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To whom it may concern

Subject: Contribution to the funding application for the research Project "Artificial intelligence for enhanced hydraulic turbine lifetime"

This document outlines the contributions to the funding application for the aforementioned research project. It is a 4.5-year project with a total budget of 12 498 000 SEK.

The proposal was accepted by the Swedish Center for Sustainable Hydropower (SVC). This is a competence center, which means that only people assigned as "senior researcher" in the center can submit proposals. Prof. Håkan Nilsson is a "senior researcher" in SVC. A requirement is also that the university provides 39.5% in-kind to the project. In this specific project, this was taken care of by combining two projects out of which an internally funded PhD project is in-kind to a project for researcher Dr. Saeed Salehi. Both these projects are based on Machine Learning and CFD, and therefore form a good combination.

The required in-kind PhD project, on "Multi-Fidelity Physics-Informed Neural Network (PINN) to Solve Partial Differential Equations - an innovative approach to model fluid dynamics and ocean wave evolution" was granted internal funding in competition. The team consisted of Prof. Håkan Nilsson, Prof. Wengang Mao, Dr. Arash Eslamdoost and Dr. Saeed Salehi, as a cross-divisional collaboration between the divisions of Fluid Dynamics and Marine Technology. Further details about the different contributions to the application for funding of that project can be found in another document.

The project for researcher Dr. Saeed Salehi was designed in collaboration between Dr. Saeed Salehi and Prof. Håkan Nilsson. Prof. Håkan Nilsson had the necessary possibility to apply for funding in SVC and had a strong wish to continue collaborating with Dr. Saeed Salehi also after his two post-docs, after which Dr. Saeed Salehi was employed by Chalmers Industriteknik. The interests of Prof. Håkan Nilsson (and SVC) in fluid flow in hydraulic turbines and the competences of Dr. Saeed Salehi in Machine Learning for CFD lead to the final proposal. The application area (hydropower) was something that both applicants had worked with before, both individually and together. However, the specialty of Machine Learning techniques for CFD was something that only Dr. Saeed Salehi had knowledge of. Discussions about relevant research on hydropower (by both) using Machine Learning techniques (by Dr. Saeed Salehi) lead to a proposal based on deep reinforcement learning for active flow control of hydraulic turbines. This is a substantial change in direction compared to previous projects owned by Prof. Håkan Nilsson, and could not have been formulated without Dr. Saeed Salehi. The success of the project is also completely dependent on Dr. Saeed Salehi and his knowledge in Machine Learning and CFD. The hydropower application can be seen as only an application area for a research project on deep reinforcement learning for active flow control. In fact, the derived machine learning methods are general and can be transferred also to other application areas, including experimental studies or innovative applications in real machines.

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