S-100 Test Framework

Delivering the future navigational environment
And reflecting the lessons of S-57 ENC/ECDIS

Draft Version 0.2
September 2013

1   Introduction

The development of S-100 and S-101 by the IHO has reached the stage where testing and further development are required to complete the standards and associated elements to deliver a specification that can produce data and be used operationally. This document presents a framework for the incremental testing of the systems which make up the future marine navigational environment. It adopts a systems engineering approach (using ISO 15288:2008) reflecting that standards can only be tested based on implementation and that a complex system of systems make up the marine navigational environment.

2   Background

Since the 1980's a digital revolution has occurred. No domains have been unaffected by this global phenomenon. In the marine navigation domain this led to the development of digital navigation. Initially with raster charts but leading to the Electronic Navigational Chart standardised in the IHO S-57 Specification and built on the S-57 standard. This has progressed to become a mandatory carriage requirement for some vessels in concert with ECDIS.

The digital revolution has continued and technology has evolved, in the early 2000's IHO recognised the need to develop a contemporary standard and also to broaden the scope of exchange standards to support a wider variety of digital information.

S-100 provides the framework standard for the future marine navigational environment. It is realised through the creation of product specifications which enable data exchange and product delivery by defining the content, display and structure of marine spatial data.

Experience with S-57 ECDIS has shown that disconnected standards cannot deliver the user expectation for marine navigation. Instead there must be a clear connection from the user needs to system functions and to the underlying data which supports these functions. The standards simply define the data structures and the systems within this environment.

In addition the regulatory and testing environment must be coherent. This test framework should feed into the development of appropriate test plans, cases and datasets. Draft versions for further development should be deliverables of this work.

It should be noted that while one of the main components of S-100 is the IHO Geospatial Information Registry, for the purposes of this framework it is considered to be out of scope. The S-100 GI Registry has already undergone testing and is in use by the IHO and several other organizations, and while it is not part of the testing regime, it is considered a major input item to this testing framework. In addition, through this test framework, some gaps within the registry may be identified and will be directed to the appropriate working group for consideration.

3   The Approach

Reflecting contemporary development paradigms for complex software systems involving the integration of systems and data; a system engineering approach is adopted for the testing of S-100 and associated product specifications. This approach utilises the ISO 15288 standard which;

"provides a common process framework covering the life cycle of man-made systems. This life cycle spans the conception of ideas through to the retirement of a system. It provides the processes for acquiring and supplying systems. In addition, this framework provides for the assessment and improvement of the life cycle processes."

This framework will specifically use the Technical Process defined in part 5.5 of ISO 15288 which consists of the following processes;

> a) Stakeholder Requirements Definition Process;
> b) Requirements Analysis Process;
> c) Architectural Design Process;
> d) Implementation Process;
> e) Integration Process;
> f) Verification Process;
> g) Transition Process;
> h) Validation Process;
> i) Operation Process;
> j) Maintenance Process;
> k) Disposal Process. – This process is not applicable for this framework.

For each component system identified, these processes will be applied as appropriate and documented within this Test Framework and associated supporting documents. Each system of interest will also be documented as a system defining its inputs, outputs and processes.

This approach will be applied in an incremental fashion where each stage builds upon the previous and requirements must ensure the successful integration of the systems. Such requirements must reflect the integration and interfaces of systems. They must cater for another system operating in states where it has not met its requirements.

4   Goals

The goal for the S-100 Test Program for which this framework forms the basis is as follows;

To provide a set of complete and validated standards and specifications and associated documents to support the development of S-100 marine navigation systems which meet the user need.

5   Objectives

This goal can be subdivided into the following objectives working backwards from the use of S-100 products in ECDIS;

- *S-100 products display and function as required by users in S-100 ECDIS. Standards and testing must ensure the required level of consistency and reliability.*

- *S-100 products can be distributed and ingested in a proper and reliable manner by S-100 ECDIS.*

- *S-100 products can be collated and packaged into distribution packages with required data integrity etc*

- *S-100 products can be validated to conform to defining standards and acceptable quality levels.*

- *S-100 products can be created and updated.*

- *S-100 feature and portrayal catalogues can be created and updated. Processes must ensure catalogues are valid and consistent.*

More specifically, this framework will test four major types of products that could be used within an S-100 ECDIS. They are:

- *S-101 ENC Product Specification*

- *S-10X Overlay – where the data would overlay the base ENC to provide additional information*

- *S-10X Partial Replacement – where the data would replace part of the base ENC to provide more detailed information*

- *S -10X wholesale replacement – where the data would replace the entire ENC. For example a port ENC may replace the existing harbour ENC.*

The following functional flowchart depicts the high level S-100 System Overview. Each box represents a component or a set of components that will be tested utilizing this framework.
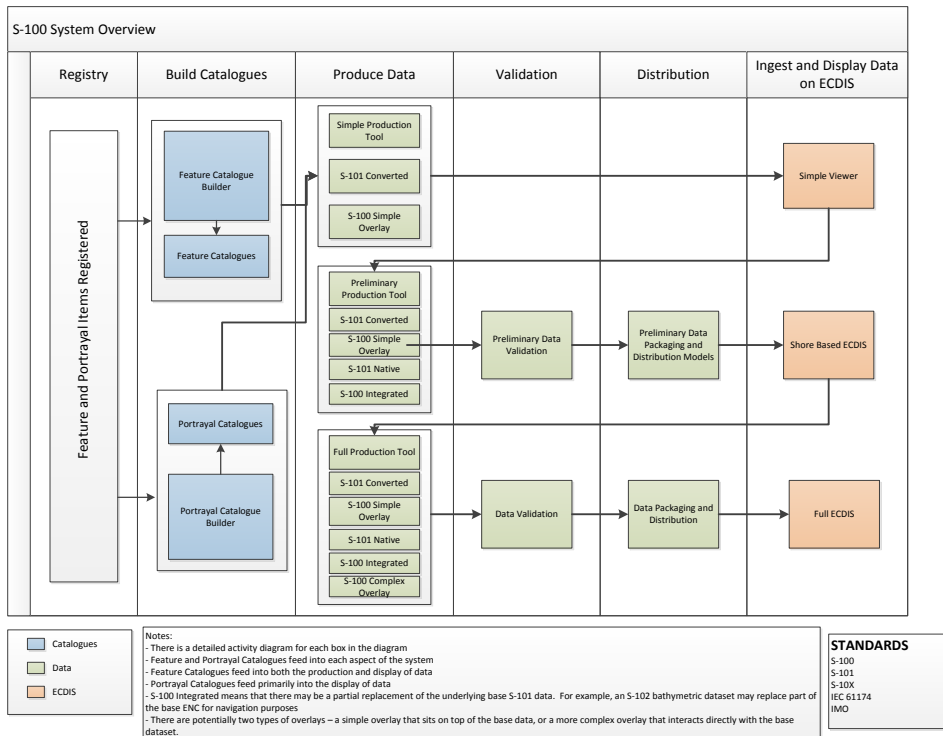
S-100 System Overview

Registry	Build Catalogues	Produce Data	Validation	Distribution	Ingest and Display Data on ECDIS

Feature and Portrayal Items Registered

Feature Catalogue Builder
Feature Catalogues

Portrayal Catalogues
Portrayal Catalogue Builder

Simple Production Tool
S-101 Converted
S-100 Simple Overlay

Preliminary Production Tool
S-101 Converted
S-100 Simple Overlay
S-101 Native
S-100 Integrated

Full Production Tool
S-101 Converted
S-100 Simple Overlay
S-101 Native
S-100 Integrated
S-100 Complex Overlay

Preliminary Data Validation

Data Validation

Preliminary Data Packaging and Distribution Models

Data Packaging and Distribution

Simple Viewer

Shore Based ECDIS

Full ECDIS

Catalogues
Data
ECDIS

Notes:
- There is a detailed activity diagram for each box in the diagram
- Feature and Portrayal Catalogues feed into each aspect of the system
- Feature Catalogues feed into both the production and display of data
- Portrayal Catalogues feed primarily into the display of data
- S-100 Integrated means that there may be a partial replacement of the underlying base S-101 data. For example, an S-102 bathymetric dataset may replace part of the base ENC for navigation purposes
- There are potentially two types of overlays – a simple overlay that sits on top of the base data, or a more complex overlay that interacts directly with the base dataset.

STANDARDS
S-100
S-101
S-10X
IEC 61174
IMO

Figure 1 - S-100 High Level System Overview

6 Phases

In order to manage the number of sub systems and complexity involved this framework will break the overall S-100 system testing into 9 phases. These are shown in figure 2 and follow a logical progression from catalogue creation through to use within ECDIS.
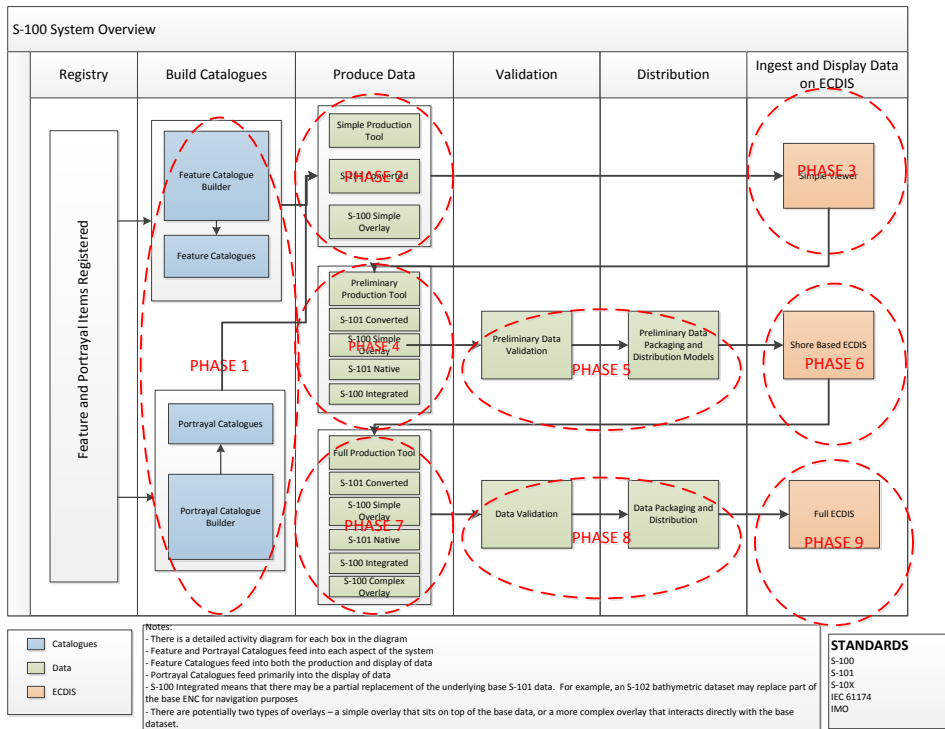
Figure 2 - S-100 High Level System Overview with Phases

Breaking out the testing through phases allows for the iterative development of future ECDIS as a system by gradually expanding requirements and test bed. At a high level the phases are as follows:

Phase 1: Feature and Portrayal Catalogue Generation. This phase concentrates on the feature and portrayal catalogue builders and the generation of catalogues to support the S-101 product specification and S-10X overlays.

Phase 2: Simple Production Tool. This phase deals with creating S-101 ENCs by using the S-57 convertor. In addition, it will also look to create an S-100 simple overlay file for use in testing.

Phase 3: Simple Viewer. This phase creates a simple viewer that will ingest feature and portrayal catalogues, along with an S-101 dataset to validate if the dataset displays according to what is defined in the portrayal catalogue. At this phase S-101 updates will not be tested.

Phase 4: Preliminary Production Tool. This phase deals with creating a tool that can edit and produce S-101 data and updates. In addition, there may be a secondary tool that will have the ability to produce S-10X data that is meant to be integrated within an S-101 dataset.

Phase 5: Preliminary Data Validation and Distribution. This phase will put in place draft data validation rules and test data packaging and distribution models.

Phase 6: Shore-Based ECDIS. This phase deals with the creation and testing of several shore based ECDIS. This version of the S-100 ECDIS is not expected to have the full capabilities of an ECDIS that will undergo type approval, but should be able to handle different types of S-100 based data, perform basic navigation functions – such as set the safety contour and have the pick report functionality implemented.

Phase 7 – 9: Full Production Tool, Data Validation, Distribution, and Full ECDIS. These final three phases deal with the full system testing and implementation of S-100 and S-101.

The following section in this document is structured to reflect each phase and document requirements, processes and the systems model. Individual test cases and test datasets are stored separately from this document.

7   Phase 1 Production and Maintenance of Catalogues

S-100 realises its flexibility by encapsulating data content and display content within exchangeable catalogue files. These catalogues are defined within S-100 and form a constituent part of product specifications. The systems for the production and maintenance of S-100 catalogues are considered enabling systems within the future navigational environment.

This phase is divided into two parts A and B to cover feature and portrayal catalogues respectively. Due to the relationship between feature and portrayal catalogues part B is dependent on part A.

7.1   Phase 1A Feature Catalogue Builder

System of interest – S-100 Feature Catalogue Builder

Inputs – Register items, User input items

Processes – Creation of feature catalogue, editing of feature catalogues, deletion of feature catalogues, output of catalogues
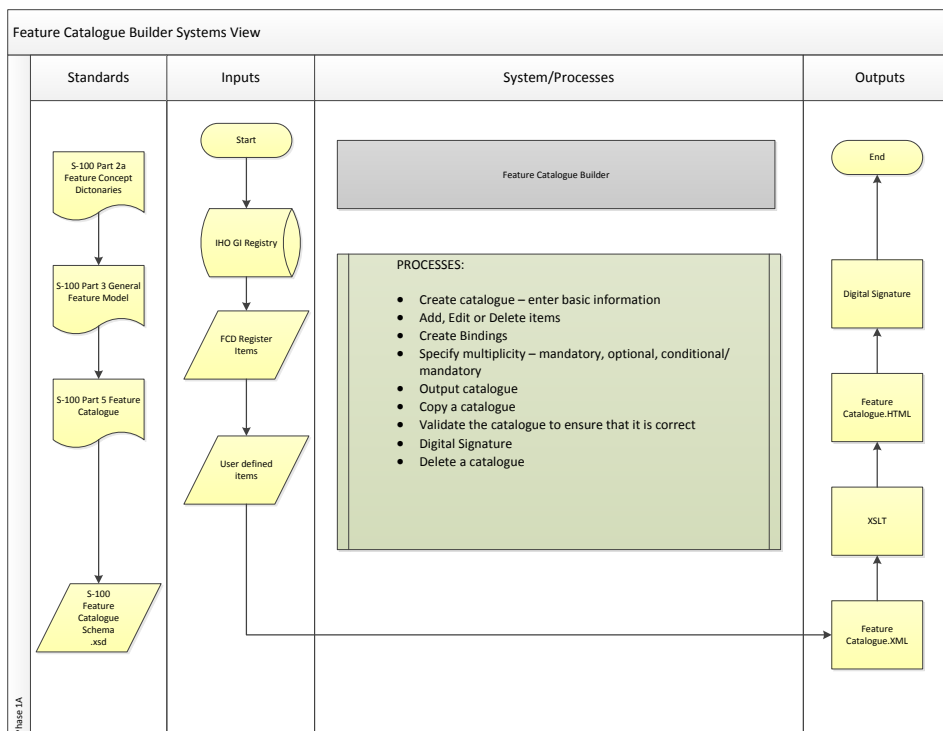
Outputs – Valid S-100 Feature Catalogue

Figure 2- Feature Catalogue Builder Systems View

a) Stakeholder requirements Process

<u>Stakeholders</u>

Product specification developers/editors – primary users who require the ability to create a catalogue from scratch, edit catalogues and output finalised catalogues

Catalogue builder manager – a support role, the point of contact for issues with or changes to the catalogue builder

<u>System constraints</u>

- The output catalogues must conform to the S-100 Feature Catalogue Schema.
- The system must be accessible to the broad range of S-100 users irrespective of platform and location.

<u>Stakeholder Activities</u>

Stakeholders require access to the catalogue builder to create new catalogues, edit existing catalogues or delete a catalogue. They must also be able to validate a catalogue to ensure that it conforms to S-100 and create a digital signature against the catalogue.

<u>Security</u>

The system requires user login and catalogues must be assigned to a specified user.

The system shall be able to create a digital signature

b) Requirements Analysis Process;

<u>General Requirements:</u>

The catalogue builder must be able to build catalogues on different versions of S-100.

<u>Requirements</u>

Based on the stakeholder activities the following detailed requirements are developed. Each one of these requirements will have an associated test case/test scenario.

Ref	Requirement	Comment

1.0	Access system	
1.1	System Log on	User access through a password protected login.
1.2	Assign User Roles	
1.2.1	Read Only Role	
1.2.2	Read/Write Role	
1.2.3	Administrator role	
1.2.4	Approving Official Role	Assigns the final Digital Signature
1.3	Read Access to the IHO GI Register	
2.0	Catalogue Management	These are functions to the database (not opening the XML)
2.1	Create catalogue	
2.1.1	Input catalogue metadata	This would include that the catalogue is valid for several versions of the product specification.
2.2	Open existing catalogue	
2.3	Copy existing catalogue to a new catalogue	
2.4	Delete Catalogue	This is for test catalogues – will not be able to delete a validated catalogue
2.5	View Catalogue	
3.0	Edit catalogue	Items can be added from either the Feature Concept Dictionary or by user input if they are non-registered items
3.1	Add items	Items added from the S-100 GI Registry
3.1.1	Add attributes	
3.1.2	Add features	
3.1.3	Add information types	
3.1.4	Add enumerations	
3.1.5	Add complex attributes	
3.1.6	Add associations	
3.1.7	Add association roles	
3.2	Add items	Items added manually
3.2.1	Add attributes	
3.2.2	Add features	
3.2.3	Add information types	
3.2.4	Add enumerations	
3.2.5	Add complex attributes	
3.2.6	Add associations	
3.2.7	Add association roles	
3.3	Edit catalogue items	
3.3.1	Edit feature primitives	Adding the geometry
3.3.2	Edit feature attributes	Binding attributes to the feature and adding multiplicity
3.3.3	Edit complex attributes	Constructing the complex and there are cases where there will be a complex within a complex
3.3.4	Edit information type attributes	Information types can also be bound to features
3.3.5	Edit enumerations	

Comment [br1]: Is this in the FC model.

JLP: I don't think so. But we need to track this.

3.3.6	Edit catalogue details	
3.3.7	Edit associations	
3.3.8	Edit dataset attributes	
3.3.8	Edit supertypes	They are defined in the feature catalogue of S-100
3.3.9	Edit subtypes	They are defined in the in the feature catalogue of S-100
3.4	Delete catalogue items	Items can only be deleted before the catalogue has been validated
3.4.1	Delete feature primitives	
3.4.2	Delete feature attributes	
3.4.3	Delete complex attributes	
3.4.4	Delete information type attributes	
3.4.5	Delete enumerations	
3.4.6	Delete catalogue details	
3.4.7	Delete associations	
3.4.8	Delete dataset attributes	
3.4.9	Delete supertypes	
3.4.10	Delete subtypes	
4.0	Output catalogue	
4.1	Export .XML catalogue file	Export .xml catalogue file conforming to S100 FC schemas
4.2	Be able to display an HTML version of the catalogue using a common style sheet and create a PDF version of the catalogue	Export HTML style sheet for a human readable catalogue
5.0	Validation	
5.1	Is the catalogue valid to the schema	
5.2	Is the catalogue valid for content	
6.0	Digital Signature	Final authority on if the catalogue is correct.

c) Architectural Design Process;

N/A - the feature catalogue builder must make catalogues that conform to S-100

d) Implementation Process;

The feature catalogue builder must be maintainable and have proper documentation.

e) Integration Process;

The FC builder is integrated into the registry process and is connected as the inputs.

f) Verification Process;

Based on these requirements verification and validation tests are provided in a separate document. These must be conducted by the tester and reviewed by the test reviewer and signed off as follows when complete;

Tester Name	Tester Signature	Date
Reviewer Name	Reviewer Signature	Date

g) Transition Process;

N/A

h) Validation Process;

N/A – The validation process is over the entire system and not just at the subcomponent level

i) Operation Process;

The user documentation must outline how the feature catalogue builder will work.

j) Maintenance Process;

The following maintenance process is defined for the feature catalogue builder;

<u>Point of contact</u>

The role of Feature Catalogue Builder manager is defined to support the maintenance and use of the builder. The contact details are listed on the opening page of the builder. The process is defined as follows;

<u>General Processes</u>

Change request – minor/major

Requestor emails manager with change, manager decides if it's a simple cosmetic change or enhancement or whether it constitutes a substantive major change. Changes which are not consistent with S-100 part 5 etc cannot be considered and must be put through as changes to S-100 first. Substantive major changes must be scoped and estimated by the manager and a submission made to TSMAD.

S-100 change

Any significant changes to the S-100 GFM and S-100 Part 5 may impact the feature catalogue builder. When any such changes are being prepared the feature catalogue

builder manager must prepare a change proposal with estimates of resources required and submit to TSMAD.

It is necessary to allow output of catalogues conforming to previous S-100 versions therefore the output catalogue component of the application may need to support more than one S-100 version.

7.2   Phase 1B Portrayal Catalogue Builder

System of interest – S-100 Portrayal Catalogue Builder

Inputs – Register items, User input items

Processes – Creation of portrayal catalogue, editing of portrayal catalogues, deletion of portrayal catalogues, output of catalogues
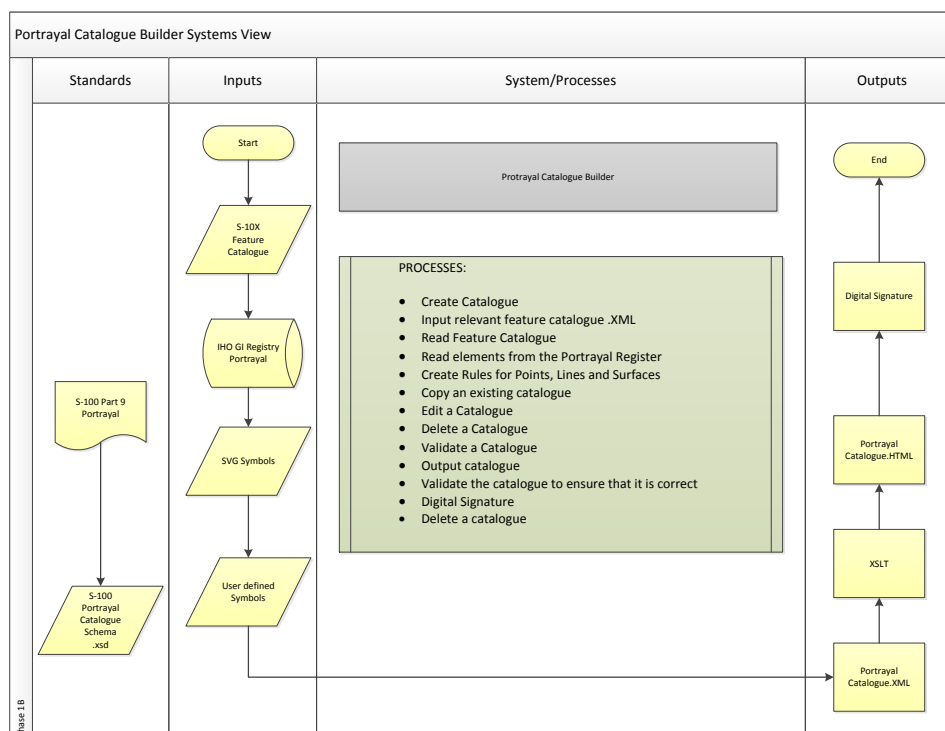
Outputs – Valid S-100 Portrayal Catalogue

Figure 3 - Portrayal Catalogue

a) Stakeholder requirements Process

Stakeholders

Product specification developers/editors – primary users who require the ability to create a catalogue from scratch, edit catalogues and output finalised catalogues

Catalogue builder manager – a support role, the point of contact for issues with or changes to the catalogue builder

System constraints

- The output catalogues must conform to the S-100 Portrayal Catalogue Schemata.
- The system must be accessible to the broad range of S-100 users irrespective of platform and location.
- Conditional Symbology is outside the system

<u>Stakeholder Activities</u>

Stakeholders require access to the catalogue builder to create new catalogues, edit existing catalogues or delete a catalogue. They must also be able to validate a catalogue to ensure that it conforms to S-100 and create a digital signature against the catalogue.

<u>Security</u>

The system requires user login and catalogues must be assigned to a specified user.

The system shall be able to create a digital signature

b) Requirements Analysis Process;

<u>General Requirements:</u>

The catalogue builder must be able to build catalogues on different versions of S-100.

The catalogue builder and portrayal catalogues must conform to S-100 part 9.

<u>Requirements</u>

Based on the stakeholder activities the following detailed requirements are developed. Each one of these requirements will have an associated test case/test scenario.

Ref	Requirement	Comment
1.0	Access system	
1.1	System Log on	
1.2	Assign User Roles	
1.2.2	Read Only Role	
1.2.2	Read/Write Role	
1.2.3	Administrator role	
1.2.4	Approving Official Role	Assigns the final Digital Signature
2.0	Catalogue Management	These are functions to the database (not opening the XML)
2.1	Create catalogue	

2.1.2	Input catalogue metadata	This would include that the catalogue is valid for several versions of the product specification.
2.1.3	Input the relevant feature catalogue .XML	
2.1.4	Read in elements from the Portrayal Register	
2.1.4.1	Symbols	
2.1.4.2	Colour Tokens	
2.1.4.3	Line Styles	
2.1.4.4	PENs	Defines how symbols are drawn
2.1.4.5	Area Files	
2.1.4.6	Pix Maps	
2.1.4.7	Viewing Groups	
2.1.4.8	Display Panes	
2.4.1.9	Rule-sets	To include portrayal rules
2.2	Open existing catalogue	
2.3	Copy existing catalogue to a new catalogue	
2.4	Delete Catalogue	This is for test catalogues – will not be able to delete a validated catalogue
2.5	View Catalogue	
3.0	Edit Catalogue	
3.1	Add Items	
3.1.1	Point Features	
3.1.1.1	Add symbol	(SVG file – should include pivot point and offset)
3.1.1.2	Add viewing group	
3.1.1.3	Add Display Mode	
3.1.1.4	Add Display Pane	
3.1.1.5	Add Ruleset	
3.1.1.6	Add User defined variables	
3.1.1.7	Add alerts and indications	
3.1.1.8	Part 9 Clause 10.1	Add in tests to conform to Part 9 Clause 10.1
3.1.2	Line Features	
3.1.2.1	Add Simple Line Style	
3.1.2.1.1	Add Colour Token	
3.1.2.2	Add Complex Line Style	
3.1.2.3	Add viewing group	
3.1.2.4	Add Display Mode	
3.1.2.5	Add Display Pane	
3.1.2.6	Add Ruleset	
3.1.2.7	Add User defined variables	
3.1.2.8	Add alerts and indications	
3.1.2.9	Part 9 Clause 10.4	Add in tests to conform to Part 9 clause 10.4
3.1.3	Surface Features	
3.1.3.1	Add Area Fill	
3.1.3.1.1	Add Colour token	
3.1.3.2	Add Area Pattern	
3.1.2.3	Add viewing group	

3.1.2.4	Add Display Mode	
3.1.2.5	Add Display Pane	
3.1.2.6	Add Ruleset	
3.1.2.7	Add User defined variables	
3.1.2.8	Add alerts and indications	
3.1.2.9	Part 9 Clause 10.5	Add in tests to conform to Part 9 clause 10.5
3.2	Edit items	
3.2.2	Point Features	
3.2.2.1	Edit symbol	(SVG file – should include pivot point and offset)
3.2.2.2	Edit viewing group	
3.2.2.3	Edit Display Mode	
3.2.2.4	Edit Display Pane	
3.2.2.5	Edit Ruleset	
3.2.2.6	Edit User defined variables	
3.2.2.7	Edit alerts and indications	
3.2.2.8	Part 9 Clause 10.1	Add in tests to conform to Part 9 Clause 10.1
3.2.3	Line Features	
3.2.3.1	Edit Simple Line Style	
3.2.3.1.1	Edit Colour Token	
3.2.3.2	Edit Complex Line Style	
3.2.3.3	Edit viewing group	
3.2.3.4	Edit Display Mode	
3.2.3.5	Edit Display Pane	
3.2.3.6	Edit Ruleset	
3.2.3.7	Edit User defined variables	
3.2.3.8	Edit alerts and indications	
3.2.3.9	Part 9 Clause 10.4	Add in tests to conform to Part 9 clause 10.4
3.2.4	Surface Features	
3.2.4.1	Edit Area Fill	
3.2.4.1.1	Edit Colour token	
3.2.4.2	Edit Area Pattern	
3.2.4.3	Edit viewing group	
3.2.4.4	Edit Display Mode	
3.2.4.5	Edit Display Pane	
3.2.4.6	Edit Ruleset	
3.2.4.7	Edit User defined variables	
3.2.4.8	Edit alerts and indications	
3.2.4.9	Part 9 Clause 10.5	Add in tests to conform to Part 9 clause 10.5
3.3	Delete items	
3.3.2	Point Features	
3.3.2.1	Delete symbol	(SVG file – should include pivot point and offset)
3.3.2.2	Delete viewing group	
3.3.2.3	Delete Display Mode	
3.3.2.4	Delete Display Pane	
3.3.2.5	Delete Ruleset	
3.3.2.6	Delete User defined variables	

3.3.2.7	Delete alerts and indications	
3.3.2.8	Part 9 Clause 10.1	Add in tests to conform to Part 9 Clause 10.1
3.3.3	Line Features	
3.3.3.1	Delete Simple Line Style	
3.3.3.1.1	Delete Colour Token	
3.3.3.2	Delete Complex Line Style	
3.3.3.3	Delete viewing group	
3.3.3.4	Delete Display Mode	
3.3.3.5	Delete Display Pane	
3.3.3.6	Delete Ruleset	
3.3.3.7	Delete User defined variables	
3.3.3.8	Delete alerts and indications	
3.3.3.9	Part 9 Clause 10.4	Add in tests to conform to Part 9 clause 10.4
3.3.4	Surface Features	
3.3.4.1	Delete Area Fill	
3.3.4.1.1	Delete Colour token	
3.3.4.2	Delete Area Pattern	
3.3.4.3	Delete viewing group	
3.3.4.4	Delete Display Mode	
3.3.4.5	Delete Display Pane	
3.3.4.6	Delete Ruleset	
3.3.4.7	Delete User defined variables	
3.3.4.8	Delete alerts and indications	
3.3.4.9	Part 9 Clause 10.5	Add in tests to conform to Part 9 clause 10.5
4.0	Output catalogue	
4.1	Export .XML catalogue file	Export .xml catalogue file conforming to S100 FC schemas
4.2	Export HTML style sheet	Export HTML style sheet for a human readable catalogue
5.0	Validation	
5.1	Is the catalogue valid to the schema	
5.2	Is the catalogue valid for content	
6.0	Digital Signature	Final authority on if the catalogue is correct.

c) Architectural Design Process;

N/A – Portrayal Catalogue builder must comply to S-100 Part 9 and the architectural design process is being handled via an IHO contract and managed by DIPWG

d) Implementation Process;

The portrayal catalogue builder must be maintainable and have proper documentation.

e) Integration Process;

The PC builder is integrated via both the registry process and the feature catalogue. The PC utilizes the Feature Catalogue as in input along with the portrayal register and provides an output for the associated product specification.

f) Verification Process;

Based on these requirements verification and validation tests are provided in a separate document. These must be conducted by the tester and reviewed by the test reviewer and signed off as follows when complete;

Tester Name	Tester Signature	Date
Reviewer Name	Reviewer Signature	Date

g) Transition Process;

N/A

h) Validation Process;

N/A – The validation process is over the entire system and not just at the subcomponent level

i) Operation Process;

Reference the user documentation process.

j) Maintenance Process;

The following maintenance process is defined for the portrayal catalogue builder;

Point of contact

The role of Portrayal Catalogue Builder manager is defined to support the maintenance and use of the builder. The contact details are listed on the opening page of the builder. The process is defined as follows;

General Process

Change request – minor/major

Requestor emails manager with change, manager decides if it's a simple cosmetic change or enhancement or whether it constitutes a substantive major change. Changes which are not consistent with S-100 part 9 etc cannot be considered and must be put through as changes to S-100 first. Substantive major changes must be scoped and estimated by the manager and a submission made to TSMAD/DIPWG.

S-100 change

Any significant changes to the S-100 Part 9 - portrayal may impact the portrayal catalogue builder. When any such changes are being prepared the feature catalogue builder manager must prepare a change proposal with estimates of resources required and submit to DIPWG.

It is necessary to allow output of catalogues conforming to previous S-100 versions therefore the output catalogue component of the application may need to support more than one S-100 version.

8 Phase 2 Simple Production Tool

System of interest – S-10X Convertor

Inputs – S-57 ENCs, S-101 Feature Catalogue, S-10X Feature Catalogues, S-57 based overlays

Processes – Conversion of S-57 ENCs to S-101 ENCs, conversion of S-57 overlay data to S-101 Simple Overlays

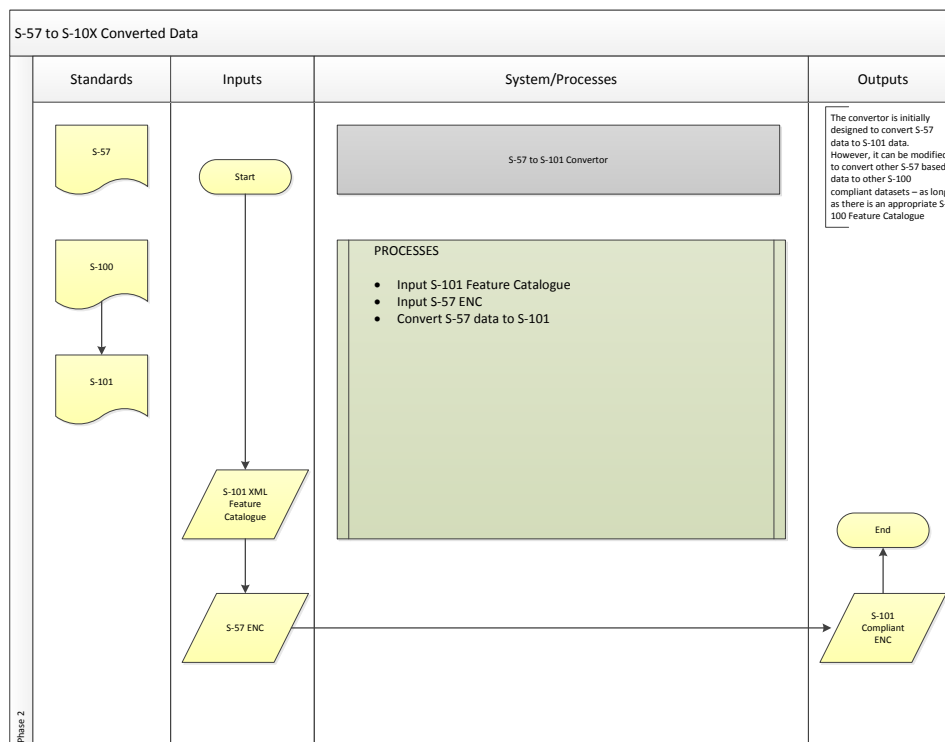**Outputs** – S-10X Data (8211 encoding)

Figure 4 - S-57 to S-101 converted data

a) Stakeholder requirements Process

<u>Stakeholders</u>

Product specification developers – those who need the ability to create S-101 Vector data for test bed purposes

Software Manufactures – they may choose to implement parts of the convertor

ECDIS Manufacturers – they will be eventually reading in converted data into an S-100 ECDIS.

Hydrographic Offices – a support role, they will be eventually responsible for converting their ENC suite or authorizing a RENC/VAR to handle the conversion.

RENCs/VARs – support role, they have access to large amounts of ENC data to test the conversion process. They may also eventually be handling data conversion for some Hydrographic Offices.

<u>System constraints</u>

- Initially, the convertor will handle updates as a re-issue process
- The convertor will most likely be able to only convert simple overlays
- The convertor must be open source
- The convertor will be finalized with the final version of S-101 that is released for implementation.

<u>Stakeholder Activities</u>

Stakeholders require access to the convertor in order to convert S-57 ENC datasets.

<u>Security</u>

The integrity of the data must remain the same during the conversion process

b) Requirements Analysis Process;

<u>General Requirements:</u>

The convertor must be open source and must convert S-57 ENCs to S-101 ENCs based on the S-101 Feature Catalogue.

The convertor must conform to applicable sections of S-101.

The convertor may be modified to handle S-10x overlay data conversion.

<u>Requirements</u>

Based on the stakeholder activities the following detailed requirements are developed. Each one of these requirements will have an associated test case/test scenario.

Ref	Requirement	Comment
1.0	Input S-101 Feature Catalogue	
2.0	Input S-57 ENCs	
2.1	Set appropriate Minimum and Maximum Display Scale mapping	

2.2	Convert simple attributes to Complex Attributes	There will be a mapping table to identify which will be converted
2.3	Convert S-57 lights model to S-101 lights model	
2.4	Calculate the new attributes required to eliminate CSPs	
2.4.1	Default Clearance Depth	
2.4.2	Minimum Surrounding Depth	
2.4.3	Flare Angle	
2.4.4	Sector Extension	
3.0	Output S-101 ENC Basefile	
3.1	Output S-101 updates as reissues	
3.2	Output S-101 updates	

c) Architectural Design Process;

N/A – The convertor is being developed as an open source application. For this effort TSMAD is only concerned about the inputs and the expected outputs and does not want to constrain the design of the convertor

d) Implementation Process;

The convertor must be maintainable and have proper documentation.

e) Integration Process;

The S-10x convertor is a standalone application.

f) Verification Process;

Based on these requirements verification and validation tests are provided in a separate document. These must be conducted by the tester and reviewed by the test reviewer and signed off as follows when complete;

Tester Name	Tester Signature	Date
Reviewer Name	Reviewer Signature	Date

g) Transition Process;

N/A

h) Validation Process;

N/A – The validation process is over the entire system and not just at the subcomponent level

i) Operation Process;

Reference the user documentation process.

j) Maintenance Process;

The following maintenance process is defined for the portrayal catalogue builder;

<u>Point of contact</u>

The point of contact for the convertor is currently Tom Depuyt of ESRI. Once the convertor is finalized it will be turned over to the IHO for management and distribution;

<u>General Process</u>

Change request – minor/major

Change requests for the convertor must be made through TSMAD.

9 Phase 3 Simple Chart Viewer

Manual loading

System of interest – S-100 Simple Chart Viewer

Inputs – S-101 ENCs, S-101 Feature Catalogue, S-101 Portrayal Catalogue, S-10X simple overlays, S-10X Feature Catalogue, S-10X Portrayal Catalogue

Processes – Supports the display of individual datasets according to the feature catalogue and portrayal catalogue

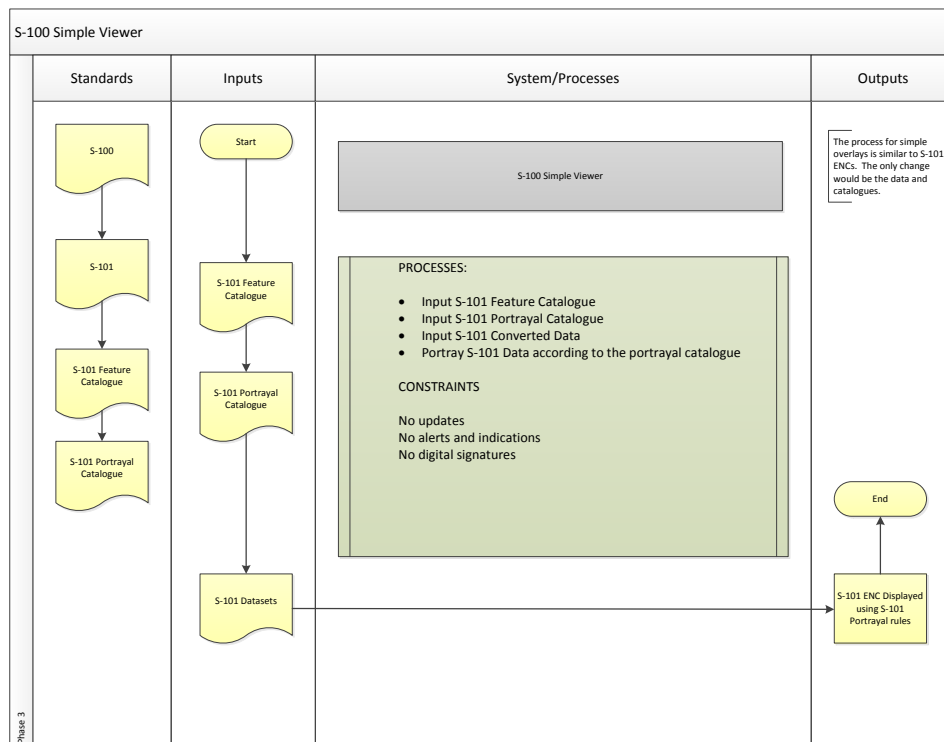**Outputs** – Proper display of S-101 data and simple overlays according to the portrayal catalogues

Figure 5 - S-100 Simple Viewer

a) Stakeholder requirements Process

Stakeholders

Product specification developers – those who need to be able to test simple portrayal aspects of their datasets

Software Manufactures – To ensure that the data is ingested properly

ECDIS Manufacturers – to ensure that the data is ingested and displayed properly

Hydrographic Offices – a support role, to ensure that the product specification is working as designed.

<u>System constraints</u>

- It does not have to be able to apply updates
- Does not have to handle alerts and indications
- Does not have to handle digital signatures
- Text placement only in north up mode can be tested

<u>Stakeholder Activities</u>

Stakeholders will need to have a simple viewer to test initial functionality of S-100 based datasets.

<u>Security</u>

N/A

b) Requirements Analysis Process;

<u>General Requirements:</u>

At a high level the simple viewer must be capable of loading multiple datasets in multiple display scales and be able to pan and zoom (horizontal and vertical).

It must also be capable of loading in specific feature and portrayal catalogues and properly displaying the data.

At a minimum the simple viewer must comply too the S-101 product specification, feature catalogue, portrayal catalogues and exchange set metadata, except where it has been specifically constrained.

<u>Requirements</u>

Based on the stakeholder activities the following detailed requirements are developed. Each one of these requirements will have an associated test case/test scenario.

Ref	Requirement	Comment
1.0	Catalogue Loading	
1.1	Load in S-101 Feature Catalogue	

1.1.1	Load in an updated S-101 Feature Catalogue	
1.2	Load in S-101 Portrayal Catalogue	
1.2.1	Load in an updated S-01 Portrayal Catalogue	
1.3	Load in S-10x Feature Catalogue	At a minimum those that use the S-100 8211 specification
1.4	Load in S-10x Portrayal Catalogue	At a minimum those that use the S-100 8211 specification
2.0	Dataset Loading	
2.1	Load in multiple S-101 datasets	
2.1.1	Load in data at multiple display scales	
2.1.2	Load in data that is associated with two different editions of the S-101 Feature Catalogue	
2.1.3	Load in data that is associated with two different editions of the S-101 Portrayal Catalogue	
2.2	Load in S-101 Exchange Sets	
2.2.1	Read in S-101 Exchange Set Catalogue metadata	
2.3	Load in S-10x Simple Overlay	
2.3.1	Load in S-10x Exchange Sets	
2.3.2	Read in S-10x Exchange set catalogue metadata	
3.0	Display	
3.1	Ability to pan	
3.2	Ability to zoom	
3.3	Ability to query attributes	
3.3.1	Ability to use the S-101 Pick Report Method	
3.4	Ability to use the S-101 palettes	
3.5	Ability to use the S-101 viewing groups	
3.6	Ability to change display modes	

c) Architectural Design Process;

N/A – The simple viewer must meet the requirements outlined above. For this effort TSMAD is only concerned about the inputs and the expected outputs and does not want to constrain the design of the simple viewer.

d) Implementation Process;

The simple viewer must be able to be used on a PC.

e) Integration Process;

The S-100 Simple Viewer is a standalone application.

f) Verification Process;

Based on these requirements verification and validation tests are provided in a separate document. These must be conducted by the tester and reviewed by the test reviewer and signed off as follows when complete;

Tester Name	Tester Signature	Date
Reviewer Name	Reviewer Signature	Date

g) Transition Process;

N/A

h) Validation Process;

N/A – The validation process is over the entire system and not just at the subcomponent level

i) Operation Process;

Reference the user documentation process.

j) Maintenance Process;

The following maintenance process is defined for the portrayal catalogue builder;

Point of contact

The point of contact for the S-100 Simple Viewer (s) will be the company or organization responsible for its developement;

General Process

Change request – minor/major

Change requests for the simple viewer must be made through TSMAD.

10 Phase 4 Preliminary Production Tool

System of interest –

Inputs –

Processes –

Outputs –

a) Stakeholder Requirements Definition Process;
b) Requirements Analysis Process;
c) Architectural Design Process;
d) Implementation Process;
e) Integration Process;
f) Verification Process;
g) Transition Process;
h) Validation Process;
i) Operation Process;
j) Maintenance Process;
k) Disposal Process

11 Phase 5 Preliminary Data Validation and Distribution

11.1 Phase 5A Preliminary Data Validation

System of interest –

Inputs –

Processes –

Outputs –

a) Stakeholder Requirements Definition Process;
b) Requirements Analysis Process;
c) Architectural Design Process;
d) Implementation Process;
e) Integration Process;
f) Verification Process;
g) Transition Process;
h) Validation Process;
i) Operation Process;
j) Maintenance Process;
k) Disposal Process

11.2 Phase 5B preliminary Data Packaging and Distribution Models

System of interest –

Inputs –

Processes –

Outputs –

a) Stakeholder Requirements Definition Process;
b) Requirements Analysis Process;
c) Architectural Design Process;
d) Implementation Process;
e) Integration Process;
f) Verification Process;
g) Transition Process;
h) Validation Process;
i) Operation Process;
j) Maintenance Process;
k) Disposal Process

12 Phase 6 Shore based ECDIS

Supports exchange sets (unencrypted)

Supports multiple products possibly used together

Supports loading strategy

System of interest –

Inputs –

Processes –

Outputs –

a) Stakeholder Requirements Definition Process;
b) Requirements Analysis Process;
c) Architectural Design Process;
d) Implementation Process;
e) Integration Process;
f) Verification Process;
g) Transition Process;
h) Validation Process;
i) Operation Process;
j) Maintenance Process;
k) Disposal Process

13 Phase 7 Full Production Tool

System of interest –

Inputs –

Processes –

Outputs –

a) Stakeholder Requirements Definition Process;
b) Requirements Analysis Process;
c) Architectural Design Process;
d) Implementation Process;
e) Integration Process;
f) Verification Process;
g) Transition Process;
h) Validation Process;
i) Operation Process;
j) Maintenance Process;
k) Disposal Process

14 Phase 8 Data Validation and Distribution

System of interest –

Inputs –

Processes –

Outputs –

a) Stakeholder Requirements Definition Process;
b) Requirements Analysis Process;
c) Architectural Design Process;
d) Implementation Process;
e) Integration Process;
f) Verification Process;
g) Transition Process;
h) Validation Process;
i) Operation Process;
j) Maintenance Process;
k) Disposal Process

15 Phase 9 Full ECDIS

Connections to all relevant systems Radar AIS etc

Incorporation of GNSS etc

Testing of encrypted exchange sets and other products used together.

System of interest –

Inputs –

Processes –

Outputs –

a) Stakeholder Requirements Definition Process;
b) Requirements Analysis Process;
c) Architectural Design Process;
d) Implementation Process;
e) Integration Process;
f) Verification Process;
g) Transition Process;
h) Validation Process;
i) Operation Process;
j) Maintenance Process;
k) Disposal Process.