



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
- ❑ Previous AMES V5.0 Work for ERCOT Test Cases (M3.2)
 - Tested AMES V5.0 for different values of RTM duration
 - Resolved “file-closing” problem found while running Pyomo
- Latest AMES V5.0 Work for ERCOT Test Cases (M3.2)
 - Implemented **zonal** reserve constraints expressing down/up zonal reserve requirements as decimal percentages of net load
 - Resolved “invalid argument” error found while running Pyomo
 - 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

❑ Zonal Reserve Constraints

- Modified PSST to model the down/up reserve requirements for zonal reserve constraints as decimal percentages of forecasted net load.
- User needs to set values for ReserveDownZonalPercent (RD) and ReserveUpZonalPercent (RU), the reserve-down and reserve-up percentages for each zone
- Currently ReserveDownZonalPercent (RD(z)) and ReserveUpZonalPercent (RU(z)) 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 zonal down/up reserve requirements from input data file of AMES to PSST.

➤ **Input format: Example**

NumberOfReserveZones 3

#ZoneDataStart

// ZoneName	Buses	ReserveDownZonalPercent	ReserveUpZonalPercent
Zone1	1,2,3	0.1	0.15
Zone2	4,5,6	0.2	0.25
Zone3	7,8	0.3	0.35

#ZoneDataEnd

Resolution of “Invalid Argument” Error with Pyomo

❑ Error message thrown by Pyomo (version 5.5) while running

➤ **OSError: [Errno 22] Invalid argument:**
'C:\\...\\TESAgents\\PyomoTempFiles\\tmpf2nst73z.cplex.log'

➤ **Error Resolution:**

- Comment out the following lines of 'shellcmd.py' located at C:\\ProgramData\\Miniconda3\\Lib\\site-packages\\pyomo\\opt\\solver to prevent the error:

if self._log_file is not None:

 OUTPUT=open(self._log_file,"w")

 OUTPUT.write("Solver command line: "+str(self._command.cmd)+'\\n')

 OUTPUT.write("\\n")

 OUTPUT.write(self._log+'\\n')

 OUTPUT.close()

ECA Model Notes (EMN) Implementation	Equation No in EMN	Implemented in AMES V5.0?	Validated?	Remarks
Objective Function	(16)	Partial	Partial	AMES V5.0 currently has a single penalty factor for imbalance (absolute value), whereas penalty factors for negative and positive imbalances are defined in EMN
Power Flow Constraints	(33)-(34)	Yes	No	
Power Balance Constraints	(35)	Yes	No	
Slack Variable Constraints	(36)-(37)	-	-	AMES V5.0 implementation 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)	Yes	No	
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. The file **constraints.py** handles the modeling of the objective function and constraints