Guidance for Risk Assessment and Criteria for Mount Selection For Current Meter Deployments

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1. **Title** SOP # 3.2.3.6 (F10) Risk Assessment and Criteria for Mount Selection for Current Meter Deployments.

2. **Purpose**

This document outlines the procedure for mount selection and risk assessment for current meter deployments given the deployment performance criteria and reconnaissance report information. Proper selection of the mount and assessment of risk is required in the determination of deployment location, to ensure the likelihood of sensor retrieval and high data quality.

3. **Background/History**

The National Oceanic and Atmospheric Administration (NOAA)/ National Ocean Service's (NOS) Center for Operational Oceanographic Products and Services (CO-OPS) manages the National Current Observation Program (NCOP) to collect, analyze, and distribute observations and predictions of currents. The program's goals are to ensure safe, efficient and environmentally sound maritime commerce, and to support environmental needs. The program's goals are primarily met by the deployment of autonomous current meters in a variety of mounting platforms. Historically, failed primary sensor recovery mechanisms and poor data quality have been quite costly to NCOP. Failed initial recovery requires expensive and time consuming secondary recovery measures. With each failure, an attempt is made to note the failure mode and improve the system and deployment location selection. The risk assessment discussed in this SOP is a detailed evaluation of the proposed deployment location, mounting apparatus, and reconnaissance report details including: current speed and direction, depth, vessel traffic, tide range, sediment type, local knowledge and the likelihood of successful deployment, data collection and retrieval.

4. **Scope/Applicability**

This SOP is applicable to all projects taken by CO-OPS to support NCOP and PORTS, i.e., both self-contained and real-time deployments. It is a guideline for lessening risk, and is not intended to cover every possible situation involving potential loss of equipment.

5. Main Processes

1. Review of Project Documentation and Evaluation of the Reconnaissance Report
2. Inventory Assessment
3. Evaluation of Risks Associated with Selected Mount.
4. Documentation of Selection and Risk Assessment

6. Detailed Sub-Processes/Checklists

6.1. Review of Project Documentation and Evaluation of the Reconnaissance Report

The risk assessment requires the assessor to have a full understanding of the goal and scope of the proposed deployment. The assessor must review proposed locations, understand the goal of the deployment and planned duration of the deployment, and evaluate the physical characteristics of the deployment location including the depth, bottom characteristics including sediment type, maximum current speed, water debris loading, vessel traffic, and local knowledge.

6.2. Inventory Assessment

NCOP currently has three typical mounting platforms in various quantities: bottom mount, surface buoy mount and sub-surface buoy mount.

Bottom Mount: Bottom mounted ADCPs offer the most flexibility in deployment locations and conditions, but carry the greatest risk for non-recovery due to inundation by debris or sediment. NCOP uses several commercial off-the-shelf (COTS) bottom mounts and a CO-OPS designed ES model with several variations of modifications. The COTS bottom mounts are a free fall trawl resistant bottom mount (TRBM) by Flotation Technologies, a tripod mount without trawl resistant panels by Mooring Systems and the mTRBM by Mooring Systems.

Surface Buoy Mount: A surface buoy mounted ADCP configuration has a very low risk of non-recovery but is limited by the location of the USCG aid to navigation (ATON) buoys within a waterway. NCOP currently uses the Clamparatus designed by Oceanscience to mount an ADCP to ATON buoys. This configuration allows for real-time data transmission; however, the ADCP's internal compass is influenced by the buoy and requires an additional in-situ calibration.

Sub-surface Buoy Mount: Sub-surface buoy mounts are used in deep-water (depth greater than 10m) deployments where no surface buoy is available to capture near surface currents. This mount is highly susceptible to damage by ship strikes or snagged by anchoring vessels. In high current environment the SUBS is subject to suppression.

6.3. Evaluation of Risk Associated with Selected Mount

Each type of mount is susceptible to specific fouling and has limitations. Table 1 outlines general limitations specific to depth and current for each type of platform.

	DEPTH	CURRENT	Retrieval Method	Secondary Retrieval Method
Bottom Mounts	< 30m	N/A	Acoustic Release	Drag / Dive
Surface Buoy Mount	< 25m*	N/A	N/A	Safety Cable
Sub-Surface Buoy Mount	> 10m**	< 2kts***	Acoustic Release	Drag / Dive
* Limited by the Nortek maxium range (25-30m)				
** Dependent on the SUBS configuration and the length of mooring cable				
*** Minimal depression				

Table 1: ADCP Mount Limitation Matrix

The following paragraphs detail each platform's characteristics and considerations.

6.3.1. Bottom Mount Types

ES-2: Mount is 35 inches high and is taller than other trawl resistant bottom mounts. Higher mounts are good in conditions where sediment waves could cover the entire platform. This platform has a four-inch skirt which makes it the best bottom mount for digging into compact sand and shell sediment bottoms. This mount is suitable for rocky bottom deployments as well. It is not recommended for locations with soft sand, mud and organic sediment bottoms since it has a tendency to sink into the sediment due to its weight.

The ES-2 currently uses a Teledyne Benthos 875-PUB Pop Up Buoy system that incorporates an acoustic release with a maximum depth rating of 305m and six months of battery life. CO-OPS has added additional flotation to the pop up float for additional buoyancy specifically for high current environments.

This configuration requires a 1/4 inch thick open cell foam ring coated with Desitin to be placed over the gap between the floatation ring and the housing to prevent sedimentation from inhibiting release. Additional care is required to insure the release catch is not so tight that it prevents proper rotation of the release. Future iterations of the buoy system may need modification.

FloTech AL-200 Trawl Resistant Bottom Mount: The AL-200 is 18 inches tall, nearly half the height of the ES-2. The bottom of the mount is aluminum with perimeter grates that spread the weight over the entire surface area of the platform bottom, thus reducing the risk of sinking into a soft sediment bottom. The low profile of the platform reduces the potential for recovery in areas where the platform could be covered due to high silting rates or sand waves.

The AL-200 currently is designed to use the Teledyne Benthos 867-A Transponding Release with a Strongback which has a maximum depth rating of 305m and a two year battery life. The release mechanism is horizontal and close to the bottom of the mount. This configuration allows sediment to cake around the release and may cause the release to malfunction. Biofouling on the

release linkage is another cause of potential failure. Suitable antifouling paint should be applied directly to the release.

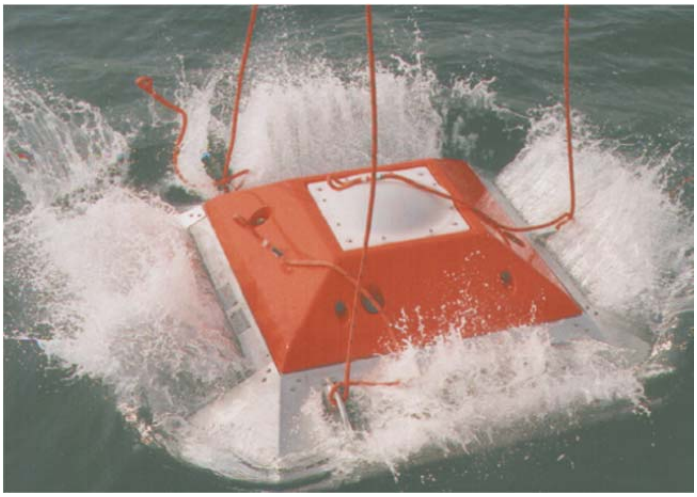

Figure 1: FloTech AL-200 Trawl Resistant Bottom Mount

Mooring Systems Inc. Tripod: The tripod mount is deployed without a float or release. It has a height of 20 inches (0.5m) and a diameter of 60 inches (1.5m). It can be deployed with a drag line or tied to a fixed surface for retrieval. This setup has greater risk of being moved or removed prematurely due to a vessel or person inadvertently meddling with the sensor.

Figure 2: Mooring Systems Inc. Tripod

Mooring Systems Inc. Trawl Resistant Bottom Mount mTRBM: The mTRBM has a height of 18 inches (470mm) and is 70 inches (1775mm) long. It uses a Teledyne Benthos 867-A Transponding Release or a Teledyne Benthos 875-A Shallow Water Release with a Strongback; both have a maximum depth rating of 305m and a battery life of six months. The mTRBM has a fiberglass grate bottom which makes sinking into sediment less of a risk, however very soft sediment can ooze through the grate into the housing. The potential for sediment caking around

the release is still present as well as biofouling. Painting the release mechanism with anti-fouling paint is recommended.

Figure 3: Mooring Systems Inc. mTRBM

Considerations for ALL bottom mounts:

- All mounts should be deployed on a level bottom to lessen the risk of the mount overturning.
- All mounts should include weights that correspond with current speed in order to keep the mount stationary.
- Deployment depth is a factor in placement since many mounts are deployed in ship channels. Sufficient clearance is needed to allow the keel of a vessel to pass without striking the sensor mount.
- All the mounts are designed to be trawl resistant which means a trawling vessel should be able to drag across without damaging the sensor or mount. Despite mounts being trawl resistant, deploying a trawl resistant mount in a known trawling area carries GREAT risk.
- Tag lines should be added to all bottom mounted configurations as a secondary recovery mechanism if the release fails. The tag line should be at least 3 times the water depth of the deployment location.

6.3.2. Surface Buoy Mount

The mounting requirements for the surface buoy configuration have been dictated by the narrow range of ATON buoys sizes used by the US Coast Guard (USCG). The standard USCG ATON buoys are 8ft by 26 ft. A clamparatus has also been installed on the smaller ATON buoys which are 6ft by 20ft. In this configuration the electronics box is located at the center of the buoy. The greatest hazard to this configuration is being struck by a passing vessel. A safety line is attached to the submerged sensor to prevent its loss should the mount or mounting tube separate from the buoy.

Figure 4: Oceanscience Clamparatus

Buoy installations require additional care when deploying the sensor to avoid acoustic path interference by the buoy anchoring system. The installation requirements are well documented in the *Field Installation Guide For ATON Current Measurement Systems* and should be followed. Data quality can be greatly increased if recon data is collected that details the orientation of the buoy.

6.3.3. Sub-Surface Buoy Mount

Standard sub-surface (SUBS) buoy mooring systems are a minimum of 5m long and are most susceptible to movement in areas of high current. The chosen anchor weight must counterbalance the buoyancy and the horizontal forces from the current.

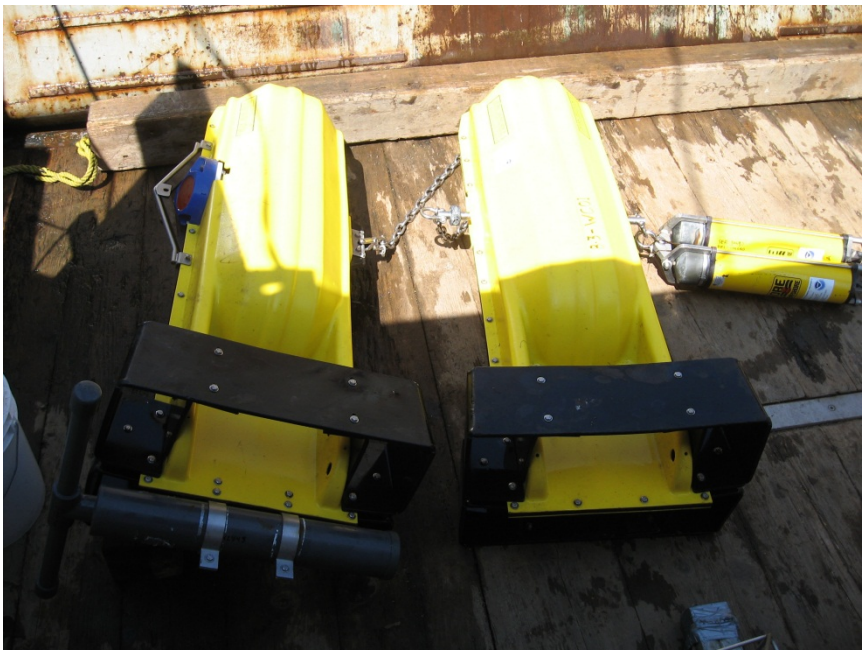

Figure 5: Double SUBS Mooring Configuration Pre-Deployment

The SUBS mount uses dual ORE Offshore (now EdgeTech) light duty CART releases in tandem which reduces the risk of recovery failure. The mooring configuration (including height) and current speed determine the depression and number of anchors to be used. They are depth-limited depending on the SUBS configuration and ADCP model frequency.

6.4. Documentation of Selection and Risk Assessment

The platform selection is largely dictated by the physical parameters at the deployment site. However, the risk of slipping and tipping can be evaluated through a series of calculations. The Engineering and Development Branch will provide the analysis of the calculations per the agreed upon roles and responsibilities.

The decision to deploy a current meter using a specific platform is a complex decision which requires a full understanding of the site, assessment of risk and application of lessons learned from previous deployments and iterations of standard equipment used for deployments. A complete assessment includes the detailed site reconnaissance report, desktop study of the site including applicable hydrographic survey data of the area from the Office of Coast Survey and the US Army Corp of Engineers, inventory review and risk assessment. The following suitability matrix details the conditions for each mount which are most preferred.

	DEPTH	CURRENT	Suitable Conditions for Deployment	Conditions that Prohibit Deployment
Bottom Mounts	< 30m	N/A	• Hard to Soft Sand Bottom • Open Water	• Sand Waves • Mooring Areas • Anchorages • Industrial Outfalls • Soft Organic Mud Bottom
Surface Buoy Mount	< 25m	N/A	• Existence of ATON Buoy	• Historical Vessel Strikes to ATON
Sub-Surface Buoy Mount	> 10m* < 120m	< 2kts***	• Deep Water • Any Bottom Type • Open Water	• Mooring Areas • Anchorages • Within Navigation Channel and Vessel Draft Requirement

* Limited by the Nortek maxium range (25-30m).

** Dependent on the SUBS configuration and the length of mooring cable.

***For minimal depression. Higher currents may be acceptable but resulting data loss due to depression must be accounted for.

Table 2: Suitable Conditions Matrix

If the deployment location is deemed unsuitable for deployment due to a high risk of failed retrieval, a different location can be chosen and assessed or an ADCP vessel mounted survey can be proposed. In many deployment scenarios, multiple mounts could be used; the selected mount should reflect the lowest risk (highest probability) of retrieval, best data quality and most simplistic configuration.

7. Quality Assurance / Control

Knowledge from past projects along with the advances in technology should be used to improve the methodology for current survey deployments and quality control of the entire cycle from planning through recovery.

8. Management / Responsibility

The Engineering and Development Branch is responsible for updating this SOP.