19th Meeting of the Data Quality Working Group (DQWG)

Report from the Tides Water Levels and Surface Currents Working Group (TWCWG)
Chris Jones, UK (UKHO) – TWCWG Chair

Agenda Item 2.6

DQWG19, VTC, 25-26 March 2024

TWCWG8 VTC 20-22 FEB 2024

- **62 Registered Delegates**
  - **47 Member State (MS) Representatives**
  - **15 Other Representatives (Industry, Expert Contributors and Other Organizations, inc. GLOSS)**

'**Standing' Agenda items discussed**:

- Standard Constituent List.

- The study of long-term data sets for the determination of global sea level rise and changes in tidal range.

- Compare Tidal Predictions generated as a result of analysis of a common data set by different analysis software (including the **International Association for the Physical Sciences of the Oceans (IAPSO)** Best Practice Study group on Tidal Analysis).

- Historical data recovery/data archaeology.

- Establishment and Maintenance of Vertical Reference Frames (VRF) for High Resolution Bathymetric Surfaces.

- Determining ellipsoidal height of MSL at the coast.

- Inventory of Tide gauges used by IHO Member States.

- Actual Tides On-line Link [ATOLL] status.

- List of vertical datums in use to describe Chart Datum.

- Review of relevant IHO Resolutions and Charting Specifications.

- Capacity Building: Tides training course.

PRINCIPAL ACTIVITIES AND ACHIEVEMENTS

Intersessional work between TWCWG7 (February 2023) and TWCWG8 (February 2024)

1. Extensive development (by correspondence of the TWCWG Project Teams) of S-104 & S-111 Product Specifications. (**S-104 Ed. 1.1.0** and **S-111 Ed 1.2.0** were already finalised at TWCWG7 and subsequently passed to the GI Registry; **Editions 2.0.0** are in development – see later).

2. Second meeting (November 2023, Liverpool, UK) of the **International Association for the Physical Sciences of the Oceans (IAPSO)** Best Practice Study group on Tidal Analysis. **_ACTION HSSC14/70_**

3. A second **Survey/Questionnaire**, again kindly prepared by **KHOA**, for circulation to TWCWG Member States, on the ongoing progress of MS **Water Level (S-104) and Surface Currents (S-111) Data Production Methods and Data Formats.**

4. A first **Survey/Questionnaire**, kindly prepared by **BRA**, on the subject of the **IHO Resolutions (M-3), Datums & Benchmarks, Resolution 3/1919 as amended, A2.5**

S-104 WATER LEVEL INFORMATION FOR SURFACE NAVIGATION

IHO

International Hydrographic Organization

Why?

- The development of electronic navigation with high resolution bathymetric data, and the drive to increase mariners' safety are now demanding temporal data such as water level heights to be available.

What?

- S-104 describes the **provision of water level height data** as single entity irrespective of whether they are observations, or model derived predictions.

- S-104 may be used **alone** or it may be **combined** with ENC or other S-100 compatible data.

- S-104 describes **one of a number of additional information** that could be integrated with other 'S-100' products for use with ENC.

- S-104 defines a **content model** and an **exchange file format** for the exchange of tidal height entity data. There currently are no recognized standards on the exchange of tidal height single point data.
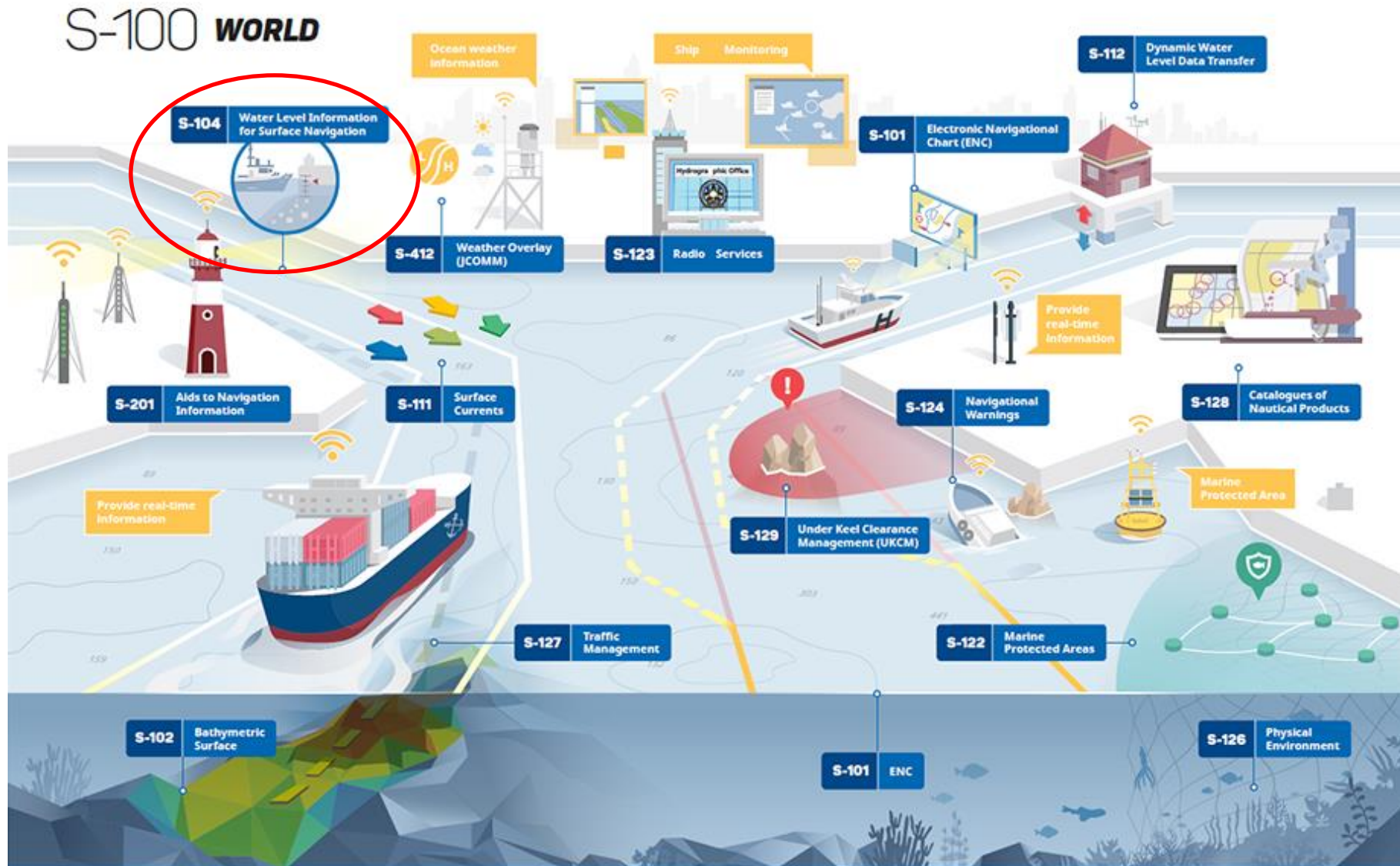
How?

- IHO Tides Water Levels & Surface Currents Working Group (TWCWG) – Project Team (PT)

S-104 WATER LEVEL INFORMATION FOR SURFACE NAVIGATION

S-104 WATER LEVEL INFORMATION FOR SURFACE NAVIGATION

- **Key elements / considerations of the S-104 Product Specification**

- "Hierarchical Data Format 5", HDF5
  - *Open source and good for encoding and storing large data volumes and metadata for quick access, as well as array-oriented scientific data*

- Primary purpose of S-104 is navigation in terms of updating water depths for under-keel clearance management.

- Data types delivered by S-104 are simple;
  - Time series of water level height relative to a vertical datum
  - Water level trend.

«FeatureType» WaterLevel	«enumeration» waterLevelTrend
+ waterLevelHeight: Real + waterLevelTrend: waterLevelTrend + waterLevelTime: DateTime [0..1]	decreasing = 1 increasing = 2 steady = 3

Figure 4.1 - Water Level Feature

- ~~Either a single point (i.e. one geographic location), or~~

- An array of points contained in a grid.

- Time and datum information are contained in the metadata.

S-104 WATER LEVEL INFORMATION FOR SURFACE NAVIGATION

S-104 Edition 2.0.0

- TWCWG S-104 PT is now working on publishing a draft S-104 Ed 2.0.0

- To be conformant with S-100 Ed 5.2.0

- S-104 Ed 2.0.0 is now in the process of being amended / "*pared back*" in its scope, in response to S-100WG8 decision:

6.17	Water level on ECDIS	[**Decision 8/27**] **S-100WG8 recommended** that the S-104 PS should focus on the initial scope of S-104, which is for water level adjustment to be applied in conjunction with S-102.

- Therefore S-104 will be reduced to the regular grid spatial type and observed / predicted / forecast data, that is, coverage types and kinds of data useful for water level adjustment as described in S-98 Annex C (C-4-2)

Table 4-2 – Water level data types and their coverages

Type of Data	Spatial Structure	Coverage Type
~~Time series data at one or more stationary locations at one or more times, organised by time~~		~~S100_PointCoverage~~
~~Time series data at one or more stationary locations at one or more times, organised by location~~		~~S100_PointCoverage~~
Regularly-gridded data at one or more times	S100_IF_Grid	S100_IF_GridCoverage
~~Ungeorectified gridded data at one or more times~~		~~CV_ReferenceableGrid⁺~~
~~TIN coverage at one or more times~~		~~S100_TINCoverage~~

- S-104 Ed 2.0.0 is planned to be submitted to HSSC for approval around June 2024.

S-111 SURFACE CURRENT INFORMATION FOR SURFACE NAVIGATION

IHO

Why?

- With the advent of electronic navigation, surface current data and updates are more accessible and easier to integrate into navigation displays. This integration of the chart with other supplemental data improves decision making and results in more efficient navigation.

What?

- S-111 describes all the **features**, **attributes** and **relationships** of surface currents and their **mapping** to a dataset.

- S-111 includes general information for data **identification** as well as for data **content** and **structure**, **reference system**, **data quality** aspects, data **capture**, **maintenance**, **encoding**, **delivery**, **metadata** and **portrayal**.

- S-111 defines the '**data coverage**'; most commonly a **regular grid**, or also a **point set**.

- S-111 defines a **content model** and an **exchange file format** for the exchange of tidal surface currents data. There currently are no recognized standards on the exchange of tidal surface currents data.

How?

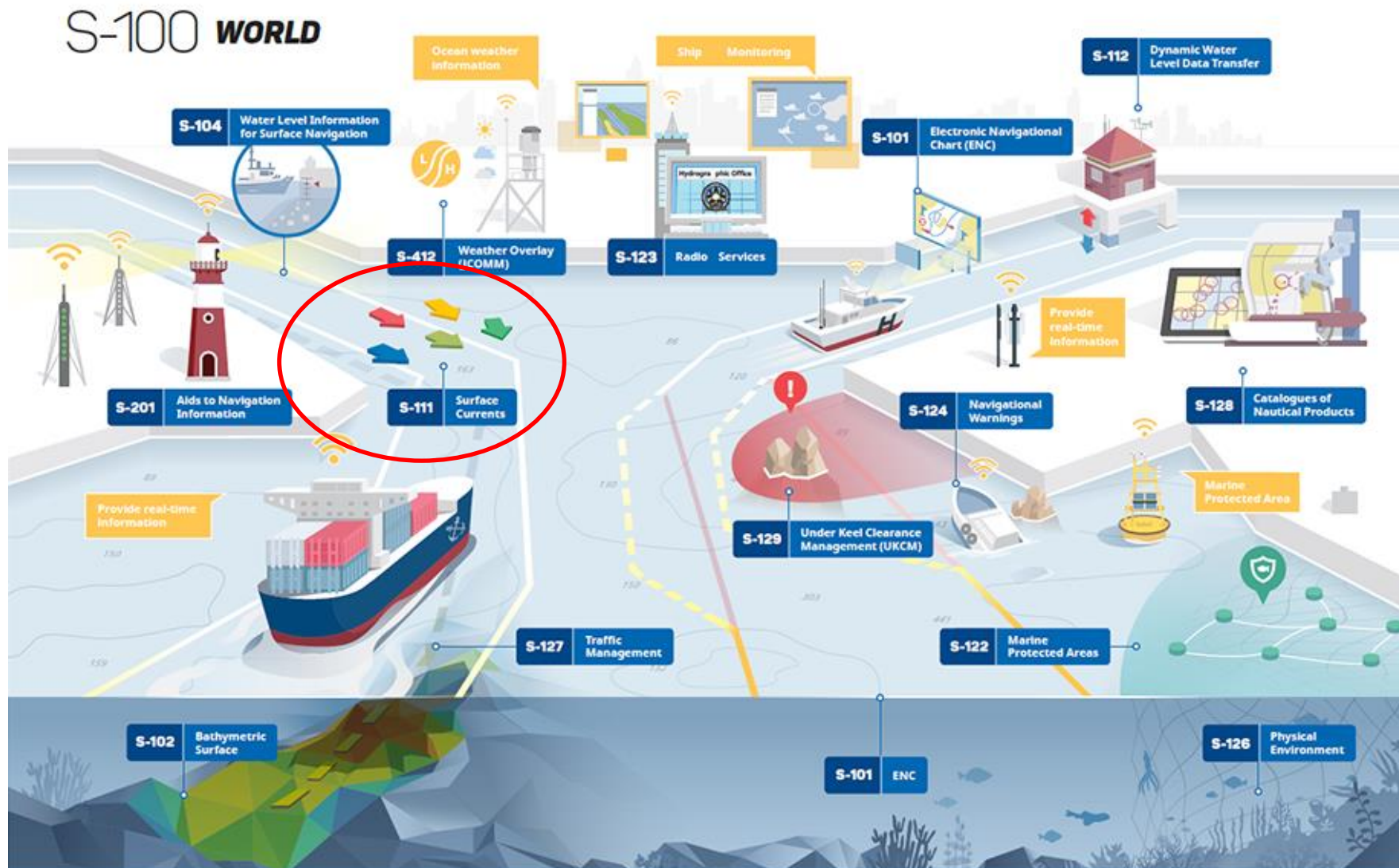- IHO Tides Water Levels & Surface Currents Working Group (TWCWG) – Project Team (PT)

S-111 SURFACE CURRENT INFORMATION FOR SURFACE NAVIGATION

IHO

International Hydrographic Organization

http://s100.iho.int/S100/home/s100-introduction

S-111 SURFACE CURRENT INFORMATION FOR SURFACE NAVIGATION

Key elements / considerations of the S-111 Product Specification

- "Hierarchical Data Format 5", HDF5

  - *Open source and good for encoding and storing large data volumes and metadata for quick access, as well as array-oriented scientific data*

- Primary purpose of S-111 is navigation in terms of spatial awareness of surface currents, for planning / route execution

- Data type delivered by S-111 is simple;

  - Time series of surface current rates and directions

«FeatureType» S-111 Domain Model::SurfaceCurrent
+ surfaceCurrentSpeed: real
+ surfaceCurrentDirection: real
constraints {Can only have one coverage type in a dataset}

Figure C.2 - Surface Current Model.

- Either a single point (i.e. one geographic location), or

- An array of points contained in a grid.

- Lots of other information included, including in the metadata!

- S-111 Ed 2.0.0 is planned to be submitted to HSSC for approval around June 2024.
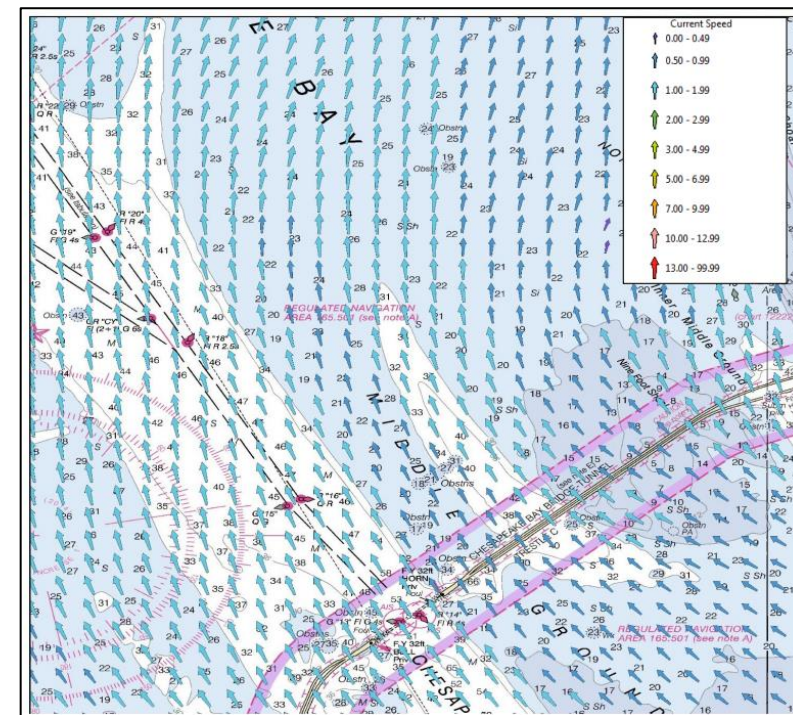

Figure 9-10 – Sample depiction of gridded surface current data in an electronic chart. Note that arrow height in scale may not strictly conform to the portrayal rules. (Image courtesy of the University of New Hampshire, US)

IHO S-104 & S-111 DQWG-RELATED ASPECTS

Uncertainty attributes

Uncertainty attributes will be included in the product specifications but populating them will be optional. Methods specialized to water level and surface current uncertainty determination will be used to calculate uncertainty.

From S-104 PS

Uncertainty Dataset – The (optional) uncertainty data is contained in a compound HDF5 dataset named 'uncertainty'. There is a name and an uncertainty value for water level height, which is *waterLevelHeight*. The units of height uncertainty are metres. The default, denoting a missing value, is -1.0. The values in the uncertainty dataset are overridden for individual grid points by the *uncertainty* component of the values record when it is populated by a non-fill value.

From S-111 PS

Uncertainty Dataset – The (optional) uncertainty data is contained in a compound HDF5 dataset named 'uncertainty'. There is a name and an uncertainty value for surface current speed and direction, which are, respectively, *surfaceCurrentSpeed* and *surfaceCurrentDirection*. The units of speed uncertainty are knots, and the units of direction are arc-degrees. The default, denoting a missing value, is -1.0.

Note that The definition of *surfaceCurrentSpeed* has been modified to distinguish it from speed in general. Now defined as "**Magnitude of current velocity at the water surface, measured or calculated at a depth (or range of depths) consistent with the data product**."

S-104 & S-111 DQWG-RELATED ASPECTS

IHO

International Hydrographic Organization

Discussion of DQWG documents during TWCWG7

- Definition of *surfaceCurrentSpeed* – already addressed – see previous slide.

- Add a time attribute to S-111 for non-uniform time interval data (analogous to the *waterLevelTime* attribute in s-104), i.e. a new attribute, *surfaceCurrentTime*. This has been completed (Definition = The time of the surface current data, expressed in ISO 8601 Date time format).

- DQWG cross-checks of the DQ Chapters between S-104 and S-111, and between the S-104 and S-111 Feature Catalogues (FC) with the corresponding DCEG document.
  - The cross checks were made on **Eds 1.0.0** of both PS, both completed in 2018, before S-97 Part C (Data Quality) was prepared.
  - TWCWG noted there can be issues when cross-comparing one PS feature catalogue (FC) with another.
  - Whether two concepts are over-similar is an IHO GI Registry matter; If two concepts are registered, both can be used.
  - Each PS has its own FC and each FC is available to the applications. Additionally, interoperability (S-100 Part 16 and S-98) does not require different products to use the same feature and attribute names.

- Since the S-100 WG deferred consideration of the DQWG papers concerning S-100 amendments for DQ until the publication of S-100 Edition 6.0.0, then S-104 and S-111 Editions 2.0.0 will continue to follow the current guidance for DQ, as outlined in S-97 Part C.