MARINE ENGINEERING SOFTWARE

Mastering AVEVA Marine 12.1: A Comprehensive Technical Guide to Integrated Hull Design, Pipework Modelling, and System Administration

Published: December 20, 2025 | Index ID: #321

The maritime industry has undergone a radical digital transformation, moving from disparate 2D drafting methods to integrated, high-fidelity 3D lifecycle management systems. At the forefront of this evolution is **AVEVA Marine (12.1 series)**, a sophisticated software suite designed to streamline the complex processes of ship design, hull engineering, and outfitting. This technical guide provides an in-depth exploration of the AVEVA Marine ecosystem, focusing on the core modules of Hull Detailed Design, Pipework Modelling, and Diagrams Administration.

1. The Architecture of AVEVA Marine 12.1

AVEVA Marine is built upon the robust **DABACON**(Data Base Access and CONtrol) database technology, which allows for a multi-user, multi-disciplinary collaborative environment. Unlike traditional CAD software that stores data in individual files, AVEVA Marine stores information in a hierarchical database structure. This ensures that every stakeholder—from structural engineers to piping designers—works on a single, unified source of truth.

The 12.1 release brought significant enhancements in terms of integration between the **Plant** and **Marine** environments. This convergence allows for shared libraries, consistent **PML (Programmable Macro Language)** expressions, and unified diagramming tools. The system is divided into several specialized modules, each governed by specific training manuals (TM series), which serve as the gold standard for technical proficiency.

2. Hull Detailed Design and Planar Modelling (TM-2101 & TM-2102)

The foundation of any vessel is its hull. In AVEVA Marine, **Hull Detailed Design (TM-2102)** focuses on the process of transforming a conceptual hull form into a manufacturable digital twin. A core concept within this module is **Planar Steel Modelling**.

Core Principles of Planar Modelling

Planar modelling involves the definition of steel surfaces—such as bulkheads, decks, and web frames—that are essentially flat or can be developed from flat plates. The workflow generally follows these steps:

- Definition of Ship Coordinate Systems: Establishing the baseline, centerline, and frame numbering systems.
- Surface Creation: Generating the primary structural planes using geometric constraints.
- Stiffener Allocation: Applying profiles to the plates based on the structural requirements. AVEVA Marine allows for the automatic calculation of stiffener intersections and end-cuts.
- Plate Nesting: Preparing the geometry for CNC cutting machines by optimizing the layout of parts on a standard steel sheet.

Comparison: Hull Structural Design vs. Hull Detailed Design

Feature	Hull Structural Design (TM-2101)	Hull Detailed Design (TM-2102)
Primary Focus	Basic design and classification approval.	Production-ready modeling and manufacturing.
Geometry Detail	High-level structural members.	Specific plate parts, brackets, and cutouts.
Output	Classification drawings and weight estimates.	NC data, assembly drawings, and material lists.
Level of Detail (LOD)	LOD 200-300	LOD 400-500

3. Advanced Pipework Modelling (TM-2220)

Outfitting, particularly **Pipework Modelling (TM-2220)**, represents one of the most labor-intensive aspects of marine engineering. The AVEVA Marine outfitting module utilizes a specification-driven approach, ensuring that all components placed in the 3D model adhere to the project's engineering standards.

The Hierarchy of Pipework Objects

To maintain database integrity, AVEVA Marine organizes piping data in a strict hierarchy:

1. World (WORLD): The root of the database.
2. Site (SITE): Usually represents a specific ship or a major section of a shipyard.
3. Zone (ZONE): A functional area, such as the Engine Room or Pump Room.
4. Pipe (PIPE): A logical collection of branches.
5. Branch (BRAN): The actual path of the pipe, defined by a head and a tail.
6. Components: Flanges, elbows, valves, and gaskets.

Technical Execution: The 'Snap to' Mechanism

A critical skill detailed in TM-2220 is the **Move using Snap to**command. This function utilizes the software's ability to identify 'P-points' (Position Points) on components. For example, when aligning a pump discharge to a piping system, the designer uses snapping to ensure that the P-point of the flange perfectly matches the P-point of the valve, maintaining the continuity of the fluid flow logic and preventing physical clashes.

4. Integrated Diagrams and P&ID (TM-3534 & P&ID 12.2.3.0)

One of the most powerful features of the 12.1 series is the integration of **AVEVA Plant and Marine Diagrams**. This allows for a bi-directional link between 2D schematics (P&IDs) and the 3D model.

Diagrams Administration and PML1 Expressions

The **TM-3534 Diagrams Administration**manual outlines how to manage the backend of the schematic tools. Key technical components include:

- Annotation Logic: Using PML1 Expressions to automate the labeling of equipment. For instance, a tag can be programmed to automatically pull the 'Temperature' or 'Pressure' attribute from the database.
- Alarm Label Positioning: In version 12.2.3.0, designers can insert up to six alarm labels at fixed locations relative to an instrument. This ensures that the schematic remains readable even in high-density drawings.
- Consistency Checking: A technical workflow that compares the 2D P&ID against the 3D model to identify

missing components or mismatched specifications.

5. System Administration and Data Integrity (TM-2120)

Managing an AVEVA Marine environment requires specialized knowledge found in **TM-2120 System Administration**. The administrator's role is to ensure the **Multi-Write** capabilities of the database are functioning correctly without data corruption.

Database Types in AVEVA Marine

Database Type	Function	Access Level
DESI (Design)	Stores 3D model geometry and attributes.	Read/Write for Designers.
CATA (Catalogue)	Stores component specifications and dimensions.	Read-only for Designers.
PADD (Drafting)	Stores 2D drawing sheets and annotations.	Read/Write for Drafters.
DICT (Dictionary)	Defines User Defined Attributes (UDAs).	Admin only.

Command Syntax and Conventions

AVEVA Marine utilizes a command-line interface (CLI) that accepts a specific syntax. As noted in the **Conventions Manual**, commands are often shown in a mix of uppercase and lowercase. The uppercase letters represent the minimum required abbreviation. For example, NEW PIPE can often be shortened to NE PI. Understanding these conventions is vital for high-speed power users and for writing custom PML scripts.

6. Practical Implementation: Step-by-Step Pipe Branch Construction

To illustrate the technical depth of the software, let us examine the procedural workflow for creating a spec-driven pipe branch:

Step 1: Setup and Specification Selection

The user selects the appropriate **Piping Specification**(e.g., A1A for Carbon Steel). This specification filters the available components to only those approved for the specific pressure and temperature rating of the system.

Step 2: Defining Head and Tail

Every branch must have a start (Head) and an end (Tail). The Head is typically connected to an equipment nozzle (using **Connect** or **Snap**), while the Tail might end at another pipe or a bulkhead penetration. The software calculates the 'Flow Direction' based on these points.

Step 3: Component Routing

Using the **Model Editor**, the designer drags the pipe along the X, Y, or Z axes. When a turn is required, the software automatically inserts the correct elbow from the specification. If a branch needs to split, a Tee is inserted, and a new 'BRAN' element is created in the hierarchy.

Step 4: Isometric Generation

Once the 3D model is complete, the **Isodraft**module is used to generate a 2D isometric drawing. This drawing includes a full Bill of Materials (BOM) and cut-length calculations, which are used directly by the fabrication shop.

7. Troubleshooting and Common Operational Challenges

Even with advanced software, engineering projects face technical hurdles. Below are common failure modes and their respective solutions in AVEVA Marine:

A. Database Claim Contention

Problem: Multiple users attempting to modify the same element simultaneously, leading to "Element Locked" errors.**Solution:** Implement a strict **Claim/Release**workflow. Administrators should also monitor the 'MDB' (Multi-Database) settings to ensure proper user partitioning.

B. Specification Mismatches

Problem: A component appears as a "red box" or a simple cylinder in the 3D view.**Solution:** This indicates a missing 3D graphical representation in the Catalogue (CATA). The administrator must verify that the **SKEY**(Symbol Key) and the geometry set are correctly mapped in the Paragon module.

C. PML Syntax Errors

Problem: Custom macros fail to execute during automated drawing generation.**Solution:**Use the Q VAR command to debug variable values. Ensure that all strings are correctly enclosed in single quotes and that the PML1 or PML2 syntax rules regarding object members are followed.

8. Evolutionary Implications: From 12.1 to Integrated Ship Life Cycle

The technical capabilities of AVEVA Marine 12.1 extend far beyond mere drafting. By utilizing the **AVEVA Global** server technology, shipyards can distribute a single project across multiple geographical locations (e.g., design in Europe, fabrication in Asia) with real-time synchronization. The data generated during the modelling phase (TM-2220, TM-2102) remains valuable long after the ship is launched.

This "Digital Twin" allows ship owners to manage maintenance, repairs, and retrofits using the original design data. For example, if a ballast water treatment system needs to be retrofitted, engineers can use the existing 3D pipework model to perform clash detection and pre-fabricate the new piping before the ship even arrives at the dry dock.

The integration of **AVEVA P&ID** and **AVEVA Marine Diagrams**ensures that the operational logic of the vessel is preserved. When a valve is closed in the digital twin, the system can predict the impact on the entire fluid system, providing a level of operational intelligence that was previously impossible.

In conclusion, mastering the modules defined in the TM-2000 series manuals is not just about learning a software tool; it is about adopting a rigorous, data-centric approach to maritime engineering. By leveraging the hierarchical database structure, specification-driven design, and integrated schematic logic, engineers can deliver more complex vessels with higher precision, lower costs, and significantly reduced lead times. The future of marine design lies in this deep integration, where every bolt, plate, and pipe is a living part of a global data ecosystem.

Tags: #AVEVA Marine #Hull Design #Pipework Modelling #Marine Engineering #3D Modelling #P ID