

## **US Hydro 2005**

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**Highest quality  
throughout all ENC product stages**

*- ensuring highest possible quality  
from chart to exchange sets -*

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## 1. Introduction

The term ENC Quality Control and Assurance is not limited to the production process for individual charts, but have to include the full ENC life cycle.

The life cycle for an ENC, with respect to source data assessment and verification, product compilation, validation and publication followed by product maintenance and eventually termination is a complex procedure where quality processes must/should be integrated.

The issuing Authorities responsibility is further extended to also include the distribution aspect, as a minimum limited to the data collection quality.

The term Quality Control is and cannot therefore be limited to S-57 encoding and successful testing stipulated by IHO S-58 "Recommended ENC Check list".

As a cartographer already is aware of, there are a variety of scenarios that cannot be detected by automatic testing and validation performed on ENC data, this is related to source data correctness, available Meta data, digitizing and product collection within IHO S-57 Exchange sets.

Further on, for the producer to ensure safety of their data it has been accepted within the hydrographic community that encryption of IHO S-57 data is required, and consequently IHO S63 have been issued in order to standardize the encryption of the data files.

It's also worth mentioning that the ENC term now a day's is even further expanded, with introduction of more product specifications/-standard based on S-57. Inland ENC and Additional Military Layers have been introduced and users have even further requests.

This paper focuses on all the aspects for quality control and assessment throughout the ENC product stages, from planning, compilation, production, distribution and maintenance to the ENC's termination.

The paper will not focus on production itself or the practical compilation of ENC's. Nor will it focus on any preferred production priorities defined by Paper chart driven or ENC Cell driven production.

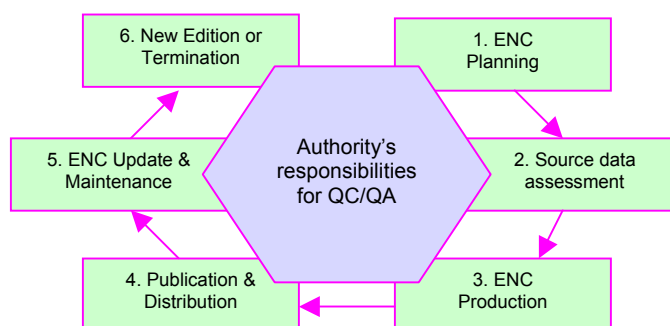


Figure 1 ENC Life Cycle

## 2. ENC Planning

### 1. ENC Planning

- **Coverage model** (Paper chart equivalent or Cell grid based)
- **Usage (Scale) band** (Small-/large scale coverage; priorities)
- **Available sources** (existing products, surveys, fair sheets, survey sheets etc)
- **Bi-lateral agreements** (covering national border areas)

ENC Planning, is defined by “the establishment of a seamless and adequate ENC coverage within given usage bands, and assurance of source data quality required to enable safe navigation”.

To allow an effective quality management for the planning process, the producer should have effective tools and technologies at hand enabling the operator access to all required source data (and their meta data) and have them visualized for easy comparison. The sources Meta data must hold enough information so that the operator may take qualified decisions.

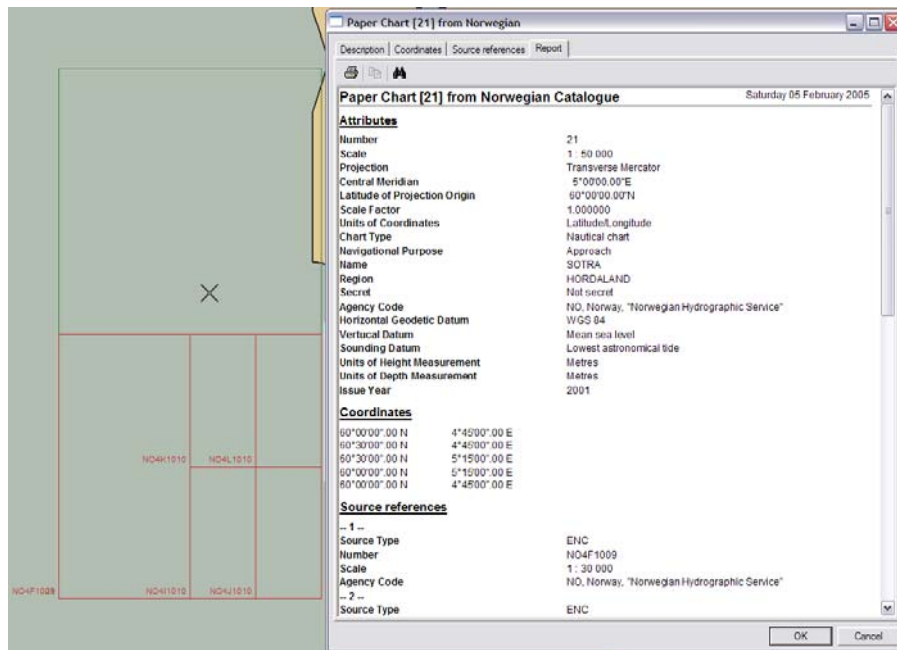


Figure 2 dKart Catalogue database

### 3. Source data assessment

2. Source data assessment

- **Source data retrieval**
- **Normalizing/Transformation** (raster sources)
- **Processing survey data** (product preparation for source survey data)
- **Other Available sources** (List of lights, old reprints)
- **Databases** (other available sources Land data, international available data, etc)

The source data assessment involves not only retrieval/collection of available/required source data for the ENC product(s), but with a primary goal to ensure highest possible quality for the chart coverage.

The producer need tools and technology to assess and fine tune the sources to meet the minimum requirement for ENC production, here implicit (not limited to) product dependant data cleaning/-collection, normalization and transformation of analogue sources where the quality aspect for the normalization is vital.

### 4. ENC Production

3. ENC Production

- **Meta data** (Accessibility to required meta data)
- **Positional accuracy** (Positional accuracy must be accessible and of high enough quality)
- **Digitizing/S57 Encoding** (integrated quality control means avoiding/limiting human errors)
- **Import** (imports should be directly to S57 format, enabling on-the-fly object and attribute creation and consequently quality control)
- **S58 Validation** (automatic testing routines towards IHO S58 checks)
- **Coverage accuracy** (Visual means must be available to handle edge matching, coverage consistency etc.)

When the production is planned, sources are assessed and made available for the production unit and the product compilation is started.

It's however believed that a production tool should be consistent with respect to data formats, input, internal and output, to ensure and allow a highest possible quality throughout the production. Limiting the number of conversions to/from data formats will improve the quality of data and consequently the need for special attention to the operator in means of quality control.

HydroService has always focused on this matter, where as the internal format used is standard IHO S-57, and any data imported to the production tool is "directly", with assistance of controlled import routines, converted directly to S-57. This allows the users to validate the imported data on-the-fly allowing resources to be allocated with other more important processes within a production.

With the IHO S-58 standard the producer has been provided with a common platform for testing and validating the ENC's. This further improves the quality of the end product, but again to have an effective testing and resolution process the native format in production should be S-57. If it is, the user will have a WYSIWYG scenario and testing may be run on the fly when objects and its attributes are created or operator may at any time start S-58 testing on the data.

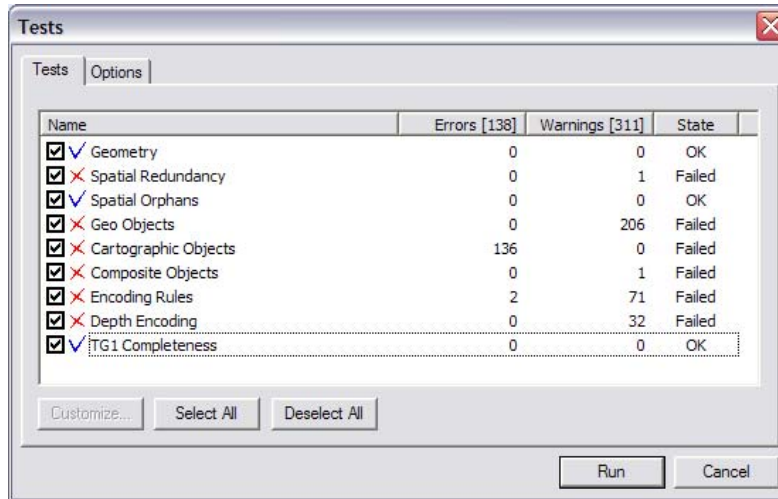


Figure 3 dKart Editor/dKart Inspector Test menu

Even though the S-58 standard provides effective means to test and ensure the quality of an ENC, there are still a variety of important elements, which is not covered by the standard. This be correct presence of objects and attributes, positional accuracy etc. An effective production tool must be able to provide secure and effective means to also quality assure these items.

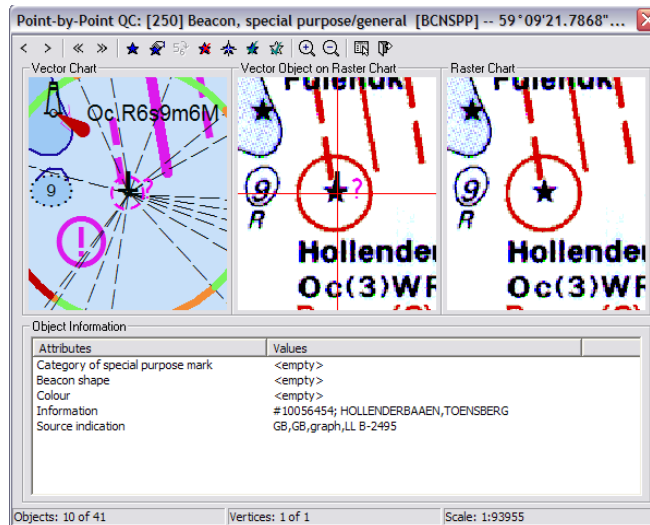


Figure 4 Point-by-Point QC in dKart Editor

Point-by-point QC allows the user to validate that all objects from an analogue source have been encoded and positioned correctly. The user is guided through all, or queried, objects where visualization gives position, object and attribute values and last but not least each check object is “flagged” checked.

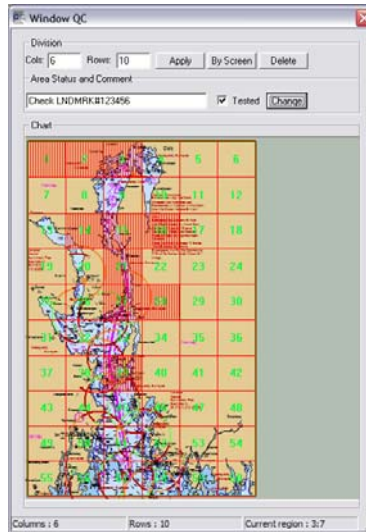


Figure 5 Window-by-Window QC in dKart Editor

Window-by-Window QC allows the user to be guided through the entire coverage area and visual control on object digitizing and encoding is preformed.

These additional QC functions, integrated with automatic checking routines a comprehensive and controlled QC environment to the user, ensuring completeness and correctness to the cartographic work undertaken.

## 5. Publication and Distribution

### 4. Publication and Distribution

- **Final quality control** (Full testing, manual and automatic, is required before an ENC is finalized)
- **ENC Stamping** (Upon completion of all QC/QA routines the ENC file is “stamped” so that any further changes made, will automatically create S57 update files (ER files))
- **Exchange set creation** (S57 defines exchange set parameters for release of an ENC file as a set of files, named S57 Exchange Set. This is a collection of ENC(s) and referenced and required files)
- **S63 Encryption** (depending on policy, the ENC Exchange Set may be encrypted to avoid piracy and illegal copying of the data)
- **Distribution** (depending on policy, distribution of ENC’s may be made through International ENC centers or private industry, or a combination of both)

Following successful and accepted quality control and assurance routines, the ENC is ready for distribution to mariners. There are a variety of different ways to handle this, but the majority of released ENC’s are distributed through bi-lateral and/or private channels on a commercial basis.

When the production of a S-57 cell is declared completed and approved, the “stamping” of the cell will “confirm” it, resulting in a “Published” ENC. Any changes made to/on a stamped ENC will automatically create a S-57 ER file (Update file).

Encryption of an ENC, or more correctly an ENC Exchange Set, is in practical sense a direct change of the data itself and quality assurance must therefore be performed on the encrypted data set. Validation and Quality assurance in this respect implies the ability to de-encrypt the exchange set, perform consistency checks and subsequent approval of the data set.

The complexity of IHO S63 is rather high, but nevertheless the user/producer must be capable of performing such validation to further ensure safe navigation for mariners. In most of the cases

this validation resides within a RENC organization today (if this is used), but even for “internally” released ENC’s such testing must be conducted.

Distribution will not be further discussed within this paper, as there already exists well known entities holding ISO type approved infrastructures for this.

## 6. ENC Update and Maintenance

### 5. ENC Update & Maintenance

- **Source assessment** (There is a high requirement to the quality for sources used for updating ENC’s, both positional and product relevant)
- **ENC Update production** (ENC Update creation should be handled/covered by standard production routines)
- **ENC Re-issue** (The amount of updates defines that an ENC should be re-issued. Meaning that all update files are combined within the ENC EN-file)
- **ENC Update validation** (ENC Updates do undertake the same level of quality control as for the main ENC file, and update files must therefore be tested individually and as an integrated part of the main ENC file)
- **ENC Update distribution** (Distribution of ENC Updates undertake the same quality control requirements as for ENC distribution)

**“An ENC is an ENC only until next update”.**

If a maintenance program does not cover an ENC it is no longer an ENC. This is not limited to when an update is actually available for the chart, but to when an ENC was “Last checked” for updates.

To raise the quality of the maintenance process the source messages are fully integrated within the production line. This means that source messages for NtM’s or general corrections are used for the update task and its quality control.

Only physical ENC update files are distributed.

The paper describes “a fully integrated NtM Source message handling for ENC Updating and Quality control”.

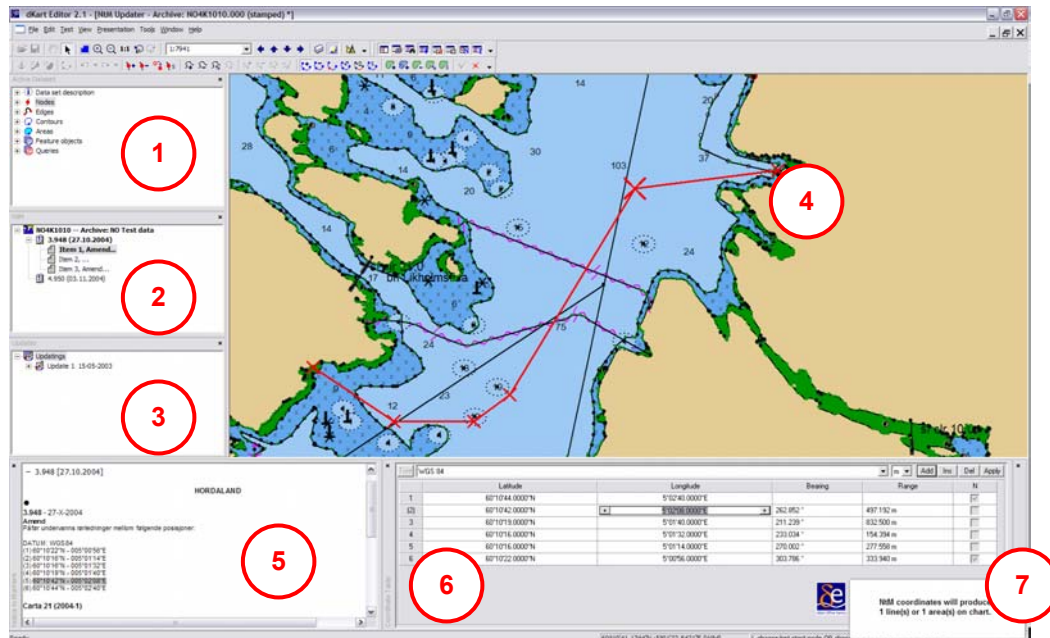


Figure 6 Integrated NtM based ENC updating

## 7. ENC Termination

6. New Edition or Termination

- **New Edition** (amount of or nature of corrections/maintenance defines the ENC to be issued as a new edition.
- **Termination** (The ENC product is defined as obsolete, which results in an “termination” update file, and no further updates may be done on the ENC)

When an ENC is defined as obsolete, for several reasons; new coverage/products available, obsolete products e.g., the operator must be able to validate and quality assure the decision basis for the termination process. In the same context the “Termination” process must be accessible only when given criteria’s are fulfilled and cancellation update must be created automatically (and distributed through standard distribution means).

From a quality control side a termination must result in a “locked” dataset, where no further corrections/changes may be applied.

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