Base Load Power Hub (BLPH)

INFORMATION QUALITY MANAGEMENT FRAMEWORK (IQMF)

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1 INTRODUCTION

1.1 PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.1.1 Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

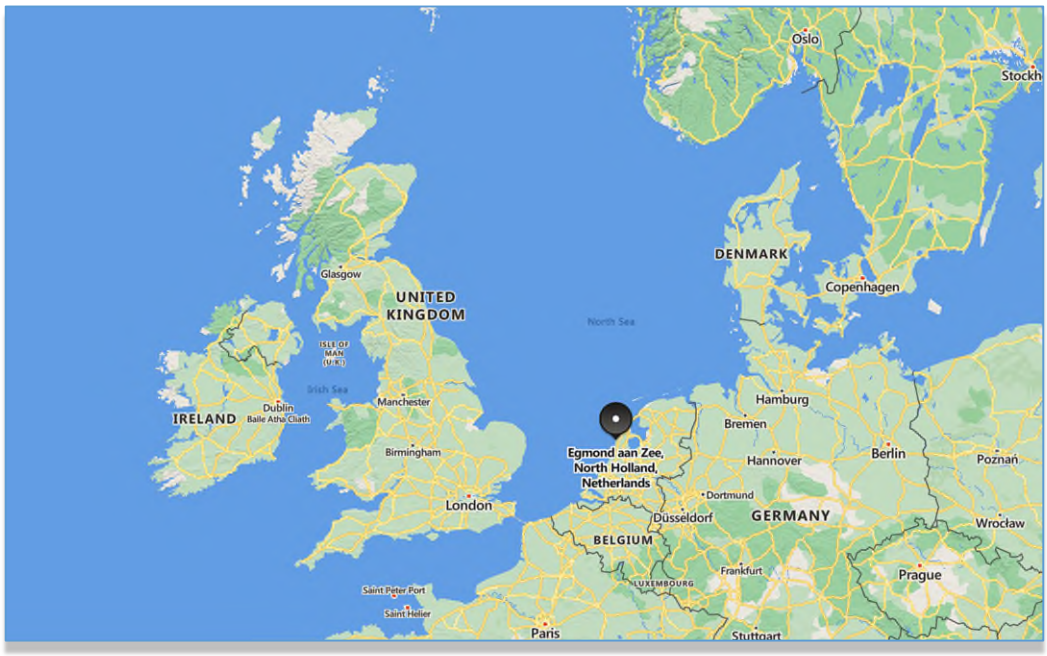


Figure 1 - HOLLANDSE KUST NOORD WIND PARK Location Map

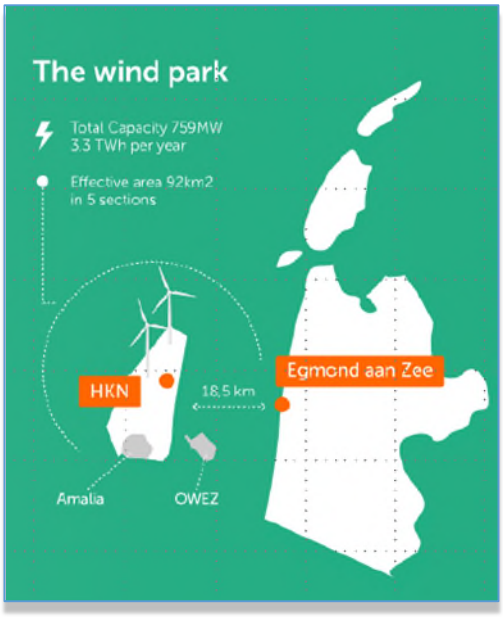


Figure 2 - Wind Park Details

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile is located on coordinates E 590719.1, N 5841602.3 and is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.1.2 Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

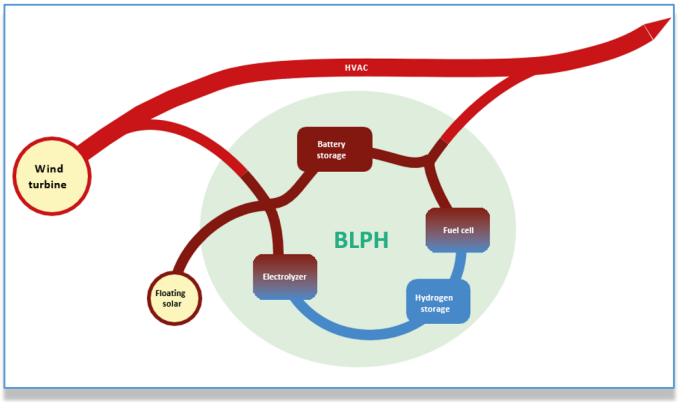


Figure 3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH is to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

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2 DOCUMENT SCOPE

The overall objective of the COMPANY regarding the Information Management is to ensure that the CONTRACTOR provides COMPANY with the minimum level of information required to effectively manage its assets and business. Good quality information adds value throughout the full lifecycle of the Asset from Project Execution through Operations to Decommissioning.

COMPANY intend to maximise the use of project information by using it in digital systems which will manage and validate all information, enabling improvements in engineering and construction information consistency, enabling quick search capability between all related data and documentation sources, and integrating with other digital systems including 3D models, photogrammetry, Asset, Facility, Operational and Production management systems.

Scope of this document is to describe how the tools selected by the CONTRACTOR allow it to manage and to hand over the information to the COMPANY, complying with its requirements.

2.1 REFERENCES

Doc. No.	Description
CONTRACT - SECTION V	Scope Description
123A90-PML-DIG-PL-00001	Digital Delivery Execution Plan
123A90-PML-PM-PL-00002	Information Technology Plan and Procedures

Table 1 - Reference Documents

2.2 DEFINITIONS

Term	Description
Attribute	Property or characteristic of an Asset object
Commissioning	The functional verification of equipment and facilities that are grouped together in systems
Company	The party that initiates the project. The term "COMPANY" mat also include agents or consultants authorized to act for, and on behalf of, COMPANY.
Construction	The project activity at which equipment and structures are installed/erected.
Contract	An acceptance of legal relations between two or more parties for the transfer of goods or services for value.
Data	The term data refers to a collection of structured information that can be supplied to, stored in or processed by an IT application. Data is always associated to the time at which is created.
Engineering Database	Managed collection of process plant data that represents information about objects for a particular Asset.

Information	Information in the form of documents and data including drawings, indexes, databases, 2D and 3D models etc.
Operation	The organization responsible for operating the plant after start up.
Project	Unique process, consisting of a set of coordinated and controlled activities with start and finish dates, undertaken to achieve an objective conforming to specific requirements, including the constraints of time, cost and resources.
Project Tools	Refer to all the applications used during the project execution, including Engineering systems (e.g. 2D and 3D cad), procurement systems, construction systems, etc.
Tag	Label composed of letters and numbers allowing to uniquely identify an Asset's object.

Table 2 - Definitions and Abbreviations

2.3 ACRONYMS

Acronym	Description
MTO	Material Take-Off
DC	Document Control
E3D	Aveva Everything 3D Software
1D/2D/3D	1/2/3 Dimensions
P&ID	Process and Instrumentation Diagram
ISO	Isometric Drawing
PSL	Project Specialist Leader
MDR	Master Document Register
E	Engineering Phase
P	Procurement Phase
C	Construction Phase
EDMS	Electronic Document Management System

Table 3 - Acronyms

3 ENGINEERING TOOLS DESCRIPTION

For BLPH Project, CONTRACTOR will use AVEVA ENGINEERING to manage data belonging to engineering lists (equipment list, line list, etc.) and to ensure consistency of the information delivered between these lists (1D and E&I), the 2D schematics and 3D Model. The data from Vendors and Suppliers will be imported in the 1D database.

Lists will be then exported to excel for the delivery to CPY through DMS.

CONTRACTOR will produce the P&IDs diagrams with AVEVA DIAGRAMS, an application that allows the creation of intelligent Process Engineering Flow Diagrams and that provides valuable information throughout the plant life cycle, ensuring design quality, data consistency, and standards compliance through a data-centric approach.

CONTRACTOR will develop a 3D CAD Model for its entire scope using AVEVA E3D, including Vendors and Suppliers data, as per mentioned contractual specifications.

For integrating and visualizing engineering, procurement and construction information, through the import of the 3D model from AVEVA E3D and for adding to the model in a dynamic and interactive manner, CONTRACTOR will use the advanced 4D feature of CADMATIC eShare solution. The adopted tool will seamlessly integrate time-based scheduling information (from Oracle Primavera P6) into the design and construction process, allowing stakeholders to visualize and understand project progression, making it easier to coordinate tasks, identifying potential conflicts, and optimizing project timelines.

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4 DATA CONCEPTUAL MODEL

The entire information inside AVEVA ENGINEERING 1D database, containing the functional and physical properties of all Asset Objects which have a tag on P&ID and/or on 3D Model, including Vendors and Suppliers data, is managed through a relational model organized into several hierarchical levels: a physical object is declined for each discipline and to each discipline belong several physical classes.

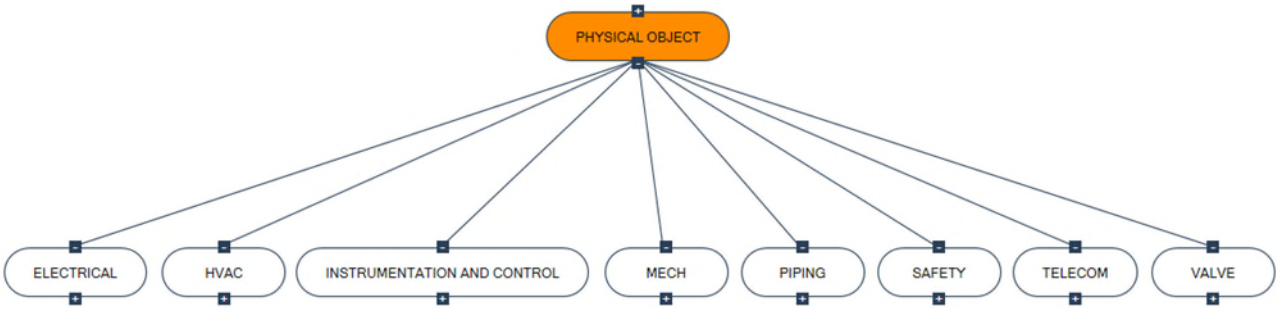


Figure 4 – First level from object to disciplines



Figure 5 – Second level from discipline to physical class

Each physical class (e.g. Pump, Heater, Compressor for Mechanical discipline) is represented by a list of attributes, grouped by families, which could be referenced to other linked classes or "native" into it.

Each attribute, for each tag/item into the list, can be populated by a PSL, depending on the discipline of interest.

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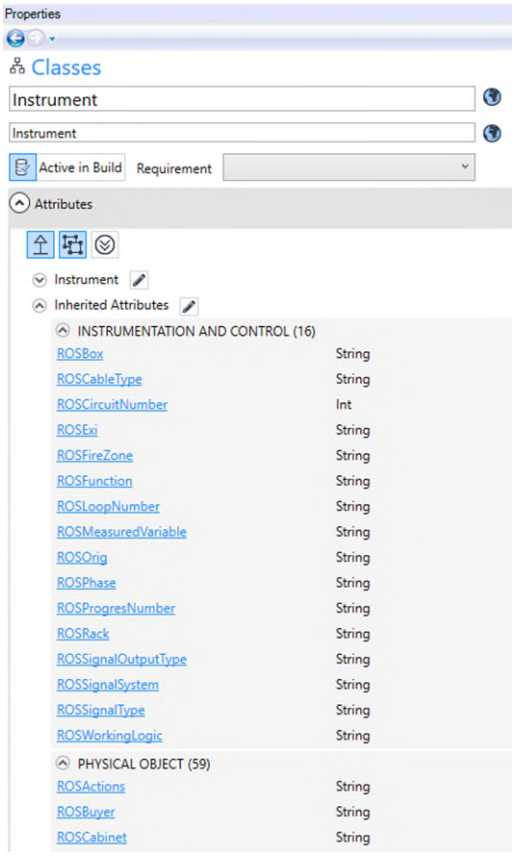


Figure 6 – Sub-list of attributes for a physical class

A typical example of reference between two different classes could be the existing one between an Instrument and a Signal or between a Pipe and a Valve.

Through class association it is possible to link two classes, i.e. Pipe and Fluid or Pipe and Valve and publish in a specific list attributes belonging to the associated class. For example if the Fluid A is associated to Pipe B, process data of Fluid A can flow to Pipe B and be published in the pipe list.

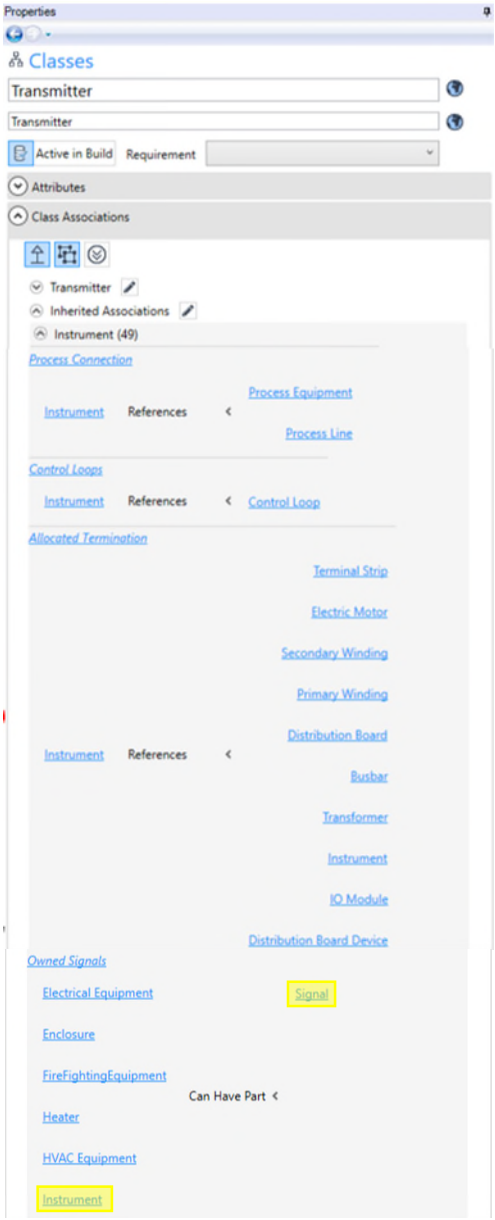


Figure 7 – Example of references between two different classes

The Data Manager is accountable for the set-up of the Data Model (i.e. classes, attributes, relationships) in accordance with project requirements.

5 DATA FLOW

CONTRACTOR is constantly committed, during the whole project duration, to manage all the project data with the following three main targets:

- to more efficiently support the engineering, procurement, construction, completions and commissioning processes, enabling the improvement of its productivity
- to be able to provide COMPANY a clear view of the project's performance, throughout the life of the Project, with a periodical data handover (Master Tag and Equipment Register, 3D Model, Asset register)
- to easily produce the final documentation at the end of the project.

To achieve the above targets, CONTRACTOR has implemented a data-centric solution primarily based on AVEVA products.

In detail, Process Design data, Tagging Specification and Material Catalog are the predecessors of the preparation of P&ID. Then the P&ID, together with Engineering Data and Vendor data represents the input for the Engineering Lists. Similarly, these lists are the input for the Master Tag & Equipment Register and, together with P&ID and Material Catalog, make possible the preparation of the 3D Model.

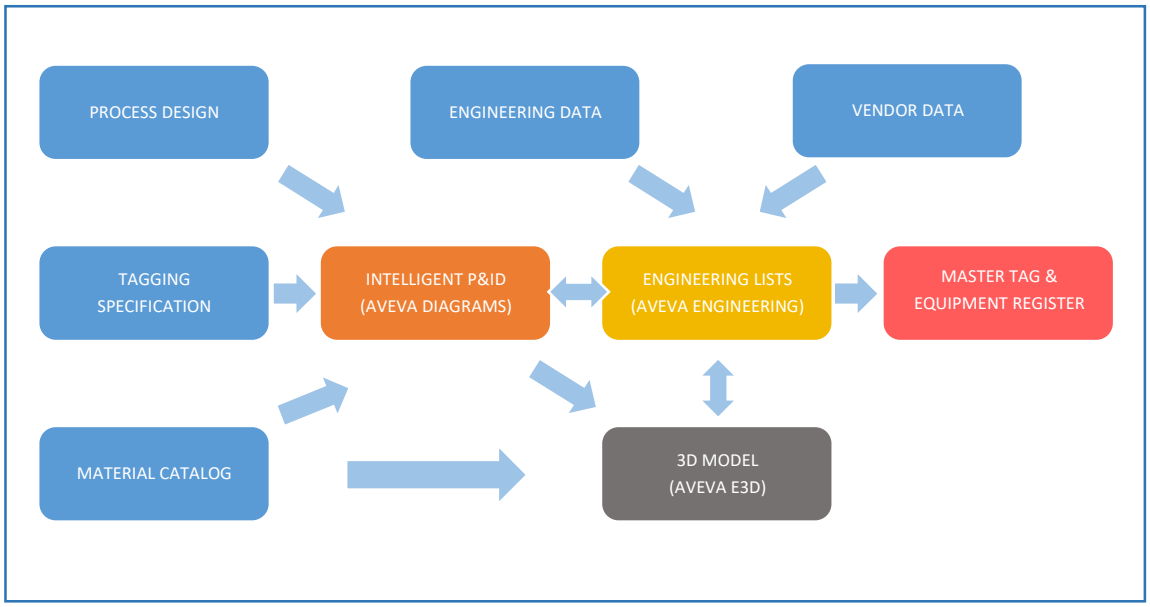


Figure 8 – Engineering Data Flow

Along the whole Project life, the information contained into the three Aveva Databases is an input for both Procurement and Construction Management, as shown in the figure below.

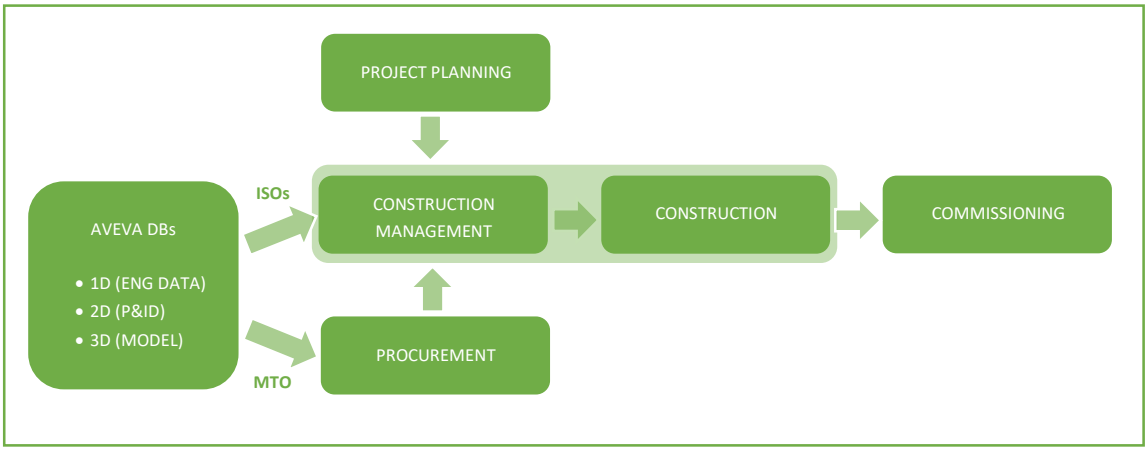


Figure 9 – Integrated Data Flow

6 DATA QUALITY

Across the whole data flow, project data are handed over to the COMPANY (i.e. Master Tag and Equipment Register, 3D Model, Asset register), periodically updated, as well as a reporting dashboard (continuously fed by the Databases), for monitoring Data Quality and Data Consistency.

For BLPH Project, to let the COMPANY be aware of Data Quality index, CONTRACTOR shall implement the following dashboard:

1. Data Quality report, which represents the consistency of the object tags with the project tagging rules and the filling ratio of the object attributes
2. Data Consistency report, which shows the congruence between the three Aveva Databases.

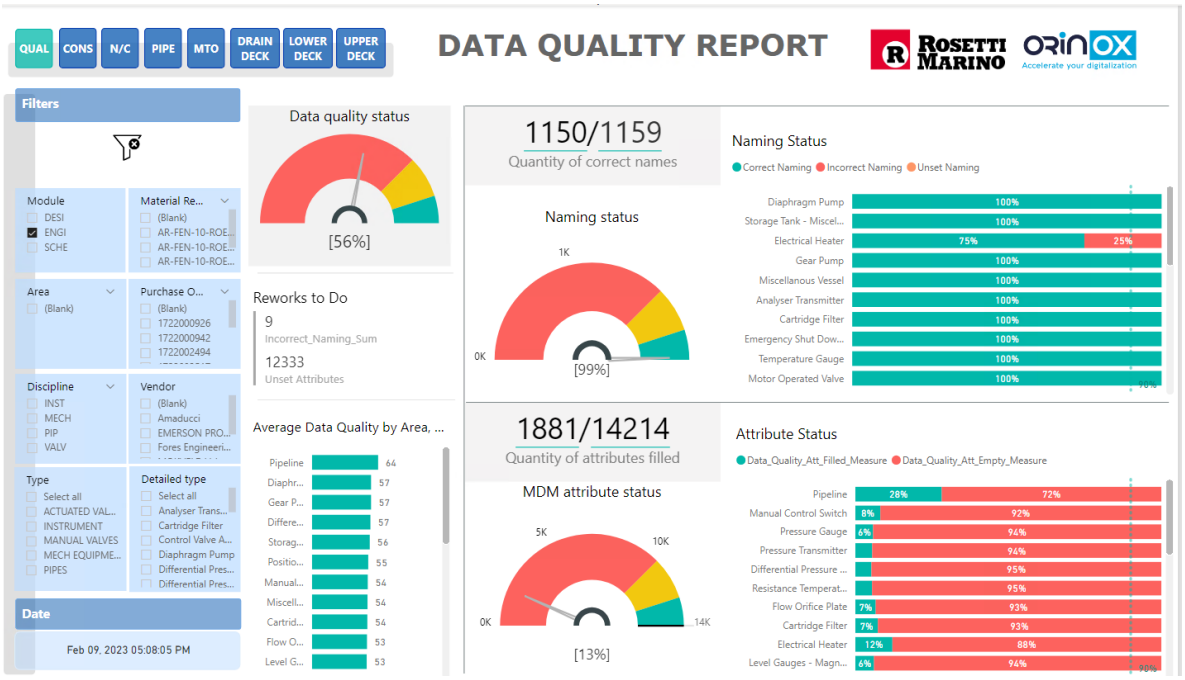


Figure 10 – Data Quality Report

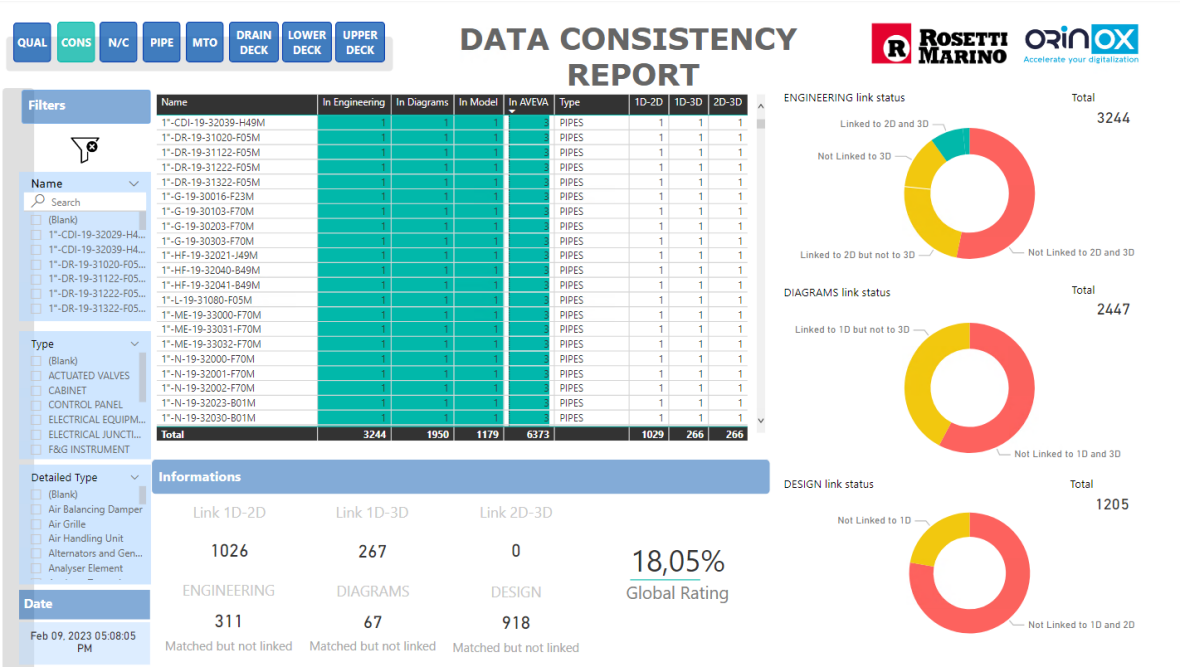


Figure 11 – Data Consistency Report

7 ROLES AND RESPONSIBILITIES

Along the whole project life, project data management is performed by several data owners, which guarantee the information quality and the data integrity through the planned workflow.

The Platform Administrator, the Engineering Administrator, the PSLs and the Vendors are all actors involved into the information management workflow. They are responsible to set up the selected tools, to provide/input/check data into the databases and to verify data consistency between each equipment/tag and between the 1D lists, the 2D diagrams and the 3D model.

7.1 DATA MANAGER ROLE

The appointed Data Manager will be the CONTRACTOR's focal point directly reporting to the CONTRACTOR Project Engineering Manager to act as the single point of contact for Client for any Information Management related topics.

The Data Manager is accountable for setting up the data model and the export of all engineering data requested by COMPANY, as well the link between data across all data bases (1D/2D/3D).

The Data Manager shall decide with the Database Administrators (Engineering and 2D/3D) on the frequency for Engineering Common Data exchanges between all databases to enable ENGINEER's daily operations requiring updated data. The Engineering Common Data will be exchanged at least prior to the regular hand over to COMPANY.

The Data Manager shall ensure both the daily operation on the 1D Database and the regular delivery of the 1D Database to COMPANY, along with the consistency reports handling and coordination.

7.2 PLATFORM ADMINISTRATOR ROLE

The Platform Administrator is accountable for the proper set-up and maintenance of the 2D/3D databases, of data exchange between Aveva Diagrams and Aveva Engineering, of Aveva Administration tool, of Isometric templates and Draw module, of the reports.

7.3 ENGINEERING ADMINISTRATOR ROLE

The Engineering DB Administrator is accountable for preparation and configuration of all project lists, for set up of import interface for accommodating data from Vendors, for set up of the export to excel of all engineering data.

7.4 PROJECT SPECIALIST LEADER ROLE

The PSL, supporting the Project Engineering Manager (PEM), is accountable for the input of all the discipline data, as for the design engineering output, and to periodically review them based on the input given by the vendors and by the construction teams (e.g. as-built).

The PSLs are also the owners of the lists, periodically exported from Aveva Engineering database, as per the accountability of their discipline.

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7.5 DOCUMENT CONTROLLER ROLE

The Document Controller is accountable for the DC activities organization, for the management of documentation flows (inside CONTRACTOR's organization and between CONTRACTOR and COMPANY), for the supervision of EDMS reliability and availability.

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