Base Load Power Hub (BLPH)

DIGITAL DELIVERY EXECUTION PLAN

Document Number: 123A90-PML-DIG-PL-00001

Document Class: 2

02	11/12/2023	Accepted for Construction (AFC)	M.W. Perfetto	G. Casolo	D. Lo Sterzo
01	29/09/2023	Revised as per ROSMA-INN-BHP-PLN-0008	M.W. Perfetto	G. Casolo	D. Lo Sterzo
00	24/08/2023	Issue for Review (IFR)	V. Fasoli	G. Casolo	M. Dossena
Rev.	Date	Description	Prepared	Reviewed	Approved

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy.

Revision / Change Log

Rev.	Description
00	Issue for Review (IFR)
01	Revised as per ROSMA-INN-BHP-PLN-0008
02	Accepted for Construction (AFC)

HOLDS LIST

No.	Description
1	
2	
3	
4	

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy.

Table of contents

1. INTRODUCTION 5
1.1 PROJECT OVERVIEW 5
1.1.1 Project Location 5
1.1.2 Project Concept 6
2. DOCUMENT SCOPE 7
2.1 REFERENCES 7
2.2 DEFINITIONS 7
2.3 acronyms 8
3. PROJECT TOOLS 9
3.1 Digital approach 9
3.2 Data Centric Design Tools 9
4. ENGINEERING PHASE – DESCRIPTION OF ADOPTED TOOLS 11
4.1 1D REQUIREMENTS 11
4.1.1 Engineering Lists 11
4.1.2 Instrumentation 11
4.1.3 Electrical 12
4.1.4 Process 12
4.2 2D REQUIREMENTS - Intelligent P&ID 12
4.2.1 Symbology and Templates 12
4.3 3D Requirements 12
4.3.1 Database Set-Up 13
4.3.2 3D plant design software 13
4.3.3 3D plant review software 13
4.4 PIPING CLASS MANAGEMENT 13
4.5 Other Tools and Softwares 14
5. PROCUREMENT PHASE – DESCRIPTION OF ADOPTED TOOLS 14
5.1 Procurement applications 14
6. CONSTRUCTION PHASE – DESCRIPTION OF ADOPTED TOOLS 14

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy.

6.1 Construction Management System 14
6.1.1 Fabrication Management System 15
6.2 SMART Construction MANAGEMENT 15
7. PROJECT MANAGEMENT AND CONTROL APPLICATIONS 16
7.1 Project Electronic Document Management System 16
7.2 Project Control System 16
7.3 Completion and Commissioning Management System 17

List of Figures

Figure 1 - HOLLANDSE KUST NOORD WIND PARK Location Map 5
Figure 2 - Wind Park Details 6
Figure 3 – BLPH Concept 6
Figure 4 – BLPH Digital Plant Design Platform 10

List of tables

Table 1 - Reference Documents 7
Table 2 - Definitions 8
Table 3 - Acronyms 9
Table 4 – Data Centric Design Tools 10

List of Attachments

NONE

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy.

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.

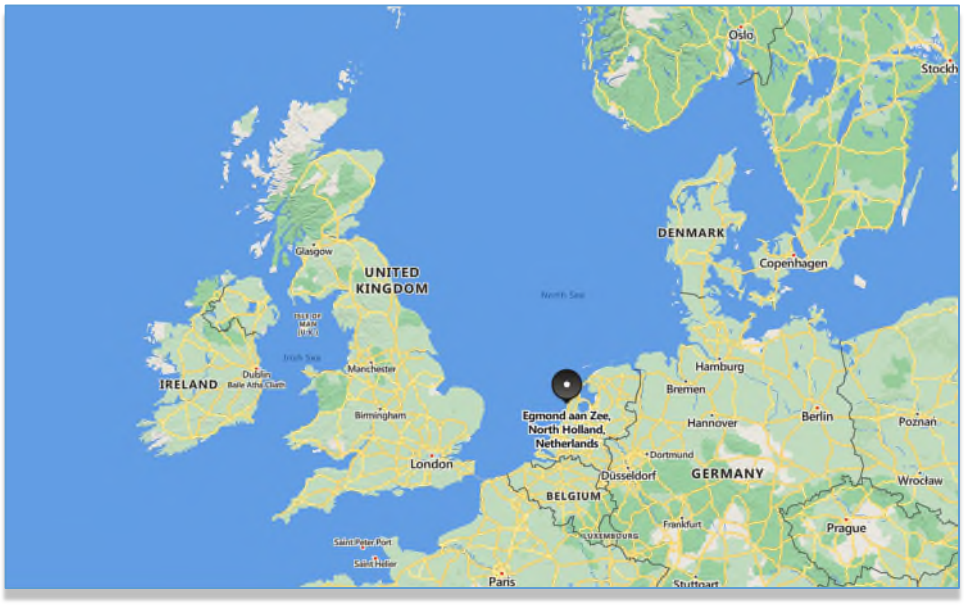


Figure 1 - HOLLANDSE KUST NOORD WIND PARK Location Map

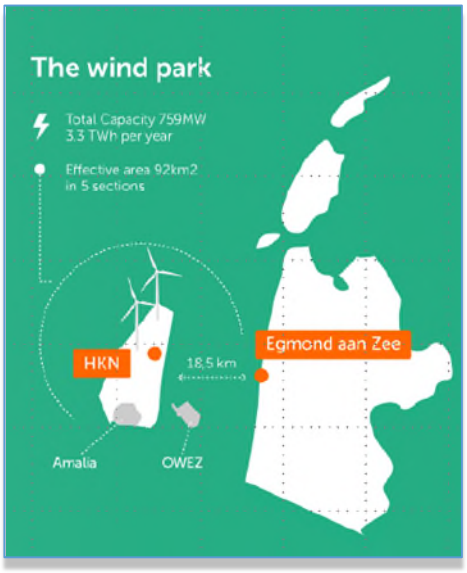


Figure 2 - Wind Park Details

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 located on coordinates E 590719.1, N 5841602.3 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.

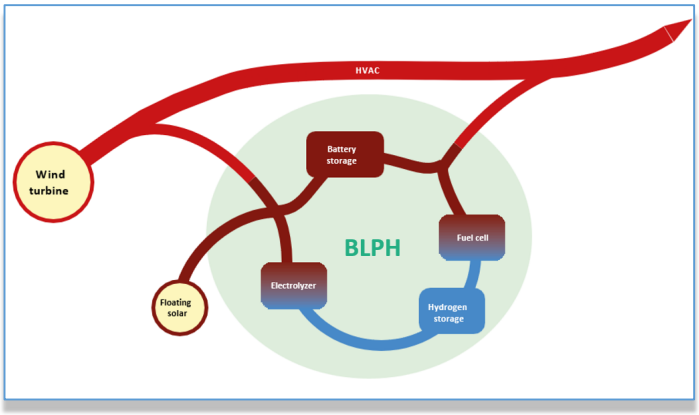


Figure 3 – BLPH Concept

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 s 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.

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 which tools are selected to fulfil COMPANY requirements and manage project information of the BLPH Project.

2.1 REFERENCES

Doc. No.	Description
123A90-PML-PM-PRO-00003	Document Control Procedure
123A90-PML-DIG-PRO-00004	3D Model Management Procedure
123A90-PML-PM-PL-00004	Project Control Procedure

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" may 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 exclusively 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

2.3 ACRONYMS

Acronym	Description
NA	Not Applicable
LCI	Life Cycle Information
MTO	Material Take-Off
PCV	Pressure Control Valve
E3D	Aveva Everything 3D Software
PAU	Plant Area Unit
PID	Process and Instrumentation Diagram

PBS	Plant Breakdown Structure
MDR	Master Document Register
E	Engineering Phase
P	Procurement Phase
C	Construction Phase
DMS	Document Management System

Table 3 - Acronyms

3. PROJECT TOOLS

3.1 DIGITAL APPROACH

CONTRACTOR is committed to continuously improve performances and reliability of its engineering activities, increasing the quality of the deliverables and the efficiency of the internal processes, and supporting the time reduction of the deliveries to the construction phase.

In this respect, CONTRACTOR launched in early 2021 the Digital Systems Integration Project, with the objective to develop and deploy a stable, inclusive and "user friendly" integrated digital platform that constitutes the collaborative environment, which meets the asks of the market (cost, time and quality), fulfilling the "digital" requirements of the CPY and maximizes productivity.

The target is the build of the Digital Twin of the BLPH platform, i.e. the digital representation of the physical asset, which includes the technical information created or modified by the Authoring tools (3D Models, Intelligent 2D schematics (e.g.: P&IDs), Tags & Attributes Repository, etc.).

3.2 DATA CENTRIC DESIGN TOOLS

DOMAIN	DISCIPLINE	TOOL
E	Intelligent 1D System	AVEVA ENGINEERING 15.7
E	Intelligent 2D System	AVEVA DIAGRAMS 14.1
E	Intelligent 3D System	AVEVA E3D 3.1
E	Intelligent Instrumentation Engineering	AVEVA ENGINEERING 15.7
E	Intelligent Electrical Engineering	AVEVA ENGINEERING 15.7
E	Structural 3D System	TRIMBLE TEKLA
EP	Cat&Spec Management	CADMATIC CLA PUMA
EC	4D Progress Management	CADMATIC e-SHARE
PC	Construction Management	ITEMTRACE

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy.

		CADMATIC CLA COSMO AUTODESK AUTOSPOOL
EPC	3D Model visualization	AUTODESK NAVISWORK
EPC	Project Planning	PRIMAVERA P6
EPC	Document Management System	IDOX FUSIONLIVE

The Project design shall be executed with intelligent systems covering the following disciplines:

Table 4 – Data Centric Design Tools

The use of the data centric design tools is to be maximized across all engineering disciplines wherever deemed appropriate for the development of data, documents and drawings for the project. In all cases the databases will be developed to include all "as-built" modifications and changes prior to final handover to COMPANY.

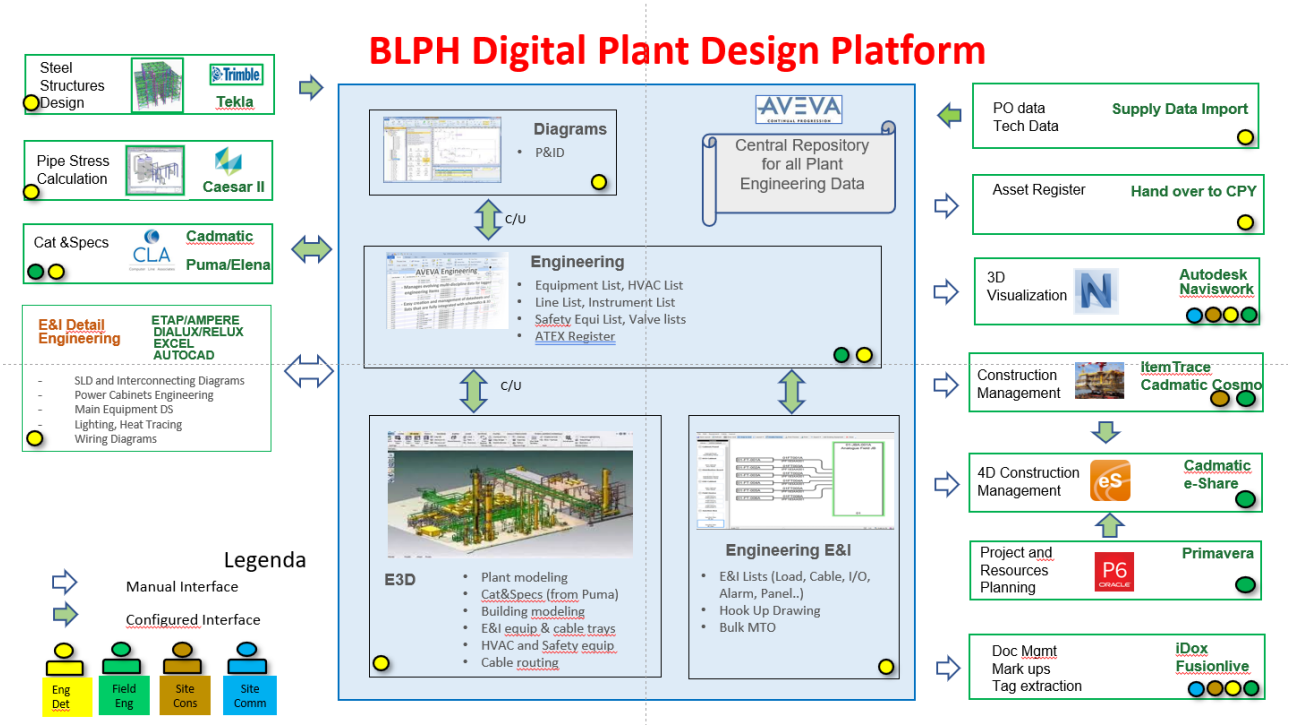


Figure 4 – BLPH Digital Plant Design Platform

4. ENGINEERING PHASE – DESCRIPTION OF ADOPTED TOOLS

4.1 1D REQUIREMENTS

CONTRACTOR will develop in AVEVA ENGINEERING a 1D database containing the functional and physical properties of all Asset Objects which have a tag on P&ID and/or on 3D Model, within the battery limit of BLPH project, including Vendors and Suppliers data.

CONTRACTOR will adopt the best engineering practices for the population of the relevant attributes related to each item category. The attributes shall be populated in order to ensure that the COMPANY information submission requirements will be completely fulfilled as possible.

It will be CONTRACTOR responsibility to not have any duplicated item tags for any object like Equipment, Instruments and Instrument loops, Piping Component, etc.

4.1.1 Engineering Lists

CONTRACTOR will use AVEVA ENGINEERING to manage data belonging to engineering lists (equipment list, line list, etc.) 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.

Therefore, CONTRACTOR will implement inside Aveva Engineering the following DBViews and Grids:

- Mechanical Equipment List
- Line List
- Manual Valve List
- Safety Equipment List
- HVAC Equipment List

Detailed list of deliverables will be provided by CONTRACTOR and included in the MDR.

4.1.2 Instrumentation

CONTRACTOR shall create and maintain Instrument Tag Database containing fields required for the production of Instrument Index and I/O Schedule deliverables. This shall include all Instruments supplied as part of mechanical equipment packages.

Instrument Index shall reference all drawings including but not limited to Hook-up's, Terminations, Layouts and Loop drawings. In addition, Index shall reference Data Sheet number, Purchase Order number, Manufacturer and Model Number.

CONTRACTOR will use AVEVA ENGINEERING for the development of agreed instrumentation drawings and schematics, like

- Instrument Index
- Actuated Valve List
- Telecom Equipment List
- I/O List

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy.

- Alarm List
- I&C and Telecom Cable List
- Control Panel List
- JB List

Other detail engineering drawings, like Loop Diagram, Hook ups Diagrams, Wiring and Termination Diagrams, etc, will be produced with Excel/Autocad. Detailed deliverable's list will be provided by CONTRACTOR.

4.1.3 Electrical

CONTRACTOR will include the following lists into AVEVA ENGINEERING with all the information required and to be handed over to CPY:

- Electrical Load List
- Electrical Equipment List
- Power Cable List
- Electrical Signal List

Special studies, like harmonic(s) studies, load flow, transients, will be performed using NEPLAN software.

Other detail engineering drawings, like Single Line Diagram, Wiring and Termination Diagrams, etc, will be produced with Excel/Autocad. Detailed deliverable's list will be provided by CONTRACTOR.

4.1.4 Process

CONTRACTOR will adopt HYSIS Process plant design software, which will allow the production of:

- Process plant design simulation
- Process Flow Diagram (PFD)

4.2 2D REQUIREMENTS - INTELLIGENT P&ID

CONTRACTOR will produce the P&IDs diagrams with AVEVA DIAGRAMS.

Aveva Diagrams is an application that allows the creation of intelligent P&ID. As a data-centric and rule-based solution tool provides valuable information throughout the plant life cycle ensuring design quality, data consistency, and standards compliance.

4.2.1 Symbology and Templates

If not otherwise defined for the project, the graphic symbols to be used for the P&ID elaboration will be conforming the FEED P&IDs and to ANSI/ISA standard symbology.

4.3 3D REQUIREMENTS

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

4.3.1 Database Set-Up

AVEVA E3D consists of a set of hierarchical databases that store the 3D model data. The database system is called Dabacon and is exclusive to AVEVA. The databases are structured specifically for design data storage and each type of database stores different data.

All E3D databases are assigned a database number that cannot be changed after creation.

E3D will not allow databases with the same number to exist in the same E3D Project and this applies to database references in external Projects.

CONTRACTOR will export the 3D model in .nwd format on daily basis for internal use and on regular basis for sharing with COMPANY.

4.3.2 3D plant design software

The adoption of E3D plant design software enables:

- Detailed 3D plant modeling with the electronic representation of all disciplines plant components, such as equipment, foundations, structures, piping lines, instrumentation, raceways, etc…
- Isometrics extraction
- Material take-off and Bill of Quantities (B.O.Q.) generation
- Interference detection and electronic walk-through performing, oriented to reduce interference, prior to Construction activities, and avoid rework cost.

The main 3D plant design software deliverables are:

- Isometrics
- Plant lay out drawings
- Bill of Quantities (B.O.Q.)
- Power and Instrumentation cables routing information.

4.3.3 3D plant review software

The adoption of Navisworks review software enables:

- 3D plant navigation. All Engineering data, such as Equipment numbers and line sizes, are available walking through the model.
- 3D plant electronic walk-through performing, oriented to reduce interference, prior to Construction activities, and avoid rework cost.

4.4 PIPING CLASS MANAGEMENT

CONTRACTOR shall use CADMATIC CLA PUMA/ELENA to manage Piping Classes and the related design\management activities of piping components during the Project activities, from the piping classes creation up to materials accounting and related MTO's, procurement and construction.

The software is integrated with CONTRACTOR material coding and allows the generation of the piping Reference Database (RDB) to be imported into the 3D CAD Model.

4.5 OTHER TOOLS AND SOFTWARES

The tools listed below will also be adopted by CONTRACTOR:

- SACS and ANSYS to perform the structural analysis and design.
- Trimble Tekla to generate the structural 3D model, then imported into the 3D model through the Tekla Interoperability tool.
- Hexagon Caesar II to perform the pipe stress calculation.
- Autocad: to generate general 2D drawings.

5. PROCUREMENT PHASE – DESCRIPTION OF ADOPTED TOOLS

5.1 PROCUREMENT APPLICATIONS

During the entire Project lifecycle, Contractor adopts for the main Procurement activities, from planning to site delivery, SAP modules (e.g., SAP MM, etc.).

All SAP modules, involved in Material management, are integrated with other Engineering and Construction information systems, adopted to support this process.

For example, Material management workflow during Requisitioning and Awarding consists in:

- MTO for structural material is generated out of Tekla Structures.
- MTO for piping components and valves is generated out of Cadmatic CLA Puma application, which is encompassing both the modeled and estimated quantities.
- MTO for tagged items is generated out of Aveva Engineering, where all tagged items are managed.
- MTO for E&I cables and cable trays is elaborated in Aveva E3D where cables and cable trays are modeled and described in accordance with vendor cables and cable trays catalogues.
- MTOs for other materials are produced by the concerned discipline.

6. CONSTRUCTION PHASE – DESCRIPTION OF ADOPTED TOOLS

6.1 CONSTRUCTION MANAGEMENT SYSTEM

Due to the relevant and critical role Construction plays during the entire Project life cycle, CONTRACTOR adopts a custom suite, called Item Trace, to support Construction activities at site together with the tool Welding Register (IWM 2.0), an application dedicated to full tracking of welding production and certification.

This suite for Construction activities is linked to Aveva Engineering for engineering data import and to Procurement suite for procurement data import, enabling:

- Activities planning and progress monitoring
- Accounting

- Quality & system completion.

In addition, CONTRACTOR adopts a set of commercial tools to enable:

- 4D Construction simulation with **Cadmatic e-Share** tool.
- Piping Spools generation with **Autodesk Autospool** tool.
- Constructability analysis with **Cadmatic CLA COSMO** tool.

6.1.1 Fabrication Management System

Project activities executed in the Fabrication Yards are managed by CONTRACTOR through a permanent organization with a multi-project view, which is responsible to fulfil projects requirements in term of time, costs and quality.

The CONTRACTOR's Corporate work model and software tools to manage Production and Quality Control in Fabrication Yards are **Item Trace** (custom tool) and Welding Register. **Item Trace** is a web-based application with central installation and multi-site architecture, running on SQL Server DB, supported by Corporate ICT, integrated with Project and Corporate systems through manual or automatic batch procedures or through defined interchange files. It includes several functionalities, as:

- **Data upload from other systems:** MTO, Weld Lists, Schedule, Purchase Orders, Post-Order Info, etc.
- **Project Material Management**: feasibility, warehouse receiving, inspection, nesting, reservation, withdrawal, utilization monitoring and traceability.
- Preparation and estimation of **work packs** to feed production.
- Collection and validation of **production feedbacks**: executed tasks, used materials, spent hours.
- **Quality Control**: material inspection, weld, non-destructive controls, paint.
- **Feedback to Projects**: progress, material utilization.
- **Production Analysis and Reporting**: material utilization/need/reconciliation, workload, productivity, weld process utilization, etc.
- Storage of historical data, consistent among Yards/Projects.

6.2 SMART CONSTRUCTION MANAGEMENT

CADMATIC eShare is the adopted solution for integrating and visualizing engineering, procurement and construction information, through the import of the 3D model from AVEVA E3D.

With its advanced 4D feature, **CADMATIC eShare** seamlessly integrates time-based scheduling information (from Oracle Primavera P6) into the design and construction process.

This allows stakeholders to visualize and understand project progression in a dynamic and interactive manner, making it easier to coordinate tasks, identify potential conflicts, and optimize project timelines.

As per Project Control Plan (ref. 123A90-PML-PM-PL-00004) CONTRACTOR provides a Level 4 Baseline Schedule based on work elements (activities). Level 5 and Level 6 (drawings and marks) are monitored through Work Packs in excel.

Once achieved approx. the 65% of Construction progress and approx. the 40% of the cable pulling CONTRACTOR will organize the Baseline Schedule based on Commissioning systems and sub-systems.

7. PROJECT MANAGEMENT AND CONTROL APPLICATIONS

7.1 PROJECT ELECTRONIC DOCUMENT MANAGEMENT SYSTEM

A described into the Project "Document Control Procedure" (ref. 123A90-PML-PM-PRO-00003), CONTRACTOR shall use **FusionLive** as internal Electronic Document Management System (EDMS).

It allows to manage CONTRACTOR's deliverables (Engineering, Project Management and Fabrication documents) such as documents provided by COMPANY and Vendor documents.

FusionLive repositories can be accessed from remote construction sites, as well as Partners and Clients premises, through web browsers.

CONTRACTOR shall upload the documents in the COMPANY's EDMS, which is **Aconex.**

7.2 PROJECT CONTROL SYSTEM

The activities related to Project Planning & Progress Control, Budget/Forecast/Cost Controlling and Project Risk Management are performed through the following list of main applications, grouped into different roles sections:

- Project Planning & Progress Control:
  - Oracle Primavera Enterprise Project Management
  - MS Project
  - Item Trace (construction progress)
  - Athena (Procurement Progress Log)
- Budget/Forecast/Cost Controlling:
  - SAP PS (Project System Module)
  - SAP MM (Cost Progress)
  - Business Object (Project Cost Reports)
  - Timesheet
  - Project Risk Management
  - Oracle Primavera Risk Analysis (Schedule Risk Analysis)

All the applications above mentioned have the target to establish and maintain a deep Project Planning & Control Information System during the complete Project lifecycle.

7.3 COMPLETION AND COMMISSIONING MANAGEMENT SYSTEM

The Commissioning & Completion Management System adopted by CONTRACTOR shall be **WinPCS**, which provides an integrated platform for managing the commissioning process, from pre-commissioning to final handover.

WinPCS, initially uploaded starting from engineering lists (e.g. Cable List, Electrical Item List, Instrument List, JB List, Loop Diagrams, Electrical Circuits, Test Procedure List, etc.), provides a central repository for all commissioning-related data, including test results, signed check sheets, Punch Lists closure forms, relevant documentation, engineering data, procedures, scanned images, pictures and issues. This data can be accessed in real-time, enabling stakeholders to identify issues and address them promptly.

Tagged items (not only physical items but also logical item like circuits or loops) are grouped in Sub-Systems, which represent a set of items able to provide a specific function. Tasks are then assigned to each Tagged item.

WinPCS can provide pre-configured reports related to Punch Lists, Mechanical Completion, Precommissioning/Commissioning, arranged by Area, Phase, and Discipline, in terms of completion progress and/or outstanding. Typically, a customized Reporting Dashboard is arranged for the project, managed by planning department or by the Completion Manager.

It's also possible to export WinPCS DB in other formats (e.g. excel).

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy.