Triton–C
Detailed Design:
Concrete Reaction Ring

DE-FOA-0001418: Demonstration of an Advanced Multi-Mode Point Absorber for Wave Energy Conversion
Award Number: DE-EE0007819.0000
Principle Investigator: Tim Mundon. Ph.D.
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Milestone 6
Deliverable 11

Following drawings provided (see Index in Reference for more detail:
01_Oscilla Power Inc_Phase 2 Structural Design Report_19-45-1692_FINAL_Rev0
05_OSCILLA REACTION RING_DRAWING PACKAGE_08_02_2019

Document Version Control

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R0-1 (Draft)	9/10/19	Initial Draft	KDS
R0-2	11/03/19	TRM Review	TRM
R1	11/5/2019	Final edits	KDS

Review

Name	Role	Approval
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Tim Mundon	Chief Engineer	
Kate Stinson	Engineering Project Manager	

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Summary

The second major mass or body within the Triton-C wave energy device is the reaction ring. This body is a heave plate used for further ballast used to control the devices' mass and dynamic motion. The ring is attached via tendons to the drivetrain within the surface float. This structure can be raised a lowered by the PTO during operation and during installation. Figure 1 shows the overall Triton-C arrangement at berth with the ring deployed at full draw.

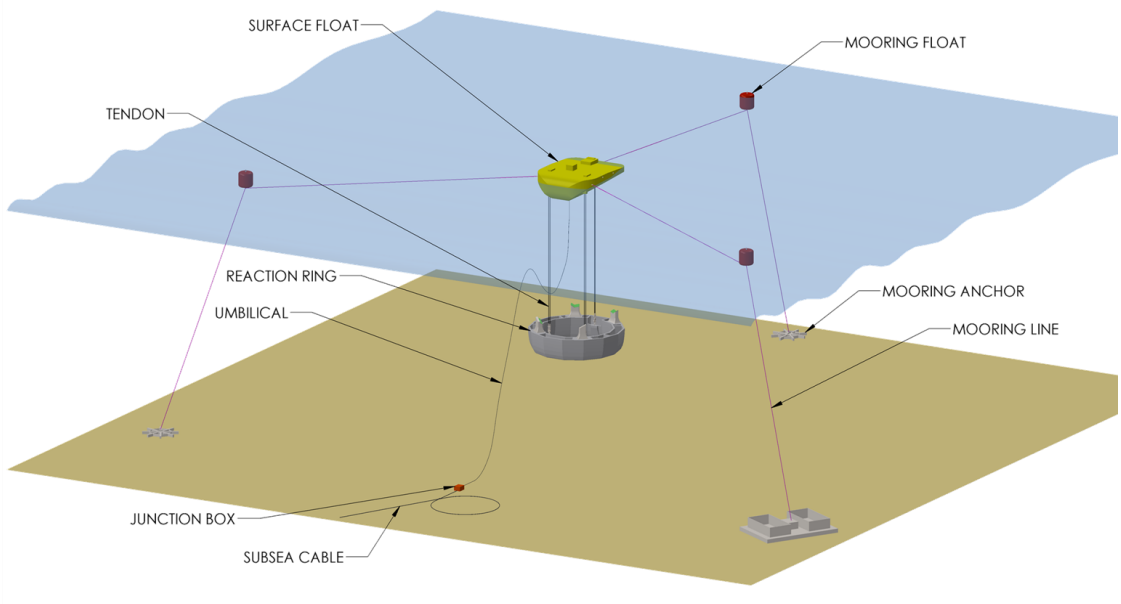

Figure 1. General layout of Triton- C

The ring as a system is attached only to the PTO; this is via tendons and instrumentation communication harnesses. Figure 2 shows this system relationship.

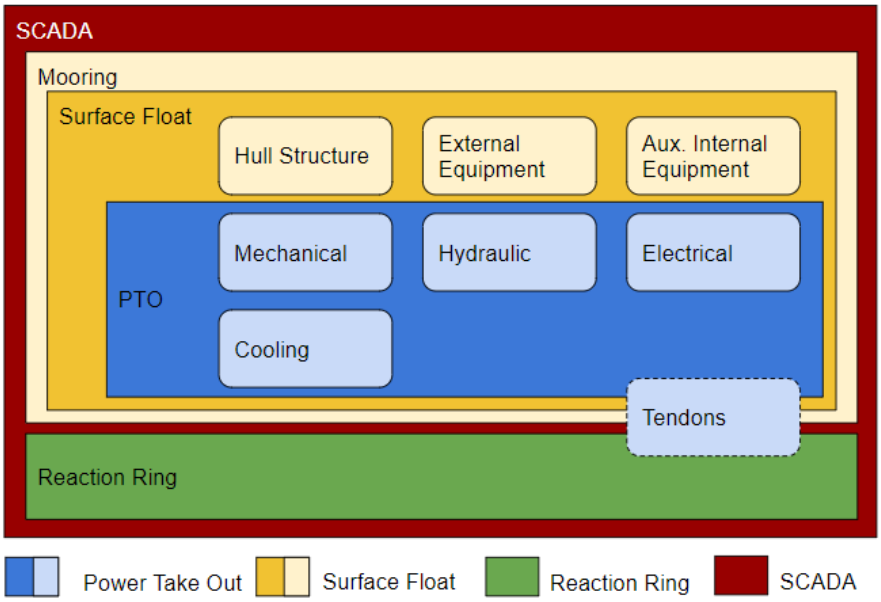

Figure 2. Triton-C system diagram

Reaction Ring

General Layout

The reaction ring is the fully submerged structural component within the Triton-C. It hangs below the hull at a depth of approximately 20 meters. This structure will be manufactured from steel reinforced concrete and pre-cast into eight sections. Once assembled, the overall reaction ring structure will have an outer diameter of 11 meters and an inner diameter of 8 meters with a mass of approximately 70 MT in air and 40 MT in water as detailed in Figure 3. This structure has a U-shaped cross-sectional profile and is detailed further in Figure 4. Three of the sections will have a connection point for the tendon, which is also known as a corbel. The expectation is that the section of the ring will be manufactured in Hawaii and transported to the assembly location via road, however, these could equally be manufactured on the mainland and transported via barge to Hawai'i. Each section will be bolted to the next and then post-tensioned to achieve the required tensional strength. For complete detail design of reaction ring design and construction please refer to University of Maine's Phase II Design Documents listed in Appendix.

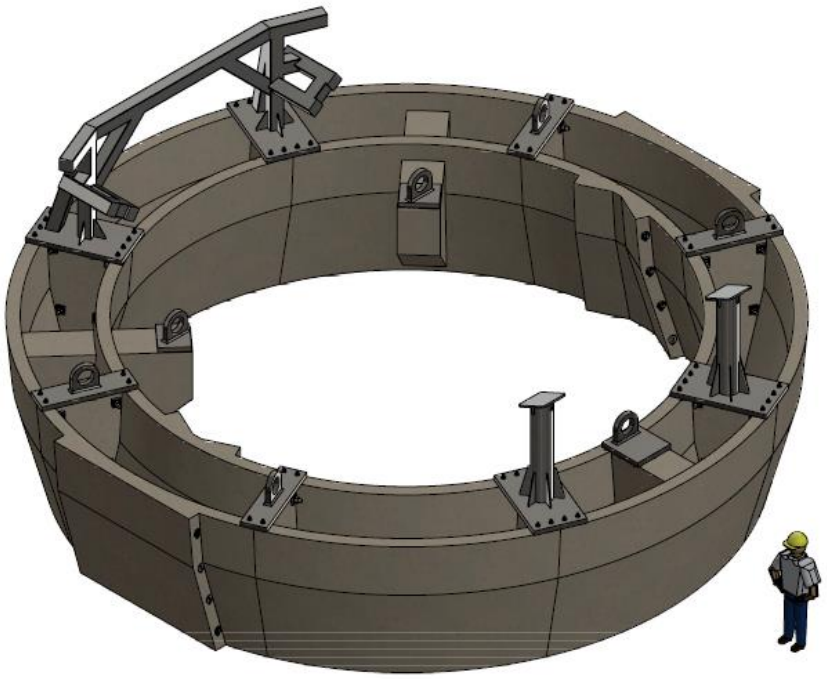

Figure 3. Reaction ring design and full assembly

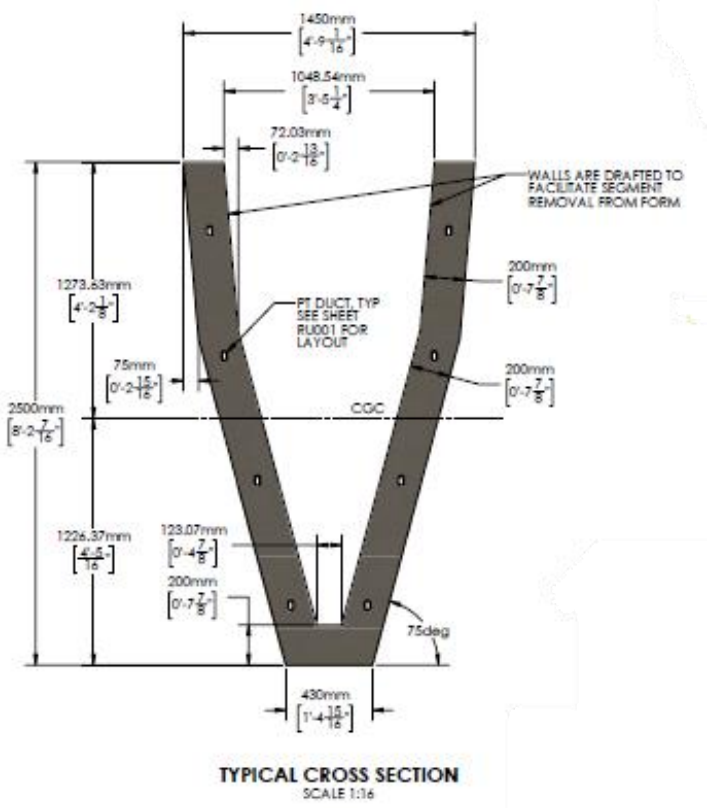

Figure 4. Reaction ring design: U-shaped cross-sectional profile

Mating Configuration

The connection points of the reaction ring and tendon are made up of steel hardware that is described in detail in the PTO report [Triton-C Detailed Design Report: Power Take Off_R0-2]. This mating arrangement can be seen in Figure 5. This mated configuration is used for at port, dockside berth, and initial installation and towing procedures. This supporting structure used to mate to the ring is detailed below as the Mating Structures.

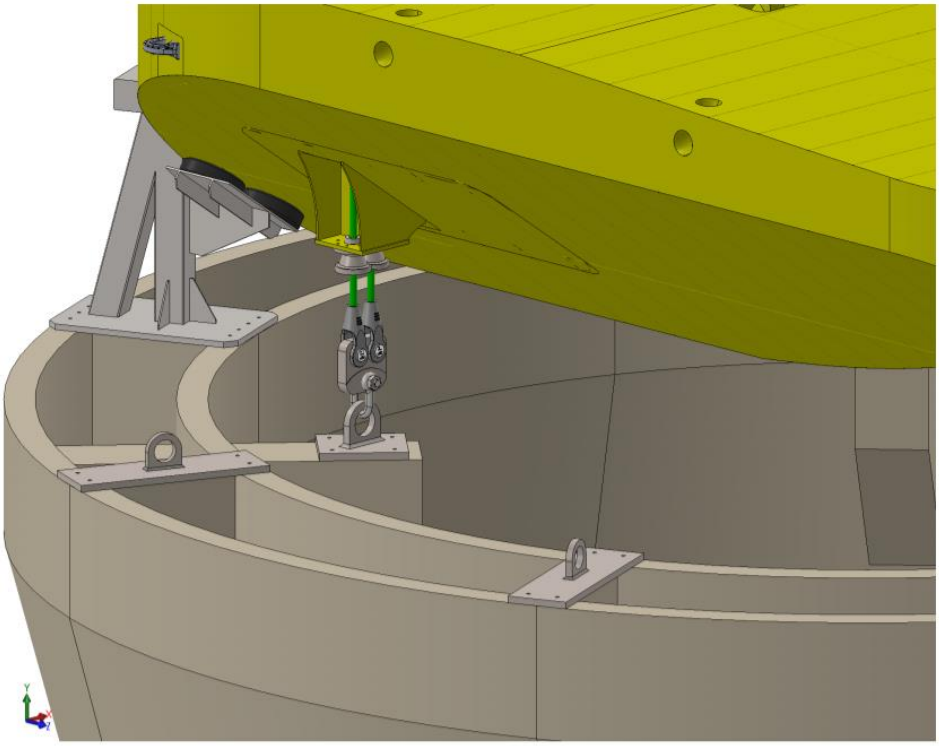

Figure 5. Port, dockside, and towing configuration

Mating Structures

For towing operations in harbor and near shore where water depth is limited, the reaction ring will be brought up against surface float hull at seen in Figure 6. The tow is conducted by rigging a bridal to the two stern mooring eyes on the hull. The superstructure on the reaction ring facilitates bringing the ring into contact with the hull, constraining motions between the two bodies, as well as transferring drag loads acting on the ring during towing to the hull.

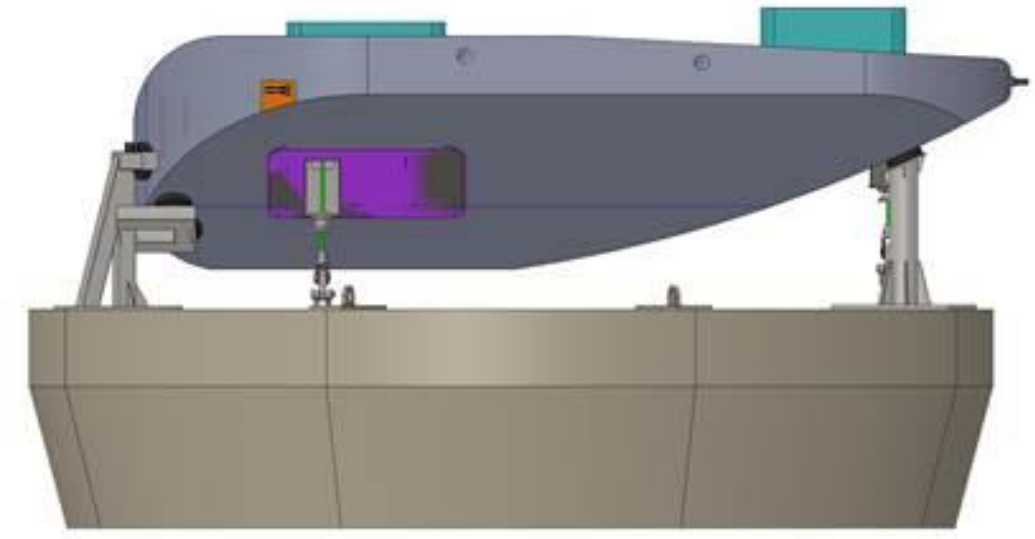

Figure 6. Hull and mated ring configuration during installation and towing. Note that the system will be towed stern first.

All drag loads on the two bodies are transferred to the hull through the stern bracket. Tires located on the stern bracket, detailed in Figure 7, as well as on two posts, in Figure 8, provide a compliant connection at the bow and sides and transmit any heave, surge, sway, and yaw loads between the two bodies.

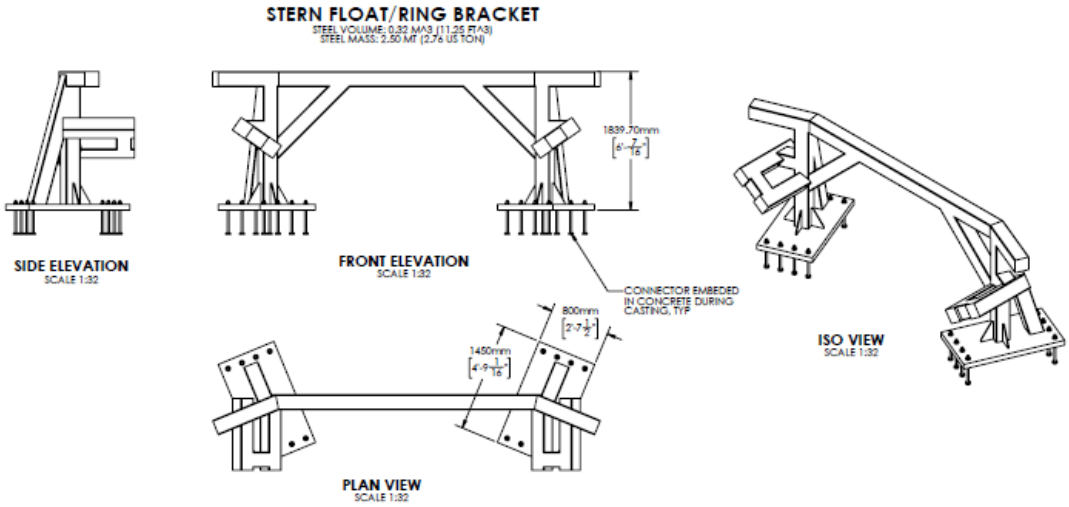

Figure 7. Stern float-ring bracket

The mating structures will be of welded steel construction and corrosion protection is to be provided using a marine epoxy paint and cathodic protection. These structures will be secured to the reaction ring through embedded anchor bolts. Fendering between them and the hull is accomplished with rubber tires secured to the stern bracket and bow posts. The structure is designed to remain secured to the reaction ring throughout the life of the device to facilitate all installation, maintenance, and recovery operations.

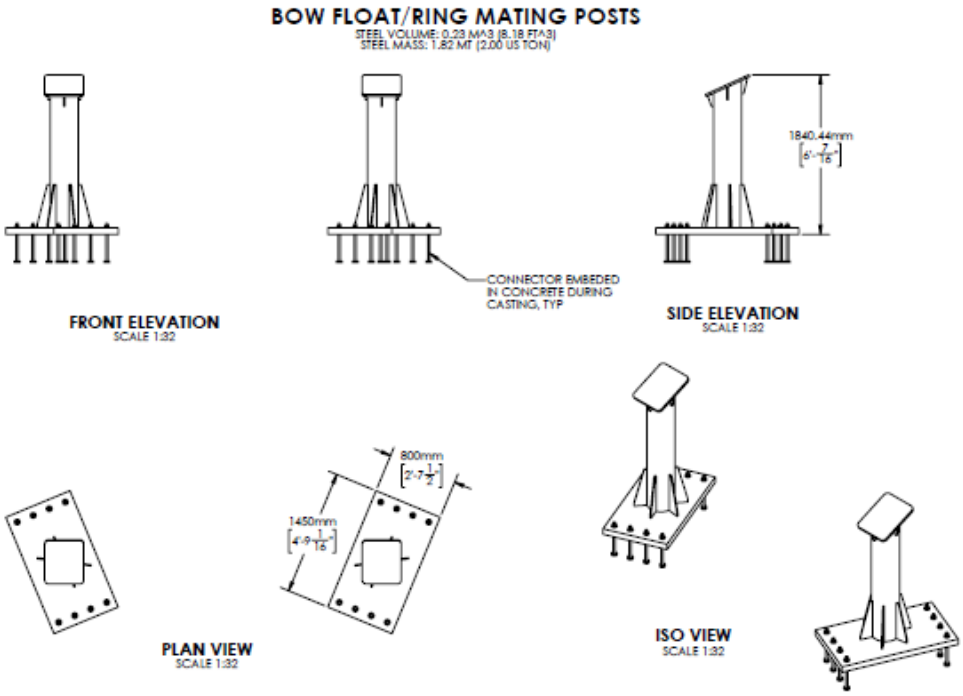

Figure 8. Bow float-ring mating posts

Deployment Configuration

The system will be deployed in water depths of greater than 30m. For operation and to protect the hull surface the ring will be lowered to equilibrium depth of around 20 meters below the water surface. Figure 9 shows the at arrangement and connection points of the reaction ring when deployed. Note fabricated part of mating structure is permanently attached to the reaction ring.

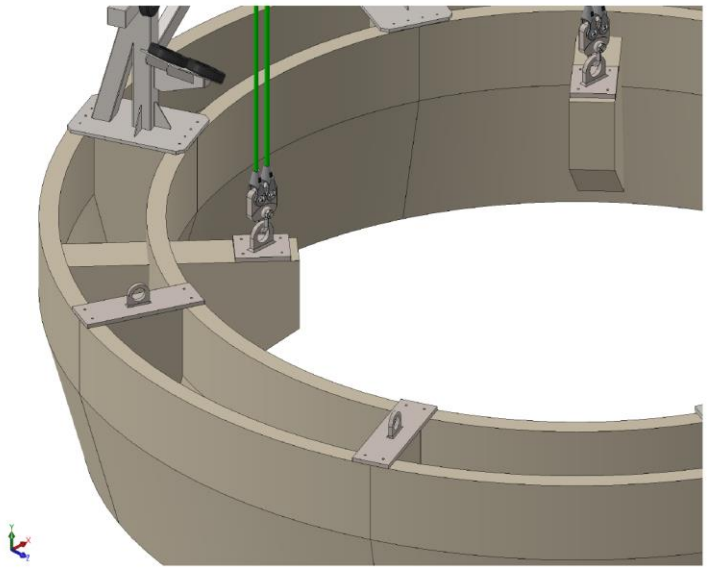

Figure 9. Operational configuration

References

Refer to Triton-C D11_Detailed Design Index_R0 for document indexing.

TritonC_Terminology_Document_R6
FEED Design Package
Drivetrain_Combined_FEED_R1-0
FEED Report – Mechanical R1-0
Electrical System FEED R1-0
Triton-C BP1-_2 Continuation Report R1-6
Triton-C Detailed Design Summary_R1
Triton-C Detailed Design Report: Power Take Off_R1
Triton-C Detailed Design Report: Surface Float_R1
Triton-C Detailed Design Report: SCADA System_R1

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