UWIG Distributed Wind User Group and Tools

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UWIG Utility Wind Integration Group

Distributed Wind Impacts Project

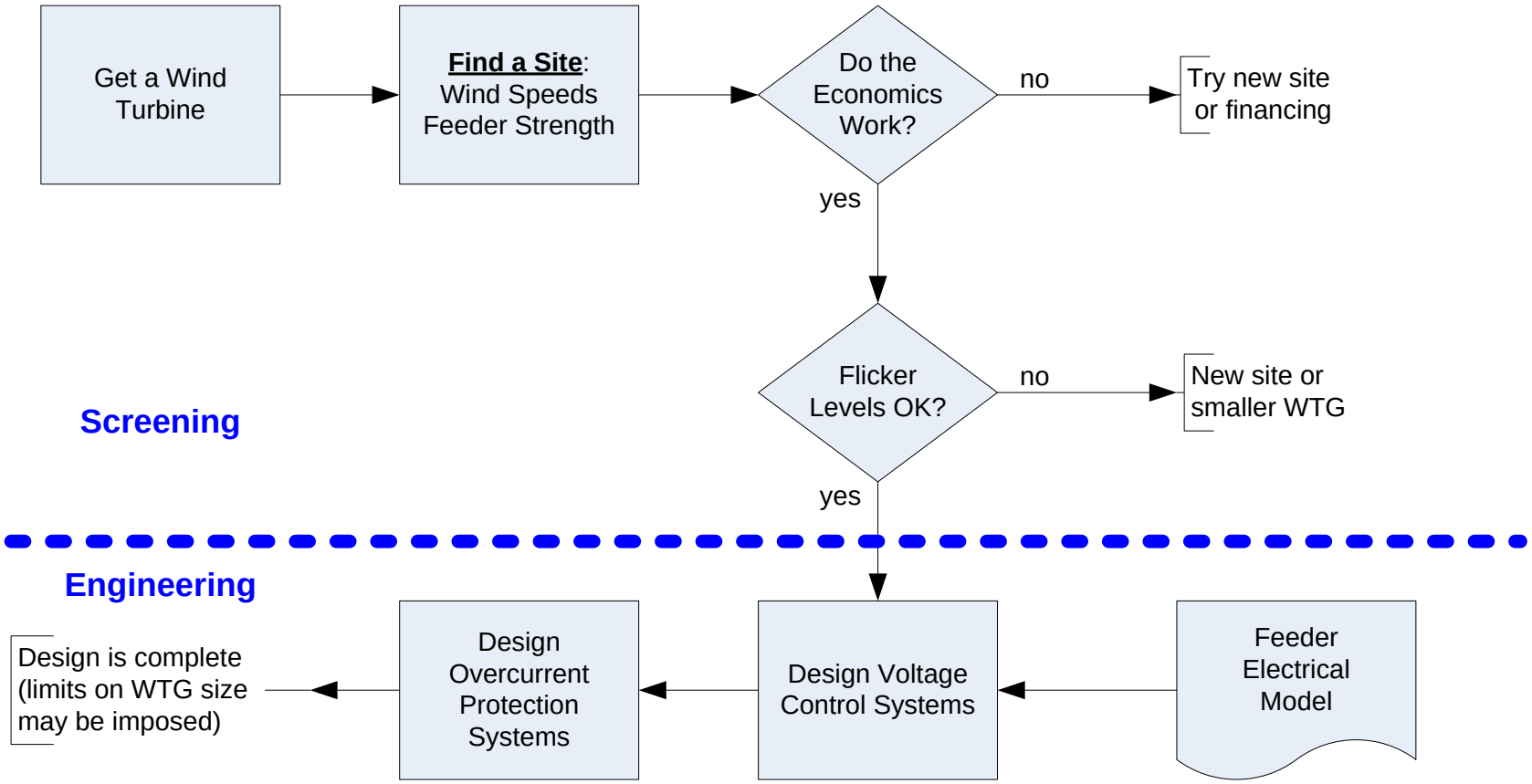
MELTRAN INC.

Web Site: **http://www.uwig.org/distwind**

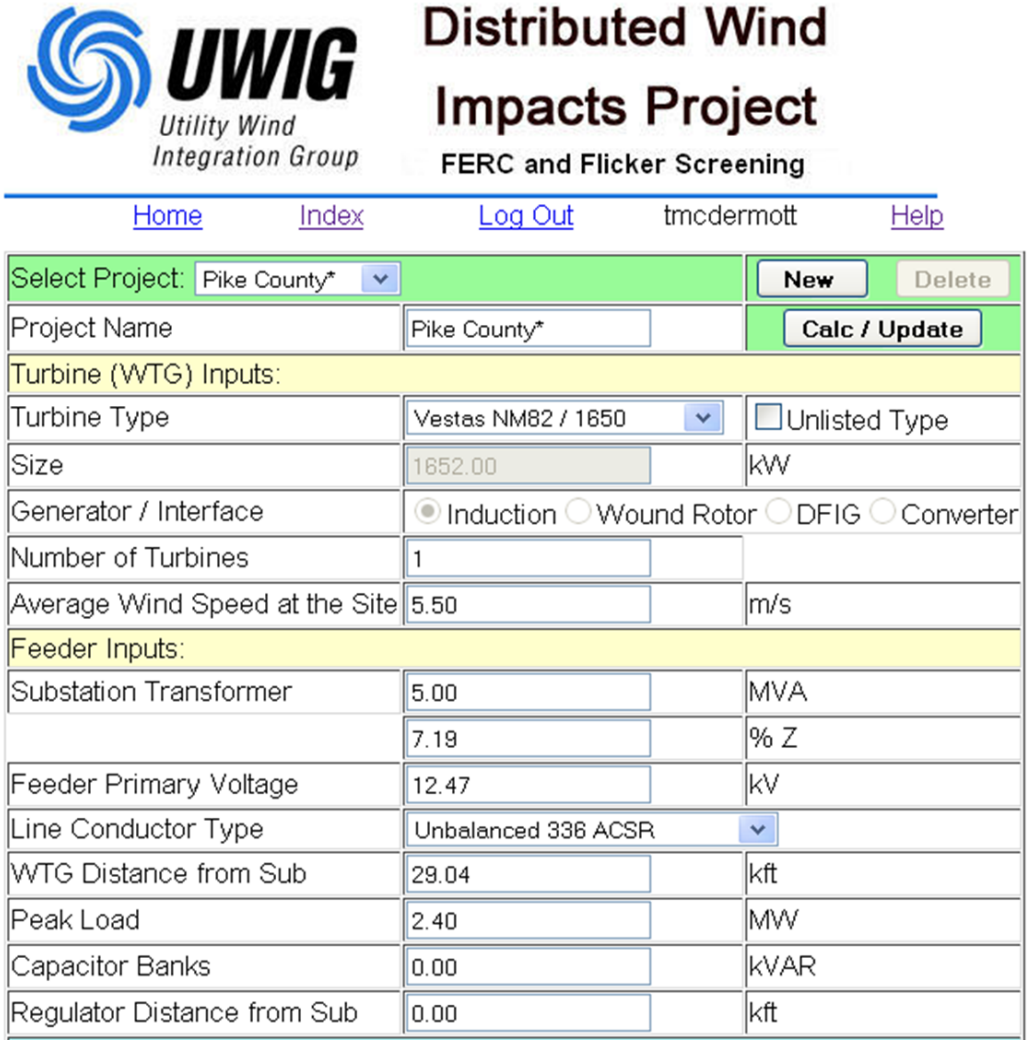
Distributed Wind Users Group

- Original Project Deliverables, 2004-2007
  - Application guides and 3 case studies
  - Turbine monitoring, 1 year at each of 3 sites
  - Web-based software tools
- Current work (NRECA, CEATI, APPA funding)
  - Application guide updates and FAQ document
  - Flicker data analysis of AOC 65-kW turbine
  - Evaluating customer interconnect requests
- Annual January workshop in Golden, CO

Screening Flowchart



Screening Inputs



UWIG Utility Wind Integration Group

Distributed Wind Impacts Project

FERC and Flicker Screening

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Select Project: Pike County*		New Delete
Project Name	Pike County*	Calc / Update
Turbine (WTG) Inputs:		
Turbine Type	Vestas NM82 / 1650	Unlisted Type
Size	1652.00	kW
Generator / Interface	Induction Wound Rotor DFIG Converter	
Number of Turbines	1	
Average Wind Speed at the Site	5.50	m/s
Feeder Inputs:		
Substation Transformer	5.00	MVA
	7.19	% Z
Feeder Primary Voltage	12.47	kV
Line Conductor Type	Unbalanced 336 ACSR	
WTG Distance from Sub	29.04	kft
Peak Load	2.40	MW
Capacitor Banks	0.00	kVAR
Regulator Distance from Sub	0.00	kft

- About 60 turbine power curves in the library
- About 12 flicker tests in the library
- Readily obtained feeder data

Screening Outputs

FERC Outputs:		
WTG Portion of Peak Load	68.83	%
WTG Fault Contribution	0.35	kA
WTG Portion of System Fault	28.79	%
FERC Fast-track?	Study Required due to Load Level, Fault Level	
Flicker Outputs:		
System Apparent Power	26.08	MVA
System Impedance Angle	73.60	Degrees
Continuous P_{ST}	0.14	
Switching P_{ST}	0.71	
Switching P_{LT}	0.50	

Feeder Simulator... Economic Analysis...

FERC Fast-Track Acceptance
(not in all jurisdictions)

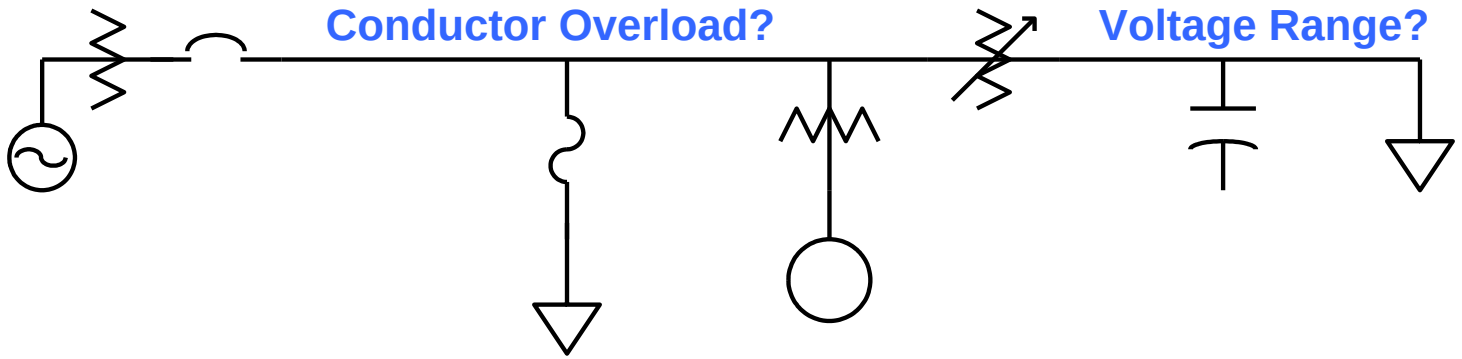
1. Design is certified
2. Project size ≤ 2 MW
3. Size ≤ 15% of Segment Load
4. Contribute ≤ 10% Utility Fault Current
5. All Utility Devices ≤ 87.5% Fault Rating

Flicker Planning Levels (IEEE Std. 1453)

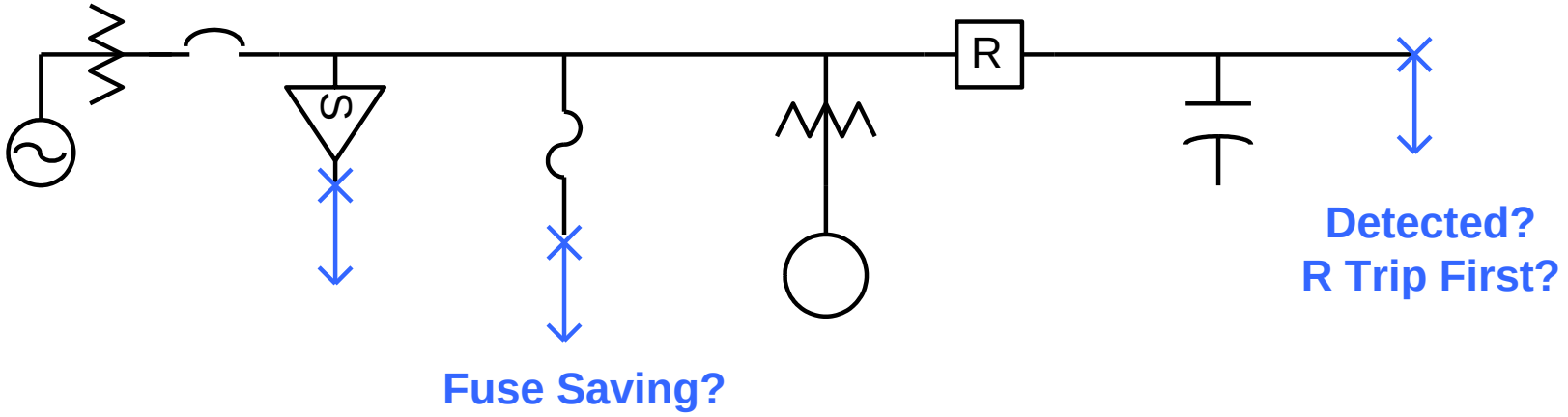
1. Continuous, $P_{ST} \leq 0.9$
2. Switching, $P_{ST} \leq 0.9$ and $P_{LT} \leq 0.7$

Feeder Simulator Applications

- Current Flow and Voltage Drop



- Overcurrent Protective Device Coordination



IEEE Std. 1547-2003

- "Standard for Interconnecting Distributed Resources with Electric Power Systems"
    1. Test Procedures (2005)
    2. Application Guide (2009)
    3. Monitoring and Control (2007)
    4. Islanding
    5. > 10 MVA on Transmission Grid
    6. Secondary Networks
- Referenced in Federal Energy Policy Act of 2005, and many State commissions
- Reaffirmed with no changes in 2008

What Does IEEE 1547 Require?

- 1 – shall not actively regulate voltage
- 2 – shall not cause any voltages outside ANSI C84 Range A (basically, 114 to 126 volts)

ANSI C84.1 Standard

	Service Voltage 120 to 600		Service Voltage > 600	
	Min [p.u.]	Max [p.u.]	Min [p.u.]	Max [p.u.]
A Range	0.9500	1.0500	0.9750	1.0500
B Range	0.9167	1.0583	0.9500	1.0583

1547 Grounding Requirements

- 3 – no overvoltages in the Area Electric Power System
- 4 – no disruption of device coordination

Transformer Connection Types

Type	Good	Bad
Y / Δ	No Overvoltage Converter Ungrounded	Ground Source Circulate Δ I
Y / Y	No Overvoltage No Circulating Δ I Commonly Available	Must Ground DG Harmonics
Δ / Y	Sometimes Available	Overvoltages
Δ / Δ	No Sags or Swells No Converter Ground	Overvoltages

1547 Fault Response Requirements

- 5 – Deenergize for faults on the connected circuit
- 6 – Deenergize prior to circuit reclosure
- 7 – Response to any PCC phase-phase (*) voltage:

Voltage Range [%]	Trip Time [s] **
$V < 50$	0.16
$50 \leq V < 88$	2.00
$110 < V < 120$	1.00
$120 \leq V$	0.16

* Respond to phase-neutral voltage for wye-wye transformers
** “default” clearing times for sizes above 30 kW

1547 Islanding Requirements

- 8 – Detect and de-energize unintentional islands within 2 seconds
  - Examples of meeting this requirement:
    - DG aggregate less than 1/3 minimum EPS load
    - Reverse power flow detection at PCC
    - Transfer trip
    - Forced frequency or voltage shifting
    - Constant power or power factor controls
    - Certified to pass a non-islanding test

Other 1547 Requirements

- 9 – Trip for frequency deviations (size > 30 kW)
  - 0.16 s if $f > 60.5$ or $f < 57.0$
  - Adjustable 0.16 – 300 s if $57.0 \leq f \leq 59.8$
- 10 – No voltage fluctuation > 5%
- 11 – No objectionable flicker (IEEE 1453)
- 12 – Harmonic limits; TDD ≤ 5% (IEEE 519)
- 13 – Shall not energize Electric Power System
- 14 – Accessible, visible, lockable isolation device
- 15 – if ≥ 250 kVA, monitor status, P, Q, V