

Evaluation Report

Wind Turbine Blade Washing Process

- Jet Wash Process -

TÜV NORD Report-No.:	8118938299-3 E Rev.0
Scope of Evaluation:	Plausibility evaluation of Jet Wash blade washing process in terms of risks of damaging the blade.
Applicant:	Jet Wash (Pvt.) Limited 208/G, PECHS Block II 75400 Karachi Pakistan
Documentation:	Jet Wash (Pvt.) Limited 208/G, PECHS Block II 75400 Karachi Pakistan
Special Remarks:	None

This Evaluation Report comprises 6 pages.

Revision	Date	Changes	Expert
0	2021-04-01	First edition	Dipl.-Ing./M.Sc. J. C. Román

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1 Documents

1.1 Evaluated Documents

[1.1.1] Jet Wash (PVT):

"Wind Turbine Blade Washing Process Description"

SHA256:

AB54A314CFE80C0B1C8E4732D8F93EBC4EA99887363FC3C11429C05D4D
D294BD, dated 2020-10-01

[1.1.2] Jet Wash (PVT):

"Impact of Blade Washing on Turbine Blades"

SHA256:

E6D018699B3DBBFCB9D829A668701571C827872E2C97111C2EC76F6DDB
05B70B, dated 2021-02-011

[1.1.3] Jet Wash (PVT):

Documentary evidence showing impact of Blade Washing on Power
Performance

"The description of the procedure used to measure before and after washing
gains via vlookup method"

SHA256:

ee62c22a38a3e9fabda2af674b26edcde5245ab5e378a29b7d3091f27bc65c54
dated 2021-03-08

[1.1.4] Jet Wash (PVT):

Documentary evidence showing impact of Blade Washing on Power
Performance

"The description of the procedure used to measure before and after washing
gains via weibull method"

SHA256:

d8f8fbed0e2280d1f660fbeab03070d7b953ab4c2a81ced0375bad5c18ab63bf

[1.1.5] Jet Wash (PVT):

Documentary evidence showing impact of Blade Washing on Power
Performance

"The description of the procedure used to measure before and after washing
gains via IEC 61400-12-2 method"

SHA256:

a0f5c34e4721688774530bfaa5a11afbc3771e1bea39149760929783f4a2f112

1.2 Noted Documents

None.

2 Applied Standards

2.1 Product/Technical Requirement

[2.1.1] IEC 61400-12-2: Wind turbines - Part 12-2: Power performance of electricity producing wind turbines based on nacelle anemometry
Edition 1.0, 2013-03

3 Introduction

This Evaluation Report describes the procedures and the results for the plausibility evaluation of the blade washing procedure designed by Jet Wash Ltd. in terms of the impact that the process can have on the structural integrity of the blade and on the power curve of the turbine.

4 Description of the process

4.1 Process Description

The process is described in [1.1.1]. The application of this process for washing the blades of a wind turbine implies that a water jet is shot vertically upwards from the ground just upwind of the tower, so that the wind blows the water to the blade. The turbine is kept running during the process. The water jet shot is adjusted following several criteria.

The whole needed equipment is truck-transported.

The most relevant material of this process is the water that is shot. In [1.1.2] an analysis of the water from a specific lake as water source is presented, confirming that it is suitable for drinking and general consumption.

5 Evaluation

5.1 Methodology & Scope

The customer delivered documents [1.1.1] and [1.1.2] explaining the washing process, and presenting a risk analysis about possibility of damaging the blade (or turbine) by applying this method. The taken actions to mitigate every risk are included as well.

Both documents are evaluated in terms of plausibility.

Additionally, videos are delivered as description media as well.

Fulfilment of applicable HSE rules is not part of this scope.

The customer also delivered documents [1.1.3] - [1.1.5] describing the procedures used to measure before and after washing gains via three different methods.

All three documents are evaluated in terms of plausibility.

5.2 Remarks

The customer has defined some process parameters and applicability ranges for them:

Maximum Height of the water jet (m):	5 to 10 m below Hub-height
Minimum Height of the water jet (m):	60 m
Distance of the washing Rig from Turbine tower:	8 m to 23 m
Wind speed limits during wash:	between 3.5 m/s and 7.5 m/s
Turbine Yaw limits:	+/- 5°

The concept of the process is using the mentioned water jet to generate some kind of artificial rain that cleans the blade surface as the real rain does.

The height of the jet is selected in such a way that the hub is not reached, being in this way almost sure that the water will not get into the blade. A possibility of water infiltration would be existence of previously created holes on the blade surface. Even in this case the applied concept would not be more dangerous than the rain.

Calculations are done to define the distance to the tower foot to get the optimum wetting of the blade, and to get lower droplet size, which is less dangerous for the blade.

The droplets size and the wind speeds are of such dimensions that this “artificial rain” represents no danger for the usually applied designs of the leading edge, aiming to 20 years lifetime.

The water jet is stopped as soon as an excessive nacelle yaw or blade pitch angels are visually detected

5.3 Results

When performing the wash under the specified conditions it is considered a safe procedure in terms of damaging the blade.

The “artificial rain concept” is deemed as harmless for the blade and turbine. The water itself is not dangerous as long as is suitable for drinking and general consumption.

All measured turbines described in [1.1.3] - [1.1.5] recorded an increase in its AEP when compared before and after blade washing activity. The increase in AEP and the corresponding conditions are described in [1.1.3] - [1.1.5].

The blade washing procedure is evaluated as effective.

6 Conditions

Not applicable.

7 Conclusion

Based on the foregoing evaluation remarks on the submitted documentation, TÜV NORD concludes that the blade washing process described in [1.1.1] and [1.1.2] is a non-intrusive method and therefore harmless for the structural integrity of the blade.

TÜV NORD also concludes that the blade washing process described in [1.1.3] - [1.1.5] is an effective method to increase the AEP of turbines which are impacted by dust accumulation on the rotor blades. The conditions in [1.1.3] - [1.1.5] have to be considered.

Changes to the described process shall be approved by the Certification Body. Otherwise the validity of this Evaluation Report expires.

Expert in Charge:

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