

2 Subsea Docking

Subsea residency is an important goal in the development of tether-less autonomous underwater vehicles. Subsea charging and data transfer will likely be a key feature required to accomplish this goal.

2.1 Mission Description

A docking station is positioned in an indoor training pool in the TAC Building. The vehicle will locate the docking station and then attempt to dock to this station. The docking station is equipped with an inductive 250W Subsea Power Puck, developed by Subsea USB, which can transfer data and power to the vehicle. The team will demonstrate power transfer by illuminating a light equipped on the vehicle connected to the secondary power puck; and establish communication with the docking station. The docking station will also be equipped with predefined visual indicators (ArUco Tags). Specific autonomous behavior will also award points.

Deliverables:

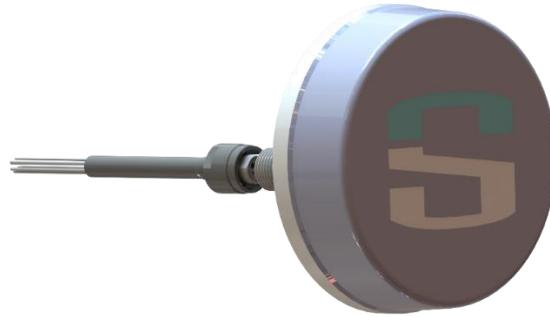
1. Successful demonstration of docking to docking station.
2. Precision Docking (NEW) (This replaces: successful demonstration of inductive communication with docking station).
3. Successful demonstration of power transfer.



2.2 Mission Details

2.2.1 Subsea USB Power Puck

- This system consists of a primary side and secondary side. The *primary Power Puck* is on the docking station and the *secondary Power Puck* is on the drone.
- The primary Power Puck is placed at the center of the docking station.
- The Power Pucks can transfer up to 100 Mbps (ethernet) when connected. Once a connection is obtained, a team member can manually establish communication between the vehicle and a topside computer. No files will be transferred, however the team must demonstrate that there is a connection.
- The pucks are also capable of delivering 250W.
- The primary Power Puck used is **model BB8290** and will be equipped on the docking station (prepared by TAC Challenge).
- The secondary Power Puck used is **model BB8813** (fixed 24VDC output) and will be provided at the competition for the teams to share. It is recommended that the teams prepare for mechanical and electrical integration in advance. TAC Challenge will have a Cobalt Series Cable, Double-ended (<https://www.bluetraileengineering.com/product-page/cobalt-series-cable-double-ended>) that connects the secondary puck to the vehicle.
- Recommended interface connector on the vehicle:
 - Connector: Cobalt Series Bulkhead Connector (male)
 - Pin configuration: 6-pin Hybrid (R1 version)
 - SKU: COB-116H0-R1
 - We cannot guarantee a compatible integration of the pucks if your team does not have this interface connector.
 - **Note:**
 - The R1 FEMALE (new version) **is compatible** with SS MALE (old version).
 - The R1 MALE (new version) **is not compatible** with the SS FEMALE (old version).
 - <https://www.bluetraileengineering.com/product-page/cobalt-series-bulkhead-connector>
- All teams will use the 24V secondary Power Puck for this mission. If your team has already started to develop a solution that is **not** based on the 24V secondary Power Puck, please contact truls@stinger.no.
- The teams will **not** be able to receive the Power Puck Testing Kit this year. There will be time for the teams to practice this mission during the testing days, prior to the competition days. The Power Pucks and Docking Station will be available at this time.
- Data sheets, CAD models, and drawings can be found in the Info Folder.



2.2.2 Precision docking (NEW) (OLD: Data transfer between vehicle and docking station (CHANGED!))

- This new deliverable replaces the “Data transfer between vehicle and docking station” deliverable.
- Since there is a new update on the Power Pucks, the “data-transfer” mission is now changed to “precision docking”.
- To achieve this, you will have to precisely dock to the docking station, so that the pucks are correctly aligned and are in contact with each other. Once these pucks are in contact, the judges will automatically be notified by the topside docking station computer.
- This means that you do not have to integrate the pucks to your drone in order to achieve points for this deliverable!

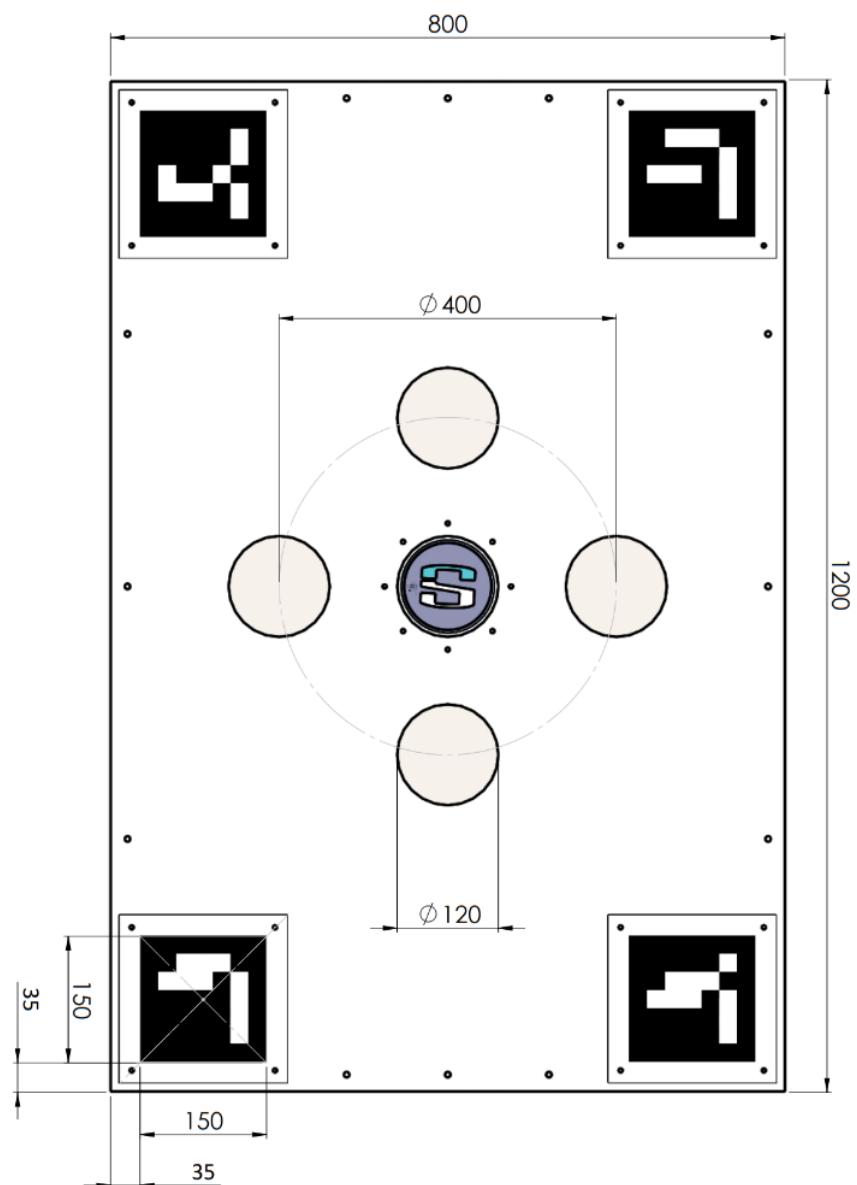
2.2.3 Light that indicates power transfer

- To receive extra points, the vehicle can be equipped with a light that illuminates when the secondary power puck receives power from the primary side (i.e., when docked).
- The light is only allowed to be powered by the power puck (i.e., it cannot be controlled and powered by the vehicle). This will be verified by the judges on land before the mission attempt starts.
- There will be no observational ROV in the testing pool, so the light must be visible from the surface.
- This system will be developed by the team.

2.2.4 Docking Station

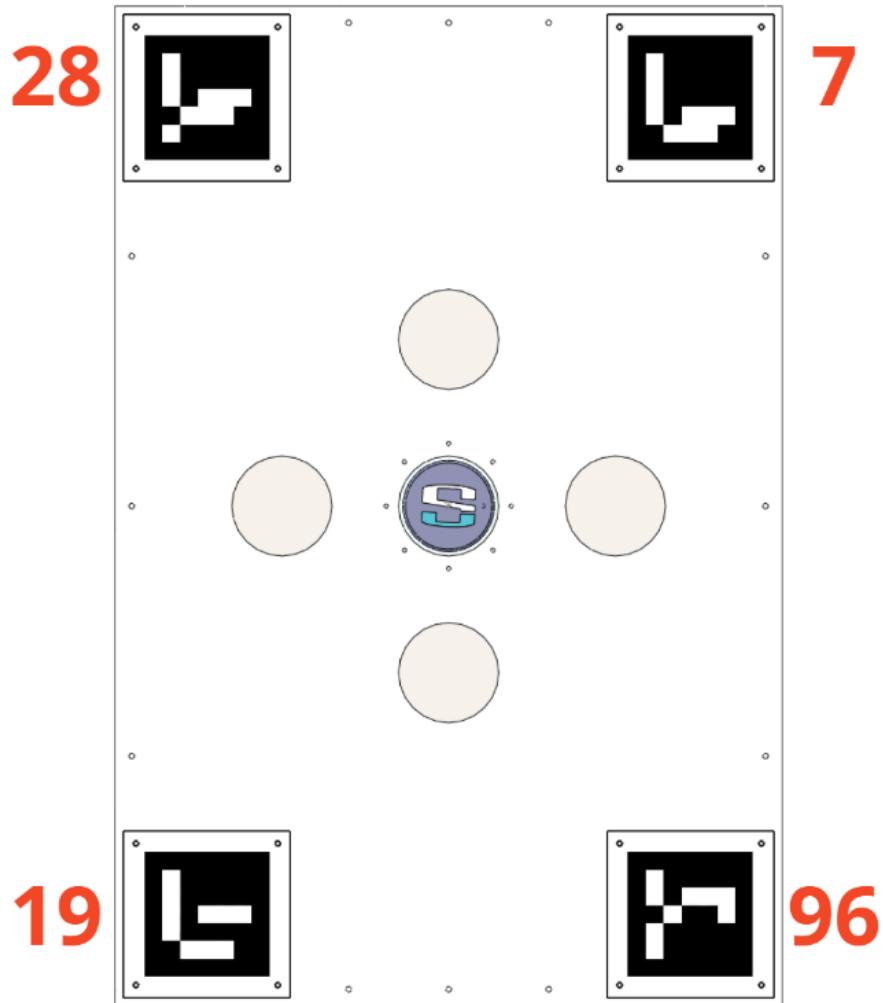
- The station is positioned on the bottom of the training pool.
- The docking station is equipped with ArUco tags with known positions and IDs.
- The inductive primary Power Puck is located at the center of the docking station.
- The color of the docking plate (top plate) is WHITE and has a thickness of 4 mm.
- Steel plates are located around the center and can be used with magnets to aid the docking.
Note that if your magnet is too strong, it may attach to the steel plate through the white docking plate.

- The steel plates are fastened on the underside the white docking plate, making them 4 mm lower than the top of the docking plate. The holes for the steel plates are in other words 4 mm deep and 120 mm in diameter.
- The overall dimensions of the docking plate are the same as a standard EUR-pallet, which are:
 - Length: 1200 mm
 - Width: 800 mm



2.2.5 ArUco markers

- Four ArUco markers are placed approximately in the corners of the docking station. The exact position and dimensions are indicated in the figure.
- Original ArUco dictionary is used. See the online generator at: <https://chev.me/arucogen/>
- The frames around the markers are made of clear plastic.
- The marker IDs used are 28, 7, 19, 96; and they are placed in the following order:



2.3 Mission Scoring

2.3.1 Standard points

Standard points will be awarded based on the results of the deliverables.

Standard Points		
Result	Description	Points
Demonstrate successful docking to the docking station	The vehicle must land in the correct position on the indicated landing area on the docking station. Once docked, the vehicle must stay there for at least 10 seconds. This will be evaluated by viewing from the poolside.	+20p
Precision Docking (NEW)	The drone must dock precisely enough that the inductive power pucks are connected. Points will be awarded as long as the primary puck establishes a connection with the secondary puck.	+50p
Demonstrate power transfer between inductive power pucks	To reward these points, the team must integrate the light indicator on the vehicle. When the vehicle is docked and receiving power from the primary power puck, the light must illuminate to indicate this connection. The light is only allowed to be powered by the power puck (i.e., it cannot be controlled or powered by the vehicle). This will be verified topside by the judges before the mission attempt starts. An ROV must be able to observe this light. Failed top-side verification will result in 0 points.	+50p

2.3.2 Bonus points

Additional bonus points will be awarded if specific autonomous behavior is demonstrated. If the team aims to attempt these specific executions, they must notify the judges during the mission brief.

Bonus Points		
Execution	Description	Bonus Points
Autonomous docking	The drone must start in the starting area of the pool. Once the mission attempt has started, piloting is not allowed. The drone cannot be piloted to locate the docking station. The vehicle must land in the correct position on the indicated landing area on the docking station. Once docked, the vehicle must stay there for at least 10 seconds. Any intervention will disqualify the team from receiving these bonus points for that attempt. The team can attempt autonomous docking as many times as they wish within the run-time. This will be evaluated by viewing from the poolside	+100p

