



## *Integrated Shipbuilding Environment Consortium*

**MariSTEP → ESTEP**

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and**

**Burt Gischner, Electric Boat Corporation  
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**June 28, 2000**



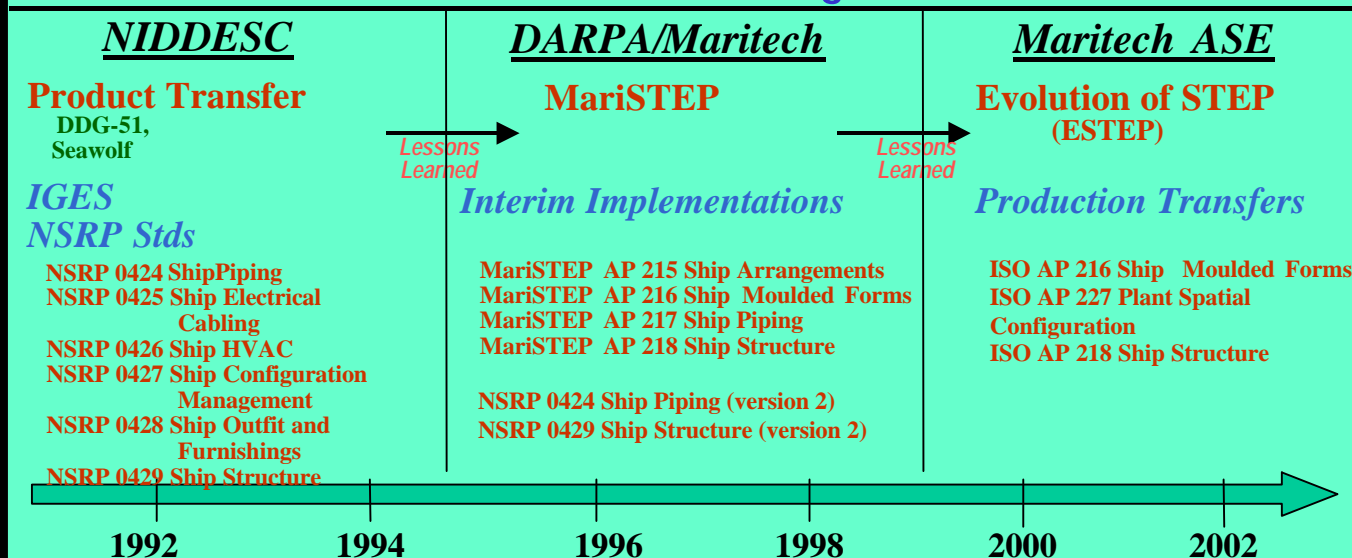
# History of US Shipbuilding Data Exchange



U.S. Shipbuilders

CAD VENDORS

## Product Model Exchange Efforts



NIDDESC / NSRP

International Standards Organization (ISO)



## ***MariSTEP***

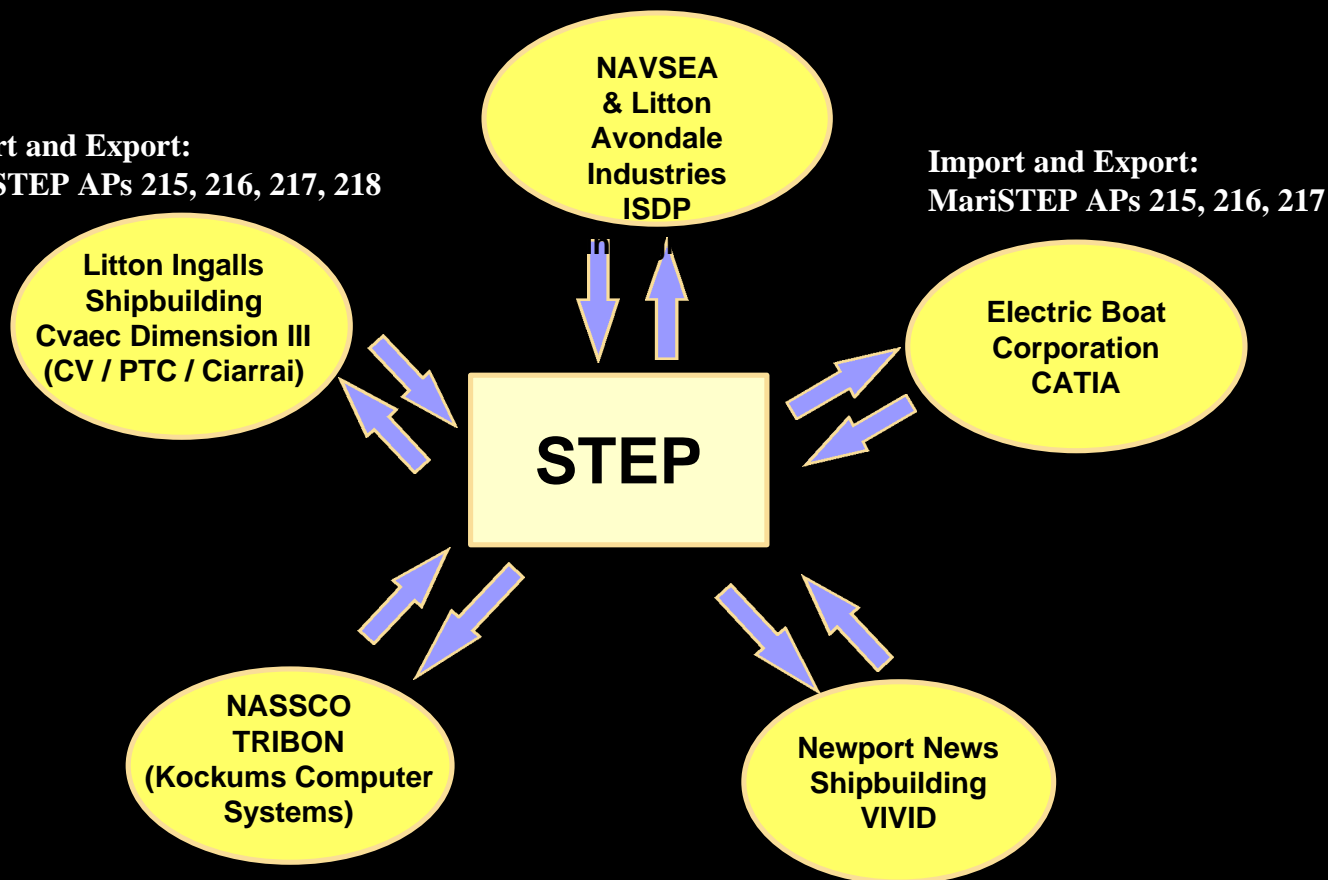
- Developed prototype translators to exchange data between diverse shipyard environments using STEP Shipbuilding Application Protocols (APs)
  - ➔ *Exchanged detailed design product model data*
  - ➔ *Based on Application Reference Model (ARM)*
- Coordinated with ISO STEP Ship Team to identify and resolve implementation and ARM schema issues for:
  - ➔ *AP 215 Ship Arrangements*
  - ➔ *AP 216 Ship Moulded Forms*
  - ➔ *AP 217 Ship Piping*
  - ➔ *AP 218 Ship Structure*
- *August 1996 to December 2000*

# MariSTEP STEP Translators

ISDP Export: MariSTEP APs 215, 216, 217, 218

GSCAD Import: MariSTEP 218

Import and Export:  
MariSTEP APs 215, 216, 217, 218



Import and Export:  
MariSTEP APs 215, 216, 217, 218

VIVID Export: MariSTEP APs 215, 216, 217, 218  
GSCAD Import: MariSTEP APs 216, 218

## ***NSRP APs - Version 2***

### **MariSTEP / MariSPRITE schemas documented as NSRP Version 2 Application Protocols (APs)**

- *NSRP 0429 Ship Structures AP*
  - ➔ *MariSTEP AP 215 Ship Arrangements*
  - ➔ *MariSTEP AP 216 Ship Moulded Forms*
  - ➔ *MariSPRITE AP 218 Ship Structures*
- *NSRP 0424 Ship Piping AP*
  - ➔ *MariSTEP AP 217 Ship Piping*

**MariSPRITE schema is result of harmonization effort between European STEP implementation project *Seasprite and MariSTEP***

- *Enables Europe / US exchange of shipbuilding product model data*
- *Has been successfully implemented and demonstrated at the ISO meeting in New Orleans, 11/99*





# Demonstration



# Test ship - Eleo Maersk

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**“Eleo Maersk”**

**Built by Odense Steel Shipyard,  
Denmark**

**Owned by AP Moller**

**First Double Hull Tanker**

**Length: 333 metres**

**Breadth: 56.4 metres**

**Draught: 22.52 metres**

**Deadweight: 301,862 Tonnes**



# The MariSPRITE Model: Subset of AP218 - Ship Structures

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## Ship general characteristics

- identification, dimensions

## Hull framing specification

## Structural elements

- plates, stiffeners

## Features

- interior, edge cutouts, seams

## Structural System breakdown

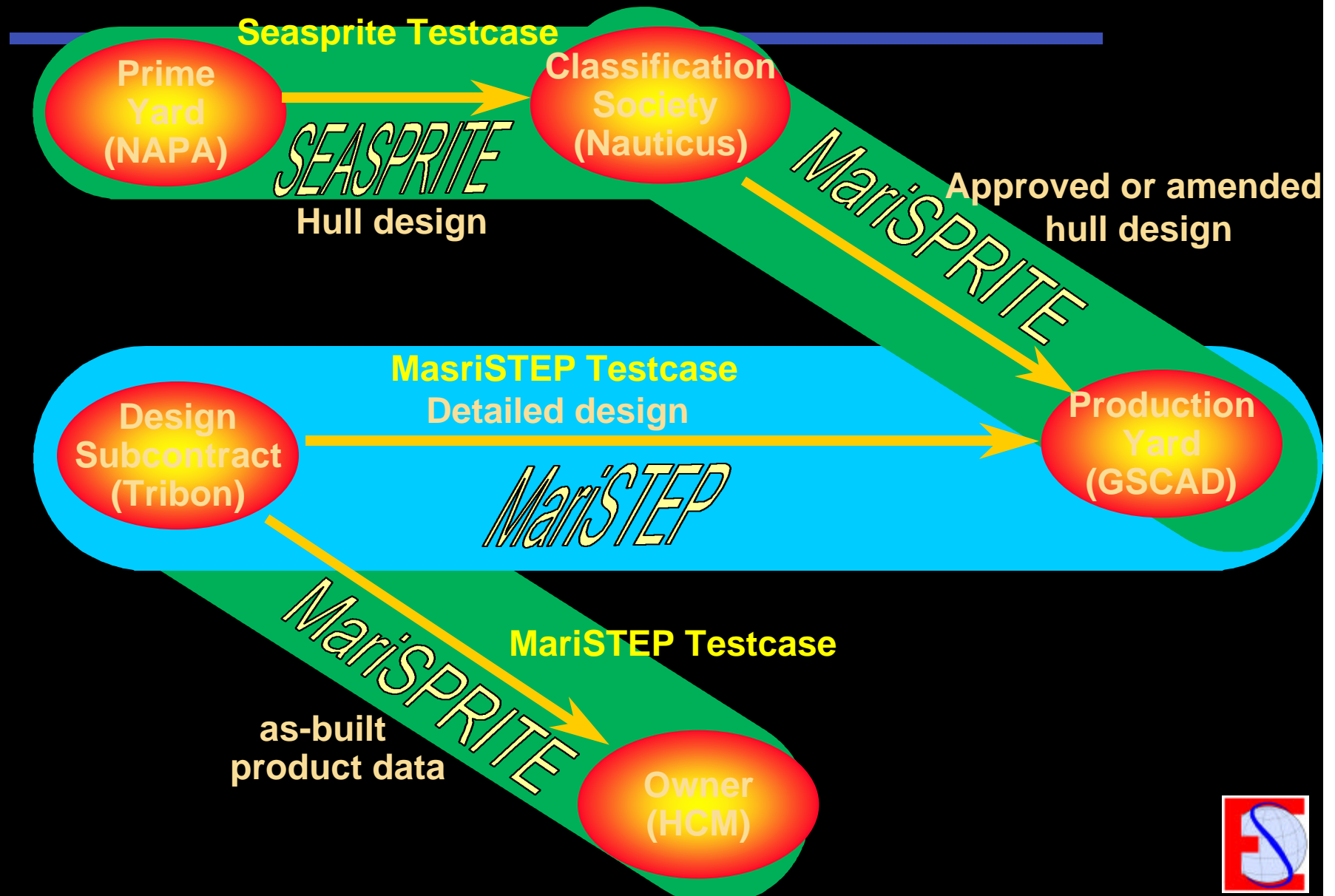
- bulkheads, decks, shell

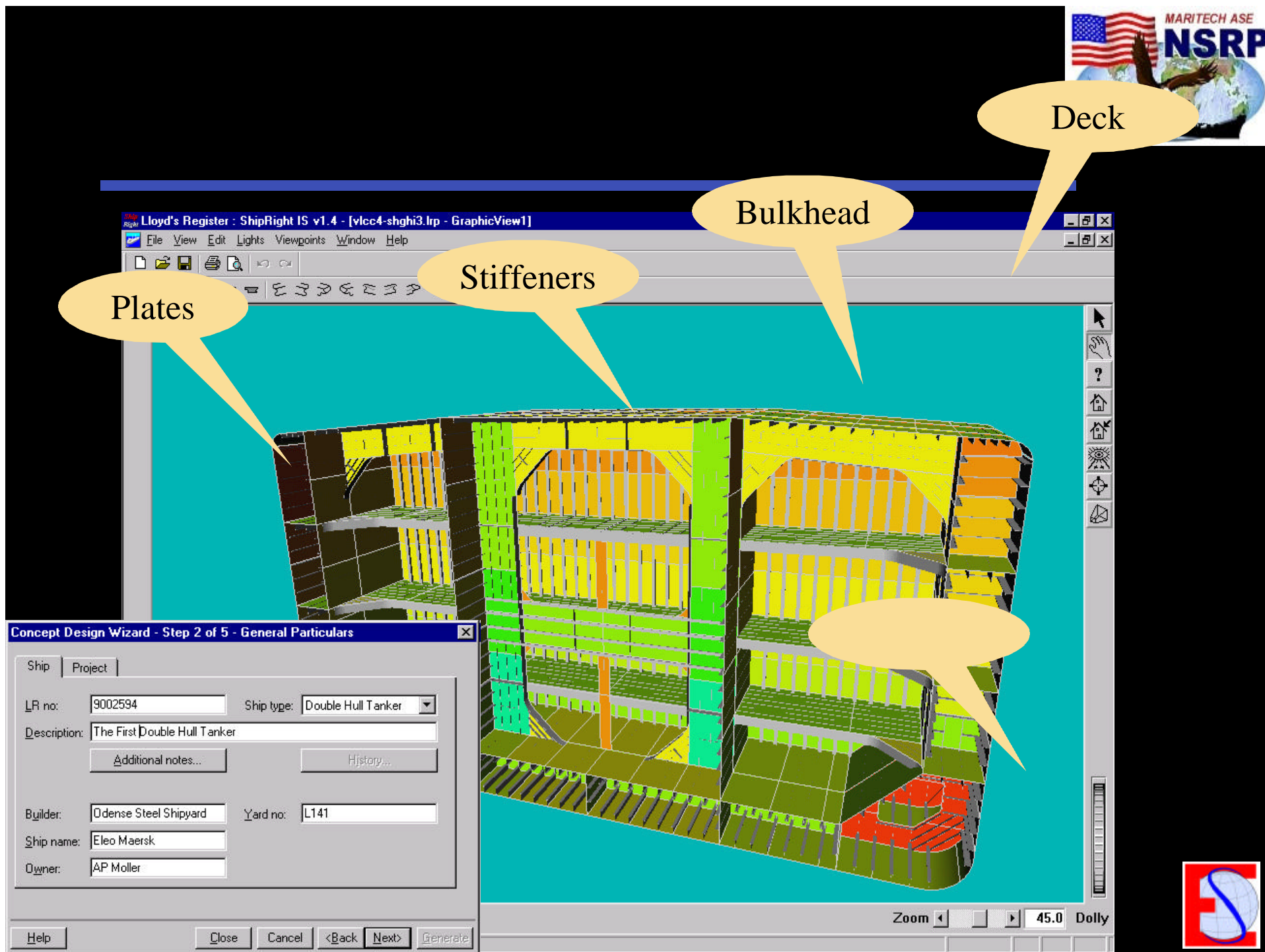




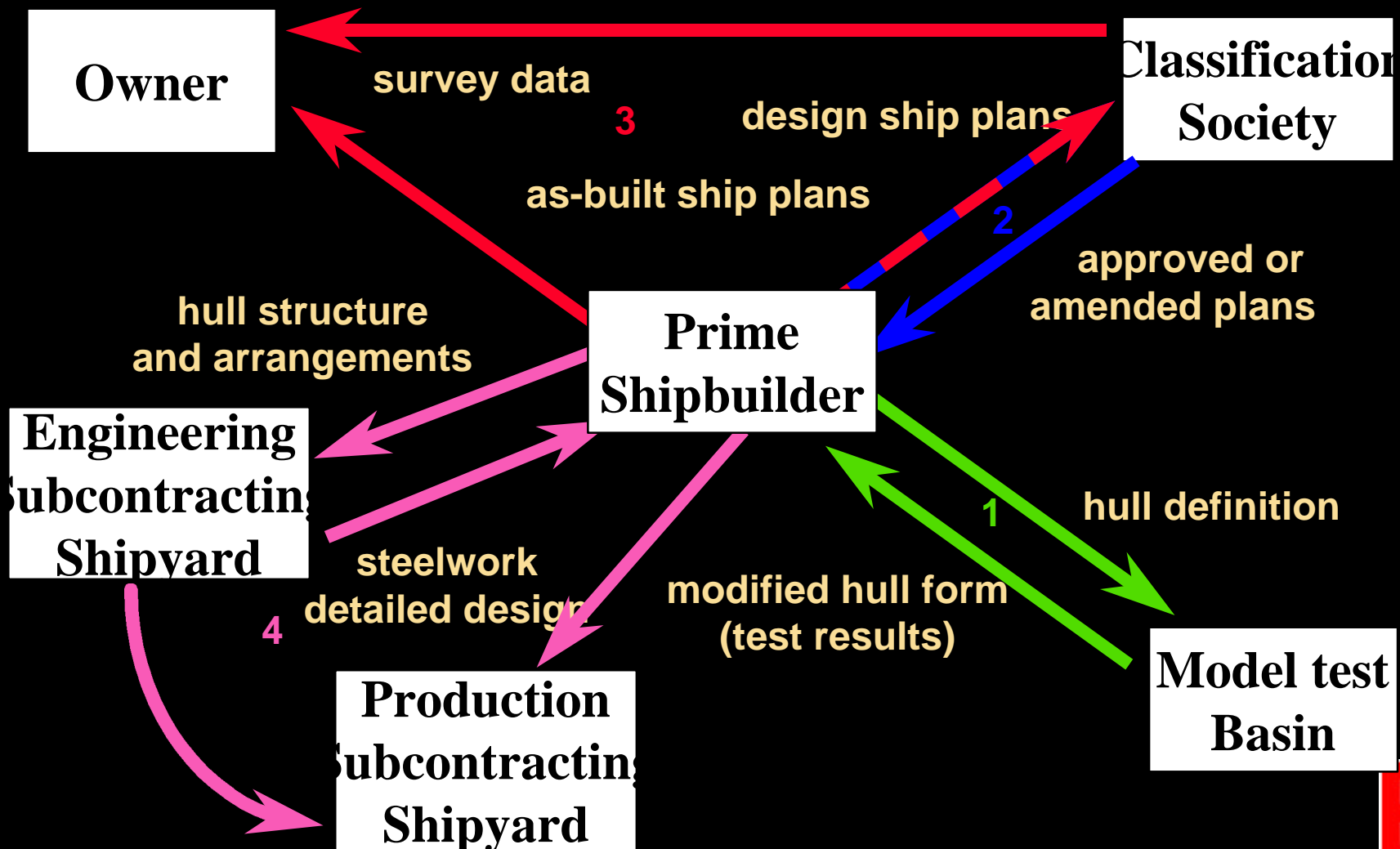
# The Demonstration

## *The Schema Mechanics*





# Business cases





# Evolution of STEP (ESTEP)

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**Phase 1: September 1999 to May 2000**

**Phase 2: May 2000 to August 2003**

## **Tasks:**

**Task 4.1 Structural Translator Development**

*- Matthias Grau (Atlantec)*

**Task 4.2 Prototype Piping Translator Development**

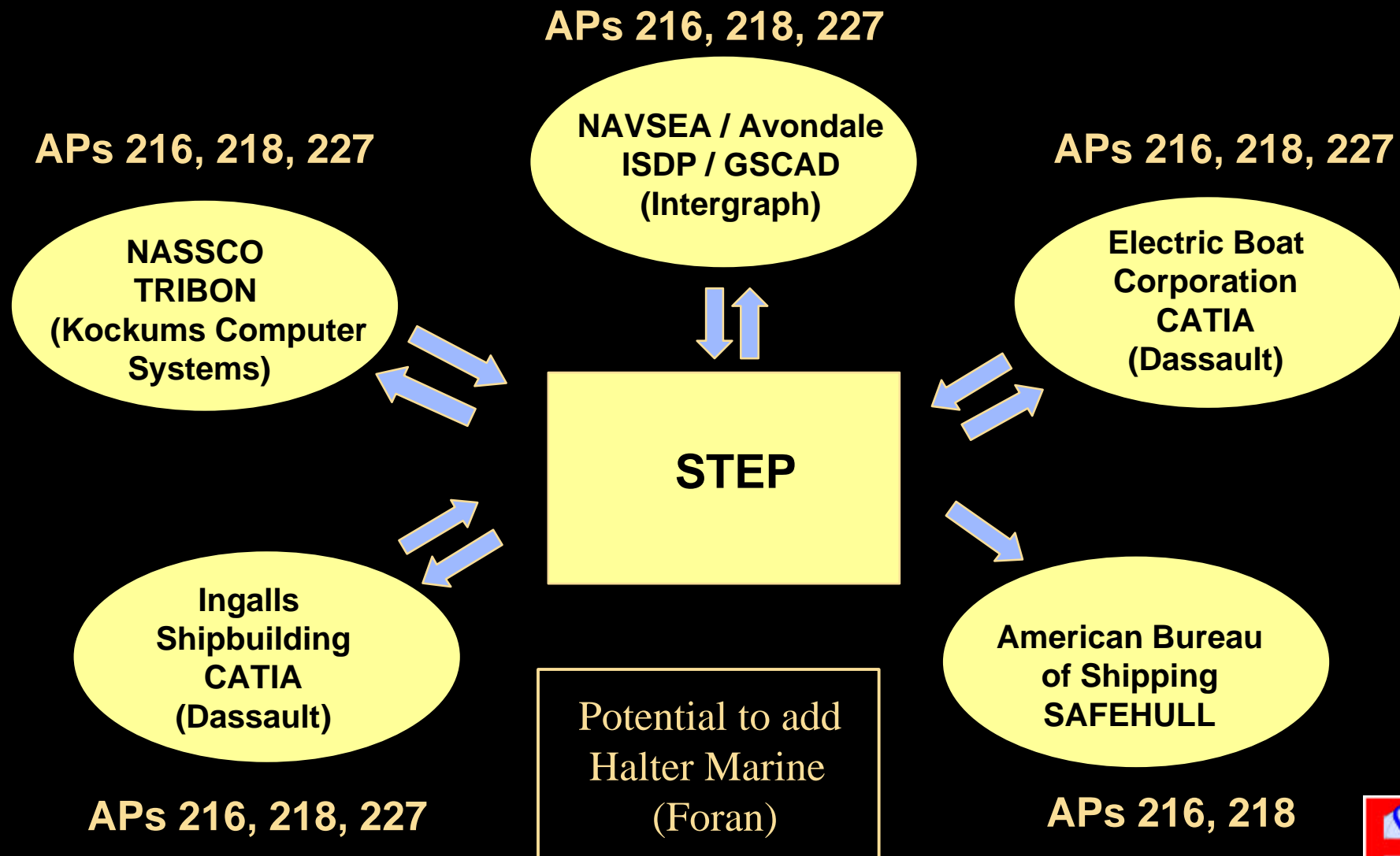
*- Dr. Burton Gischner (Electric Boat Corporation)*

**Task 4.3 ISO STEP Coordination & Modularization**

*- Ron Wood (Litton Ship Systems)*



# ESTEP - Shipyard and CAD System Environments





# Task 4.1 Structural Translator Development





# AP 216 - Ship Moulded Forms

Surface, wireframe and offset point representations

Design, Production and Operations lifecycles

General characteristics

Main dimensions

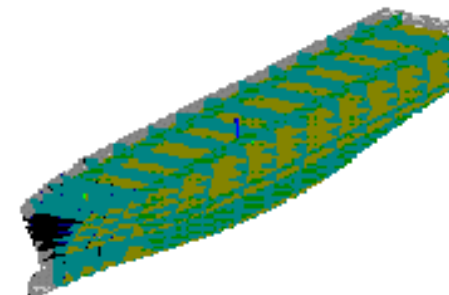
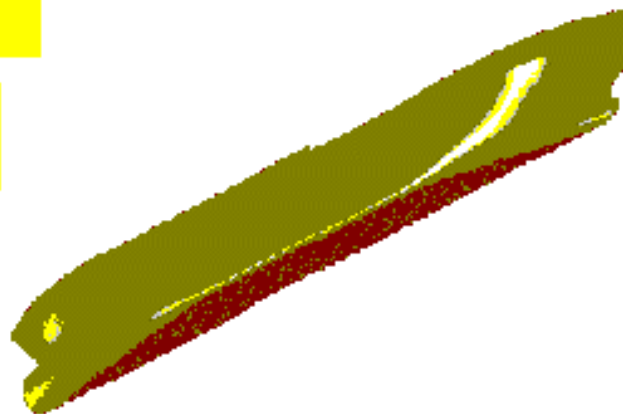
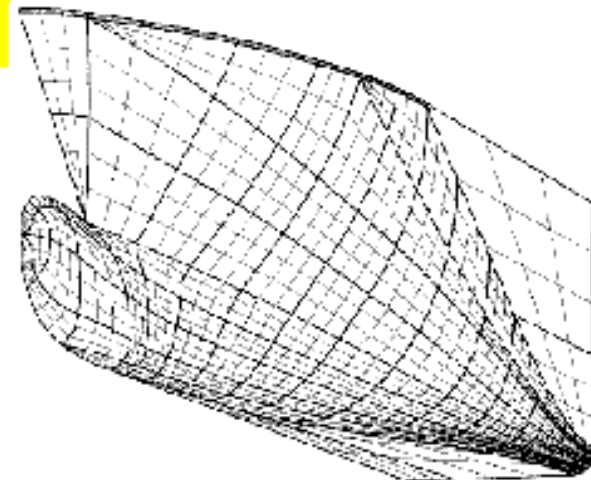
Hullform geometry

Major internal surfaces

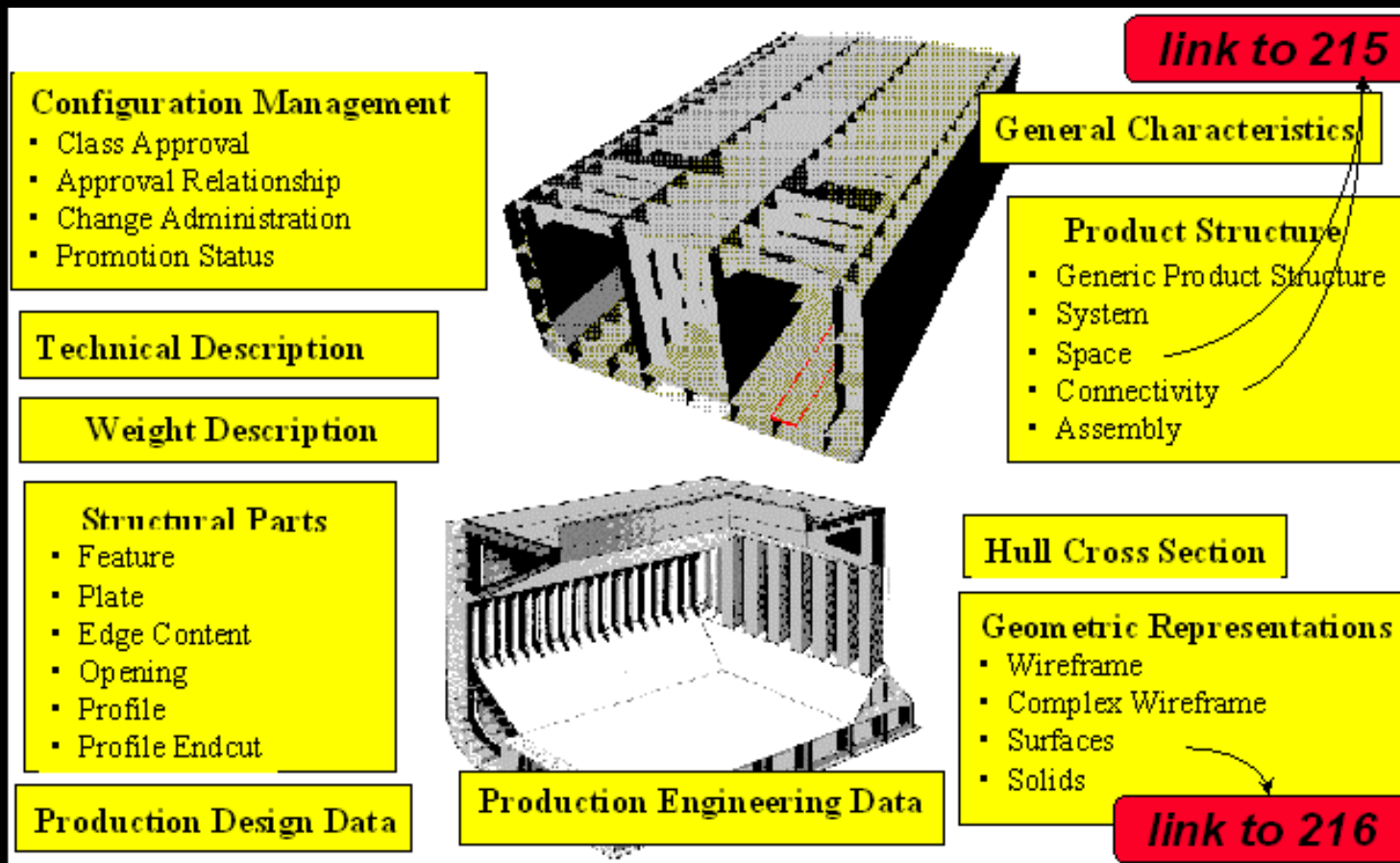
Hydrostatics

Intact Stability tables

**+  
Ship  
Common  
Model**

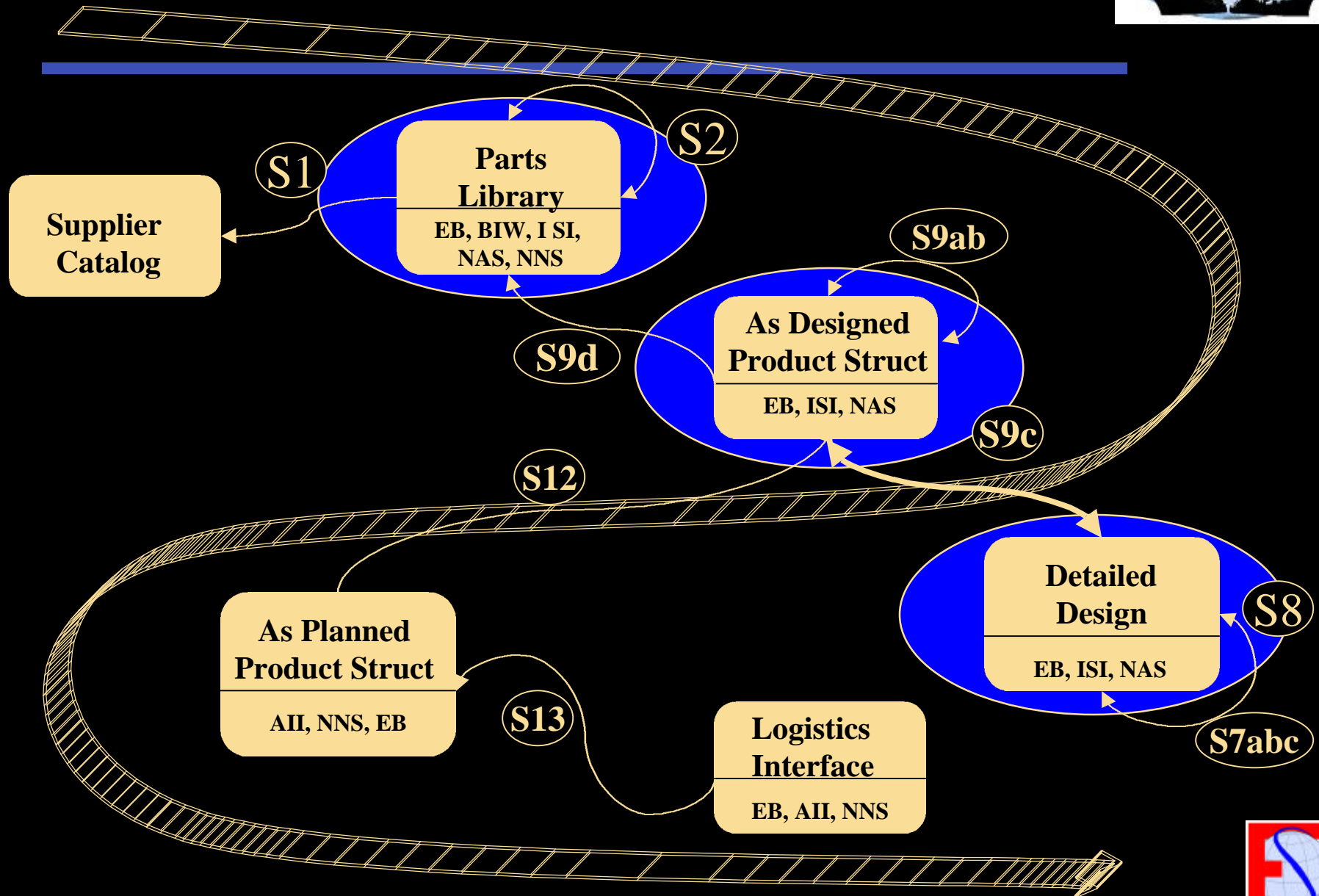


# AP 218 - Ship Structure





# ISE Structural Scenario



# Conformance Class Selection

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## Selection of conformance classes

- decision to implement Complete vs Subsetted Application Interpreted Models (AIM)
- AP216 CC4 Moulded form geometry as a surface representation
- AP218 CC1 Early design and class approval
- AP218 CC2 Detailed design

next step would be the development of the implementation models ...

# Checking and Correcting AIMs

AP216 and AP218 are both under development within ISO TC184 SC4 WG3 T23

Plan to initiate CD ballot by summer 2000

- AIM longforms were partly incomplete and did not compile error-free

AIM longforms were extracted from the latest working drafts

- AP216: WG3 N789
- AP218: WG3 N799

Compilation was done using three EXPRESS tools

- STEP Tools, EPM, ProSTEP

Corrections were made as necessary and fed back into the ISO process

# AP216 and AP218 results

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Several entities were referenced in the mapping tables but not in the longform

Issues have been raised against parts of the mapping tables

Modification and addition of missing global rules

Some issues left w/r to referencing of types in WHERE rules

- create warnings with some compilers
- possibly unclear in ISO 10303.11
- no effect on implementation -> no further action required

# STEP Integrated Resources Results



**Initial approach to use IR versions of the BB server lead to several compilation problems**

- especially with geometry AICs
- change to 2nd edition of IRs resolved most of the problems

**In addition to the AP longforms a few problems were found with the P4x**

**P42 - ENTITY surface\_of\_revolution**

- incomplete DERIVE clause

**P44 - reference to no-existing EXPRESS function**

- relatives\_of\_product\_definitions in schema product\_property\_representation\_schema referenced by schema configuration\_management\_schema
- function has been removed from product\_property\_representation\_schema in edition 2

**Both problems were raised as SEDS issues**





# Deliverables

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## ISE Structural Schemas for Moulded Forms and Structural Translators (AP 216 & 218)

- Delivered March 2000
- Includes report and final versions of structural schemas including edition 2 versions of IRs

## FDD for AP216 and AP218 Processors





# **ESTEP Task 4.2 Prototype Piping Translator Development**

# AP227 Capabilities Diagram

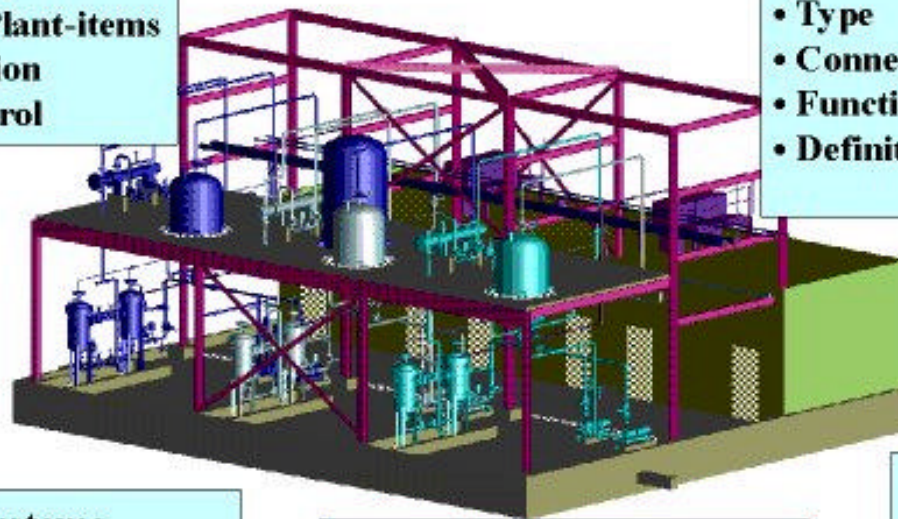
## AP 227: Plant Spatial Configuration

### Plant Layout

- Location of Plant-items
- Site Description
- Change Control

### Plant Item

- Type
- Connections
- Functional/Physical
- Definition/Occurrence



### Plant Systems

- Line Definitions
- Composition
- Capabilities
- Component Connectivity

### Functional/Analysis

- Interference
- Performance Requirements
- Requirement Satisfaction

### Shape

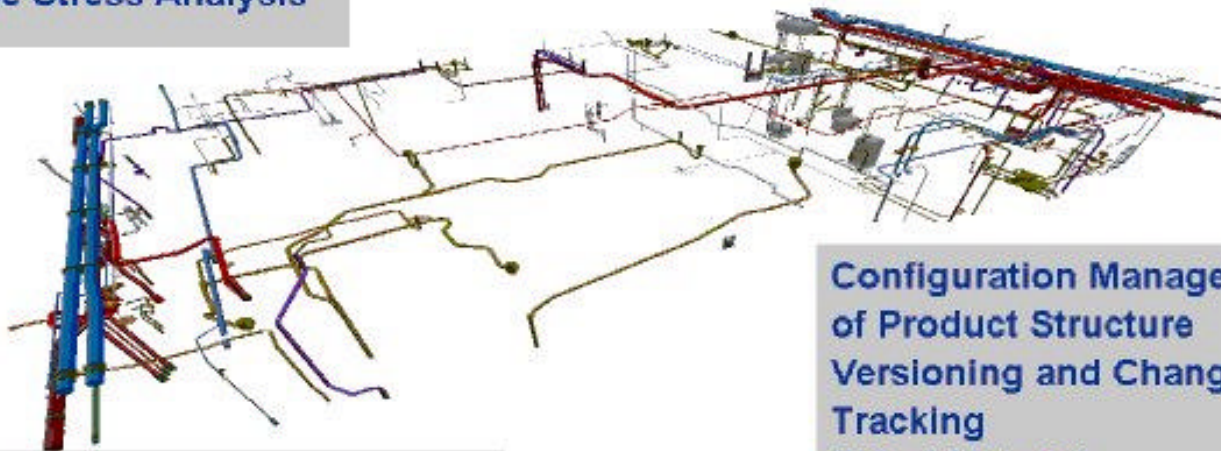
- Explicit Shape
- Brep
- CSG



# AP217 Capabilities Diagram

## AP217: Ship Piping

Pipe Stress Analysis



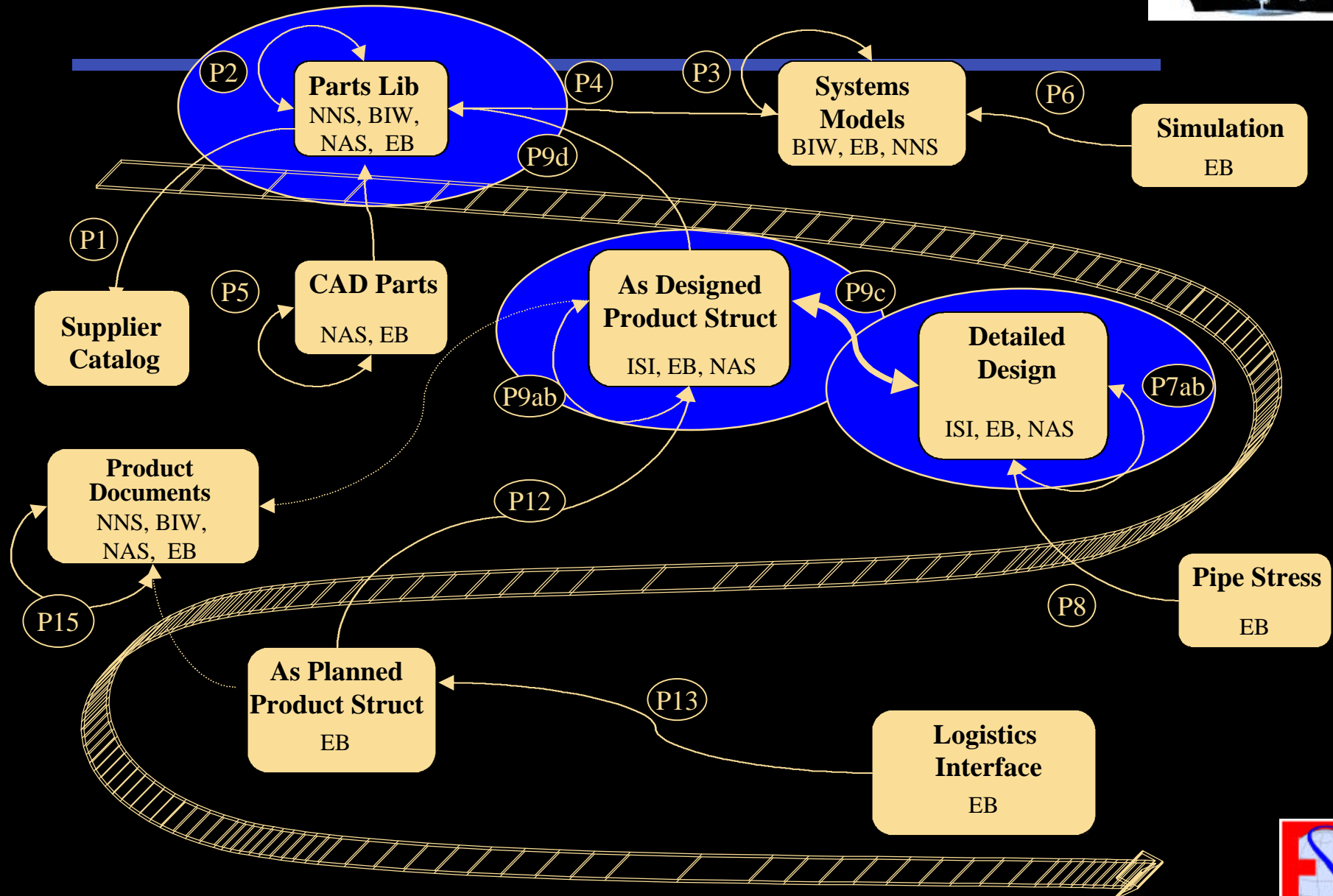
Configuration Management  
of Product Structure  
Versioning and Change  
Tracking  
Bill of Material

2-D and 3-D Shape Representation

Diagrammatic Presentation  
Solid Model Presentation  
Interference Analysis

Pipe Flow Analysis  
and Sizing

# ISE Piping Scenario



# Task 4.2.2 Report

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## Shipbuilding Requirements for Piping Exchange using AP227

### AP217 vs AP227 Decision

### Shipbuilding Requirements

- Capabilities of Edition 1
- Shipbuilding Enhancements to Edition 1
- Additional Shipbuilding Requirements
- Selected Extensions for Edition 2

# AP217 vs. AP227 Decision

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**Which STEP AP should be implemented?**

- **AP217 - Ship Piping**
- **AP227 - Plant Spatial Configuration**

**Decision based on both Technical and Business considerations**

- **2 Phase Ballot Process developed to guide Technical considerations**
- **Business considerations discussed extensively**

**Final vote held for preference of each team member**

- **Despite attempt at formal process, decision is Subjective**

# Benefits of Implementing AP217

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**Utilizes Ship Common Model (SCM) and Building Blocks**

- **Facilitates interoperability**
  - ➔ **with AP215, AP216, AP218, and PLIB**

**Use lessons learned from MariSTEP AP217 implementations**

**Meets Shipbuilding requirements**

- **Fabrication and Manufacturing**
- **Globally Unambiguous Identifiers (GUID) for External Referencing**

**Application Reference Model (ARM) in EXPRESS**



# Benefits of Implementing AP227

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**International Standard (IS)**

**Several commercial implementations**

- **including Dassault for CATIA**

**Application Interpreted Model (AIM) and Schema are finished and stable**

**ISO New Work Item will expand the scope for 2nd Edition**

**Vendors will support this standard before new Shipbuilding APs**

**More people to share development costs**

**HVAC will be added to AP**





# Decision Reached

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**ESTEP will implement AP227 Edition 2  
Shipbuilding requirements**

- **Have been identified**
- **Will be incorporated into AP**

**ESTEP is cooperating with Process  
Plant participants to develop Edition 2  
of AP227**



# ESTEP AP227 Edition 2 Participation

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## Selected representatives from ESTEP to participate in AP227 Development

- B. Gischner (EB)
- B. Kassel (NSWCCD)
- D. Martin (NASSCO)
- R. Wood (Litton Ship Systems)

## New Editor of AP227

- Dr. B. Gischner
- Will oversee incorporation of Shipbuilding requirements into Edition 2 of document

## HVAC will be added to Edition 2

- B. Kassel will lead HVAC development efforts





# Capabilities of Edition 1 of AP227

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**Plant Spatial Configuration**

**Detailed Description of Piping Systems**

**Placeholders for HVAC & Cableway  
Systems**

**Implemented by Several Process Plant  
Vendors**

- **Dassault**
- **Bentley**
- **CADCentre**



# Shipbuilding Enhancements to Edition 1 of AP227

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## Usage Guide for AP227 for Ship Piping Systems

- Preliminary Version Developed by CTC
  - ➔ Issued in November 1999
- Provides Examples of using AP227 for shipbuilding
- Final Version
  - ➔ Issued by September 2000

## EXPRESS ARM for AP227

- Will Assist Usage by Shipbuilders
- Could be used for XML Implementations



# **Selected Extensions for AP227 Edition 2**

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**Piping Prefabrication and Inspection  
Information**

**Piping Installation and Commissioning  
Information**

**HVAC**

**Support of Pipe and HVAC Flow Analysis**

**Links to Structural Systems**

**Hanger and Support Details**

**Cable tray details**

**Catalog Referencing**

**Improved Configuration Management**





# **ESTEP Task 4.3**

## **ISO STEP Coordination & Modularization**

# Task 4.3 Phase 1 Definition

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## Modularization

- **Examine current status of ISO modularization efforts**
- **Analysis of modularization plans and determine impact to shipbuilding AP's and PLib**
- **Assess impact to ESTEP translators**
- **Analyze replacing CM building blocks with STEP Common Product Structure Configuration Management (PDM)**

# Task 4.3 Phase 1 Definition (cont'd)

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## ISO Coordination

- Stay informed on ISO activities and their impact on ESTEP
- Attend ISO meetings
- Lead development of AP 215 and AP 227 towards ISO approval process
- Support development of AP 216 and AP 218 towards ISO approval process
- Provide feedback of tasks 4.1 and 4.2 to ISO

