Summary:

This study evaluates the impact of wake effects on main bearing rating lives considering 10-MW landbased wind turbines with four-point supported drivetrains and two main bearings, of which the upstream bearing carries the axial loads. Two studies are conducted. One considering two turbines separated in the mean wind direction by 5 rotor diameters, and with a variation of lateral positions of the downstream turbine. The second considers a 32-turbine wind farm subjected to environmental conditions supposedly representing a full operational life of the turbine. A variation of wind roses is considered.

This is an interesting, relevant and comprehensive study, with useful results. The text is well-formulated, and generally well organized. Some details are missing, and some assumptions related to environmental conditions can influence the conclusions significantly and should therefore be discussed. The following comments should be addressed:

Introduction

- Lines 35-43: Two questions are stated – one related to validity of ISO-based main bearing rating life, and one related to what constitutes a realistic system model. I assume that this research is an attempt to answer the latter, but this is not very clearly stated. Am I correct? If not, the second question seems redundant. Please rephrase.
- Line 37: Duplicate reference to Kenworthy et al.
- Lines 44-46: Inconsistent use of "Sect." and "Section" – please check the guidelines of WES.

Background

- The paper "Main bearing response in a waked 15-MW floating wind turbine in below-rated conditions" by Krathe et al looked at partial wake impingement effects on main bearing rating lives and should be referenced here. https://link.springer.com/article/10.1007/s10010-025-00808-z

Section 2.1

- Line 59: Radial and axial bearing loads are referred to here but not defined until p. 7. Please check give a brief description of them here.

Section 2.2

- Lines 109-110: The fatigue damage of the bearings depend highly on C_D, and it is not useful to compare the damage of the upwind and downwind main bearing without commenting on the difference in C_D.

Section 2.3

- Line 131: The reference applied for the Dynamiks Python package looks strange. Please check that it is presented as intended.
- Line 144: For someone not familiar with the model proposed by Hart, it is not trivial to understand what the elliptical and folding parameters describe. Please provide a brief explanation indicating what physical properties these parameters describe. In general, a more detailed description of this method would be useful to understand the results of this work.

Section 3.1

- Please provide more details related to the turbine. A table summarizing rated wind speed, hub-height, shaft tilt and rotor diameter would be useful. Is this a geared drivetrain?
- I assume that the wind farm is landbased (not offshore), but this is not stated anywhere. Please clarify.
- What is the rationale behind the choice of 5 % turbulence intensity? Turbulence intensity will significantly influence the wake recovery, which could alter the conclusions of this work. For a landbased turbine, 5 % is quite low compared to values recommended in the standards. It is important to discuss the validity of this assumption. The paper seeks to explain premature failure in main bearings, mainly reported for landbased turbines. If turbulence intensity is generally higher than what applied in this work, so that the wake recovers more quickly, it might not be valid to conclude that farm effects contribute that much to reduced main bearing lives.
- How is shear modeled in this work? If the power-law is applied, what shear exponent is used? Wind shear is highly important for main bearing rating lives. Combined with the wake deficit, the shear profile will determine what the "final" shear that the downstream turbine experiences. I.e. low shear could result in a "reversed" shear profile in which the wake velocity deficit (which is typically deflected vertically due to shaft tilt) leads to reduced mean wind velocity with height. Please clarify and discuss.
- It is common in industry to use a generator-side locating (carrying axial loads) bearing. To be relevant for industry, I would recommend reversing the setup (I assume this does not require running Dynamiks simulations over again but is related to post-processing).
- Please state what X and Y (load factors) are applied for each bearing. This is useful to understand the importance of thrust versus radial loads in the fatigue calculations.

- What is the rationale behind the choices of C_D? Are these values representative of 10 MW turbines? The authors later (Section 4) comment on the high rating lives, but these results highly depend on C_D.
- The authors investigate a 10 MW turbine, while main bearing failure reports mainly exist for smaller turbines. Could the authors comment on whether wake effects can be generalized across turbine sizes? Could wake effects be less important for smaller turbines, and therefore not have result in the same reduction in main bearing rating lives?

Section 3.2

- Why is 5D applied in the two-turbine parametric analysis?

Section 3.3

- It could be useful to put the parameters presented here (e.g. k, annual mean wind speed, mean wind speeds, inflow directions etc.) into a table for better overview.
- What is the spatial grid resolution in the wind farm simulations and turbulent wind fields?
- Line 214: Suggest rephrasing to: "For each main bearing <u>and each direction</u> ":
- The distances between turbines along x and y should be stated more clearly
- Figure 2a: Axes missing.
- Line 221: The reference to Hart should not be in parenthesis.
- Line 221: "Based on model fitting to data" – what kind of data? For what location are these ranges of wind roses realistic? What are the criteria for realistic? Is this data site-specific?
- Figure 3: Do all the wind roses evaluated have the prevailing direction of 180 degrees?

Section 4

- It could be useful to split this section into subsections to have a better overview of the different results.
- Line 228: The authors assume that the locating main bearing fails most commonly. What is this assumption based on? Why not present results of the rear bearing too (e.g. in the appendix)?
- Line 230 and 240: "…bearing rating lives can be seen to far exceed the minimum design life…" Again, the rating lives are dependent on the value of C_D. A more detailed description of the choice of C_D should be given if these findings should be considered important.
- Figure 4: Asymmetries are more pronounced for higher wind speeds. Could the authors comment on the differences in results between wind speeds?

- Lines 245-255: I think this explanation of the asymmetry is a bit too simple. Gravity mainly acts in the in-plane-bending moment in the blades and less so in the out-of-plane bending moment, depending on the shaft tilt and curvature of the blades. Out-of-plane blade root bending moments are predominantly important for main bearing loads (relative to in-plane BM). Is gravity in the blades driving hub pitch and yaw moments? When removing gravity, as presented in Fig. A1, the shaft moment due to rotor weight vanishes, and the radial loads are significantly reduced. With regards to the locating main bearing, bearing rating lives are now likely governed by axial loads, so that any asymmetry trend would disappear among the axial loads. It would be interesting to see a closer investigation of this effect.
- Line 257-258: "Within a wind farm, the standard grid spacing between turbines will commonly be on the order of 3D-5D". Is this referring to spacing in the predominant cross-wind direction? I believe that larger distances are seen in the predominant wind direction. A reference would be useful.
- Lines 275-285: Again, it would be useful to explain the physical meaning of *a* and *f* before discussing their impact on main bearing rating lives.

Conclusion

- The impact of turbulence intensity and shear on the results should be discussed.