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Wide Area System Islanding Contingency Detecting and Warning Scheme with the Implementation of Synchrophasor Measurements

U.S. DEPARTMENT OF ENERGY

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The Principle: Islanding Detection using Decision Tree

Major Procedures:

1. System Islanding Detecting Strategy
   - Concept level, distinguish islanding & non-islanding
2. Dynamic Simulation
   - Create isolation randomly, then apply modified enumeration method for island region selection
   - Create also normal operation cases with different load conditions; other fault/contingency cases
3. Simulation Data Analysis
   - Decision tree & Severity Index (ISI)

The Principle: Islanding Detection using Decision Tree

Decision Tree Algorithm:

– A ... ee-like graph or model
c ... g chance event
c

... n WIKI)

– I ... Trees)

– I

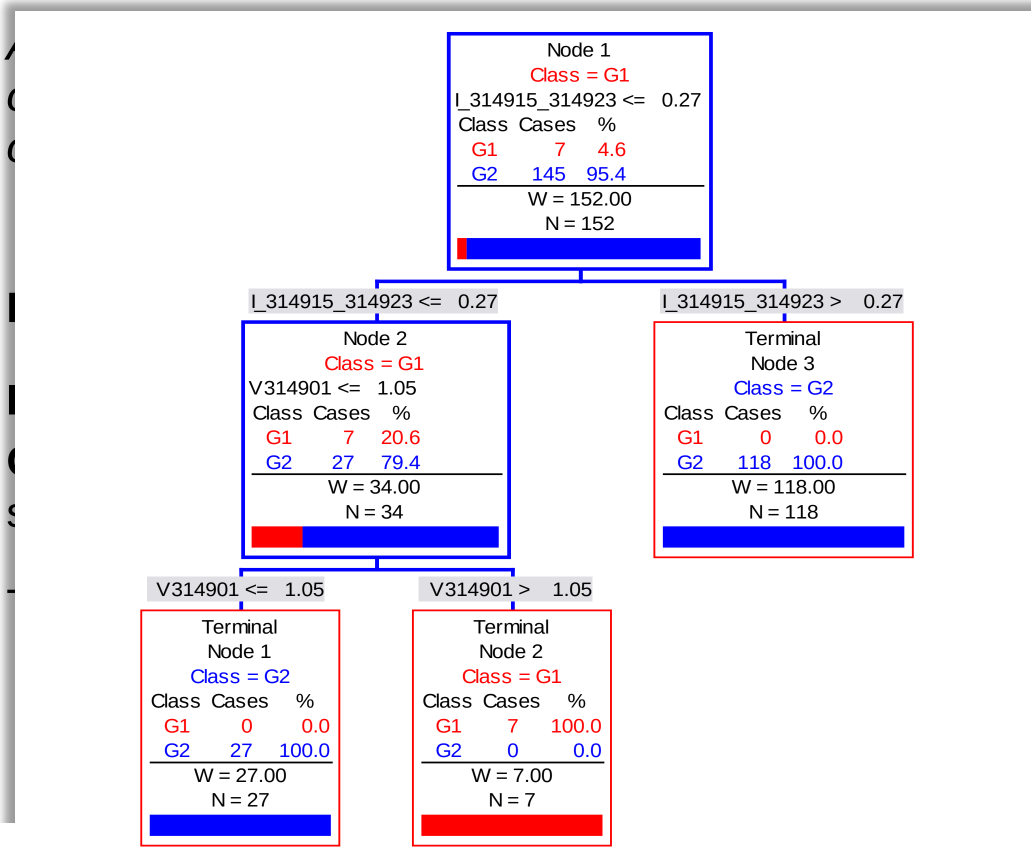
C ... rtance and prediction
S

– -

1.

2.

3. ... nly accurate tree;



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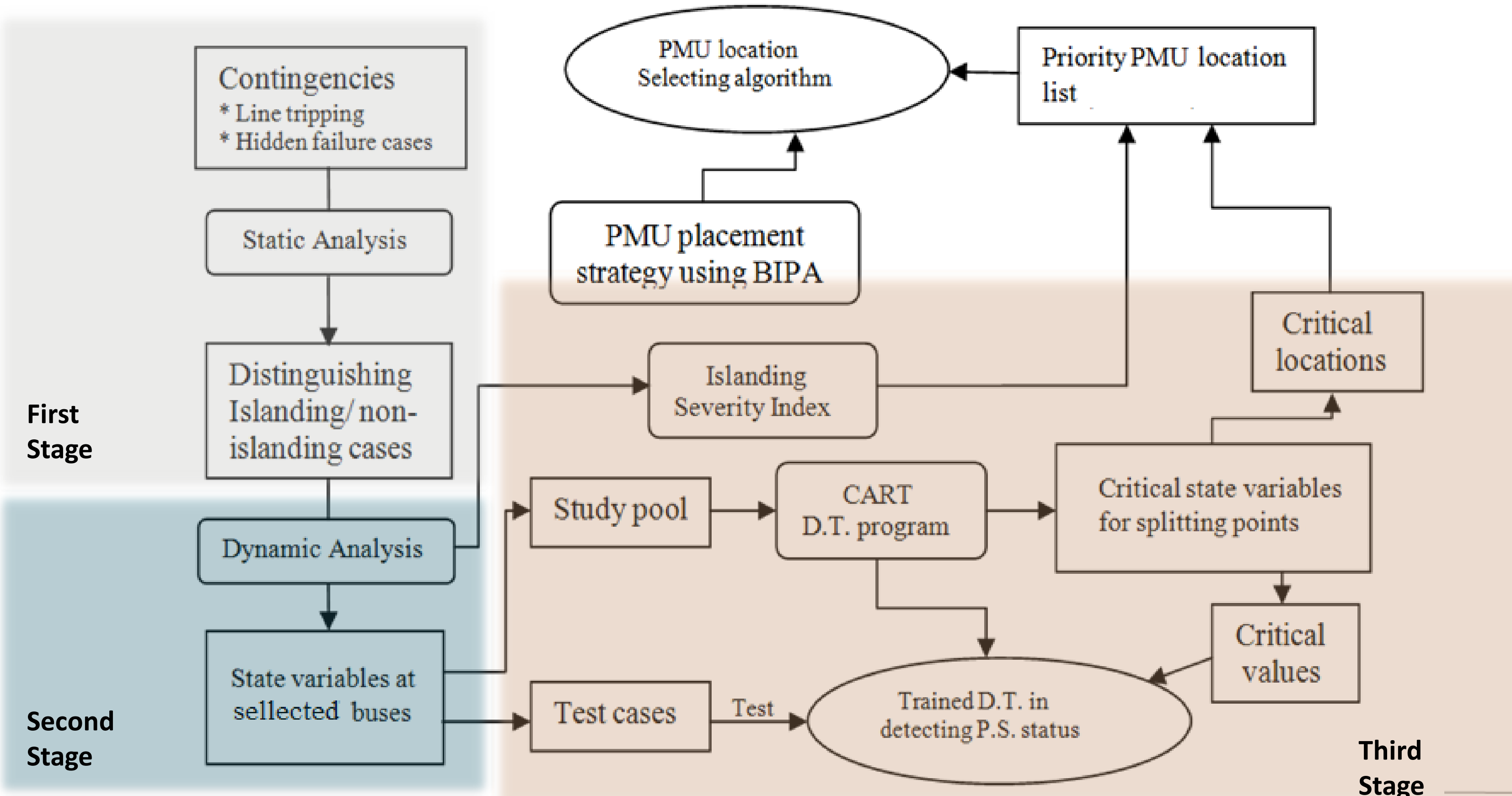
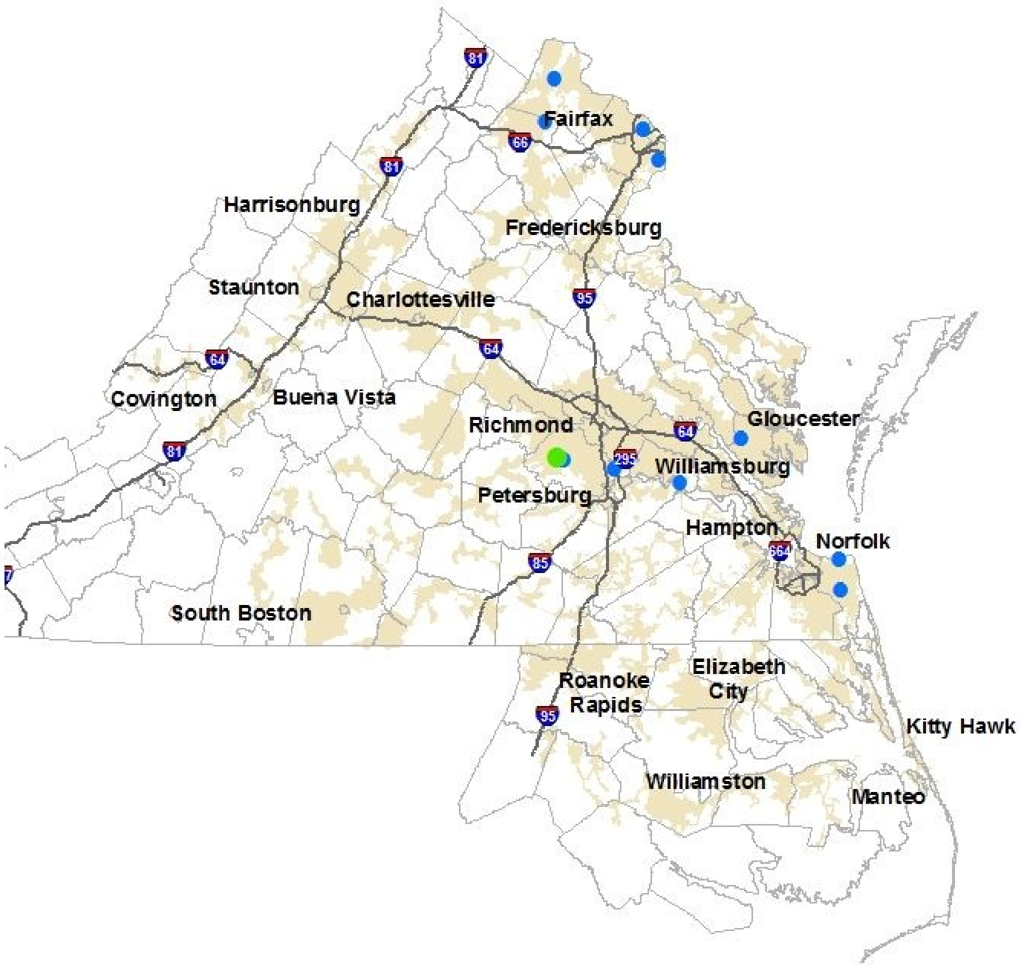
The Principle: Islanding Detection using Decision Tree

The flowchart of the islanding analysis strategy using DT



Islanding Analysis Approach in the DVP system



The islanding analysis is part of the PMU measurements application study.

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By the Year 2014, there will be 20 substations in the DVP system have PMUs implemented and all 500kV network in the DVP will be monitored under synchrophasors real-timely.

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Islanding Analysis Approach in the DVP system

The Decision tree based analysis procedures:

Step 1: Determine regions with potential islanding risk in DVP system

Region 1: Newton station	Region 2: Einstein and Dirac station	Region 3: Franklin and Raphson station

Step 2: Create geographical / system one-line diagrams at selected regions and set up cut-off locations for potential islanding criteria

Newton ▶ Geo/1-line	**Einstein** ▶ Geo/1-line	**Franklin** ▶ Geo/1-line

Step 3: PSS\e simulations on potential islanding cases with DVP load-shedding schemes applied

Step 4: Islanding contingency identification and ranking through Decision tree algorithm and severity index method based on simulation results

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Islanding Analysis Approach in the DVP system

The detailed DT and ISI calculator functions

State Estimator Component

Input channel: Voltage and current phasor variables from PMUs and the estimator; update rate: 30 times per second.

INPUT

DT 1: Full DVP area

DT 1: Full DVP area decision tree
1) Determines whether system is under islanding condition;
2) If islands occur in the system, estimates its probable location (Newton, Einstein or Franklin).

DT 2-4: vary locations

DT 2-4: Sub-system decision trees
1) Estimate the islanding event is stable or not based on the database for further use;
2) Estimate the probable islanded region (isolated GEN capacity) .

Islanding Severity Ranking Component

ISI computation program: using the analysis from DT 2-4, compute the islanding severity.

OUTPUT

Output channel: Data 1-Islanding identification (1/0); Data 2-Islanding severity ranking (1-5); update rate: event driven.

Result / Conclusion

Decision tree prediction success rate:

DT name		Covariance method			
		DT1: Full DVP	DT2: Newton	DT3: Einstein	DT4: Franklin
Islanding identification	Size	9	NA	NA	NA
	Learn	97.20			
	Test	95.67			
Location estimate	Size	13			
	Learn	99.07			
	Test	97.71			
Stability estimate	Size	NA	NA	12	11
	Learn			93.43	89.92
	Test			90.40	80.92
GEN size estimate	Size			12	3
	Learn			80.56	100
	Test			74.24	98.68

Result / Conclusion

The proposed islanding detection and strategy is

1. Online, real time updating with synchronized phasor measurements;
2. Accurate with high prediction success;
3. Updatable, the database is capable to increase and modify with historical events and simulation results;
4. Compatible with other application modules (i.e. state estimation, unbalanced current analysis).

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