IOWA STATE UNIVERSITY
Department of Economics, Department of Electrical & Computer Engineering

Report on:

ERCOT PNNL Contract 401882: *Start Date* 3/19/2018

Development of an Integrated Transmission and Distribution Test System to Evaluate Transactive Energy Systems

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ERCOT Contract: Presentation Outline

- Original Task/Milestone Schedule: M1-M3
- Updated Task/Milestone Schedule: M1-M3
- Latest AMES V5.0 Work for ERCOT Test Cases (i.e., for M3.2)
  - Tested AMES V5.0 for different values of RTM duration
  - Implemented system-wide reserve constraints expressing down/up system-wide reserve requirements as decimal percentages of net load
  - Resolved Pyomo error found while running Pyomo with Windows 10
  - Updated to-do checklist for AMES V 5.0 constraint implementations

Original Task & Milestone Schedule

Milestone	Date Due	Original Description
M1	May 31, 2018	5-zone model of the old ERCOT system, posted to a web repository.
M2	Sep 30, 2018	Nodal model of the new ERCOT system, posted to a web repository.
M3	Sep 30, 2018	Submitted conference or journal paper on this work.

Updated Task & Milestone Schedule

Milestone	Date Due	Date Delivered	Fuller Descriptions of Actual Work
M1* DONE	May 31, 2018	June 5, 2018	Development of 8-Bus ERCOT model (with nodal locational marginal pricing); grid/load/gen data posted at PNNL repository
M2.1 DONE	Sept 30, 2018	August 1, 2018	Basic 8-Bus ERCOT Test System, implemented via AMES V3.1, posted at https://github.com/ITDProject/ERCOTTestSystem
M2.2 DONE	Sept 30, 2018	August 24, 2018	8-Bus ERCOT Test System (with wind power), implemented via AMES V3.2, posted at https://github.com/ITDProject/ERCOTTestSystem
M3.1 DONE	Sept 30, 2018	August 31, 2018	200-Bus ERCOT Test System (with wind power), implemented via AMES V3.2, posted at https://github.com/ITDProject/ERCOTTestSystem/tree/master/ERCOT_Test_Systems/The_200Bus_ERCOT_Test_System
M3.2**	July 31, 2019		200-Bus ERCOT Test System (with wind power), implemented via AMES V5.0, to be posted at PNNL/ISU repositories.
M3.3**	July 31, 2019		Paper to be submitted that focuses on the development of the ERCOT Test Systems

- * **M1 Modification (Ok'd by PNNL):** For M1 we have skipped the modeling of the old (zonal) ERCOT system and instead directly worked to develop an 8-bus model of the new (nodal) ERCOT system.
- ** **M3 Modification: Contract extension through July 31, 2019 received from PNNL on March 4, 2019, for completion of task M3**

Latest Work on AMES V5.0

- AMES RTM market
  - Fixed bugs with AMES V 5.0 to run for different values of 'RTMDuration' without run-time errors, where RTMDuration = Duration of each RTM in minutes
  - Tested for RTMDuration = 5, 10, 12, 15, 20, 30, 60
  - RTMDuration must be a positive integer less than or equal to 60.
  - 60/RTMDuration = Number of times RTM runs each hour. If this ratio is not a positive integer, the message window now displays a warning message to users.
- System-wide Reserve Constraints
  - Modified PSST to model the down/up reserve requirements for system-wide reserve constraints as decimal percentages of forecasted net load.
  - User needs to set values for ReserveDownSystemPercent (RD) and ReserveUpSystemPercent (RU), the reserve-down and reserve-up percentages.
  - Currently ReserveDownSystemPercent (RD) and ReserveUpSystemPercent (RU) are set the same for the entire planning horizon
  - Modified AMES V 5.0 and PSST and established linkage between both to enable reading of system-wide down/up reserve requirements from input data file of AMES to PSST.

Resolution of Apparent Error in Pyomo

- Error message thrown by Pyomo (version 5.5) while running under Windows 10
  - **FileNotFoundError**: [WinError 2] The system cannot find the file specified: 'C:\\...\\TESAgents\\PyomoTempFiles\\tmpe_47syhv.cplex.sol'
- Discovered a Pyomo solver option that prevents above problem from happening:
  - ✓ keepfiles option
    - keepfiles provides an option to choose if intermediary files generated by Pyomo should be removed or not.
    - Default value of keepfiles is False, meaning temporary files are deleted after optimization is completed.
    - If user sets keepfiles = True, this disables deletion of temporary files, which appears to resolve the above error.

ECA Model Notes (EMN) Implementation	Equation No in EMN	Implemented in AMES V5.0?	Validated?	Remarks
Objective Function	(16)	Partial	Partial	A single imbalance penalty factor currently exists in AMES V5.0 whereas negative and positive imbalance penalty factors are defined in EMN
Power Flow Constraints	(33)-(34)	Yes	No	
Power Balance Constraints	(35)	Yes	No	
Slack Variable Constraints	(36)-(37)	-	-	Implementation in AMES V5.0 currently differs from EMN
Generator Capacity Constraints	(38)-(40)	Yes	Partial	
Generator Ramping Constraints	(41)-(43)	Yes	No	
Generator minimum-up time constraints	(44)-(46)	Yes	Yes	
Generator minimum-down time constraints	(47)-(49)	Yes	Yes	
Generator hot-start constraints	(50)-(52)	Yes	No	
Generator start-up cost constraints	(53)	Yes	Yes	
Generator shut-down cost constraints	(54)	Yes	Yes	
System-wide down/up reserve requirement constraints	(65)-(66)	Yes	No	
Zonal down/up reserve requirement constraints	(67)-(68)	-	-	Need to modify the AMES V5.0 zonal reserve requirements
Voltage angle specifications	(69)-(70)	Yes	Yes	
Total Production Cost Approximation Constraints	(71)-(80)	Yes	Partial	

Note: Above model equations are implemented in python files located at AMES-V5.0\psst\psst\model. **constraints.py** has the modeling of objective function and constraints