PJM Governor Survey Analysis

Primary Frequency Response
Sr. Task Force

December 20, 2017

- February 2016 - PJM Issued a Governor Survey
  - Total of 1440 units surveyed, based on eDART model
  - Consisted of 22 technical questions such as:
    - Is the unit equipped with a governor?
    - Is the governor operational?
    - Droop setting?
    - Deadband Setting?
    - Any control system or regulatory limitations to governor response?

- **Of the designated Black Start units on the PJM system:**

  - 100% indicated that they have a governor capable of changing output in response to locally detected changes in interconnection frequency

  - 8% were **not** within the guidelines of the NERC advisory for governor dead band settings (governor dead band not to exceed +/- 36 mHz)

  - 100% were within the guidelines of the NERC advisory for governor droop settings (governor droop settings not to exceed 5%)

  - 16% responded that they **do have** unit-level or plant-level control schemes or regulatory **restrictions that would override or limit governor response** during normal operation

- **Critical Load unit – a unit with a hot start time of 4 hours or less**
- **Critical Load units will be the first units to get start-up power from the Black Start units**
- **Of the Critical Load units on the PJM system:**

  – 3% indicated that they do **not** have a governor capable of changing output in response to locally detected changes in interconnection frequency

  – 21% were **not** within the guidelines of the NERC advisory for governor dead band settings (governor dead band not to exceed +/- 36 mHz)

  – 3% were **not** within the guidelines of the NERC advisory for governor droop settings (governor droop settings not to exceed 5%)

  – 25% responded that they **do have** unit-level or plant-level control schemes or regulatory **restrictions that would override or limit governor response** during normal operation

- **Of the Other Units:**

  – 31% indicated that they do **not** have a governor capable of changing output in response to locally detected changes in interconnection frequency

  – 48% were **not** within the guidelines of the NERC advisory for governor dead band settings (governor dead band not to exceed +/- 36 mHz)

  – 38% were **not** within the guidelines of the NERC advisory for governor droop settings (governor droop settings not to exceed 5%)

  – 37% responded that they **do have** unit-level or plant-level control schemes or regulatory **restrictions that would override or limit governor response** during normal operation

- Unit data aggregated and then broken down by technology type and fuel type

- Totals are consistent between the two but individual component totals may differ because of eDART model for 'legacy' units

  - For example, "Other" category includes any item not explicitly listed.

  - eDART Technology Type does not map one to one with Fuel Type

Governor Survey Results – Breakdown By Technology Type

Unit Does Not Have Functional Governor

Technology Type	Unit Count	iCap (MW)	% of Total iCap	% of Tech Total
Combined Cycle	4	574	0.30%	1.84%
Combustion Turbine	33	725	0.38%	2.42%
Other	48	313	0.16%	34.86%
Hydro	25	409	0.21%	4.85%
Nuclear	23	23379	12.24%	69.75%
Solar	91	580	0.30%	100.00%
Steam/Fossil	41	8470	4.43%	10.75%
Storage	8	118	0.06%	100.00%
Wind	72	7034	3.68%	93.76%
Total	**345**	**41602**	**21.78%**	

Governor Survey Results – Breakdown By Technology Type

Unit Does Not Have Deadband Setting Within Guidelines

Technology Type	Unit Count	iCap (MW)	% of Total iCap	% of Tech Total
Combined Cycle	34	5664	2.97%	18.12%
Combustion Turbine	86	3671	1.92%	12.26%
Other	66	469	0.25%	52.23%
Hydro	47	880	0.46%	10.43%
Nuclear	33	33467	17.52%	99.85%
Solar	91	580	0.30%	100.00%
Steam/Fossil	135	35387	18.53%	44.93%
Storage	8	118	0.06%	100.00%
Wind	72	6516	3.41%	86.86%
Total	**572**	**86752**	**45.42%**	

Governor Survey Results – Breakdown By Technology Type

Unit Does Not Have Droop Setting Within Guidelines

Technology Type	Unit Count	iCap (MW)	% of Total iCap	% of Tech Total
Combined Cycle	6	1227	0.64%	3.93%
Combustion Turbine	29	577	0.30%	1.93%
Other	58	386	0.20%	42.98%
Hydro	38	828	0.43%	9.82%
Nuclear	23	21613	11.31%	64.48%
Solar	91	580	0.30%	100.00%
Steam/Fossil	73	11481	6.01%	14.58%
Storage	8	118	0.06%	100.00%
Wind	73	6617	3.46%	88.20%
Total	**399**	**43427**	**22.73%**	

Unit Has Override or Limit to Governor Response (Outer Loop Controls)

Technology Type	Unit Count	iCap (MW)	% of Total iCap	% of Tech Total
Combined Cycle	27	3757	1.97%	12.02%
Combustion Turbine	134	5438	2.85%	18.16%
Other	50	328	0.17%	36.53%
Hydro	21	240	0.13%	2.85%
Nuclear	27	26320	13.78%	78.53%
Solar	91	580	0.30%	100.00%
Steam/Fossil	87	18352	9.61%	23.30%
Storage	8	118	0.06%	100.00%
Wind	66	6399	3.35%	85.30%
Total	**511**	**61532**	**32.21%**	

Units Do Not Have Functional Governor

Fuel Type	Unit Count	iCap (MW)	% of Total iCap	% of Fuel Total
Coal	22	6257	3.28%	9.83%
Hydro	25	409	0.21%	4.85%
Gas	73	3346	1.75%	5.01%
Nuclear	23	23379	12.24%	69.75%
Other	27	476	0.25%	37.25%
Petroleum	12	121	0.06%	1.32%
Solar	91	580	0.30%	100.00%
Wind	72	7034	3.68%	93.76%
Total	**345**	**41602**	**21.78%**	

Governor Survey Results – Breakdown By Fuel Type

Unit Does Not Have Deadband Setting Within Guidelines

Fuel Type	Unit Count	iCap (MW)	% of Total iCap	% of Fuel Total
Coal	67	27316	14.30%	42.90%
Hydro	47	880	0.46%	10.43%
Gas	177	12659	6.63%	18.94%
Nuclear	33	33467	17.52%	99.85%
Other	37	1018	0.53%	79.66%
Petroleum	48	4316	2.26%	46.94%
Solar	91	580	0.30%	100.00%
Wind	72	6516	3.41%	86.86%
Total	**572**	**86752**	**45.42%**	

Governor Survey Results – Breakdown By Fuel Type

Unit Does Not Have Droop Setting Within Guidelines				
Fuel Type	Unit Count	iCap (MW)	% of Total iCap	% of Fuel Total
Coal	23	7133	3.73%	11.20%
Hydro	38	828	0.43%	9.82%
Gas	99	4037	2.11%	6.04%
Nuclear	23	21613	11.31%	64.48%
Other	29	606	0.32%	47.42%
Petroleum	23	2013	1.05%	21.89%
Solar	91	580	0.30%	100.00%
Wind	73	6617	3.46%	88.20%
Total	**399**	**43427**	**22.73%**	

Governor Survey Results – Breakdown By Fuel Type

Unit Has Override or Limit to Governor Response (Outer Loop Controls)				
Fuel Type	Unit Count	iCap (MW)	% of Total iCap	% of Fuel Total
Coal	47	11215	5.87%	17.61%
Hydro	21	240	0.13%	2.85%
Gas	171	12826	6.71%	19.19%
Nuclear	27	26320	13.78%	78.53%
Other	28	518	0.27%	40.53%
Petroleum	60	3434	1.80%	37.35%
Solar	91	580	0.30%	100.00%
Wind	66	6399	3.35%	85.30%
Total	**511**	**61532**	**32.21%**	