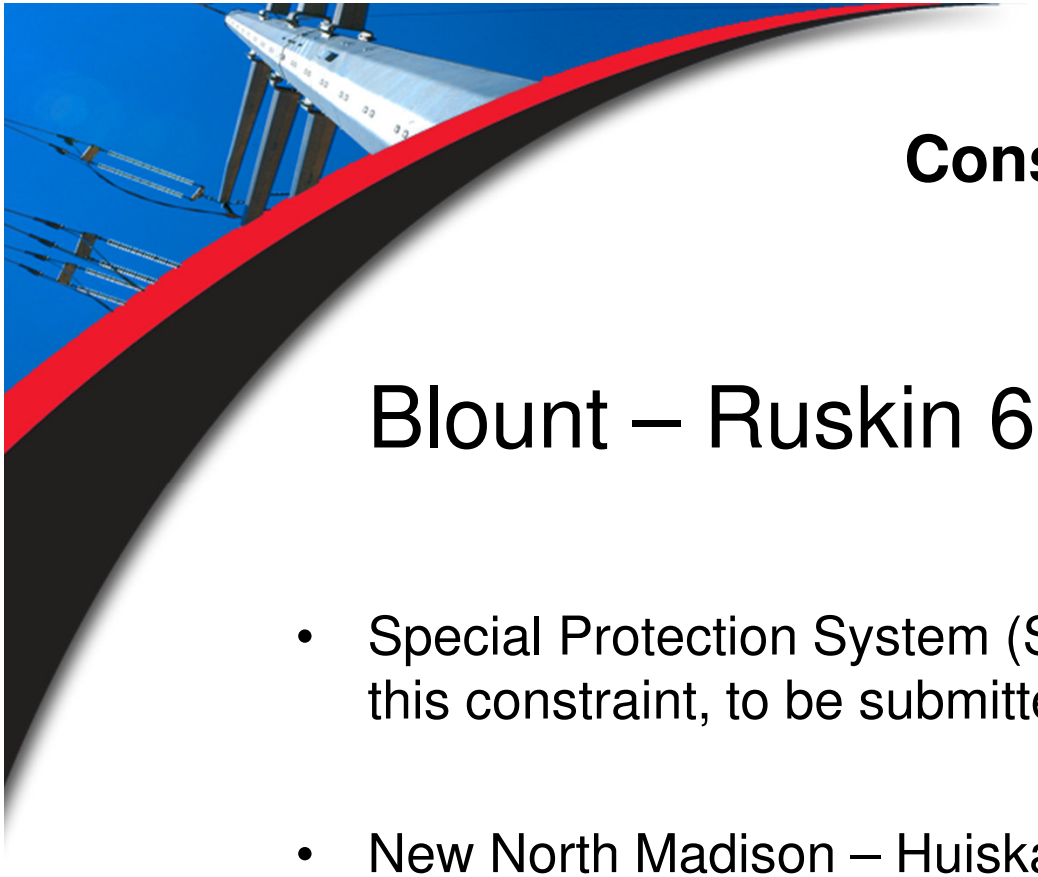

Constraint 10 – Madison area

Blount – Ruskin 69 kV circuit

- Special Protection System (SPS) is being developed for this constraint, to be submitted to MISO for review in 2008.
- New North Madison – Huiskamp 138 kV line will relieve congestion on this constraint (Planned, 2009).

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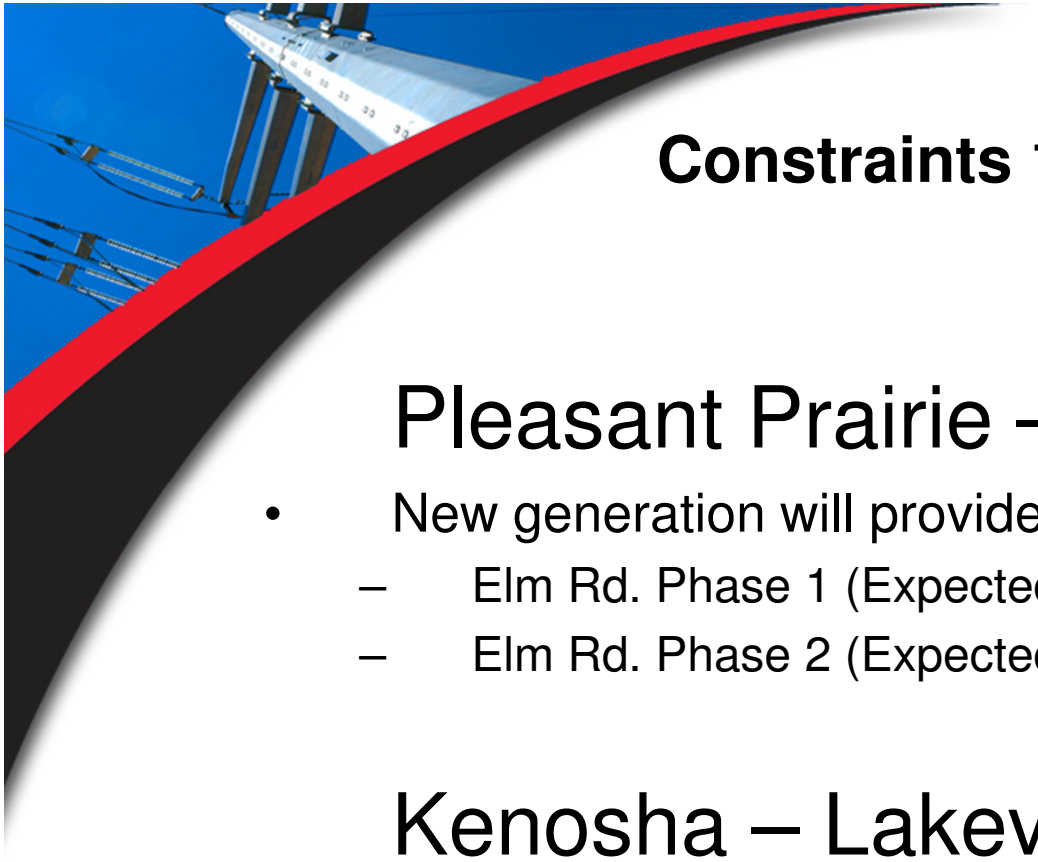

Constraints 11, 15, & 20 – SE Wisconsin

Pleasant Prairie – Racine 345 kV

- New generation will provide constraint relief:
  - Elm Rd. Phase 1 (Expected 2009)
  - Elm Rd. Phase 2 (Expected 2010)

Kenosha – Lakeview 138 kV

Lakeview – Zion 138 kV

- Operating Guide implemented in July 2007 protects system reliability and reduces constraint severity.

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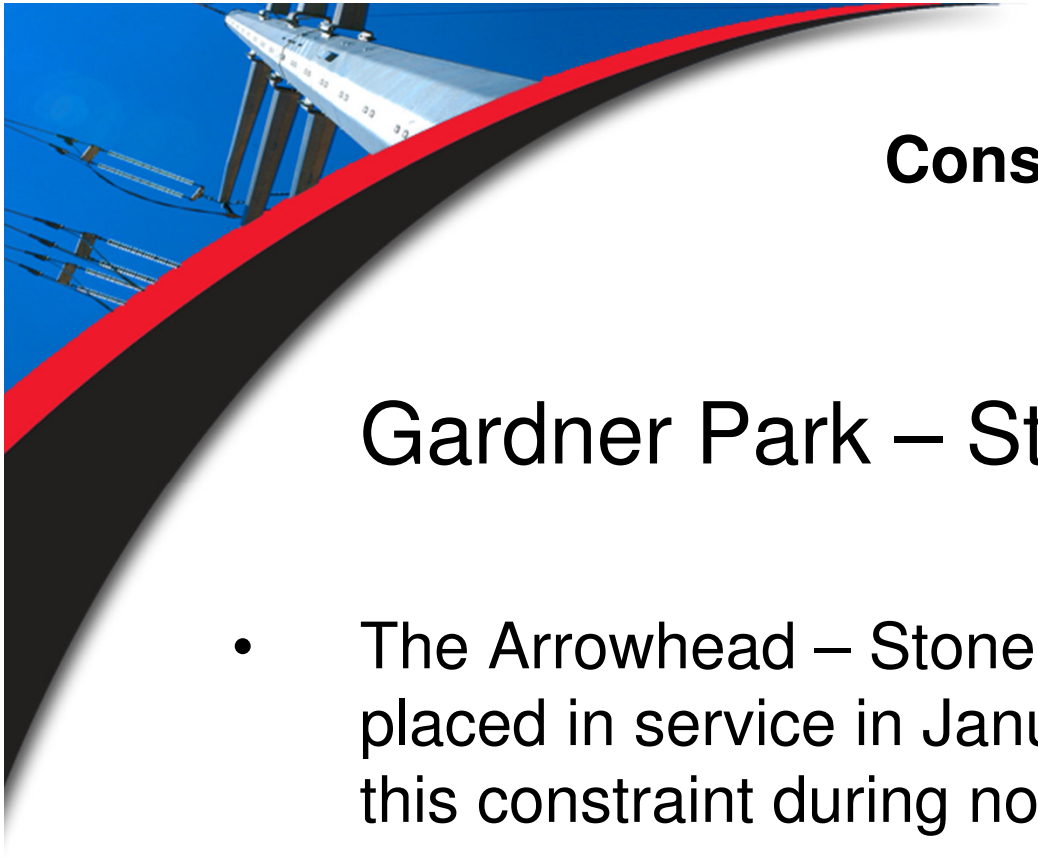

Constraint 12 – NW Wisconsin

Gardner Park – Stone Lake 345 kV

- The Arrowhead – Stone Lake – Weston line, placed in service in January 2008, will eliminate this constraint during normal system conditions.

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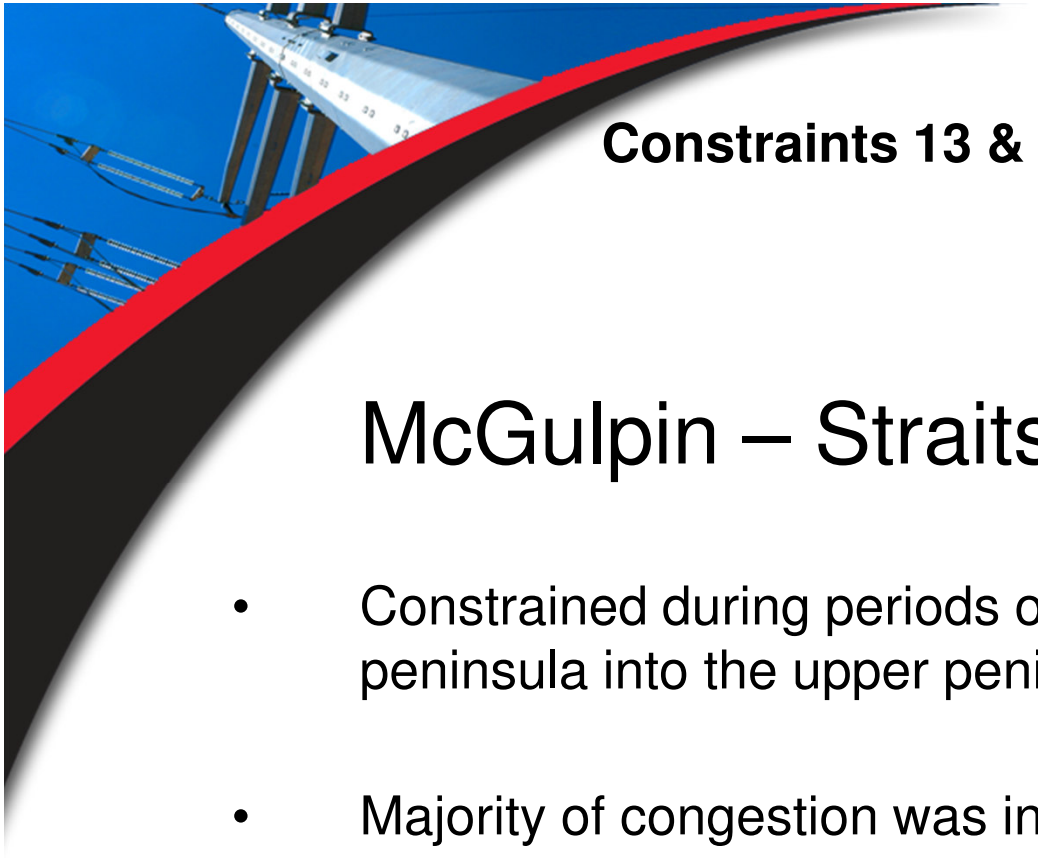

Constraints 13 & 27 – Michigan Upper Peninsula to Michigan Lower Peninsula

McGulpin – Straits 138 kV

- Constrained during periods of high flow from the lower peninsula into the upper peninsula with system ties closed.
- Majority of congestion was in November and December – unable to split system due to emergency construction.
- Upper Peninsula Energy Collaborative will investigate potential solutions in 2008.

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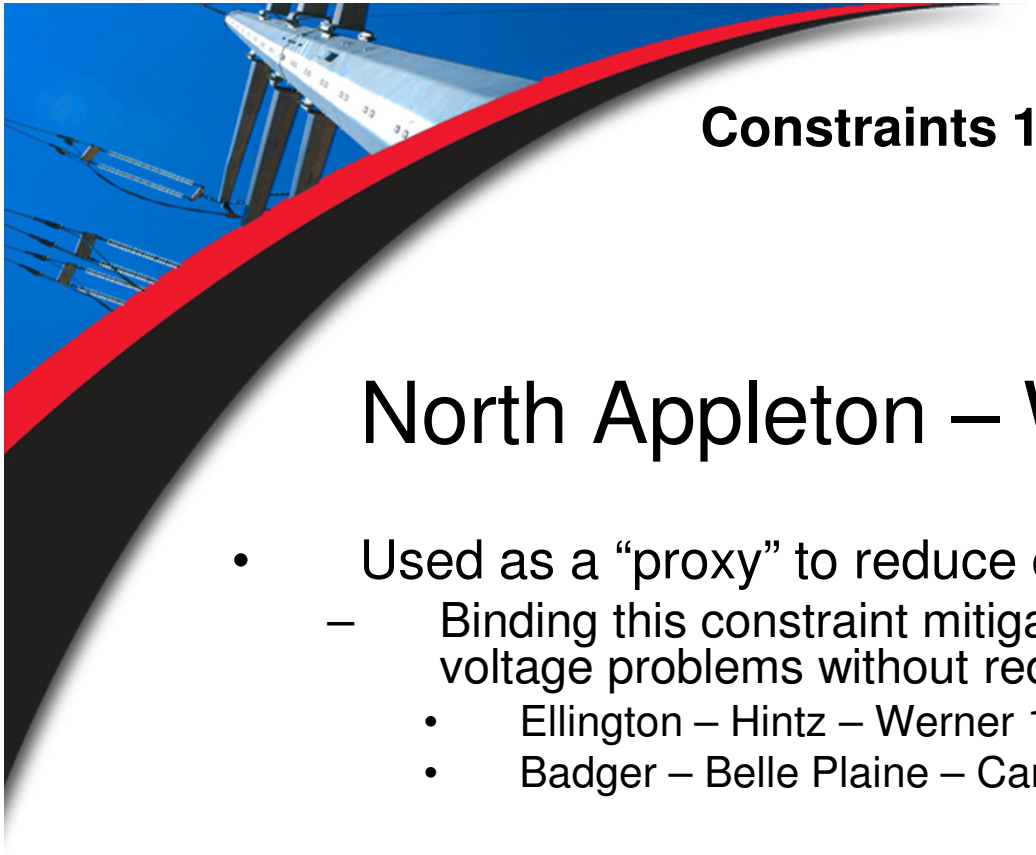

Constraints 14 & 16 – 345 kV tie from eastern Wisconsin to points west

North Appleton – Werner West

- Used as a "proxy" to reduce east-to-west flows.
  - Binding this constraint mitigates flows on multiple lower voltage problems without redispatch optimization issues.
    - Ellington – Hintz – Werner 138 kV
    - Badger – Belle Plaine – Caroline – Whitcomb 138 kV
- Operation of Weston Unit 4 (Expected 2008) will help reduce congestion.
- Highway 22, with 345 kV lines to Morgan, Werner West, and Gardner Park (Planned, 2009) will help to relieve east-to-west congestion.

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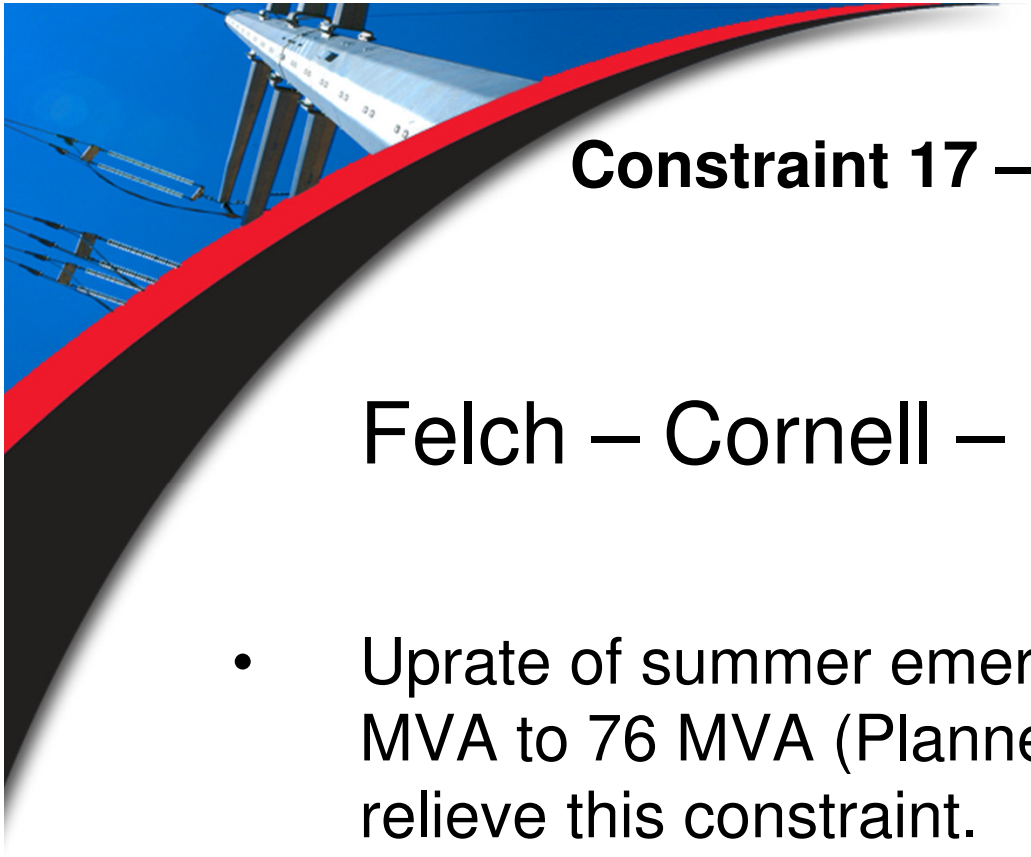

Constraint 17 – Western Upper Peninsula

Felch – Cornell – Chandler 69 kV

- Uprate of summer emergency rating from 36 MVA to 76 MVA (Planned, 2009) will help relieve this constraint.
- Other upgrades may be needed if local customers supply more of their needs via the market rather than local generation.

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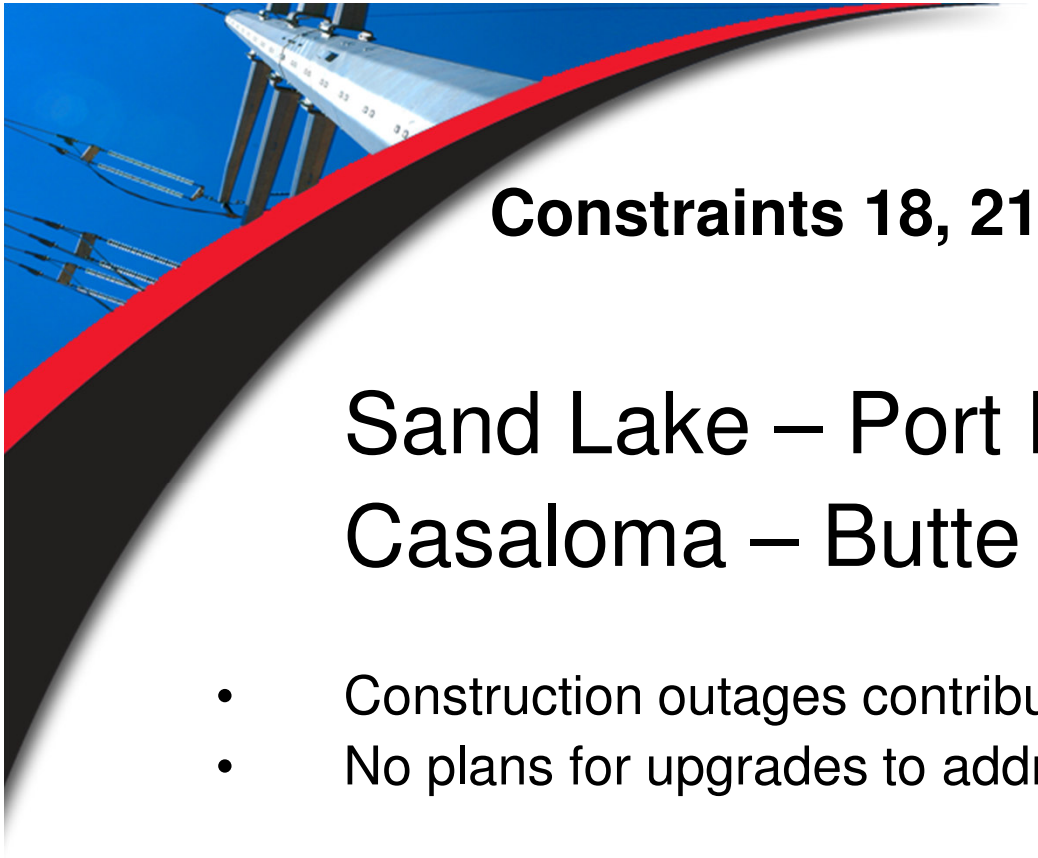

Constraints 18, 21, & 30 – Central Wisconsin

Sand Lake – Port Edwards 138 kV
Casaloma – Butte Des Mortes 138 kV

- Construction outages contributed to these constraints in 2007.
- No plans for upgrades to address these at this time.

Portage – Trienda 138 kV circuit X-19

- Uprate of summer emergency rating from 240 MVA to 321 MVA (Planned, March 2008) will relieve this constraint.

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Constraints 22, 24, 25, & 26 – Virtual

Old Quinn Transformer T4
Old Quinn Transformer T5
Detour Transformer T2
Oak Creek Unit #9 GSU

- Caused by virtual offers/bids.
- Occur only in DA market, may be due to rounding up of generation offers.

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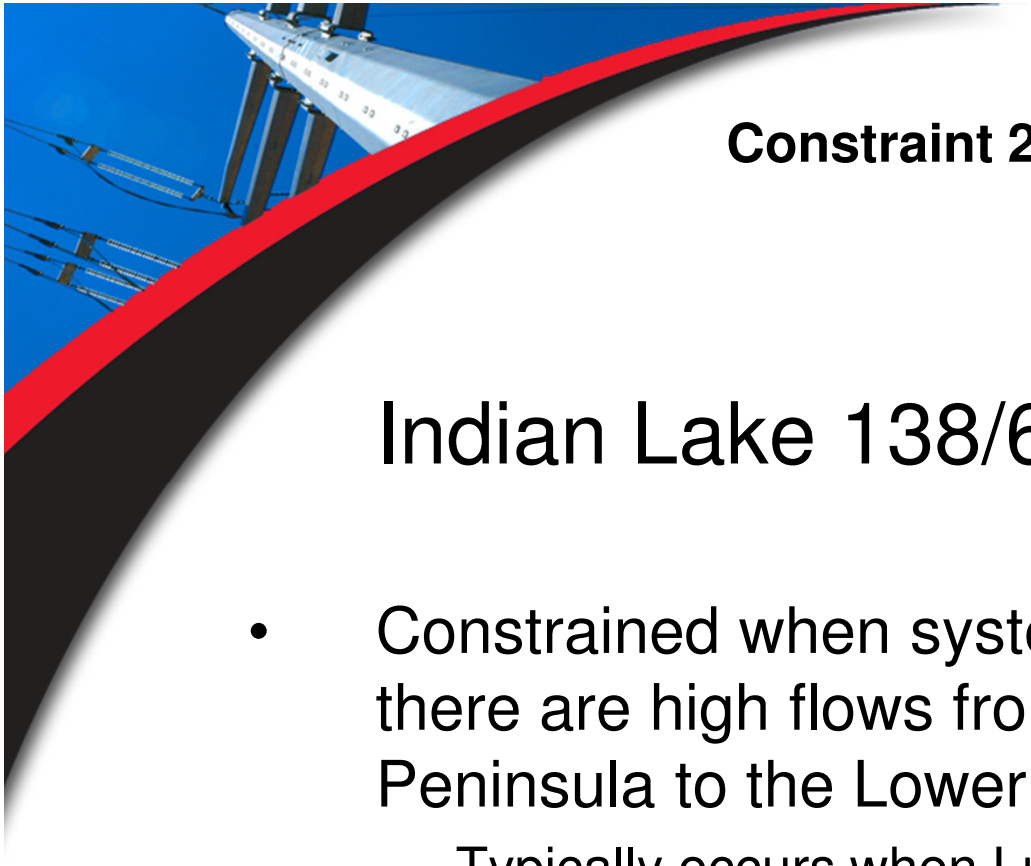

Constraint 23 – Michigan Upper Peninsula to Michigan Lower Peninsula

Indian Lake 138/69 kV transformers

- Constrained when system ties are closed and there are high flows from the Western Upper Peninsula to the Lower Peninsula
  - Typically occurs when Ludington is pumping (off-peak)
- Upper Peninsula Energy Collaborative will investigate potential solutions in 2008

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Constraint 28 – Wausau Area

Morrison Ave – Sherman St. 115 kV

- Two projects completed in first half of 2007 to help relieve this constraint
  - New Gardner Park – Hilltop 115 kV line
  - Rebuild Weston – Sherman St. – Hilltop 115 kV
- Constraint has not occurred in DA or RT since June 15, 2007.

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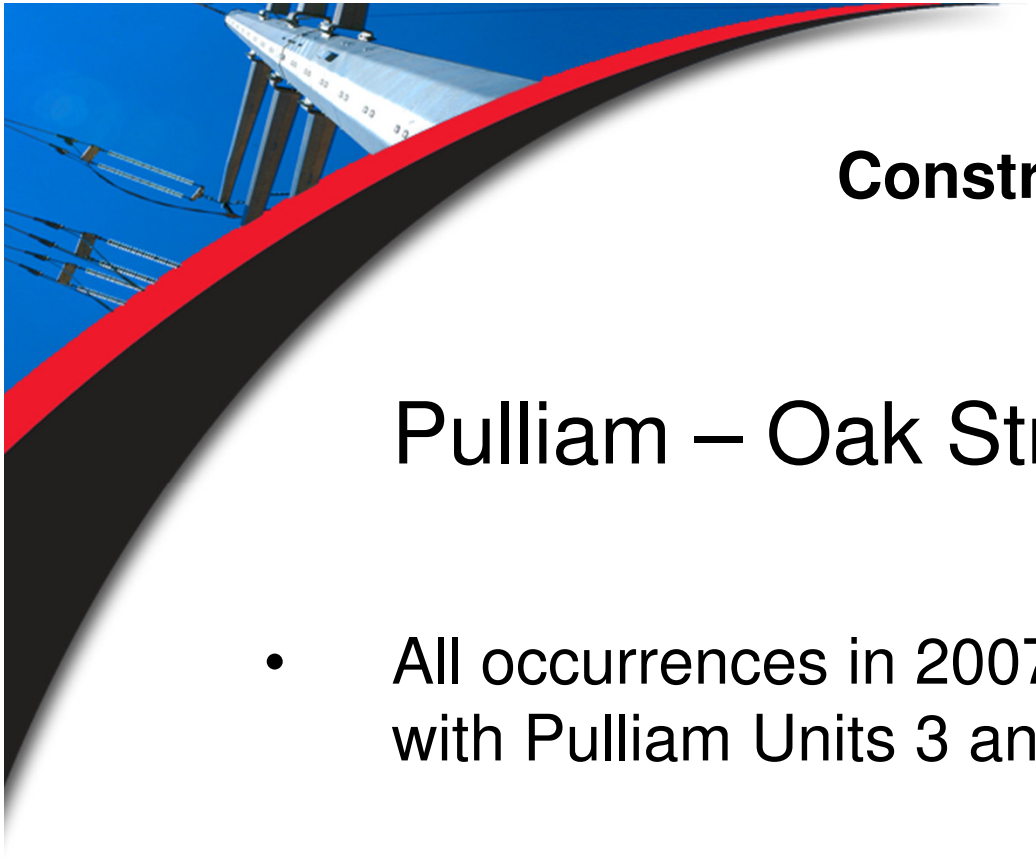

Constraint 29 – Pulliam exports

Pulliam – Oak Street 69 kV

- All occurrences in 2007 happened in December with Pulliam Units 3 and 4 running.
- Pulliam Units 3 and 4 retired in January 2008.

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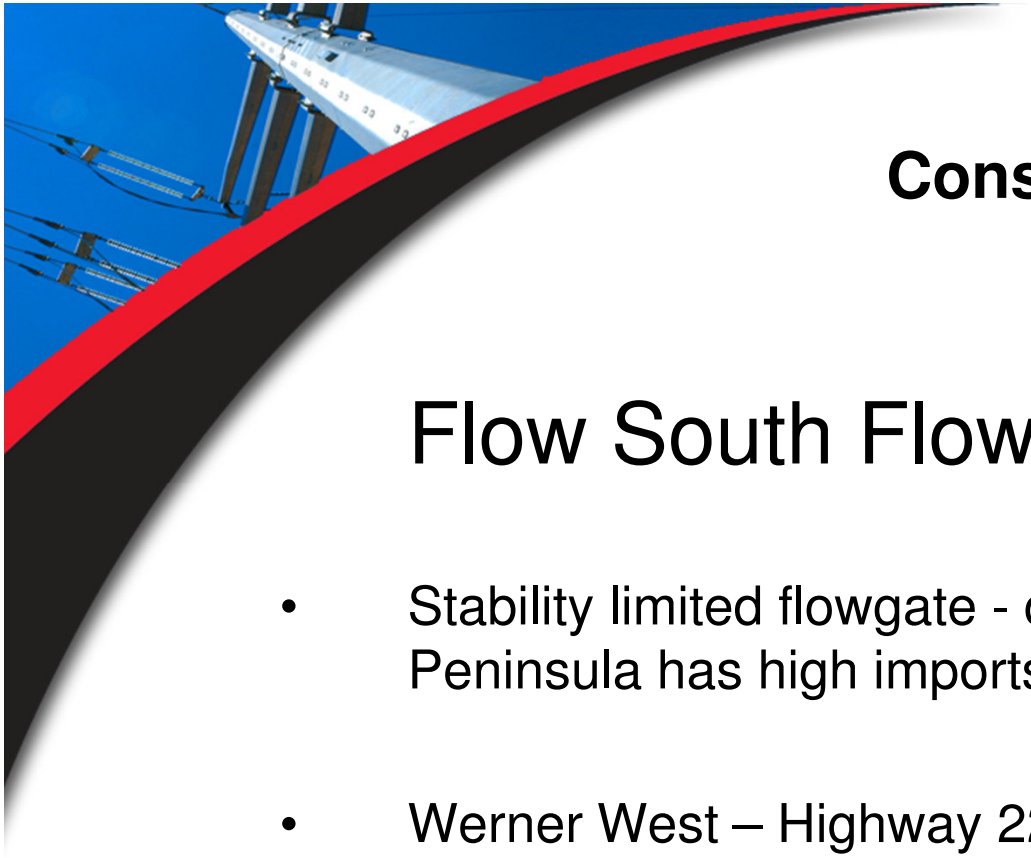

Constraint 31 – NE Wisconsin

Flow South Flowgate

- Stability limited flowgate - constrained when Upper Peninsula has high imports from Wisconsin.
- Werner West – Highway 22 – Morgan 345 kV line (Planned, 2009) will provide relief
- Cranberry – Conover – Plains 138 kV line (Planned, 2010) will provide further relief

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