VARIABLE TRANSFERS

2/20/2014

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BACKGROUND

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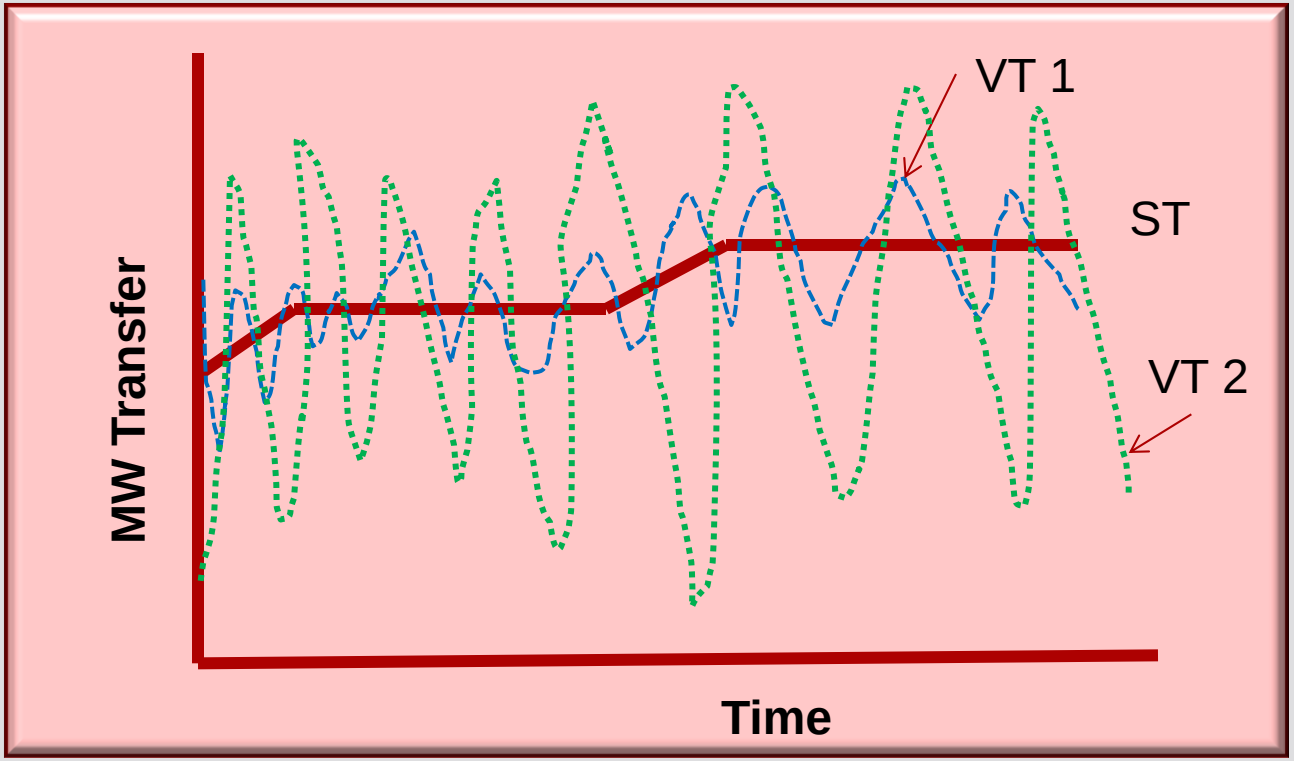
WHAT IS VARIABLE TRANSFER?



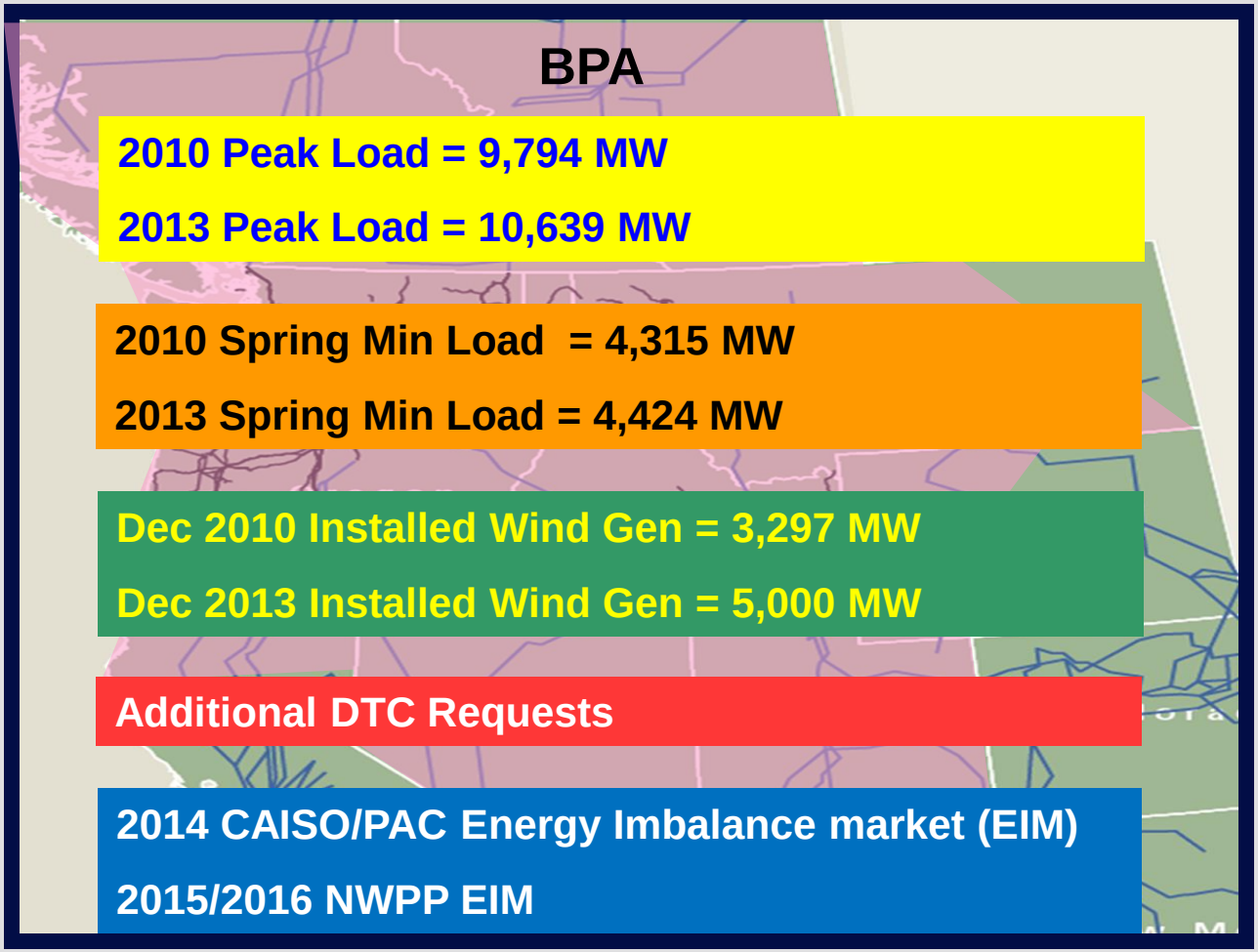
Static Transfer (ST): Conventional transfers across a path / flowgate, usually made up of fixed hourly schedules between defined PORs (Points of Receipt) and PODs (Points of Delivery)

Variable Transfer (VT): Refers to the physical variations in actual power flows across a path / flowgate that are generally unpredictable and repetitive during a defined time period (e.g. 30 minutes).

WHY VARIABLE TRANSFER LIMIT IS NEEDED IN NW?

- No ISO or RTO in the region.
- No one coordinates and controls all the reactive devices in real time in the region to maintain the voltage profile.
- Voltage and transient stability are not yet studied in real time and proper control actions are not implemented.
- Many shunt devices and transfer taps are not automatically controlled to maintain proper voltage profile.
- RAS is manually armed.
- Lot more Variable Energy Resources are integrated in NW

DRIVERS FOR VARIABLE TRANSFERS



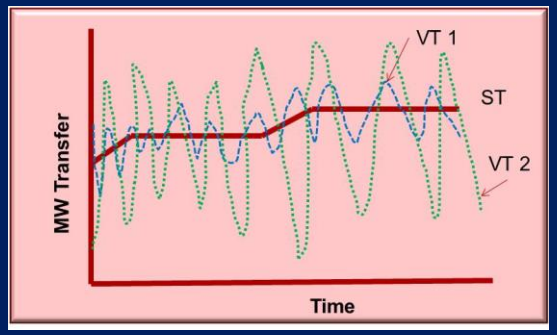
WHAT LED US HERE?

What is DTC?

Approach (DTC TF)

Unanswered Questions?

DTC = Dynamic Transfer Capability



Customer Impact Acceptable?

Equipment Impact Acceptable?

Operating Point Reliable?

Allowable voltage variation?

Elements that limit DTC?

Increased wear and tear on equipment?

How DTC limits change in real-time?

ONGOING RESEARCH

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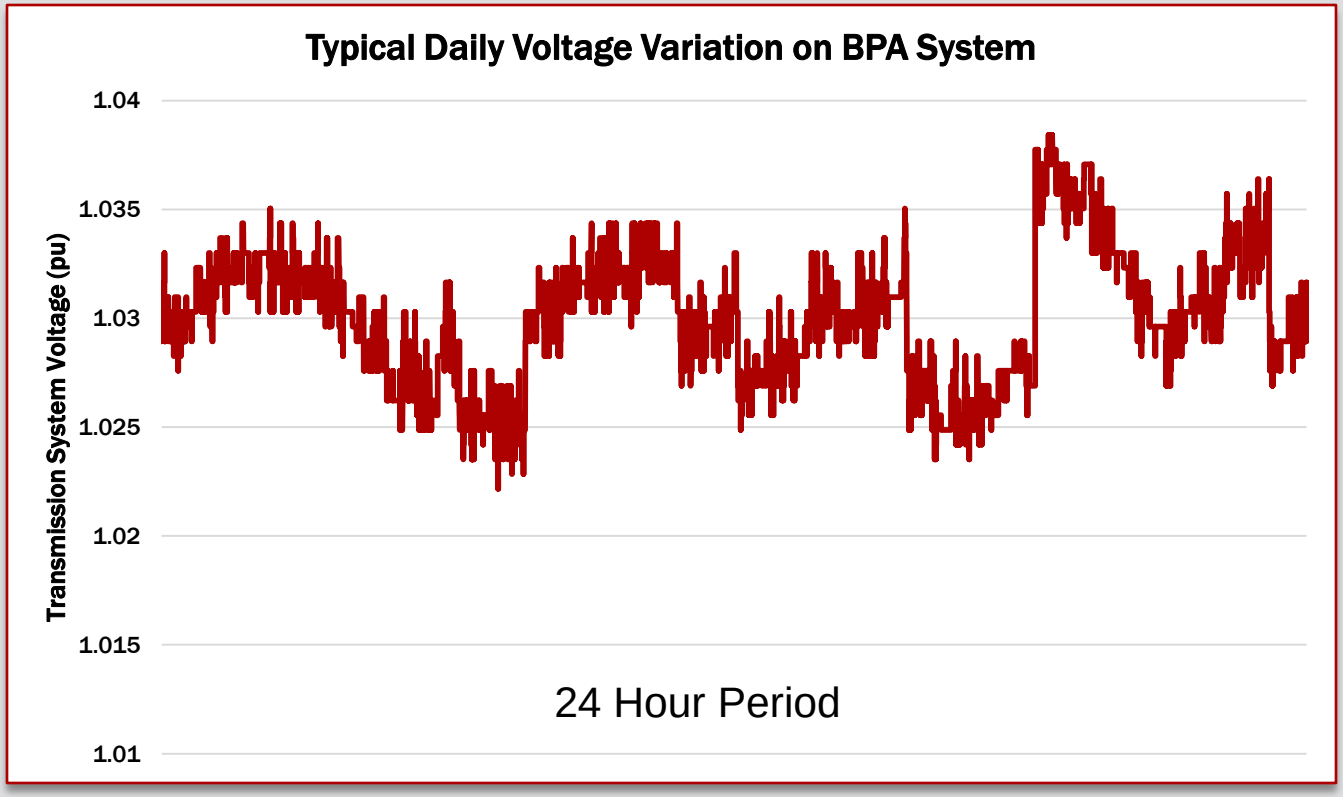
FACTORS INFLUENCING VARIABLE TRANSFERS

DISTRIBUTION IMPACT MODELING

ANSI DISTRIBUTION VOLTAGE STANDARD C84.1

ANSI Voltage Limits		
Voltage Level	Min Per-Unit Voltage (pu)	Max Per-Unit Voltage (pu)
120-600 V Systems	0.95	1.05
> 600 V Systems	0.975	1.05



VOLTAGE VARIATION

As system loading increases, allowable voltage variation decreases

As voltage variation increases, ANSI violations increase exponentially

Additional regulation equipment relaxes limits at higher loading levels

ANSI violations are dramatically reduced by additional regulation equipment

Relaxed voltage limits come at the cost of increased wear on equipment

ENERGY IMBALANCE MARKET

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CONTROLS

- BPA will send, to the EIM Market Operator (CAISO) for all relevant paths and flowgates:
  - Current Flow
  - System Operating Limit (SOL)
  - Upper Dispatch Limit
  - Lower Dispatch Limit
  - Rate of Change Limit
- CAISO will respect the limits in the Security Constraint Dispatch

VTL CALCULATION APPROACHES

- Variable Transfer Limits
  - Step 1: Historic Use
  - Step 2: Static Nomogram
  - Step 3: Real time calculations

HISTORIC USE

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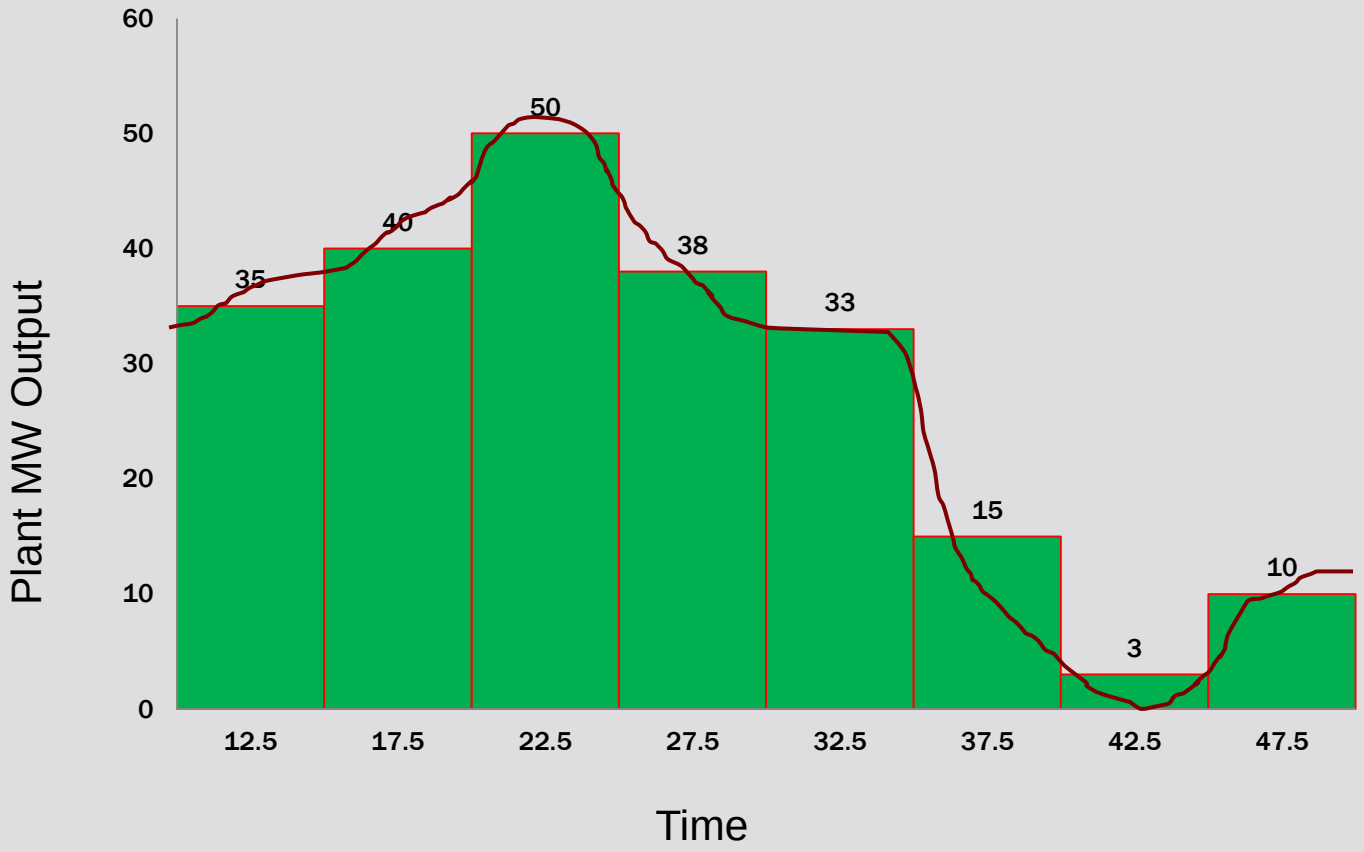
INITIAL IMPLEMENTATION

- BPA Plans to develop variable transfer limits based on historic use for the initial implementation of the EIM on October 1, 2014

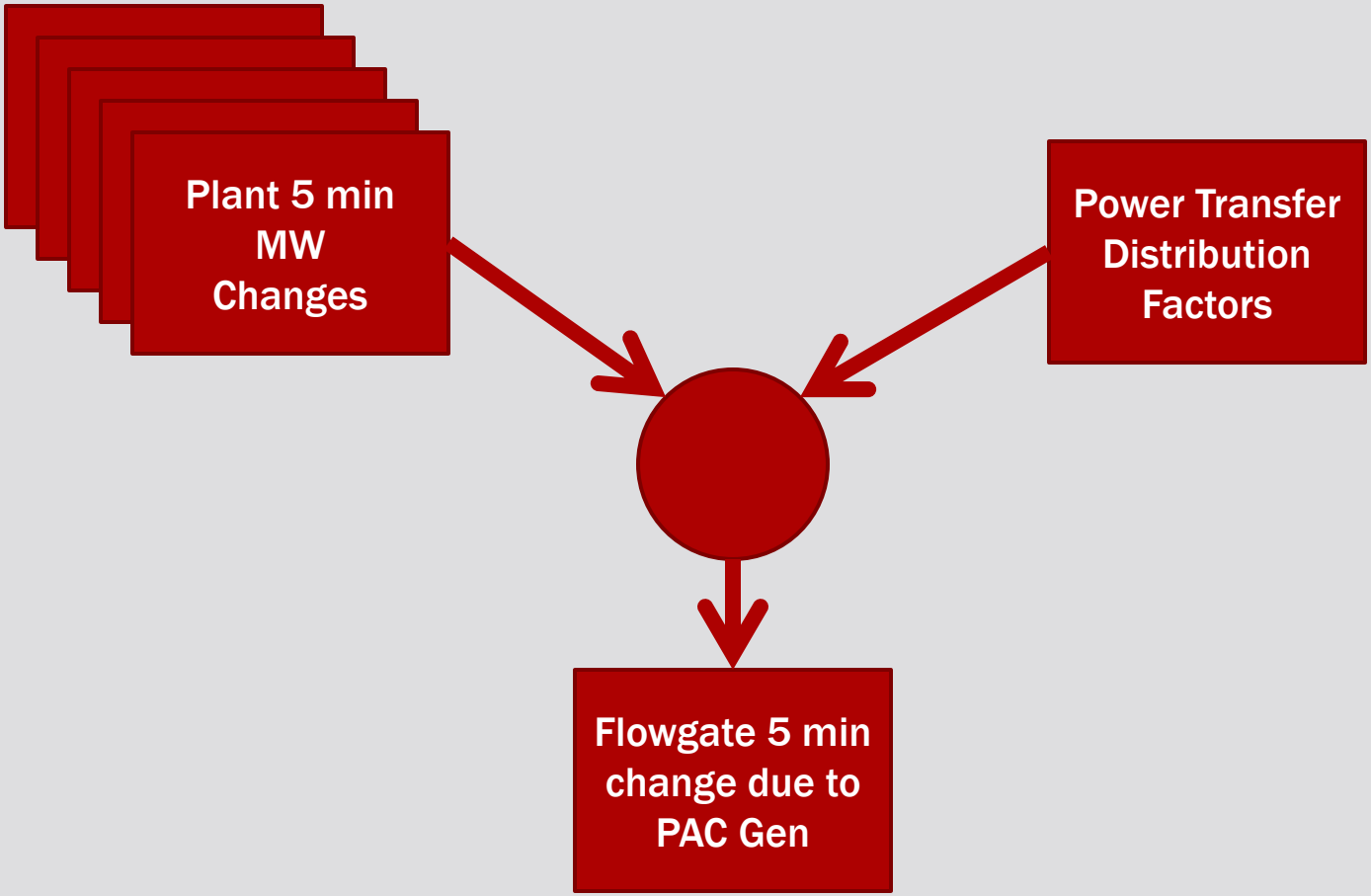
PLANT 5 MIN AVERAGE VALUE



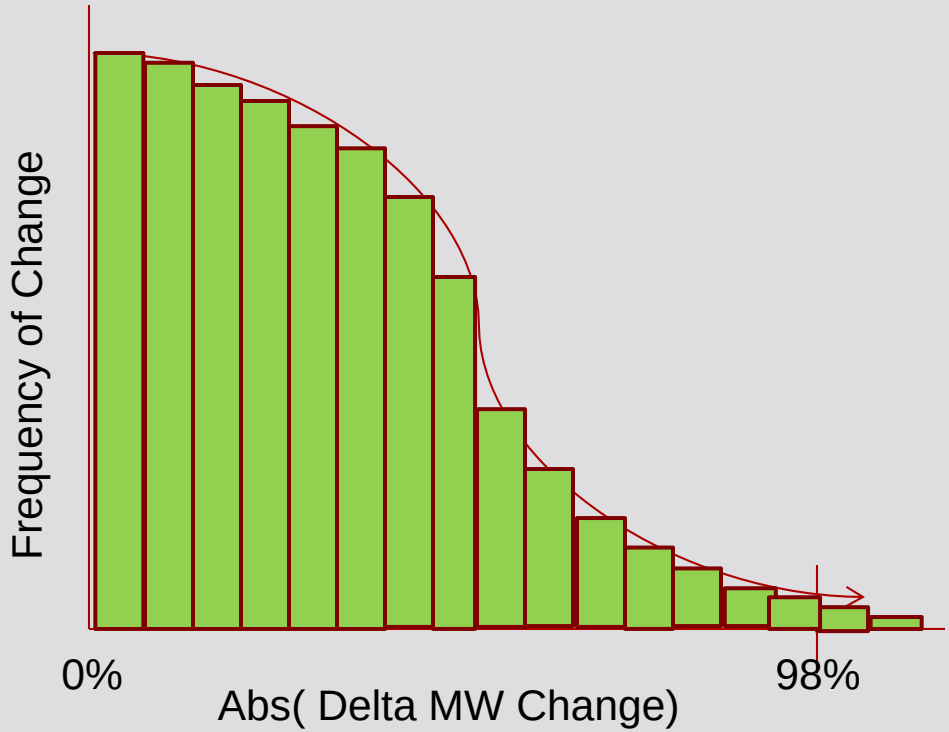
STEPS TO COMPUTE 5 MIN MW CHANGE

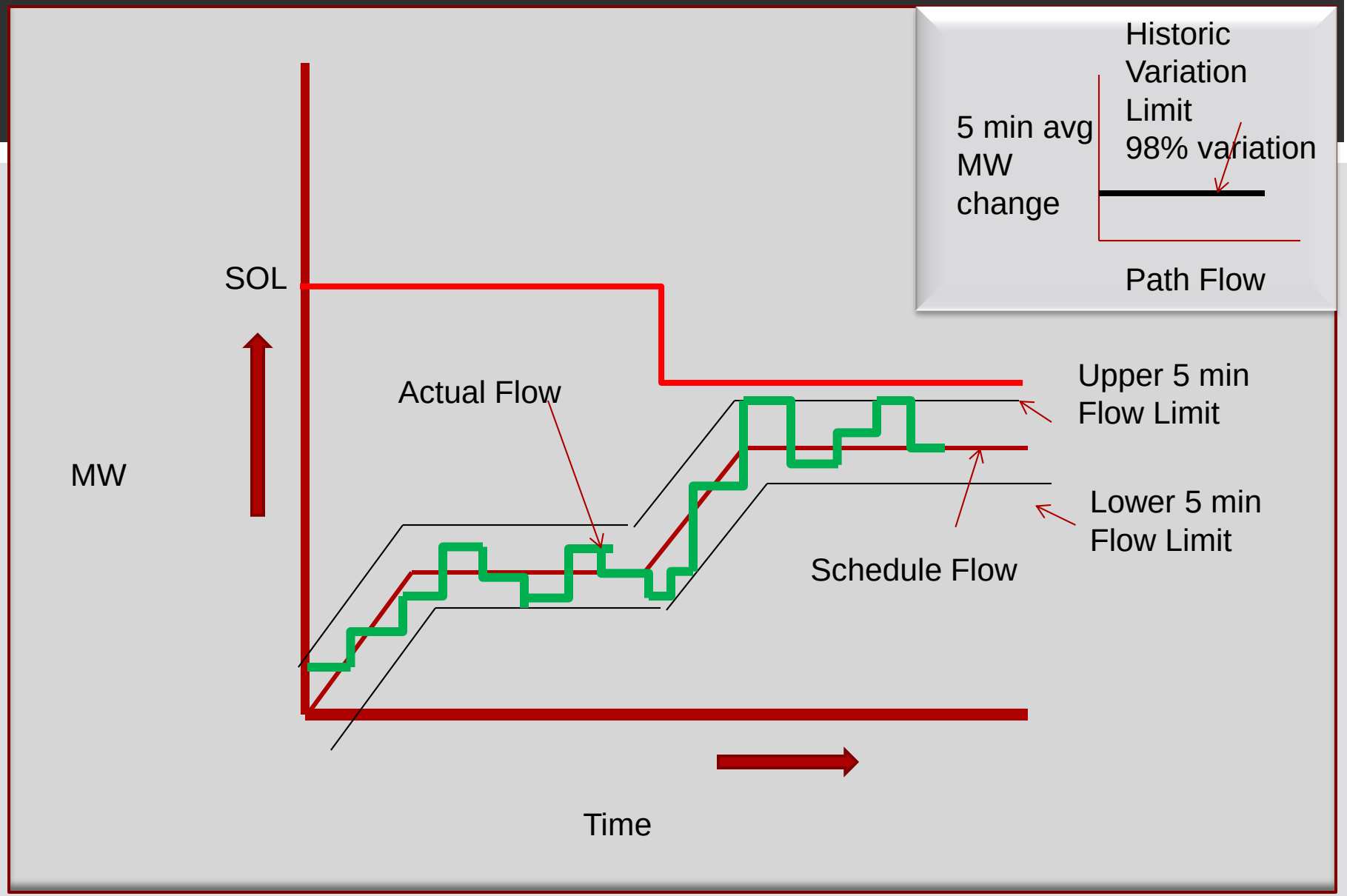
- Step 1: Identify the PAC plants participating in EIM
- Step 2: Retrieve data for period 8/4/2008 to 10/1/2013
- Step 3: Exclude Hourly ramps
  - 10 min before and 10 min after the hour
- Step 4: Perform 5 min Averaging
- Step 5: Compute Delta change for 5 min values
- Step 6: Plot the distribution of 5 min MW changes

FLOWGATE 5 MIN MW CHANGES



5 MIN FLOWGATE MW CHANGES DUE TO PAC WESTGENERATORS




Historic
Variation
Limit
98% variation
5 min avg
MW
change
Path Flow
SOL
Actual Flow
Upper 5 min
Flow Limit
MW
Lower 5 min
Flow Limit
Schedule Flow
Time

STATIC NOMOGRAM

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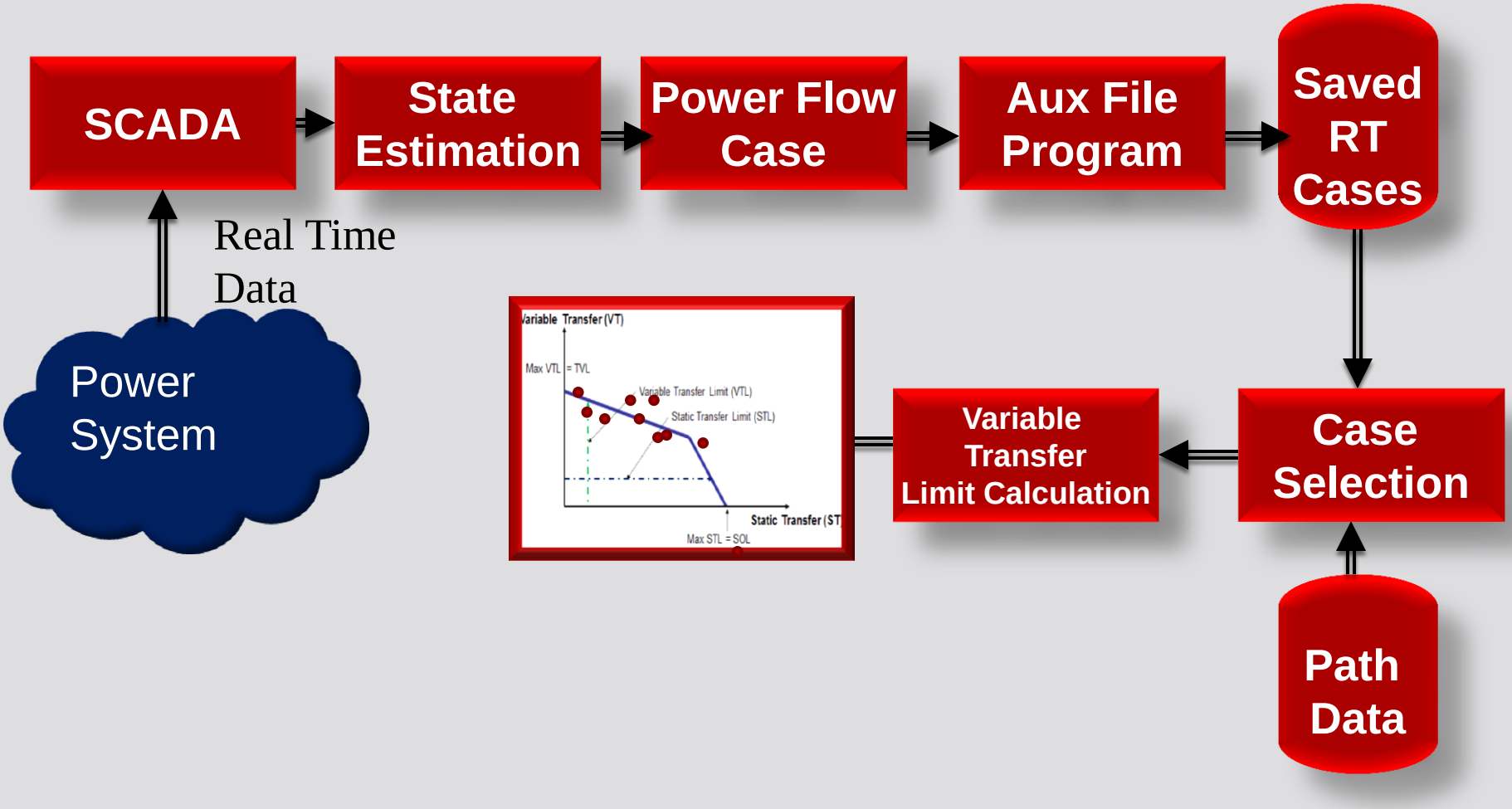
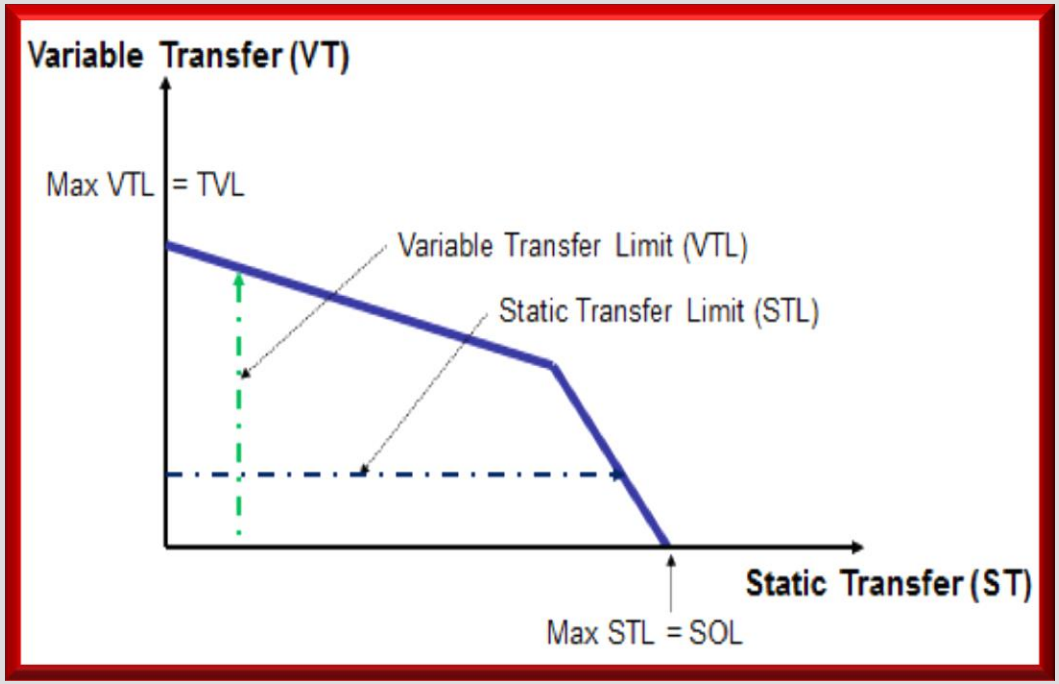
POTENTIAL FUTURE DEPLOYMENT

- BPA is also developing the capability to produce Variable Transfer Limits based on static nomograms.
- BPA hopes to deploy this methodology in the future, after further development and testing.

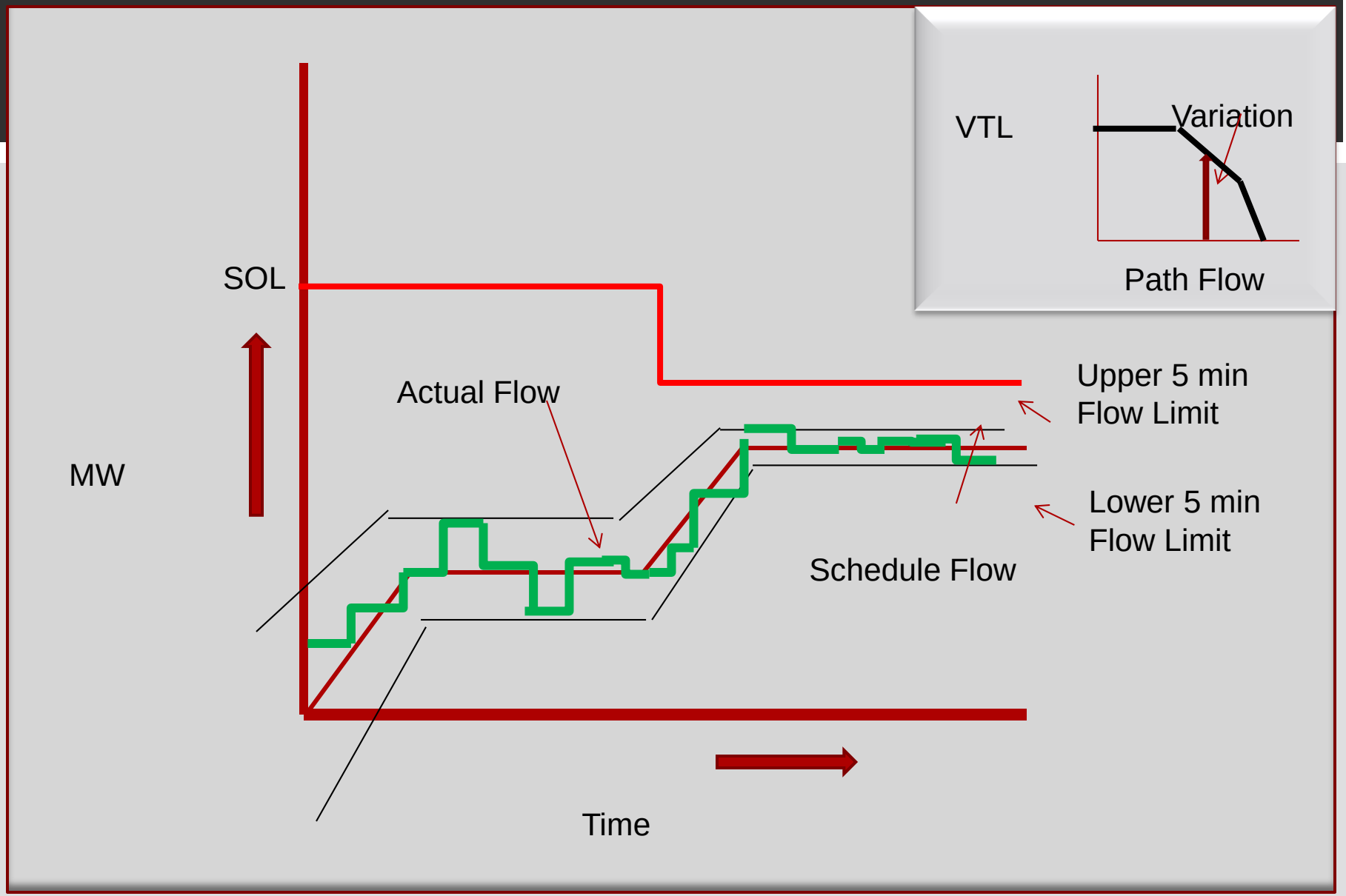
DEVELOPMENT OF VTL NOMOGRAM



STATIC VS. VARIABLE TRANSFER



- Sum of the variable transfers plus the static transfers on a path must be less than or equal to the SOL; **ST + VT <= SOL**


VTL
Variation
Path Flow
SOL
Actual Flow
Upper 5 min
Flow Limit
MW
Lower 5 min
Flow Limit
Schedule Flow
Time

REAL TIME CALCULATIONS

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POTENTIAL FUTURE DEPLOYMENT

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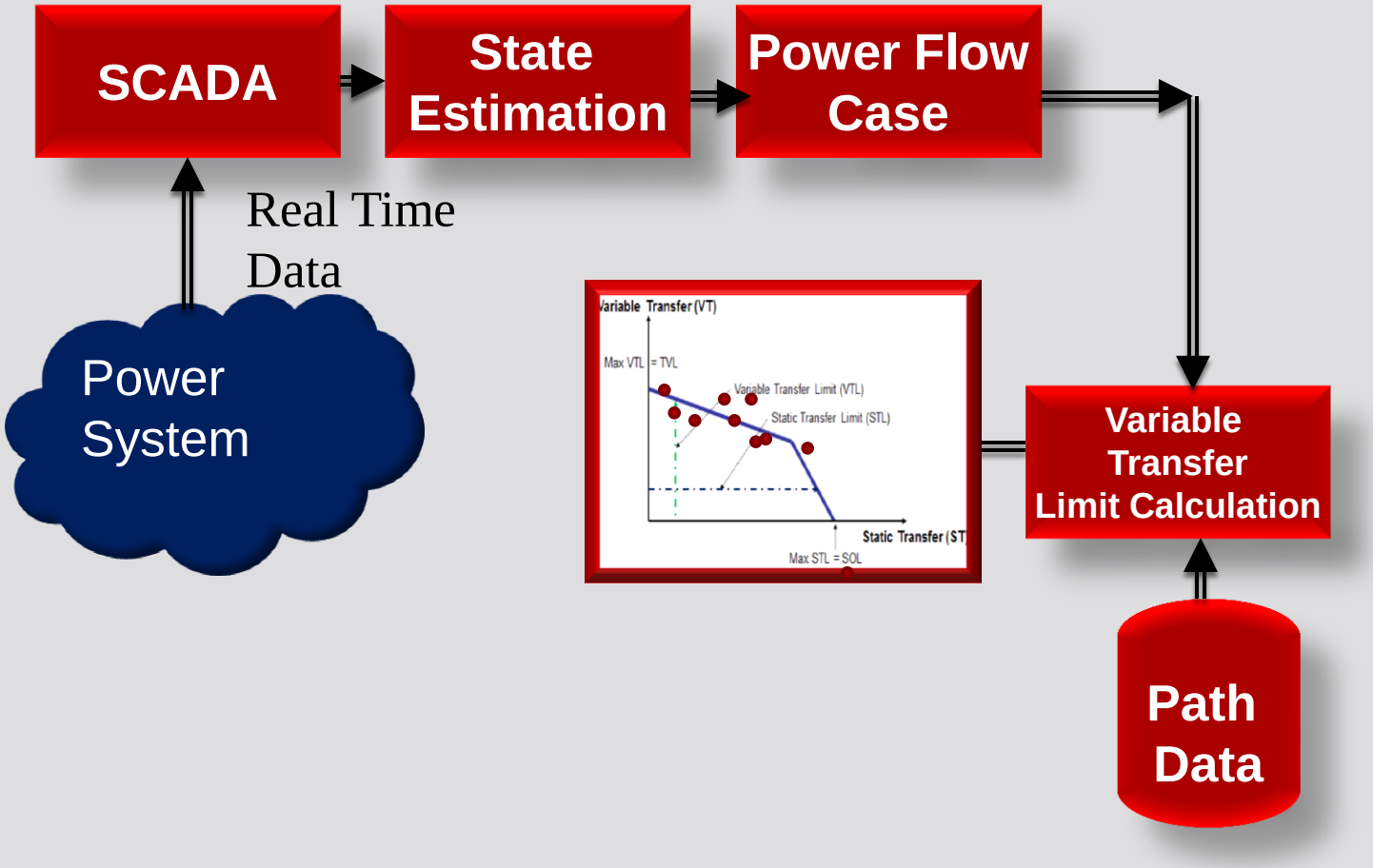
VTL CALCULATIONS – REAL TIME



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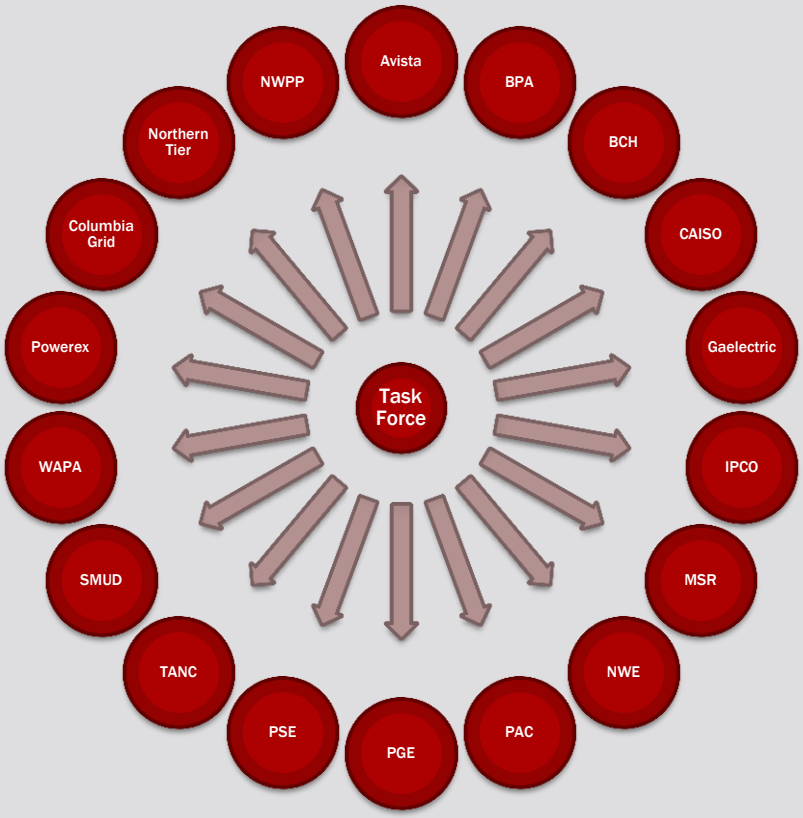
TECHNICAL PAPERS

- "Transfer Variability and the Need for New Limits on the Grid", 2012 CIGRÉ Canada Conference , Montréal, Québec, September 2012.
- "Methodology of Computing Simultaneous Variable Transfer Limits on Multiple Paths", 2012 CIGRÉ Grid of the Future Symposium, Kansas City, Oct 2012.
- "Factors that Influence Variable Transfers" UPEC Sept 2013.
- "Calculating Variable Transfer Limits for Dynamic Transfers", 2013 CIGRÉ Grid of the Future Symposium, Boston, Oct 2013.
- "An Analysis of the Impact of Transmission Level Voltage Variation on Distribution Feeder Power Quality." To Be Submitted

REPORTS



Reports

- "*Assessing the Impact of Dynamic Transfers on Transmission System Operation*", Brian Tuck and R. Ramanathan, February 15, 2010
- "RD 237 – Bidirectional Multipath Dynamic Transfer Analysis", Brian Tuck and R. Ramanathan Oct 6, 2012
- "*Dynamic Transfer Capability Task Force Phase 1 Report*", Wind Integration Study team, March 16, 2011
- "*Dynamic Transfer Capability Task Force Phase 2 Report*", Wind Integration Study team, July, 2011
- "*Dynamic Transfer Capability Task Force Phase 3 Report*", Wind Integration Study team, December, 2011