A 3D rendering of a power substation is shown on the left side of the slide. The substation is a complex structure of white metal beams and insulators. In the background, there are several high-voltage power lines and towers. Overlaid on the substation is a semi-transparent, white, mesh-like structure that resembles a network or a data flow. Red lines and dots are scattered across this mesh, suggesting a digital or data-driven overlay. The overall scene is set against a light, hazy background.

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# Piloted Protection of **Distribution Network** with integrated DERs

Power system applications – **ABB** SECRC

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# Goals & Approach

Performance comparison of **Transient-based & Conventional Directional** protection with  
**Line Differential Protection**

## Performance Parameters:

- 1) Fault Type (L-G, L-L, L-L-L)
- 2) Fault Resistance Coverage
- 3) Bidirectional Power Flow
- 4) Load Angle Variation
- 5) Fault Inception Angle
- 6) System Grounding method and NGR size variation
- 7) Source Strength Tests
- 8) Network Complexity
- 9) Data Synchronization and Channeling issues
- 10) Hardware/Equipment limitations (CT/VT, Sampling Frequency, Processor speed etc.)

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# Transient-Based (Delta Components) Directional Algorithms

Several algorithms have been **studied, duplicated, modified** and **tested** extensively

- **Energy-Based Algorithms**
  - Asea's approach (RALDA – 1978)
- **Impedance-Based Algorithms**
  - Brown Boveri & Company's Replica Impedance approach (IV Quadrants – later modified by Siemens)
  - MIMIC Filter approach (SEL and Siemens)
  - Positive Sequence Impedance Method
- **Alternate Methods**
  - Average Superimposed Quantities (sliding window)
  - Practically feasible directional algorithms

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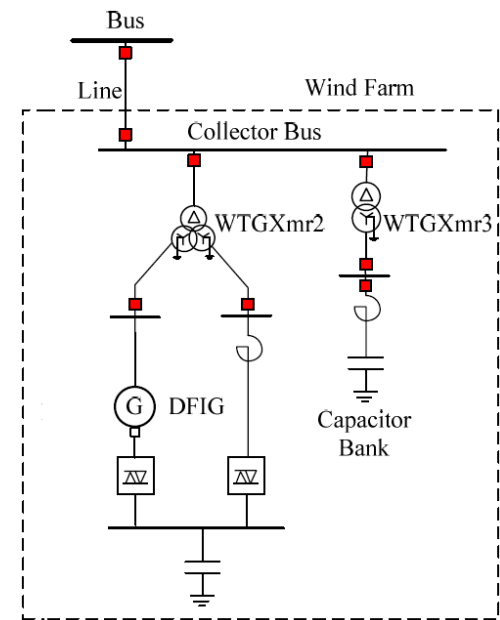
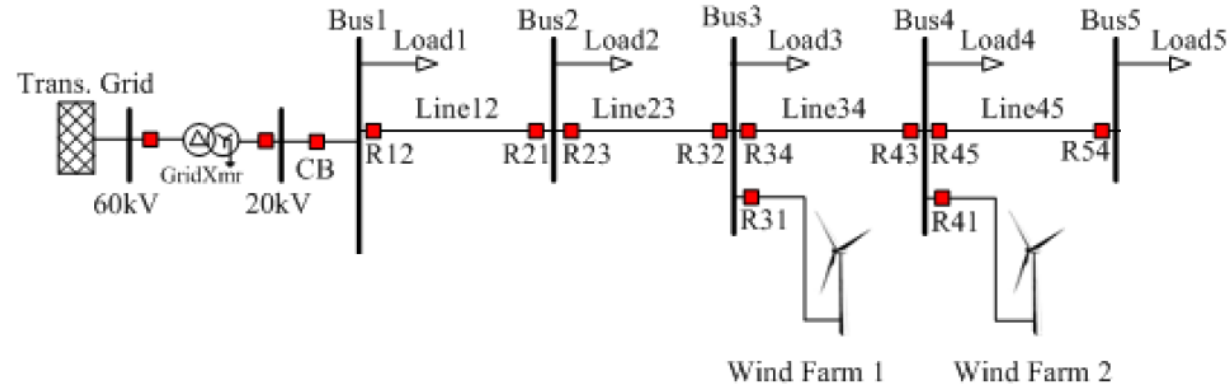
# Line Differential Algorithms

Several algorithms have been **studied, duplicated, modified** and **tested** extensively

- Dual Slope line differential (ABB RED 670/615)
- Polar Plane Analysis for Phasor Comparison (SEL)
- Phaselet & Variable Window Fourier Transform Approach (GE)

# Future Work

- Performance evaluation for a network similar to this one:





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