NSERC SMART MICROGRID NETWORK

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Project 2.4

Integration Design Guidelines and Performance Metrics - Study Cases

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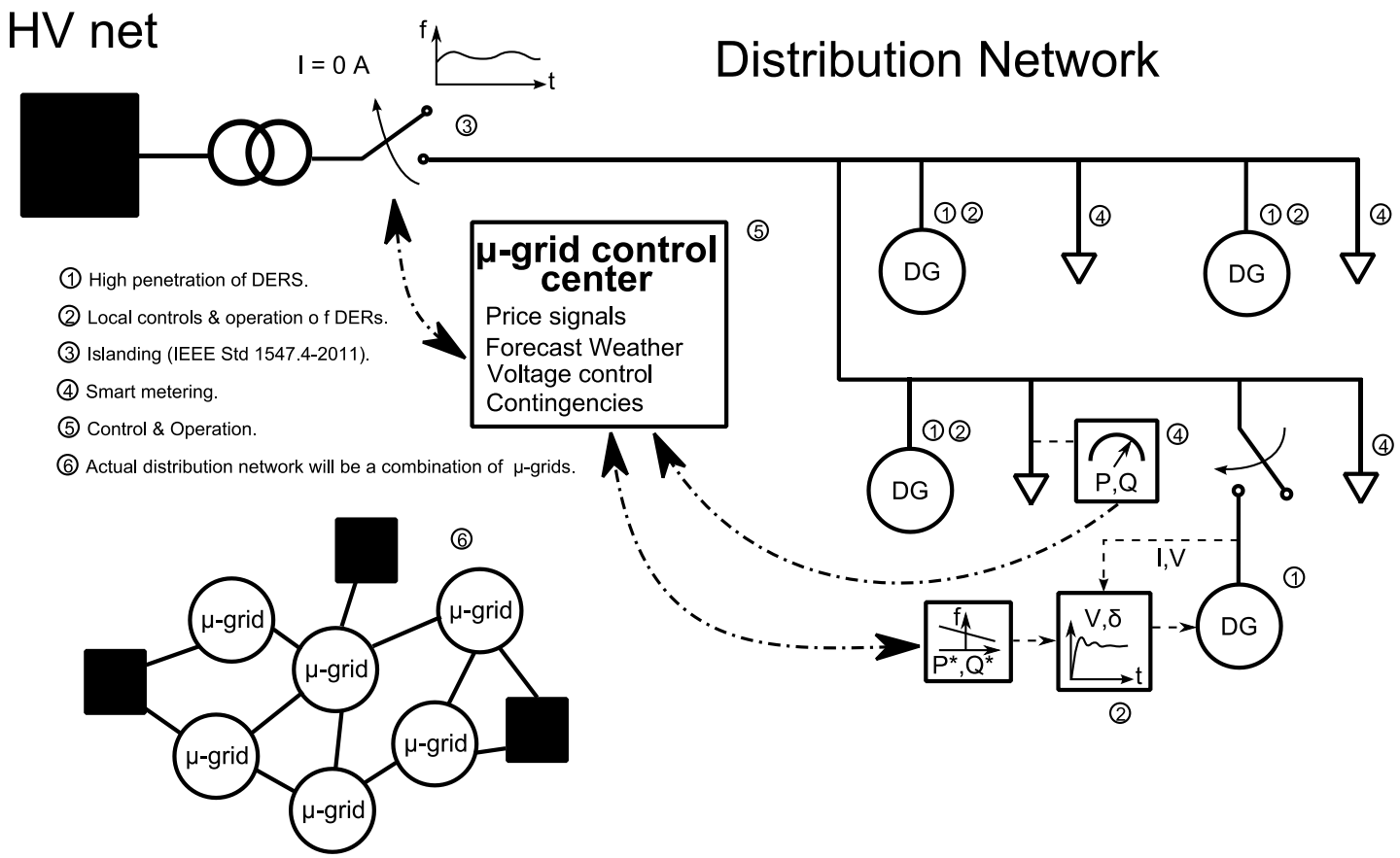
Problem

- There is currently a need to develop standardized models and benchmarks for Microgrids in Canada, based on typical distribution system configurations and operating practices
- There is a need to define a structure for the various the different studies required, including stability, load flow, transient analysis, and power quality

Problem formulation

- How distribution networks become micro-grids



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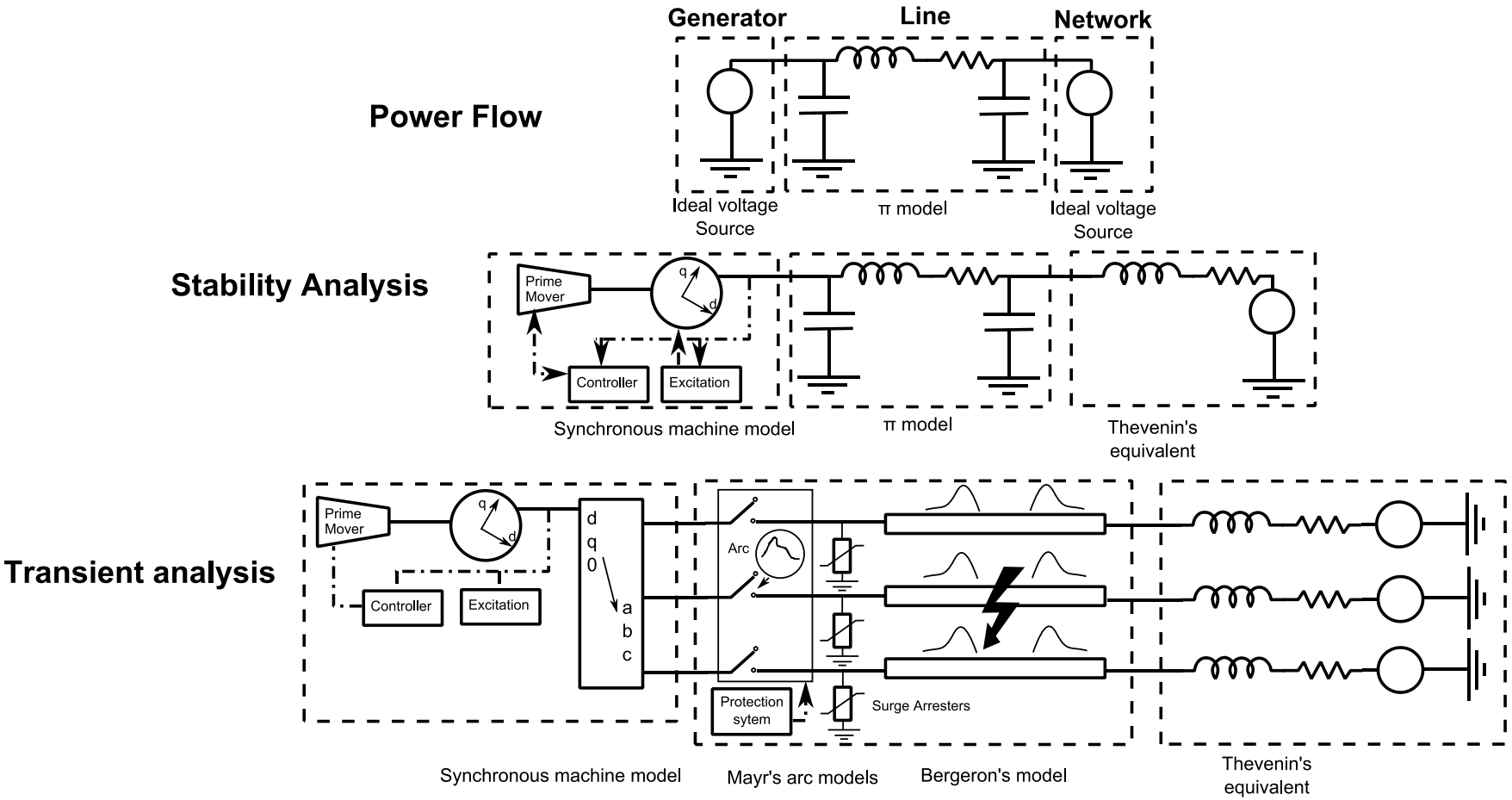
Problem formulation

- Example of study vs models.



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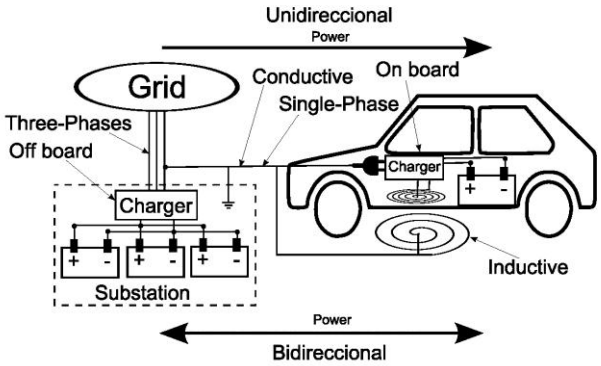
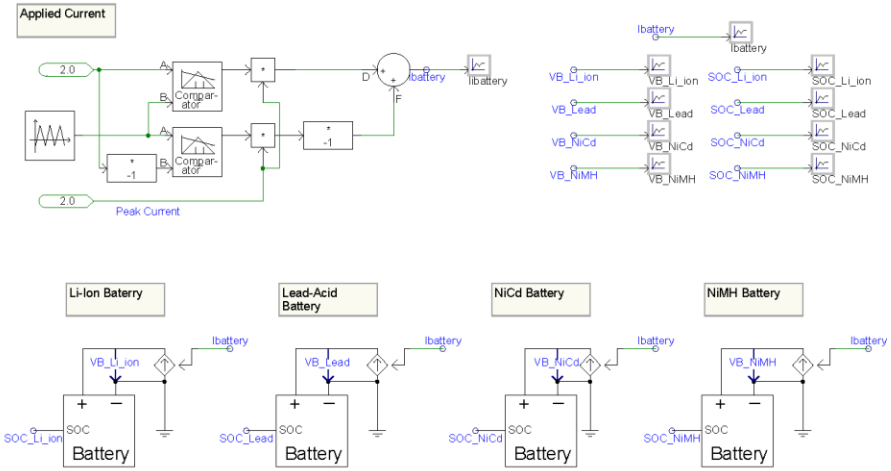
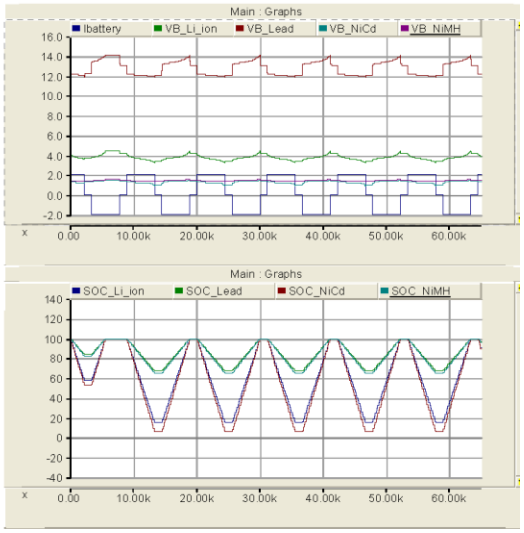
Solution formulation

- New models:
  - Prime mover models: Microturbine, PV, fuel cells…
  - Distribution load models
  - Converter controllers model.
  - Electric vehicle.
  - Energy storage systems.







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Challenges

- Multiple studies, single model of the micro-grid?
- Challenges:
  - The number of studies is large.
  - Detailed model vs. Simplified model.
    - Simplified models do not give results for all the studies.
    - Transition from a simplified model to a detailed model
      ↑ # of equations and ↑ computational effort.
  - Solution algorithms
    - Power flow algorithms do not give results for transients.
    - Transient algorithms do not give results for high frequency transients.
    - Electromagnetic transient algorithms require long computational time and many hardware resources.

Solution – tools

- Use of Canadian benchmarks as a basis
- Software
  - PSCAD-EMTDC is selected because:
  - EMTDC algorithm gives results in a large frequency spectrum.
  - PSCAD has a large pre-developed models of components.
- Use case approach

Outcomes of project

- How will your five years' work help Canada?
  - The case studies represent typical Canadian distribution systems.
- This research is using and improving the technology of power system simulation in Canada.
- The results and experiences of this research will be useful for future investigations in Canadian micro-grid technologies.

Partnerships with Canadian industry

- Collaboration on this project thus far from:
  - Hydro Quebec
    - Distribution systems data
  - Manitoba HVDC Center
    - PSCAD/EMTDC
  - CANMET Natural Resources Canada
    - Distribution benchmarks

Future work & potential collaboration

- Collaborations with the following projects will enrich the quality of the deliverables by providing models:
  - Project 1.1, 1.2 and 1.4 to create models
  - Project 2.2 to create business cases for systems that have low energy security or reliability
  - Projects 2.3, 2.4 and Theme 3 to structure the studies of technology capabilities, costs, and functionalities