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Agenda item [[2]](#footnote-2) 2.3

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Working Group WG2

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Develop Guideline on Tidal Flow Data Capture and Display

# Summary

## Purpose of the document

The tide and current data are an essential to provide vital information for safe and efficient navigation of vessels, but these measurements also play an important role in keeping people and the environment safe. And knowing how fast water is moving (and in what direction) is important for anyone involved in water-related activities. Measuring and monitoring tides and currents is important for things like getting cargo ships safely into and out of ports, determining the extent of an oil spill, building bridges and piers, determining the best fishing spots, emergency preparedness, tsunami tracking, marsh restoration, and much more.

This document is to provide technical descriptions for the Committee review in order to get feedback and comments to be consider in the development guideline on the tidal flow data capture and display.

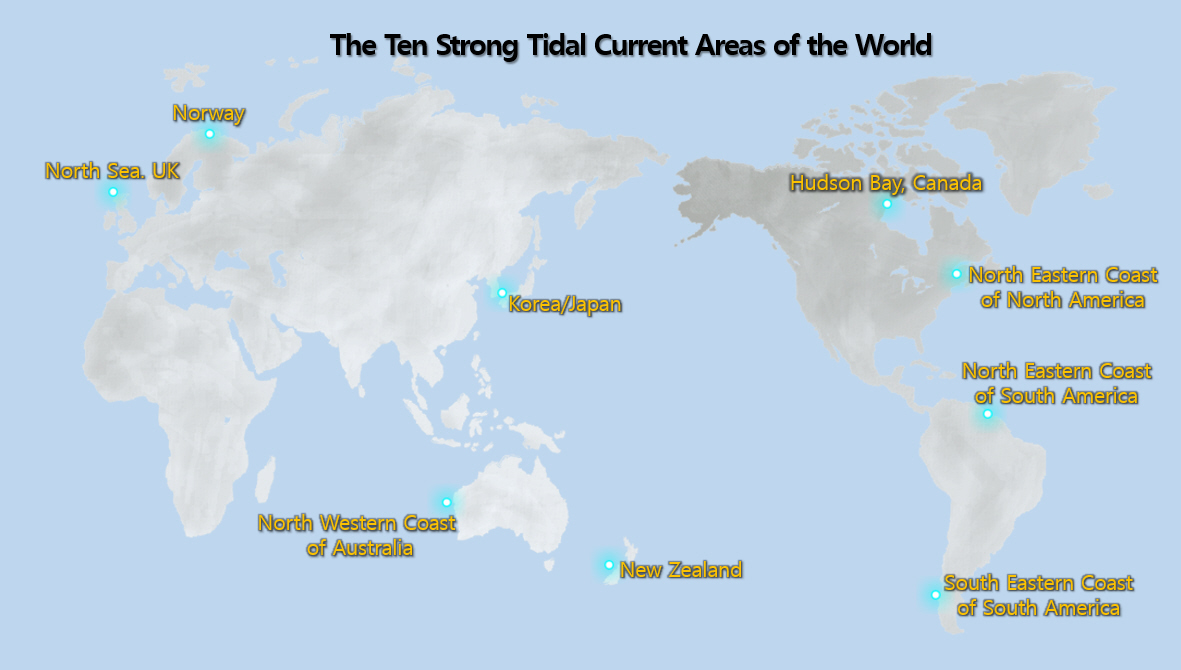
## Related documents

None

# BACKGROUND

## Introduction of tidal current

Coastal ocean tidal current normally span speeds to about 5 knots (2.5 m/s). However, nearshore current can achieve significantly higher speed in narrow inlet and along coastal areas. For example, the Bay of Fundy in eastern Canada have been reported at speed of up to 15 knots. Especially, heavily laden commercial vessels navigate in narrow dredged channels and are seriously influenced by local currents. Real-time current velocity and direction measurements in the shipping channel are imperative for safe navigation by pilots and may be used by harbour managers and decision makers for containment and clean-up in the event of a hazardous materials spill.



*Figure 1 10 locations in the fastest tidal current areas around the world*

*Table 1 The fastest tidal current coastal areas and maximum current speed*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Country | **Norway** | **England** | **Canada** | **Korea** | **Japan** | **France** | **Indonesia** | **USA** |
| Max.  Current (knot) | 22 | 17 | 15 | 11.5 | 8~10 | 6~8 | 6~8 | 5~7 |
| Area | Saltstraumen | Pentland  Firth | Bay of  Fundy | Jindo  Uldolmog | Seymour  Narrow | Normandes Islands | Lombok  Strait | East River  NY |

In situ *Eulerian* current meters have been a fixture in the ocean sciences for over 100 years since the advent of the *Ekman* current meter in 1903. Using a principle of sound waves called the Doppler effect, the Acoustic Doppler Current Profiler (ADCP) measures water current with sound, which was commercialized in the mid-1970’s, it had become widely accepted to measure water current in oceans and rivers. An ADCP mounted to the seafloor can measure current speed not just at the bottom, but also at equal intervals all the way up to the surface. The instrument can also be mounted horizontally on seawalls or bridge pilings in rivers and channels to measure the current profile from shore to shore, and to the bottoms of ships to take constant current measurements.



*Figure 2 The typical ADCP instruments and bottom mounted equipment*

## Status of the tidal current monitoring and informing system

Since the 1960s, numerous staff oceanographers and technicians have dedicated full-time to the collection, processing, and analysis of tidal current data in coastal areas. Due to the excessive labour costs and development of communication technology, the real-time observation system has expanded in the marine observation field. Also, according to the development of information technology, various techniques have been developed to transmit real- time observation information to necessary users in various ways such as ARS, FAX, WEB, SMS, and so on.

The most representative example is the United States NOAA’s Physical Oceanography Real-Time System (PORTS), which is an integrated system of sensors concentrated in seaports that provide commercial vessel operators with accurate and reliable real-time information about environmental conditions, such as water levels, currents, bridge air gap, salinity and meteorological parameters.

In Japan, the Japan Coast Guard (JCG) provides maritime weather and tidal current information for vessels which are passing coastal areas; Kurushima Kaikyo Strait and Hayamoto Seto Strait. The tidal current information used to be provided using a mixture of visual aids such as semaphore, light and electric sign methods.

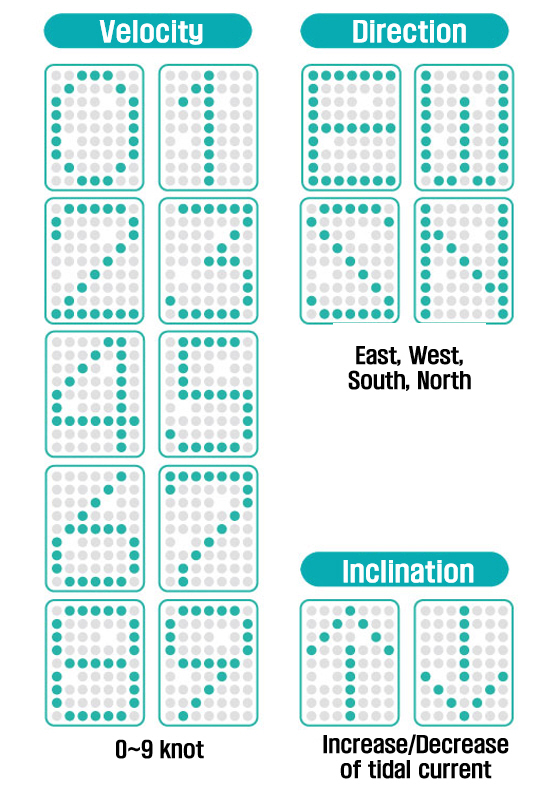
Also, in Korea, Ministry of Oceans and Fisheries has installed the real-time meteorological and oceanographic monitoring stations (over 80 stations) at aids to navigational lighthouses and buoys near major harbours since 2009. Also, real-time tidal current monitoring and informing systems has operated in Incheon harbour and Jindo Uldolmog Strait, which helps mariners by integrating real-time tidal current observation.



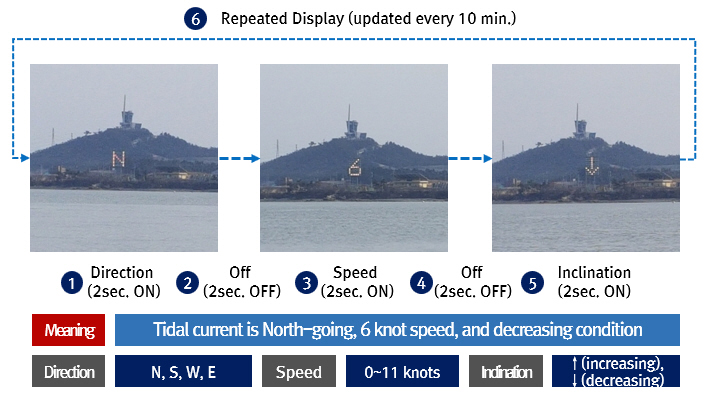
*Figure 3 The tidal current information sites in Korea and Japan*

The most significant part of the tidal current monitoring and informing systems in Korea and Japan is the information transmission method using large electronic display boards. Even though the construction cost is high, the intuitively delivering real-time data directly to the surrounding vessels provides detailed information for vessels and improve visibility and convenience for safe navigation in harsh oceanic environment condition.

The signal board shows current speed, direction, and inclination in real-time, which installs the shield beam lamps or LED lamps based on high steel structure. Depending on the installation terrain and the size of the signboard, the visible range is usually about 3 to 4km.



*Figure 4 The tidal current signal boards in Korea*

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*Figure 5 An example of tidal current information display on signal board (Jindo, Korea)*

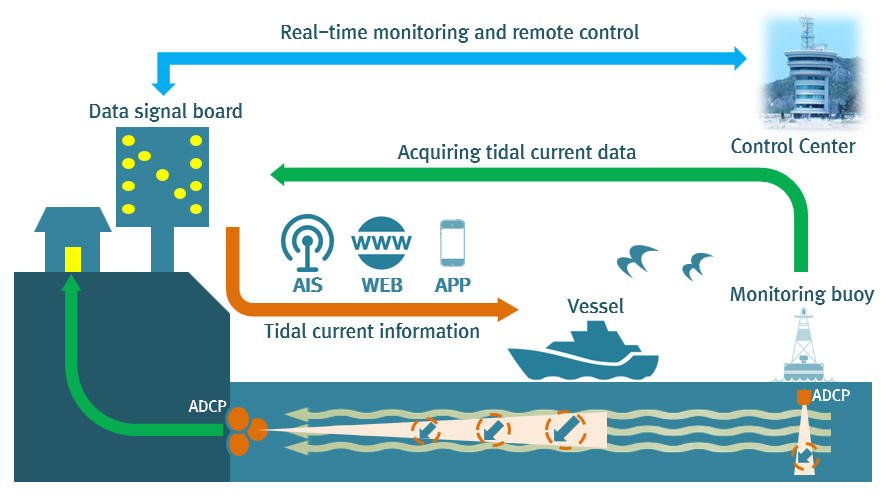


*Figure 6 The tidal current signal boards in Japan*

# DISCUSSION

## Definition of the tidal current monitoring and informing system

The real-time tidal current monitoring and informing system consists of tidal current acquisition sensor system including data-logger and communication module, data processing and DB system, and data information system such as WEB, ARS, FAX, AIS and signal board system with steel structure to provide intuitive information to ships passing by nearby waters.



*Figure 7 Configuration diagram of real-time tidal current monitoring system*

## Major factors for the tidal current monitoring and informing system

Generally, there are three major factors for real-time monitoring system to provide accurate and reliable data to users; 1) data observation & acquisition, 2) data processing, and 3) data dissemination.

In general, the traditional bottom mounted observation is the best way for gathering accurate and reliable water current data, however long underwater cables required for real-time acquisition from bottom mounted sensors are certainly rugged but are also quite expensive to install and are susceptible to being dragged and damaged. Furthermore, installation and maintenance of these traditional systems requires the use of divers and support vessels with significant lifting capacity. With an increasing emphasis on reliability and cost-effectiveness, an alternative method of measuring and reporting real-time current measurements are horizontal ADCP and buoy-mounted monitoring system. To obtain the best acquisition data, the optimum installation method should be considered the installation area and geographical characteristics, including proper preliminary site selection research.

Processing and managing the collected data are just as important as correctly collecting the data. Observing systems store data at local servers and submit copies to central storage facilities adhering to strict formatting, query, and delivery protocols. Data validation and QC/QA process are crucial in ensuring the compilation of reliable public information service. The quality of the data is analysed by reviewing the status of the transferred data and the type of error, such as global range check, local range check, spike error check, statistical inspection, same value error check and so on. To provide proper and responsible data to public as navigational safety information, it is the duty of governmental agencies or international organization to develop authoritative QA/QC guidelines for all core variables.

The challenge to the weather and ocean observing agency, once stakeholder data needs are determined, is to deliver data or graphics that effectively serve stakeholder needs. For web page display, many agencies offer a surface map depicting regional observing assets in the water, or on the coast. Also, the latest data from the instrument are provided as a single numerical readout and additionally as a self-refreshing table, virtual dials, or (and) as time-series graphs. In case of tidal current monitoring system, the intuitively delivering real-time data directly to the surrounding vessels (for example, data signal board and AtoN AIS) is also a very efficient method for safe navigation in harsh oceanic environment condition.

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# Action requested OF the Committee

The Committee is requested to:

1. review this document.
2. provide feedback and comments which can be included as input to the work item for development of a Guideline on tidal flow data capture and display.
3. provide comments for the future plan.

1. Input document number, to be assigned by the Committee Secretary [↑](#footnote-ref-1)
2. Input papers should be assigned to a work task as listed in the Committee work plan which is available in input papers. Leave open if uncertain but consider how the paper is to be processed if not relevant to a work task [↑](#footnote-ref-2)