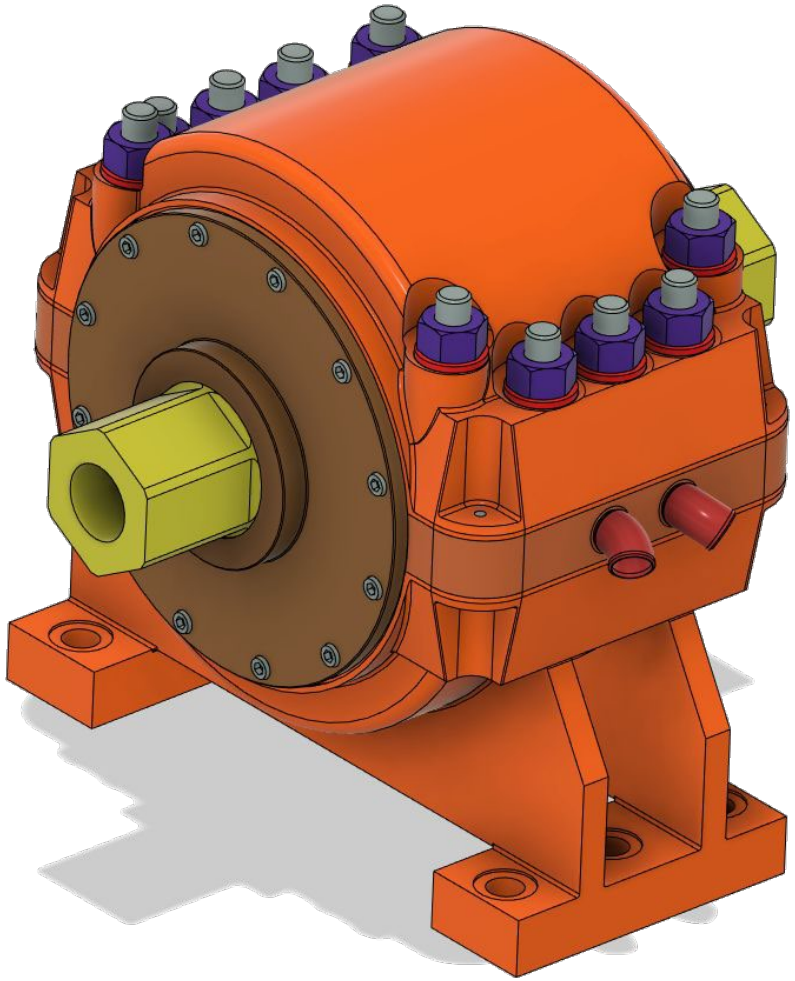
DE-FOA-0008385 -- "Seawater Compatible Rotary Pump for Wave Energy Conversion"



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Project Overview

Project Summary

This project seeked to design, manufacture, and test a novel sea-water compatible rotary vane pump to allow for real-time flap modulation in MHK energy systems. This device is necessary in order to address the end stop issue identified with most PTO architectures for oscillating surge wave energy converters. A scaled pump was manufactured, and an HIL system was used to validate the system models for the designed rotary vane pump.

Intended Outcomes

- A scaled rotary pump has been manufactured to display its feasibility and the potential for long-term durability of the vane sealing systems
- The feasibility of real-time pump reaction torque (flap load) control required to implement the improved flap capture efficiency and enhanced plant capacity factor promised by real-time flap load control has been demonstrated

Project Information

Principal Investigator(s)

- Marcus Gay

Project Partners/Subs

- Amorphic Tech
- Chesterton
- Engineering USA
- Next Rung Technologies

Project Status

Sunsetting

Project Duration

- Project Start Date: 7/1/2018
- Project End Date: 8/31/2022

Total Costed (FY19–FY21)

$1,210,648.12

Project Objectives: Relevance

Relevance to Program Goals:

- This project has contributed to the long term goal of the deployment of cost-competitive MHK projects through technology LCOE reductions
- The novel seawater rotary pump has been designed to increase performance of Resolute Marine's WEC (SurgeWEC™)
  - The pump and PTO architecture has the potential to lower the CAPEX and OPEX therefore reducing the levelized cost of energy for marine energy projects

Note: This project has synergy with blue economy program goals as this project also contributes to wave powered desalination research and development.

Project Objectives: Approach

Approach:

- Our approach to designing new MHK technology for this project was to refine a preliminary design of a controllable, seawater-compatible vane pump
  - This approach also includes performing endurance and seal testing and building a model-scale vane pump to facilitate hardware-in-the-loop (HIL) tests of the PTO system with real time controls.
- There is no evidence that work, either academically or commercially, has been done to investigate the feasibility of a seawater-compatible rotary vane pump and means to modulate its effective reaction torque in real time

Project Objectives: Expected Outputs and Intended Outcomes

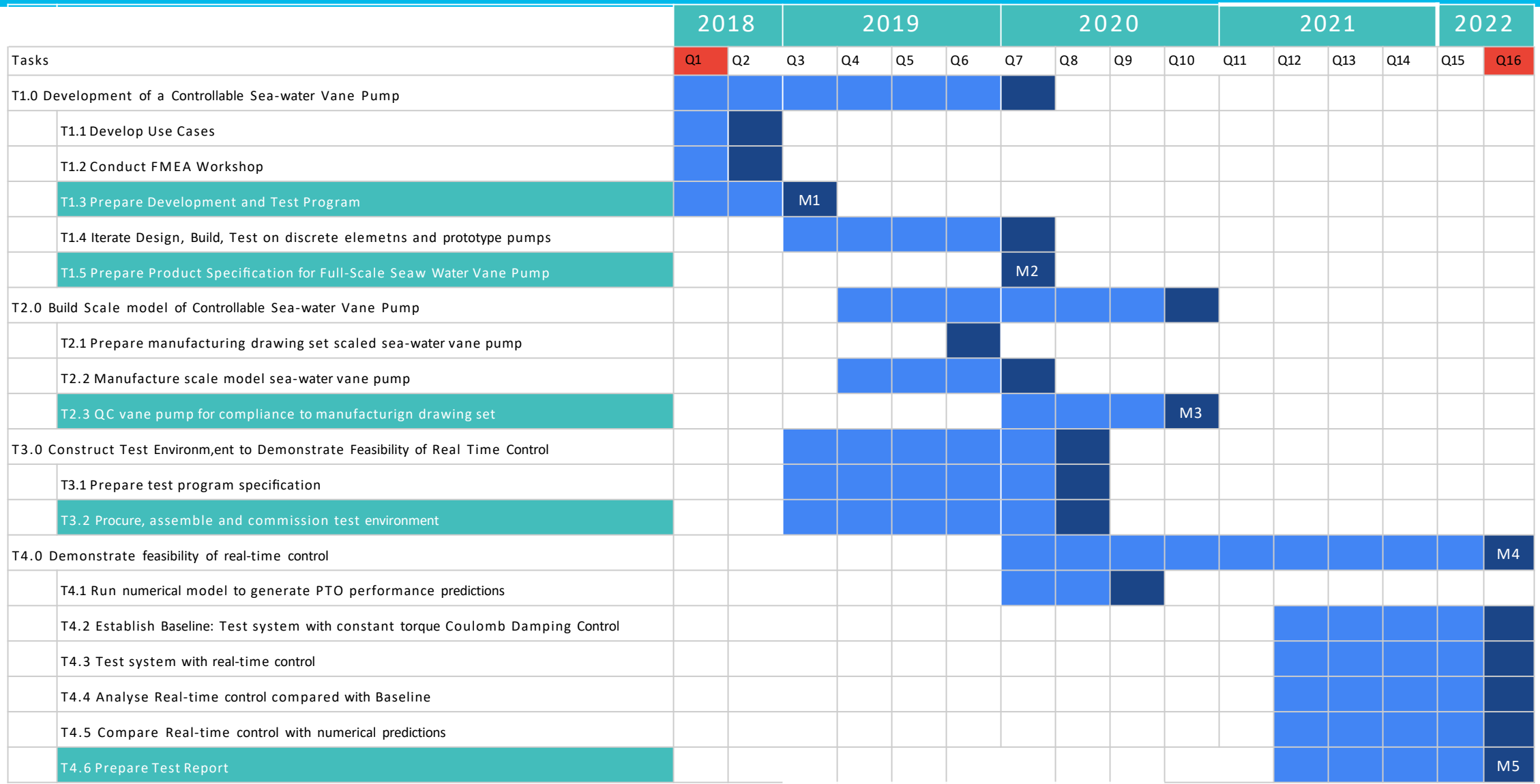
Outputs:

- Design and manufacture of a scaled rotary pump to establish its manufacturability
- Design and fabrication of a simulated test environment to evaluate PTO architecture (Hardware in the Loop)
- The construction of prototype pump to test seal design in the simulated environment
- Data obtained using the prototype pump in the simulated environment to validate mathematical models of the PTO architecture

Outcomes:

- The novel pump can offer real time control of flap load so that the SurgeWEC™ and similar OSWEC devices capture efficiency and annual energy production gains can lead to an advancement in MHK components and deployment of MHK plants
- The cost effectiveness of the developed switch mode control would be validated in MHK devices with hydraulic PTO systems
- The accuracy of integrated flap and PTO “plant model” tracked results gathered during our hardware-in-the-loop (HIL) component and system test program will be verified

Project Timeline



Red stars denote the project start and end
Dark blue cells denote the completion of the task
Teal denotes key milestones

Project Budget

Total Project Budget – Award Information		
DOE	**Cost-share**	**Total**
$1,337,557	$267,541	$1,605,098

FY19	FY20	FY21	Total Actual Costs FY19–FY21
Costed	**Costed**	**Costed**	**Total Costed**
$819,665	$317,266	$73,715	$1,210,648

End-User Engagement and Dissemination

- RME has been developing a project in Cape Verde for the pilot launch of the Wave2O™ plant, which utilizes the developed pump
  - An independent economic viability assessment was performed by INNOWWIDE and validated RME's value proposition in Cape Verde
- Due to the implementation of the real time control that the novel pump offers, the end-users determined for the pump are other hinged WEC developers looking to implement seawater pumping

Performance: Accomplishments and Progress

- Several design iterations were completed including both single and double vane pump architecture.
  - Construction of a WEC simulator / Hardware in the Loop test PTO test stand was completed.
  - Seal design was evaluated using a square piston linear-pump and hydraulic control strategies were evaluated using a round piston. Linear-pump.
- Technoeconomic analysis on the scalability of pump displayed the costs of increasing the displacement of the pump through either non-uniform length or uniform geometric scaling
- Mathematical system model were validated through an experimental campaign using the HIL test stand.
  - Several behaviors and functions were monitored to judge the performance of the system model and concept

Performance: Accomplishments and Progress (cont.)

- There is no patents, awards, or recognitions to report
- The main product resulting from this project is the manufacturing protoType of the scaled pump featured right that was designed under contract by Engineering USA (CT) and manufactured under contract by Amorphic Tech (PA).

Future Work

- The design, manufacture, and experimentation work has been completed for this project, and the next steps will be consolidating data into a full report

Q&A