Fuel Assurance for Black Start Resources Hydro Proposal Confidence Level Calculation

Tom Hauske

OC/MIC Special Session

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New Hydro Proposal Summary

	Non-Fuel Assured	Fueled Assured
Black Start MW	ICAP	ICAP * 90% confidence of 16 hours
Minimum Run Time	None	16 hours
Black Start Calculator MW	ICAP * confidence level for 16 hours	MW at 90% confidence of 16 hours
Revenue Calculation MW	ICAP	MW at 90% confidence of 16 hours
X Factor	0.01 (Status Quo)	0.02 (same as CT)
Z Factor Incentive	10%	10%
Penalty for lack of Water	None	Pumped Storage only if they fail to maintain 16 hours of storage

Historical Data

- PJM is using the historical data provided as part of the ELCC analysis in performed in December 2021
- Historical data is for the period June 1, 2012 – May 31, 2021. It includes:
  - Hourly streamflow data (converted to MWh)
  - Minimum and maximum flows (converted to MWh)
  - Exigent and ordinary storage in MWh

Non-Fuel Assured Methodology

- For each year of the historical data:
  1) PJM calculates the MWh that can be produced by the black start unit(s) for each hour of each day.
  2) The total number of hours with MWh greater than or equal to the black start ICAP MW are summed for each day.
  3) Each day where the sum is greater than or equal to 16 hours is given a 1. Days with less than 16 hours are given a 0.
  4) The confidence level for the year is calculated using a simple average.

Non-Fuel Assured Methodology

- The calculated yearly confidence levels are averaged together using an ELCC weather weighted average to calculate the unit specific confidence level (e.g. 73.4%)
  - The weights for each year are provided in the Assumptions section of the December 2021 ELCC Report available at: https://www.pjm.com/-/media/planning/res-adeq/elcc/elcc-report-december-2021.ashx
- This confidence level is only multiplied by the black start unit's MW in the Black Start Calculator.

Fuel Assured Methodology

- For each year of the historical data:
  1) PJM calculates the MWh that can be produced by the black start unit(s) for each hour of each day.
  2) The total number of hours with MWh greater than or equal to the assumed black start MW are summed for each day.
  3) Each day where the sum is greater than or equal to 16 hours is given a 1. Days with less than 16 hours are given a 0.
  4) The confidence level for the year is calculated using a simple average.

Fuel Assured Methodology

- The calculated yearly confidence levels are averaged together using an ELCC weather weighted average to calculate the unit specific confidence level (e.g. 73.4%)
  - The weights for each year are provided in the Assumptions section of the December 2021 ELCC Report available at: https://www.pjm.com/-/media/planning/res-adeq/elcc/elcc-report-december-2021.ashx
- The black start MW are iterated until the calculated yearly confidence level is equal to 90%.
- This confidence level is multiplied by the black start unit's MW in the Black Start Calculator and for its annual revenue requirement calculation.

Example Calculation Non-Fuel Assured Hydro

- Assumptions
  - Four (4) unit 100 MW ICAP run of river hydro facility
  - Two (2) 25 MW ICAP Black Start units
  - No storage available

Yearly Historical Flow / MW Data

- Delivery Year 1
  - Day 1 Hour 1, Day 1 Hour 2, ... Day 365 Hour 23, Day 365 Hour 24
  - 75 MW, 80 MW, 35 MW, 30 MW
- Delivery Year 2
  - Day 1 Hour 1, Day 1 Hour 2, ... Day 365 Hour 23, Day 365 Hour 24
  - 100 MW, 100 MW, 70 MW, 75 MW
- Delivery Years 3 through 8
  - …….
- Delivery Year 9
  - Day 1 Hour 1, Day 1 Hour 2, ... Day 365 Hour 23, Day 365 Hour 24
  - 20 MW, 25 MW, 50 MW, 45 MW

Calculate Hours with MW Greater than 50 MW for each Day

- Delivery Year 1 Day 1
  - Hour 1, Hour 2, Hour 3, ... Hour 23, Hour 24 Day Sum
  - 75 MW, 80 MW, 55 MW, 25 MW, 25 MW
  - 1, 1, 1, 0, 0 18 hours
- Delivery Year 1 Day 2
  - Hour 1, Hour 2, Hour 3, ... Hour 23, Hour 24 Day Sum
  - 25 MW, 30 MW, 55 MW, 35 MW, 35 MW
  - 0, 0, 1, 0, 0 10 hours
- Delivery Year 1 Day 3 through Delivery Year 9 Day 365
  - ……

Calculate Days >= 16 hours for each Year

- Delivery Year 1
  - Day 1, Day 2, Day 3, ... Day 364, Day 365 Sum
  - 18, 14, 16, 10, 12
  - 1, 0, 1, 0, 0 223 days
- Delivery Year 2
  - Day 1, Day 2, Day 3, ... Day 364, Day 365 Sum
  - 20, 10, 8, 16, 15
  - 1 0 0 1 1 190 days
- Delivery Year 3 through 9
  - ……

Calculate Percent of Day >= 16 hours for each Year

- Delivery Year 1
  - 223/365 = 61.1%
- Delivery Year 2
  - 190/365 = 52.0%
- Delivery Year 3
  - 291/365 = 79.7%
- Delivery Years 4 through 9
  - …….

ELCC Weight for each Historical Delivery Year Weather

Delivery Year	ELCC Weather Weight
2012	0.088
2013	0.094
2014	0.272
2015	0.208
2016	0.088
2017	0.057
2018	0.057
2019	0.068
2020	0.068

Calculate Non-Fuel Assured Confidence Level

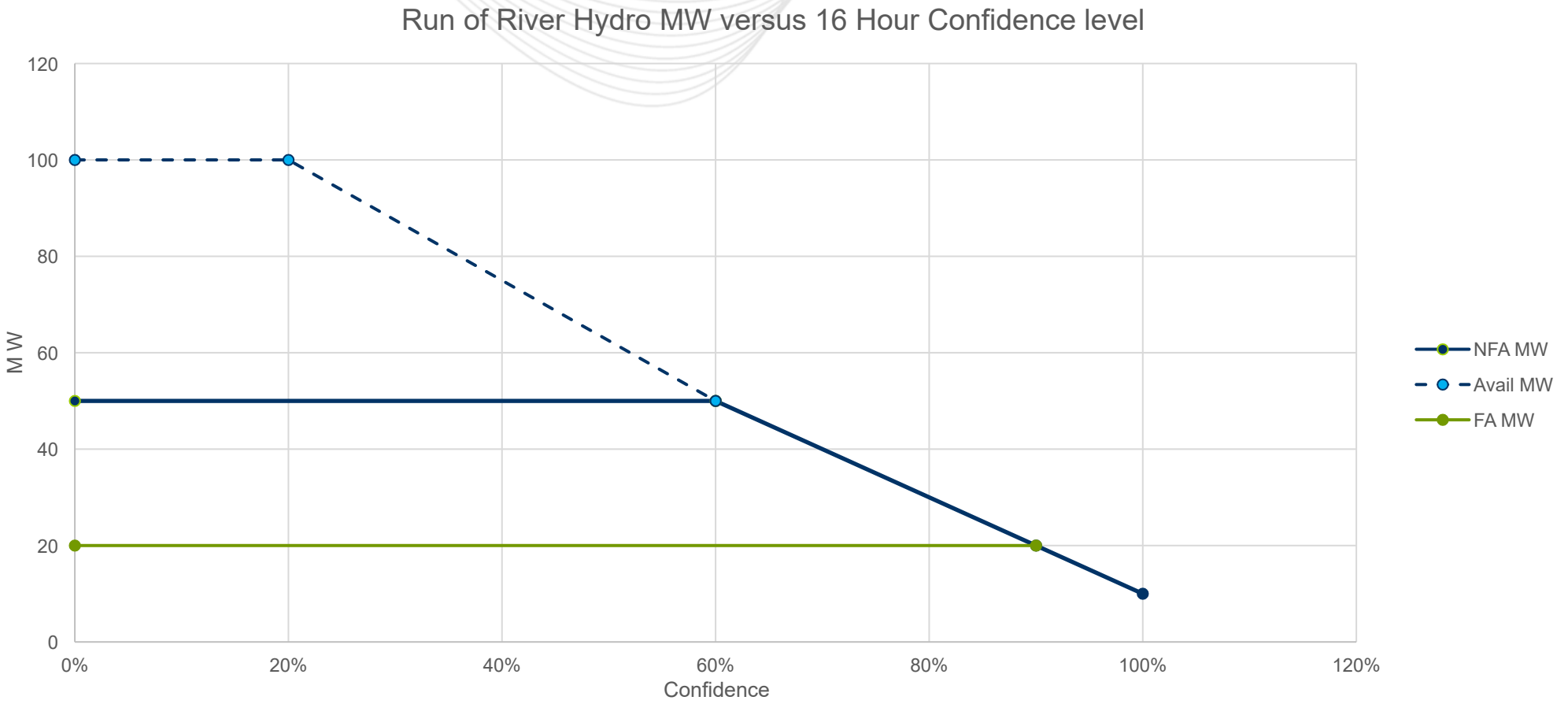
Delivery Year	ELCC Weather Weight	Percent of Days >= 16 Hours	Weighted Average
2012	0.088	61.1%	5.4%
2013	0.094	52.0%	4.9%
2014	0.272	79.7%	21.7%
2015	0.208	61.7%	12.8%
2016	0.088	72.3%	6.4%
2017	0.057	70.8%	4.0%
2018	0.057	45.4%	2.6%
2019	0.068	55.1%	3.7%
2020	0.068	63.6%	4.3%
		Confidence Level =	65.8%

Confidence Level for Fuel Assured resources

- This calculation is performed the same way as the non-fuel assured confidence level calculation, except that the Black Start MW value is iterated until the calculated confidence level is equal to 90%.

Appendix

Run of River Hydro MW versus Confidence Level



New Hydro Proposal

- Updated to leverage existing ELCC information, tools, and implementation
- Hydro units choose whether to be fuel assured or non-fuel assured. Fuel assured units have a 16 hour minimum run time requirement
- PJM uses ELCC tools and information to determine hydro unit MW capability and confidence levels
- Black Start Calculator MW for non-fuel assured resources is ICAP times PJM determined confidence level
- Fuel assured hydro units compensated the same as fuel assured CT units (Z factor increase for fuel assured units TBD)

Notes

- Hydro confidence levels calculated on 5 year basis in coordination with Five Year RTO Wide RFP
- Confidence levels are calculated based on all black start units operating simultaneously for 16 hours
- For Pumped Storage Hydro Black start resources, monthly revenues will be withheld for months in which water level falls below the run hour requirement. Monthly revenues will not be withheld if the water levels falls below the run hour requirement as a result of a regulatory requirement, an approved outage, or restoration event. If water levels fall below the run hour requirement during a PAI event, monthly Black Start revenues will be foregone.

Contact

Presenter:
Thomas Hauske,
Thomas.Hauske@pjm.com

Facilitator:
Janell Fabiano,
Janell.Fabiano@pjm.com

Secretary:
Natalie Tacka,
Natalie.Tacka@pjm.com

Member Hotline

(610) 666 – 8980

(866) 400 – 8980

custsvc@pjm.com

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