Reviewer 2 Comments and Suggestions for Authors

Several recommendations have been performed in the first review report to improve the scientific level of the manuscript as well as the clarity of the manuscript that should be easily followed by readers. A detailed analysis of the authors’ answers is given in my second review report. Some of recommendations were solved while others were not addressed. The authors define the dimensionless quantities according to the international standard IEC 60193. Then they are using other normalized values to plot the results. The authors have been applied a wrong procedure to obtain the normalized values (e.g. normalized velocity components, normalized flow angles, normalized pressure, normalized amplitude and so on). In this case, the comparison between the data obtained for different operating points is irrelevant. Several details are given in my second review report about this issue (see comments C9 and C11). It was suggested in the first review report to use a relevant quantity for the dimensionless value of the Fourier spectra amplitude. Contrary, the authors selected a maximum local value without any relevance. It was recommended (C12) to quantify the influence of the flow instabilities developed in the runner on the flow instabilities developed in the draft tube cone. This analysis can bring relevant data to elucidate the mechanism of developing the flow instabilities developed in the draft tube cone. The authors did not answered to this basic question although a lot of data is available in their investigations. As a result, I am keeping my previous recommendation MAJOR REVISION for the actual form of the manuscript.

**Answer to reviewer’s comment:** Thank you for your valuable comments. Accepting to the reviewer’s comment, the dimensionless value of the FFT analysis has been modified by $C_p$ and then the related sentences and figures have been modified and added in the manuscript as follows.

“The pressure fluctuation was normalized by the equation (11) to compare all operating conditions, and the frequency was normalized by the rotational frequency ($f_n$) of the pump-turbine.”

\[
C_p = \frac{p}{\rho E}
\]  

(a) Point 01 of guide vane outlet  
(b) Point 07 of guide vane outlet
Figure 19. Normalized unsteady pressure distributions with GVAs of 7°, 12.5°, and 21.5° at the guide vane outlets monitored with measuring points (a) 01, (b) 07, and (c) 14.

(a) Point 2 of draft tube cone with GVA of 7°  (b) Point 2 of draft tube cone with GVA of 12.5°

Figure 20. Normalized unsteady pressure distributions at the measuring points of L1, L2, L3, and L4 of the draft tube at point p2 with GVAs of (a) 7° and (b) 12.5°.
On the other hands, in order to quantify the influence of the flow instabilities developed in the runner on the flow instabilities developed in the draft tube cone, the related sentences and figure has been added in the manuscript as follows.

“As can be seen in Fig. 11(a), the both analytical and actual swirl number distributions increased maximally to 3.64 and 1.59, respectively, at a GVA 7°. In addition, the actual swirl numbers show the similar tendency with the analytical numbers when GVA is higher than 12.5°. However, when the GVA is lower than 12.5°, the actual swirl numbers show different tendency with the analytical swirl numbers. The analytical swirl numbers are tending toward $+\infty$ when the flow rate is becoming zero, which is lack of physical phenomenon. The difference between the analytical and actual results can be seen by the flow separation in the runner passages with changed relative flow angle at the runner outlet [29].”

“Although the swirl intensity increased as the flow rate decreased at the runner outlet, when an inter-blade vortex developed in the middle of the runner passage, within the specific range of low flow rates (0.82QBEP–0.44QBEP), the internal flow in the runner passage affected the flow angle distribution and the swirl characteristics at the runner outlet and in the draft tube, as shown in Figs. 11 and 14, resulting in the visible development of the vortex rope.”
(a) Analytical and actual swirl number distributions

**Figure 11.** Calculated swirl numbers from (a) analytical and actual; and on the (b) observed line for various GVAs.