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ENERGY

IEA Task 32 Power Performance Uncertainty Round Robin

Updated results for PCWG meeting in Minneapolis,29 September 2016

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29 September 2016

Overview

- Round robin was developed Q1 and Q2 of 2016
- Only considers Cat A for power and Cat B wind speed and direction related uncertainty components. Cat B uncertainty for power, density, TI normalization, etc. were not considered.
- Invitations to register for participation were distributed 14 July 2016 for IEA distribution and then on 10 August 2016 to PCWG distribution
- Dataset and instructions for exercise issued on 12 August with results due by 05 September (<4 weeks to complete the analysis..)
- Total of 36 registered participants covering 28 companies
- Round 1, Sept 7 deadline:
  - 8 submitted results before extended deadline (07 Sept)
  - 2 were incomplete due to access issues with the latest FDIS 61400-12-1 Ed. 2
- Round 2, Sept 27 deadline:
  - Two additional participants were able to complete the exercise (total of 10).
  - Three participants updated their results

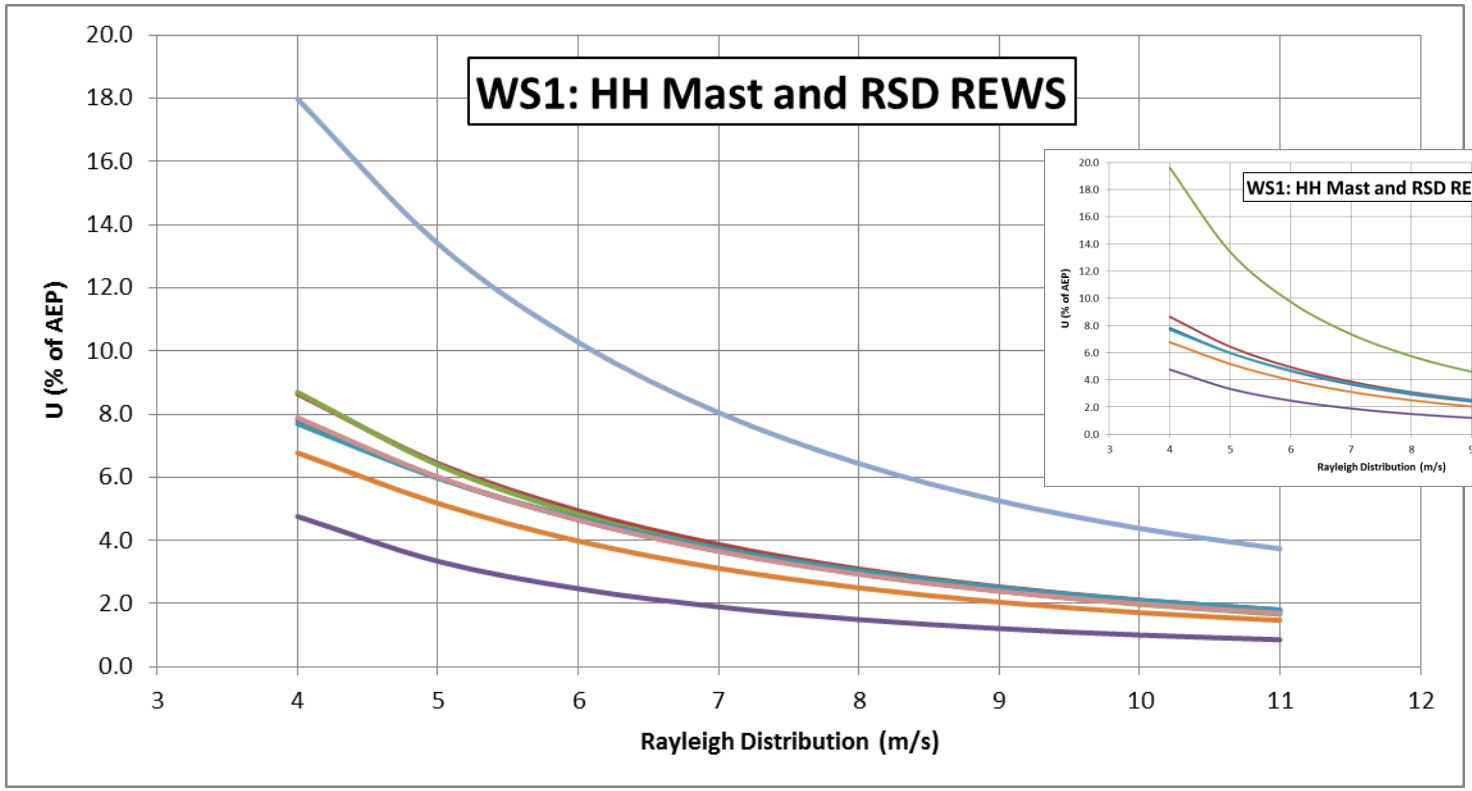
Exercise

- Calculate power curve and AEP uncertainty for Cat A and Cat B *wind speed components* only. Some parameters were provided, others must be derived by the participants.
  - WS1 is the hub height met mast wind speed incorporating REWS (shear and veer) measured by lidar using 9 heights
  - WS2 is the met mast measurements only (lower wind speed and wind direction measurements were available)

Measured parameter	Source of uncertainty	WS 1 – mast and RSD for REWS	WS 2 – mast only	Reference
Wind speed - measurement				
Wind Speed – cup	Calibration	Participant	Participant	[E.9.2]
	In-situ calibration	0 m/s	0 m/s	[E.9.3]
	Operational characteristics	Class A = 1.32	Class A = 1.32	[E.9.4]
	Mounting effects	0.5%	0.5%	[E.9.5]
	Data acquisition	0.1%	0.1%	[E.9.6]
Wind Speed RSD	Calibration	Participant	N/A	[E.7.2]
	In-situ calibration	0 m/s	N/A	[E.7.3]
	Classification	Table L.8	N/A	[E.7.4]
	Mounting	0.5%	N/A	[E.7.5]
	Flow variation	2%	N/A	[E.7.6]
	Monitoring test	0%	N/A	[E.7.7]
REWS	Wind shear	Participant [E.8.2.4]	N/A	[E.8.2]
	Wind veer	Participant	N/A	[E.12.3]
Wind speed – terrain effects				
Terrain without site calibration	Flow distortion due to terrain	2%	2%	[E.9.1]
Method				
Wind conditions	Wind shear	Participant [E.11.2.2.3]	Participant [E.11.2.2.2]	[E.11.2.2]
	Wind veer	N/A	Participant [E.11.2.3.3]	[E.11.2.3]
Wind direction only to support REWS wind veer uncertainty				
	Verification (RSD) or calibration (vane)	Participant [E.12.3.1]	1 degree [E.12.2.1]	[E.12]
	Monitoring test	0 degrees [E.12.3.2]	N/A	[E.12]
	Flow variation (RSD) or operational effects (vane)	0 degrees [E.12.3.3]	0 degrees [E.12.2.4]	[E.12]
	Alignment/North mark	2 degrees [E.12.3.4]	2 degrees [E.12.2.2 and/or E.12.2.3]	[E.12]
	Magnetic declination	0 degrees [E.12.3.5]	0 degrees [E.12.2.5]	[E.12]
	Data acquisition	0 degrees [E.12.3.6]	0 degrees [E.12.2.6]	[E.12]

WS1 – Uncertainty in AEP with hub height met wind speed and RSD measured REWS for shear and veer

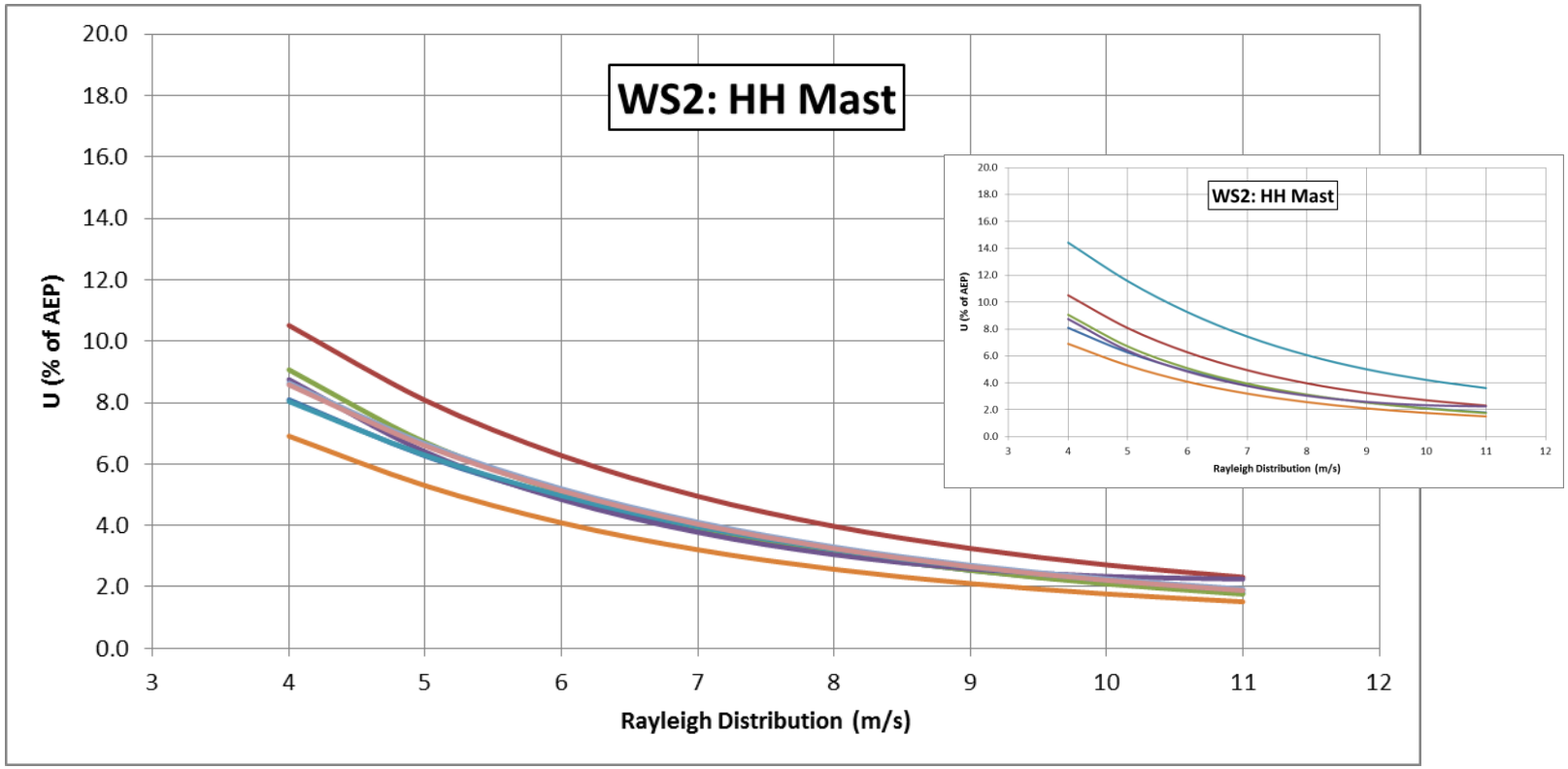
- Range is similar to previous result. Two results that are clear outliers (one high, one low)
- Eight results are within 1% across typical project wind speeds



Ungraded

WS2 – Uncertainty in AEP with hub height met mast wind speed and direction measurements

- Range of values has improved from previous results.
- Again, eight participants are in close agreement



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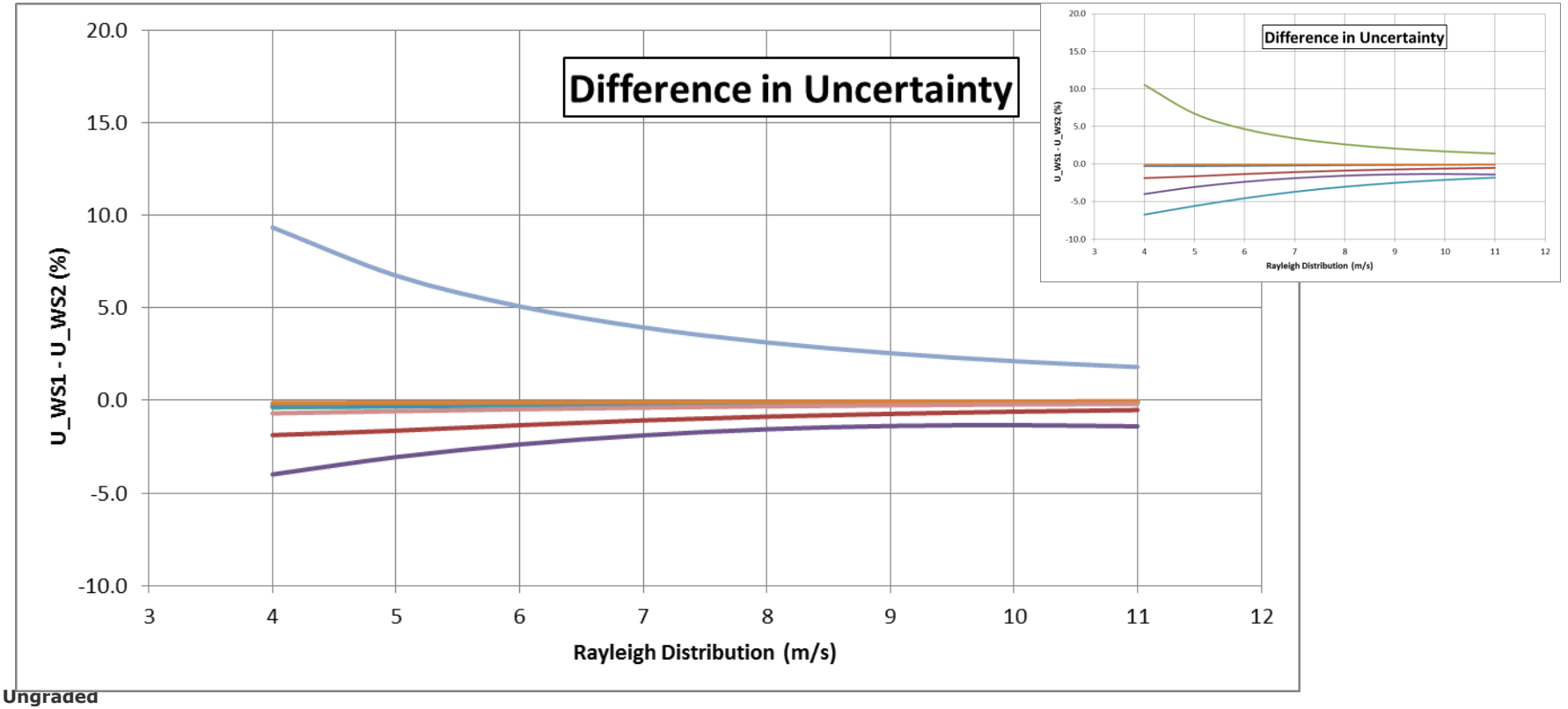
U_WS1 minus U_WS2 – What is potential reduction in uncertainty using lidar for REWS with hub height mast?

- Similar to previous, we have one outlier showing higher uncertainty with WS1.
- Seven participants show little to no difference between the two approaches.



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Observations and follow-up actions

- Limited participation – short timeline for exercise and also limited access to FDIS Standard for companies not connected to 12-1 Maintenance Team
- Update results show better agreement
- It is only an informative Annex, there are many ‘correct’ answers and we should expect some variation
- Review worked examples from PCWG
- Discuss discrepancies with participants and identify focus areas for worked examples, confirmation if verification or how calibration from RSD was applied
- Perform second round of analysis – goal TBC

Thank you

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