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DYNAMIC POSITIONING CONFERENCE
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QUALITY ASSURANCE SESSION

On the Development of a Classified Guide for the Dynamic Positioning System

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ABS

Development of a Classification Guide for the Dynamic Positioning (DP) System

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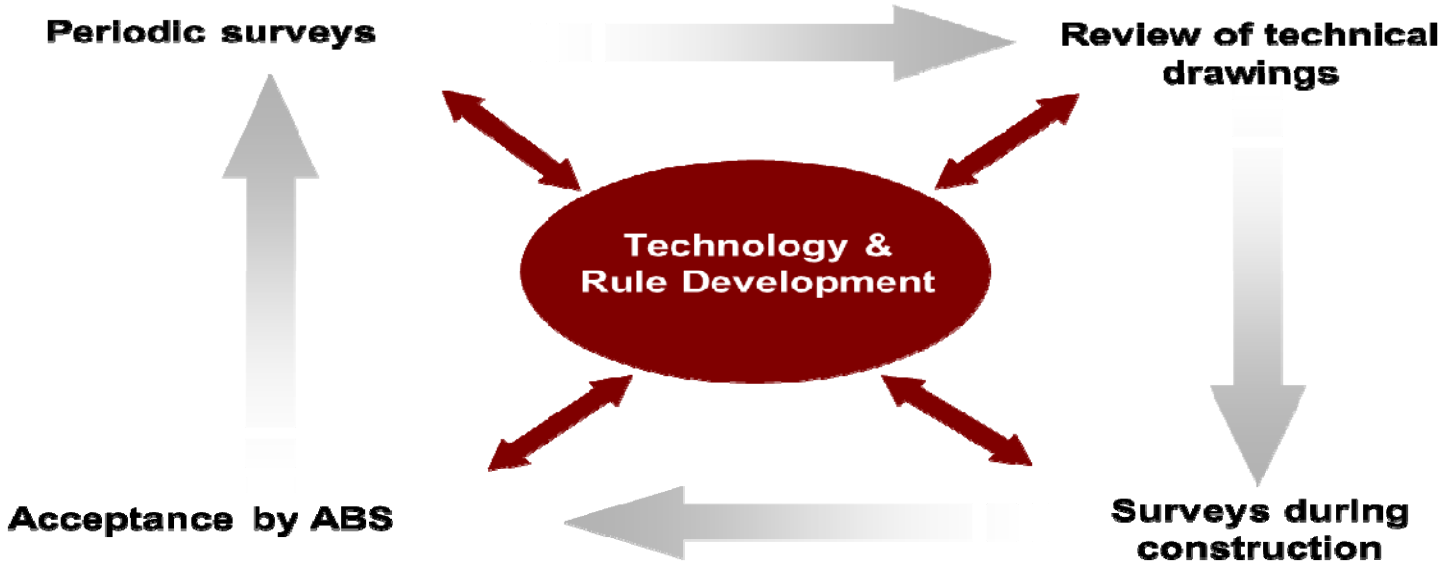
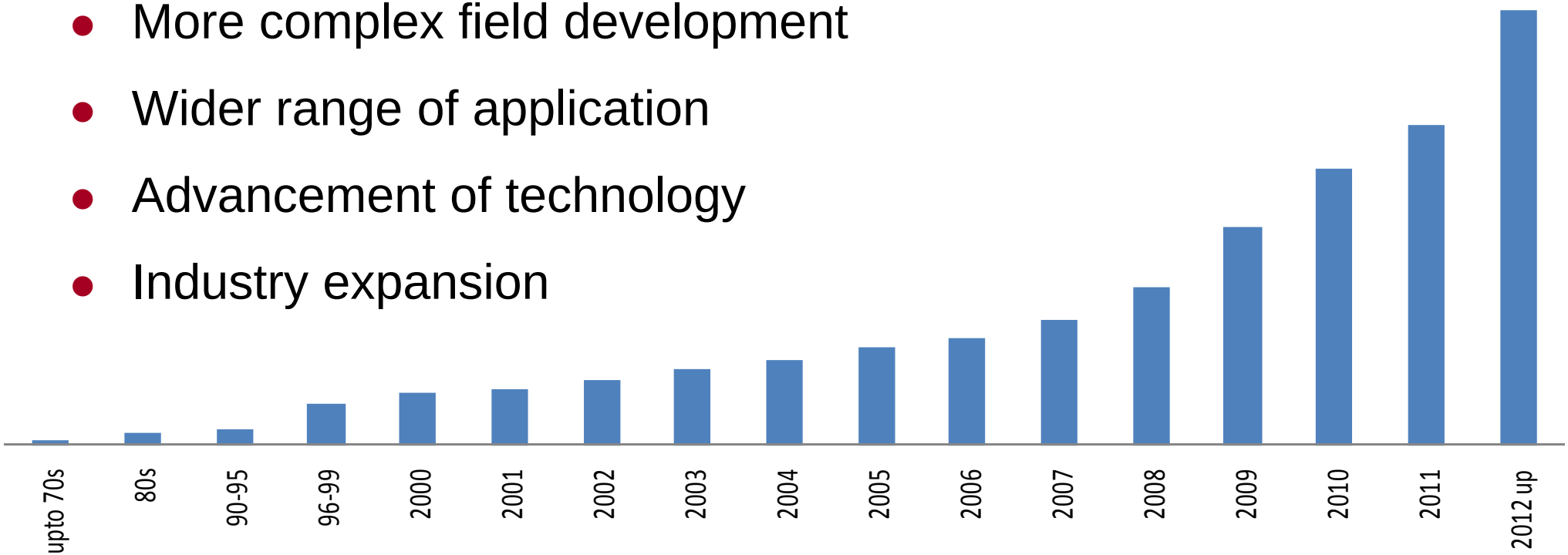
Outline

- Background on the Guide Development
- DPS Enhanced System Notation
- DPS Stationkeeping Performance Notation
- Summary



Rapid Expansion of DP Demand

- Deep-water activity
- More complex field development
- Wider range of application
- Advancement of technology
- Industry expansion



Innovation & New Technology

- Robust redundancy concept
- Advanced computing technology
- Enhanced FMEA process
- Enhanced generator protection
- Advanced thruster control and protection
- Quick black-out recovery
- Comprehensive operation monitoring

Current ABS DPS Rules & Notations

- ABS Guide for Thrusters and Dynamic Positioning System (1994) was incorporated in the Rules for Building and Classing Steel Vessels, Part 4 in 2000
- Based on IMO Guidelines for Vessels with Dynamic Positioning Systems (1994)
- DPS notations
  - **DPS-0**
  - **DPS-1**
  - **DPS-2**
  - **DPS-3**

Other ABS Rules Related to DP Components

- **ABS Steel Vessels Rules**
  - Diesel Engines – Section 4-2-1
  - Gas Turbines – Section 4-2-3
  - Electric Motors and Motor Controllers – Section 4-8-3
  - Gears – Section 4-3-1
  - Shafting – Section 4-3-2
  - Propellers – Section 4-3-3
  - Piping System – Chapter 4-6
  - Thrusters and DP Systems 4-3-5
  - Control Equipment and Systems – Section 4-9-7
- **ABS MODU Rules**
  - Pumps and Piping Systems – Chapter 4-2
  - Electrical Installation – Chapter 4-3
  - Survey After Construction – Chapter 6-1
- **ABS Rules for Survey After Construction**
  - Machinery Surveys – Chapter 7-6
  - Shipboard Automatic and Remote Control Systems – Chapter 7-8
  - Survey Requirements for Additional Systems and Services – Chapter 7-9

Gaps between Industry & Class Rules

- Level of details
- Closed bus operation versus design requirement
- Recognition of enhanced safety features
  - Propulsion system
  - Position reference system and sensors
  - Risk level based on fire and flood tolerance design
- Criteria for stationkeeping performance
- Software quality management
- Software verification
- Compatibility on testing requirement within industry

Development of ABS DPS Guide

- General
- DP System Design
- Power System
- Thruster System
- Control System
- Marine Auxiliary System
- Initial Test of DP System
- Survey
- Enhanced DP System
- Stationkeeping Performance
- Specific Vessel Types
- Other Optional DP System Notations

Red: New Sections

New Notations for Enhanced System

- Notations
  - **EHS-P** for enhanced propulsion system
  - **EHS-C** for enhanced control system
  - **EHS-F** for fire and flood tolerance design
- Supplement information for DPS-series notations
- Provide three groups for flexibility and easy recognition
- Objective
  - Improve reliability, operability and maintainability
  - Recognize safety features that beyond minimum requirements
  - Encourage higher safe design standard

Enhanced Propulsion System EHS-P

- Applicable to DPS-2 and DPS-3 system
- Features on power plant protection and quick blackout recovery
- High safety measurement against closed bus operation
- Targeting reduced consequence of failure

EHS-P Requirement

- Enhanced generator protection
  - Failure detection and discrimination of failed components before a full or partial black-out situation occurs
  - Open the bus-tie if the faulty generator fails to trip
  - One protection system per generator
- Robust redundancy design
  - Autonomous generator sets
  - Autonomous thruster sets
- Fast automatic blackout recovery

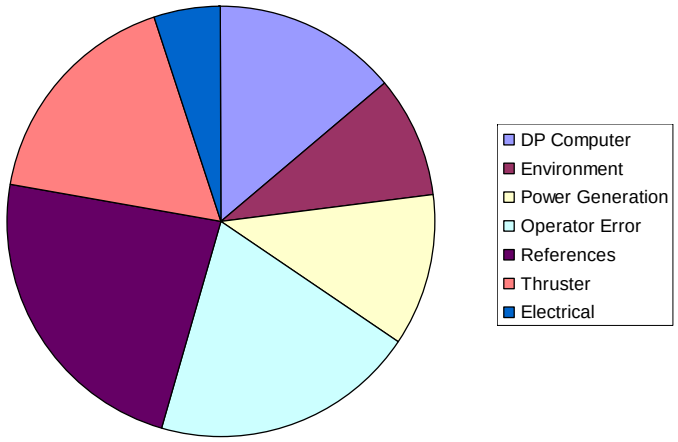
Enhanced Control System EHS-C

- Applicable to DPS-2 and DPS-3 system
- Aiming for higher availability and reliability of input data to the control system
- Statistics point to the necessary of improvement
- Encourage for higher design standard

Incidents that led to loss of position

1994-2007

DP Computer	62
Environment	40
Power Generation	50
Operator Error	89
References	103
Thruster	76
Electrical	22
Total	442



EHS-C Requirement

- Three position reference systems and sensors available at any given time
- A total of four position reference systems and four sensors with combination of different systems
- Redundancy of relative reference system for offshore support vessels
- A total of three DP control systems (one alternative)
- Equipment from different suppliers or using different principles of operation
- Utilization of Inertial Aided Navigation System
- DP Data Logger

Fire & Flood Tolerance Design EHS-F

- Applicable to DPS-2 system
- Provide another level of measurement for fire and flood tolerance design
- Focus on fire risk spaces
- Flexibility for diversified market needs

Summary of Enhanced DP System

EHS-P	EHS-C	EHS-F
Autonomous Generator Set	2+1 backup DP control computers and controllers	**Generators and Prime Movers** Separate compartments, A60 for high fire risk area. Watertight below damage waterline
Bus Tie Breaker Redundantly configured between each bus segment	Wind Sensors 3 + 1 in back up control station	
Enhanced Generator Protection	Gyros 3 + 1 in backup control station	**Power Distribution System** A0 between redundant groups. Watertight below damage waterline
Enhanced Power Management	MRU 3 + 1 in backup control station	**Thruster System** A0 between redundant groups. Watertight below damage waterline
Autonomous Thruster Set	Position reference systems 3 + 1 in backup control station	**Controller Space** A0 between redundant groups

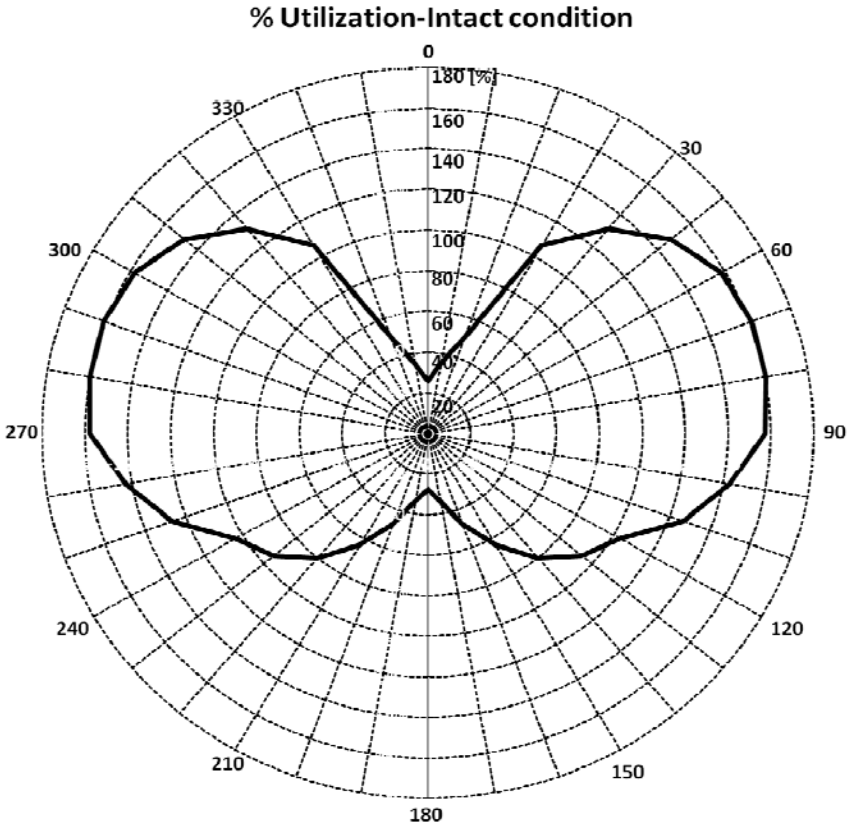
DPS Stationkeeping Performance Notation

- Notations
  - **SKP:** verification for given design environmental conditions through analysis
  - **SKP(a,b,c,d):** determine limiting environments for a given environment site through analysis
- Supplement information for DPS-series notations
- Objective
  - Recognition of DP capability
  - Encourage robust design and consistent assessment

SKP Notation

- Owner specify limiting environment conditions
  - Design wind speed and directions
  - Design wave height, related period and directions
  - Design current speed and directions
- Station keeping performance assessment
  - Environment load calculation
  - Available thrust calculation including effect due to thruster interference with others
  - Proper thrust allocation algorithm
- Analysis results demonstrate the capability of stationkeeping for the specified environment conditions
  - Quasi-static approach 20% safety margin
  - Dynamic analysis approach 10% safety margin

Result Presentation for SKP

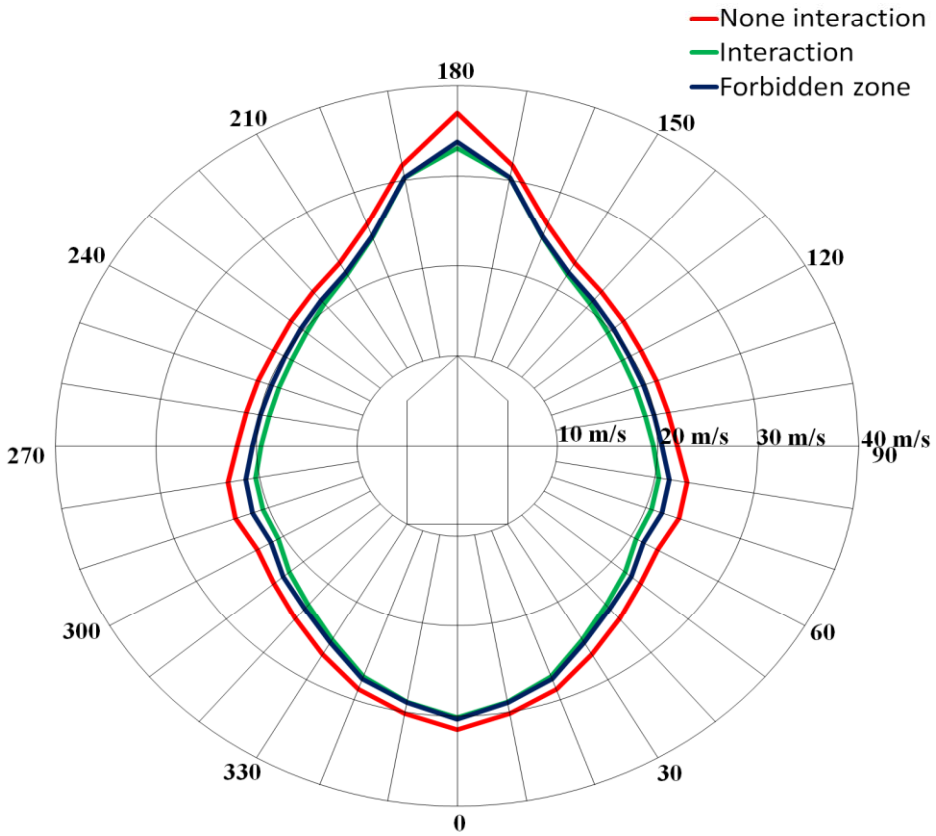


Total Thrust Utilization Plot for given Environment Condition

SKP(a,b,c,d) Notation

- **a**: the probability that the vessel can remain on station with all thrusters operating and for location **d** and current speed **c**
- **b**: the probability that the vessel can remain on station with the worst case failure condition and for location **d** and current speed **c**
- **c**: current speed in knot (owner specify or typical 1.5 kt)
- **d**: environment location (owner specify or typical North Sea)
- Same analysis procedures for load and thrust calculation
- May cover **SKP** if design environments are given and are within the limit
- Require for the relationship between wind speeds and wave heights
- Require probability of non-exceedance of wind speed

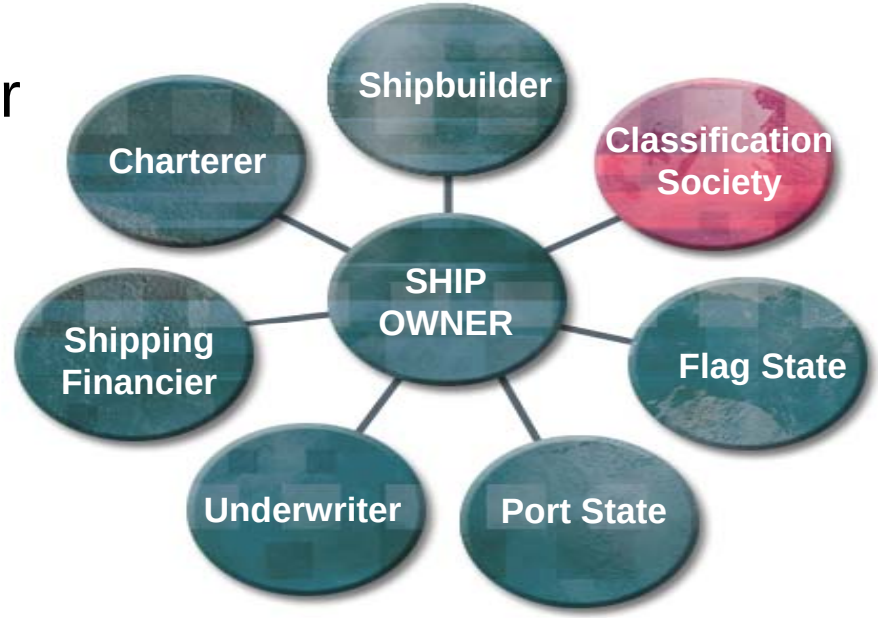
Result Presentation for SKP(a,b,c,d)



Typical DP Capability Plot

Summary

- DPS Guide to reduce the gaps between industry practices and class requirements
- New notations for enhanced system (EHS) and stationkeeping performance (SKP)
- Encourage robust design and higher safe design standard
- Provide more flexibility for owners and operators
- Need industry feedbacks for further improvement



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