

# VeriSTAR-Machinery

## Risk Based & Maintenance Centred

### Concept

Tanker Operator Conference

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## VeriSTAR-Machinery



- > Introduction
- > Risk Analysis
- > Classification
- > Conclusion

- Launched in November 1998
- Developed with Clients cooperation with clients and monitored by the French technical committee

## AIMS:

- To contribute to a rational ship operation with respect to human life and environment preservation standards, and with respect to ISM code and TMSA requirements (element 4),
- To increase ship reliability,
- To move from a reactive approach (final inspections) to a proactive approach (equipment condition assessment and maintenance auditing)

## EFFICIENCY:

- Methodical
- Very detailed
- Adapted to each vessel (type and operation)



The risk analysis covers equipment needed for:

- **voyage (propulsion, steering, navigation),**
- **ship specific mission (loading, unloading, cargo containment, ...),**
- **human life saving,**
- **environment protection,**
- **ship and cargo integrity.**



## 1 Ship modeling



- 2 Failure Modes and Effects Analysis
- 3 Criticality Analysis
- 4 Risk quantification & Identification of « critical » items



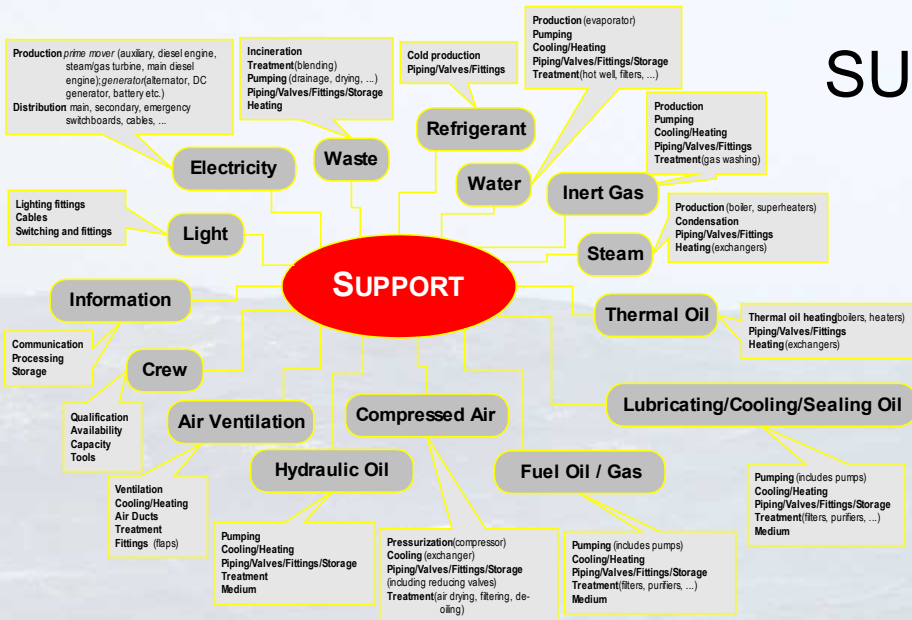
- 5 Risk reduction
- 6 Results



⇒ Ship owner's participation in the risk analysis is essential to its carrying-out and success.

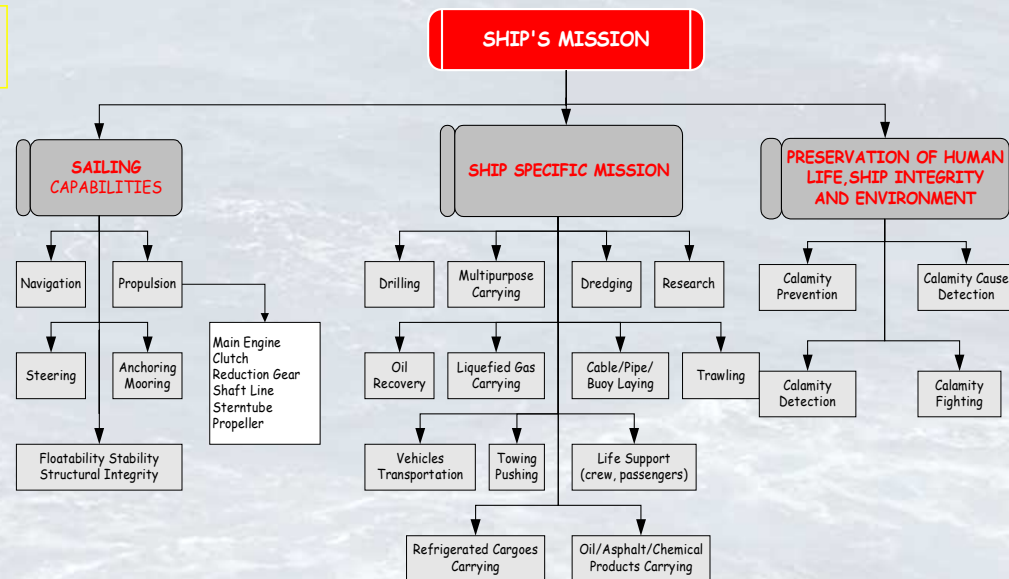


The ship is split up into:



SUPPORTS ...

.... and FUNCTIONS.

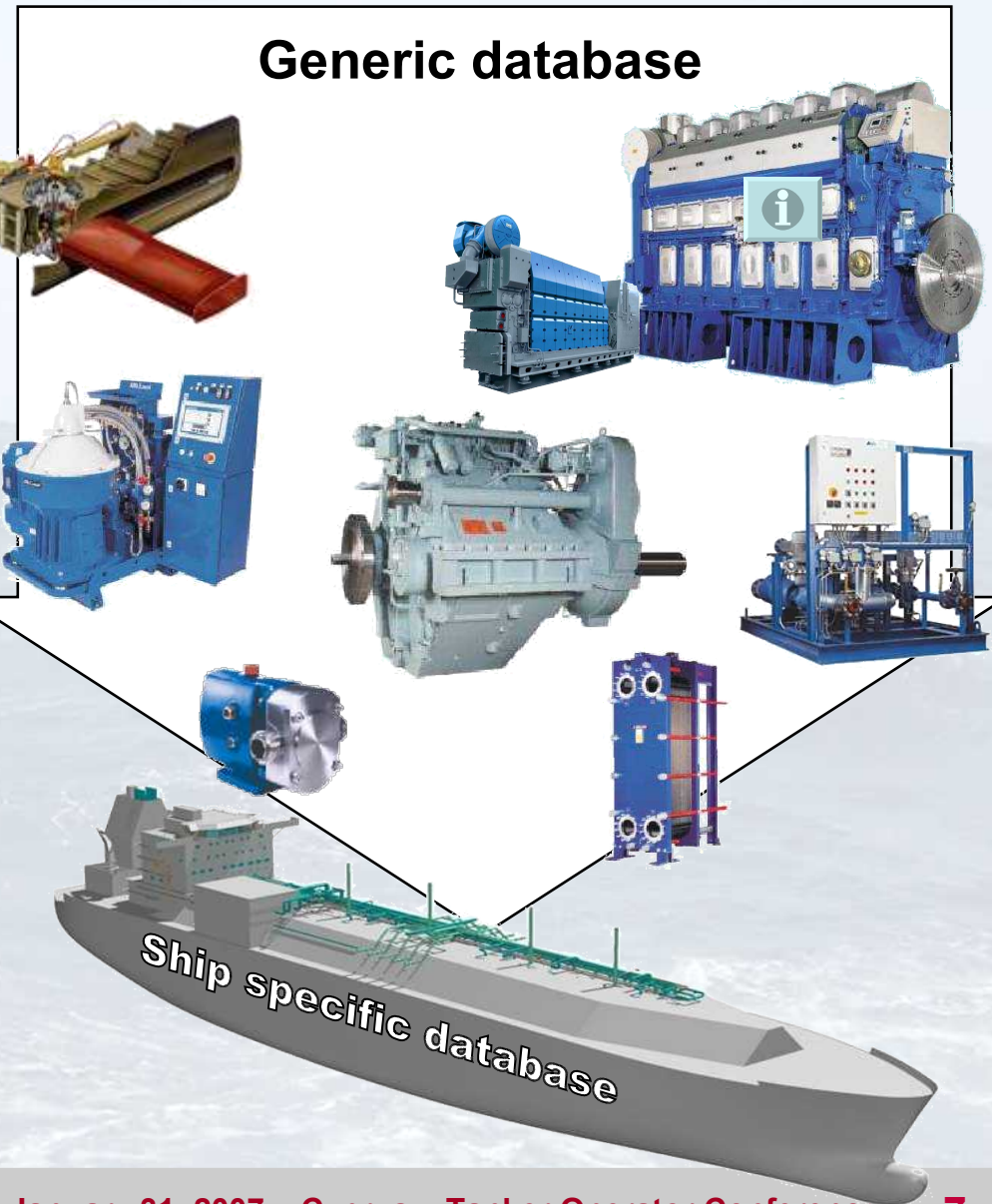


From BV Generic database containing:

- Generic equipment,
- Failure modes,
- Maintenance procedures,
- Occurrence probabilities,

Ship specific database is built up :

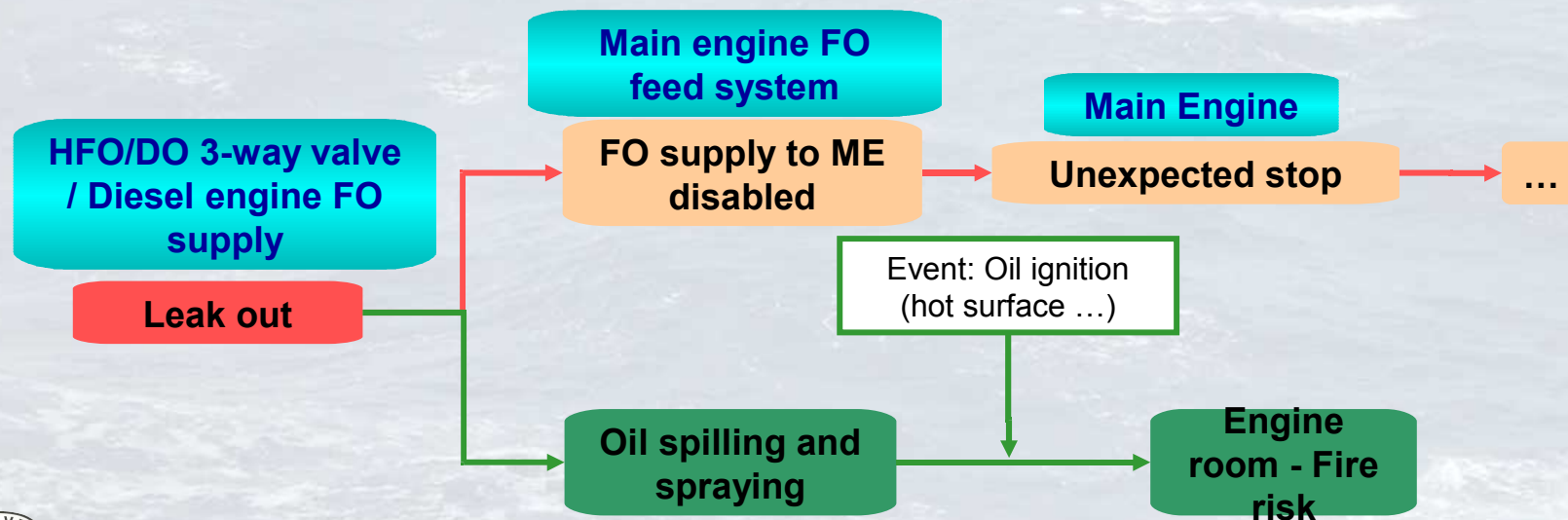
- Ship model,
- Located equipment,
- Maintenance and damage histories.



# Risk Assessment - 2. Failure Modes and Effects Analysis

The evolution of a failure may :

- lead to several consequences: functional consequences, consequences on environment and human life
- Happen either without any additional event, or with the occurrence of an event (hidden failures on protective devices).

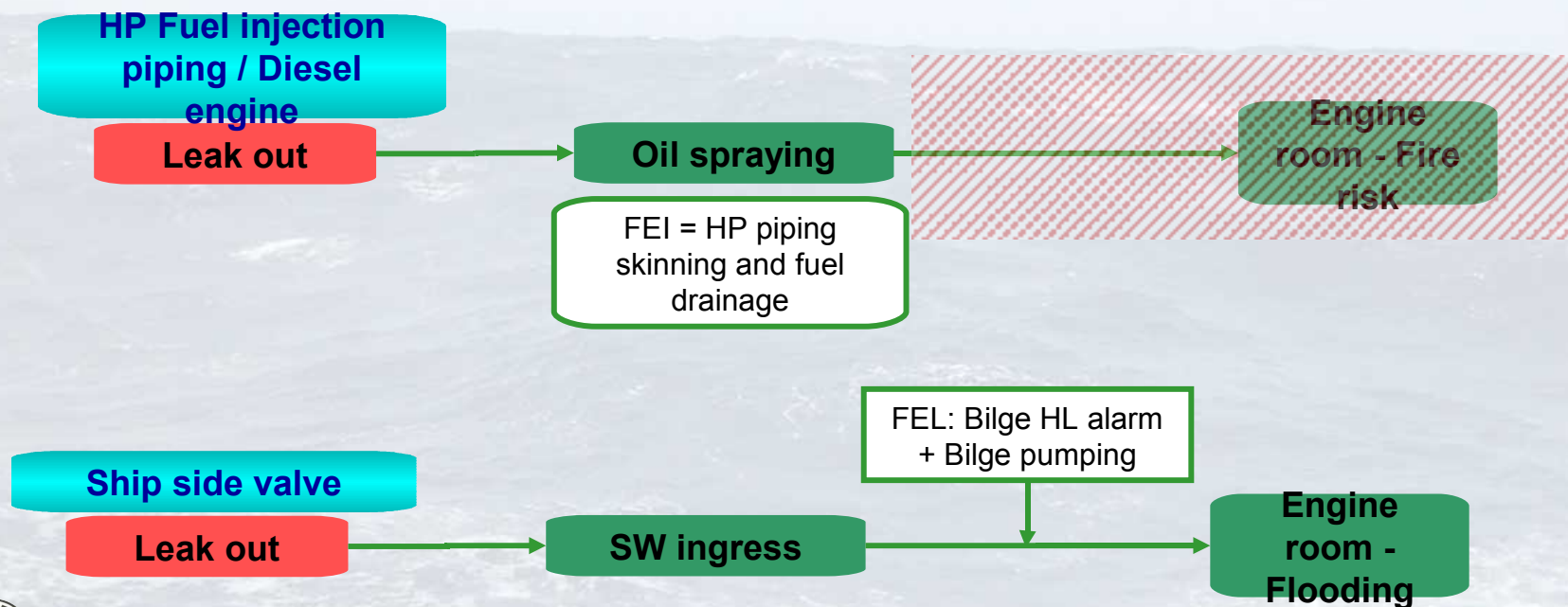


# Risk Assessment - 2. Failure Modes and Effects Analysis

The evolution of a failure may:

- Be interrupted or modified by a Failure Effect Interruption (FEI)
- Be tempered by a Failure Effect Limitation (FEL),

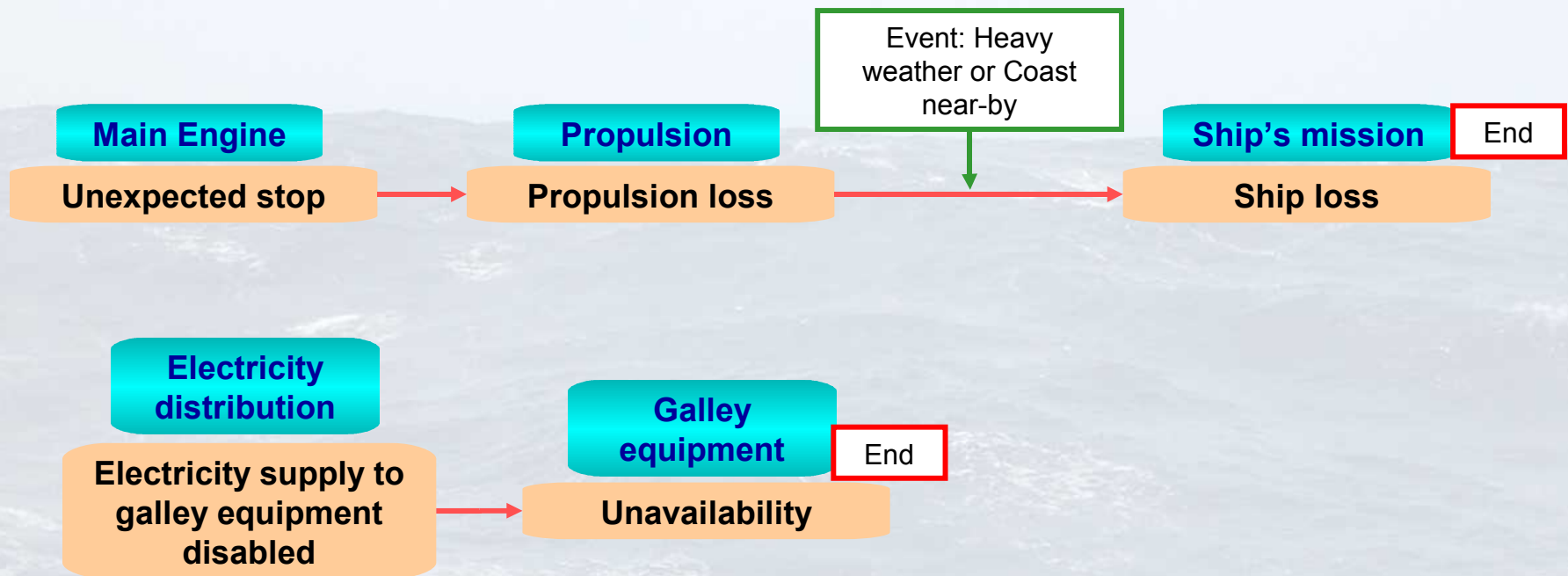
This mean may be implemented permanently, automatically or manually in time after detection.



# Risk Assessment - 2. Failure Modes and Effects Analysis

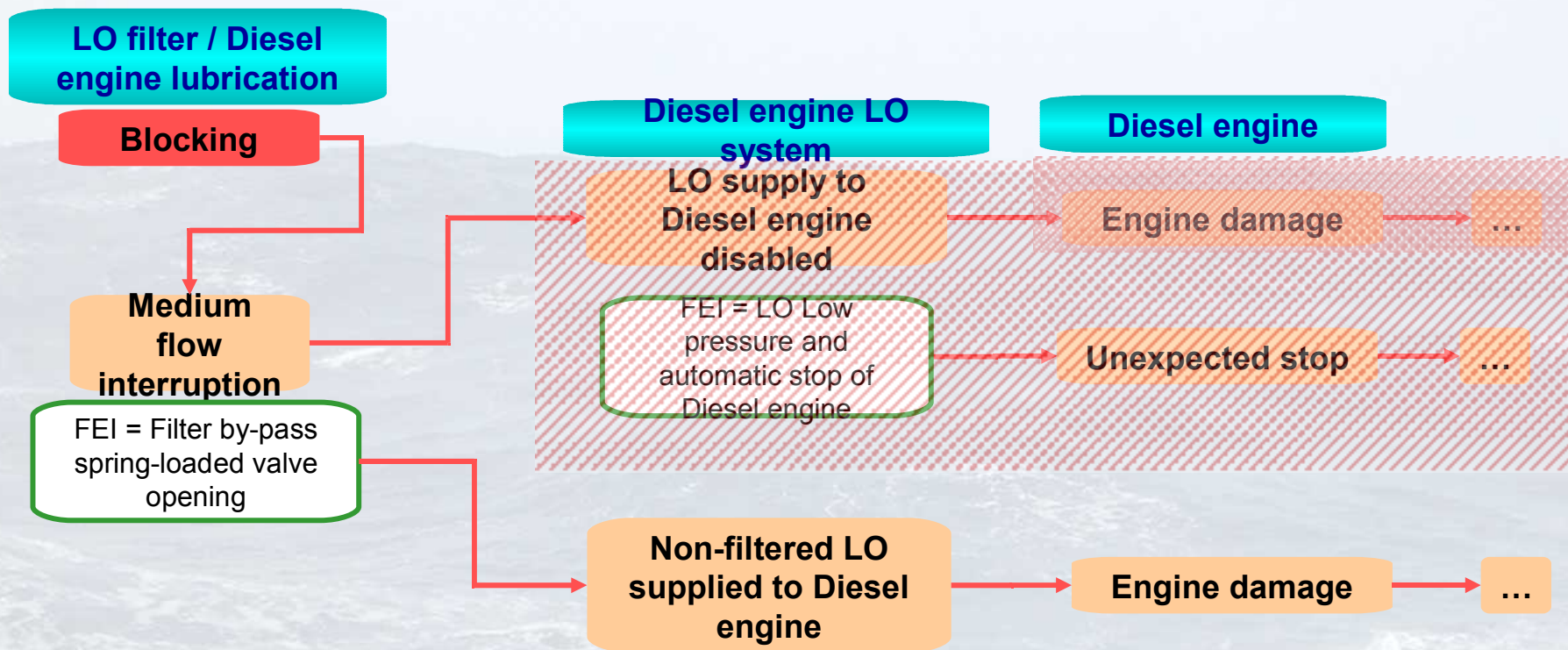
The evolution of a failure may:

- Be stopped when the feared situation is reached (at Ship's mission level), or when insignificant.



# Risk Assessment - 2. Failure Modes and Effects Analysis

Assessment of equipment failure impact on ship's mission (example)



More than 4000 studied failures per vessel ...

# Risk Assessment - 3. Criticality Analysis

**Significance of consequences on Ship's mission is quoted:**

- by BV on safety side (ship loss, pollution, physical injury ...),
- by Customer on economic side (cargo damage, ship voyage delay, equipment damage, waste treatment disabled ...).

Significance Index

Deaths; ship loss; environmental catastrophe	<b>Catastrophic</b>		<b>1</b>
Critical injury; major ship damage; pollution	<b>Critical</b>		<b><math>1.10^{-1}</math></b>
Minor injury; ship damage; ship unavailable for days	<b>Severe</b>		<b><math>1.10^{-2}</math></b>
Possible injury or damage; ship unavailable for hours	<b>Marginal</b>		<b><math>1.10^{-3}</math></b>
Ship's performance impaired	<b>Negligible</b>		<b><math>1.10^{-4}</math></b>



**Risk = Significance** of failure effects **x Probability** of failure occurrence

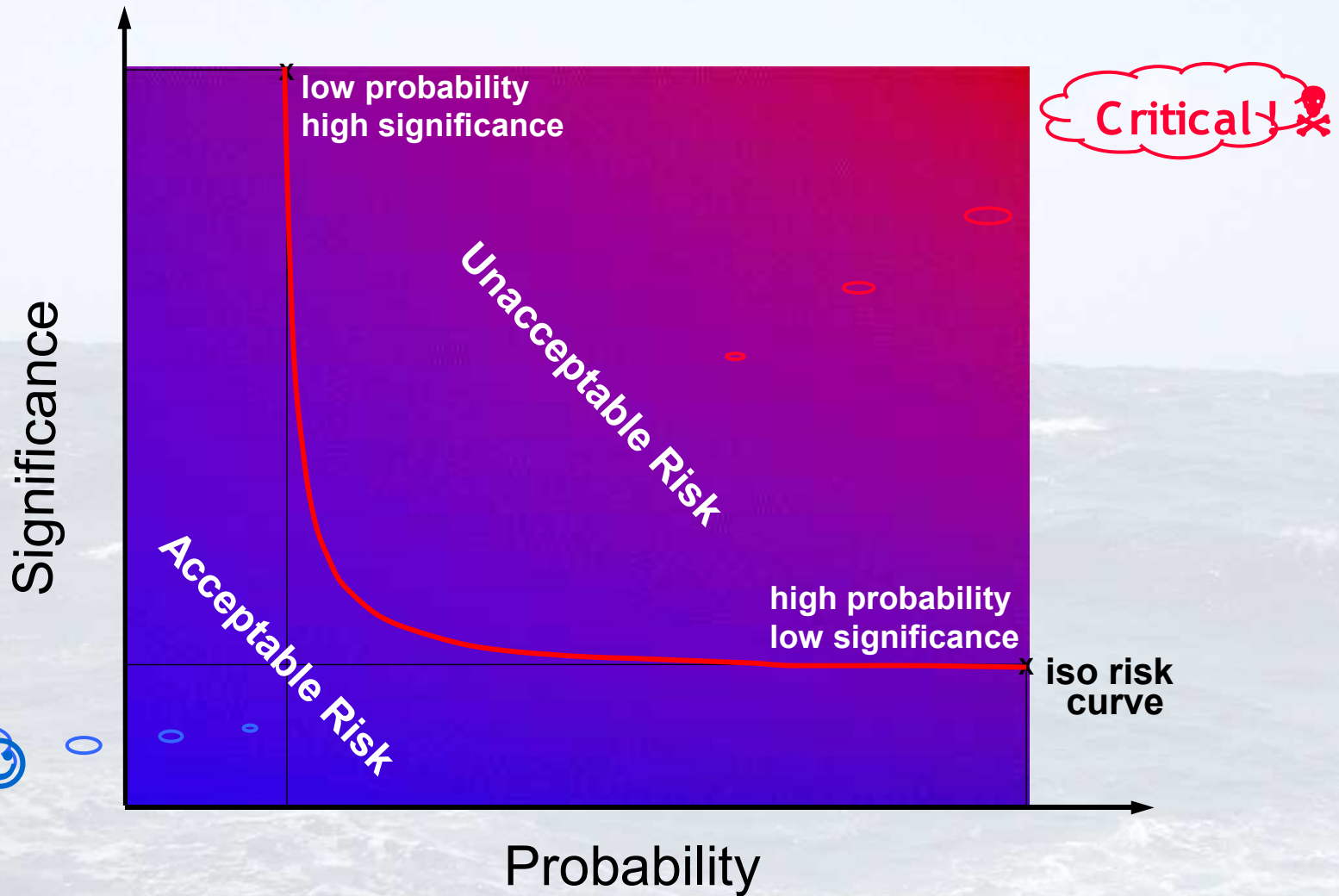
In this calculation, estimated equipment usage rates are taken into account, as well as the expected ship life.

Acceptable risk criterion has been defined on:

- Analysis of historical maritime catastrophes over the last 40 years,
- Aeronautics methodologies  
(Maintenance Steering Group-3, Federal Aviation Regulation...),
- B.V.'s expertise



# Risk Assessment - 4. Risk quantification & « critical » items

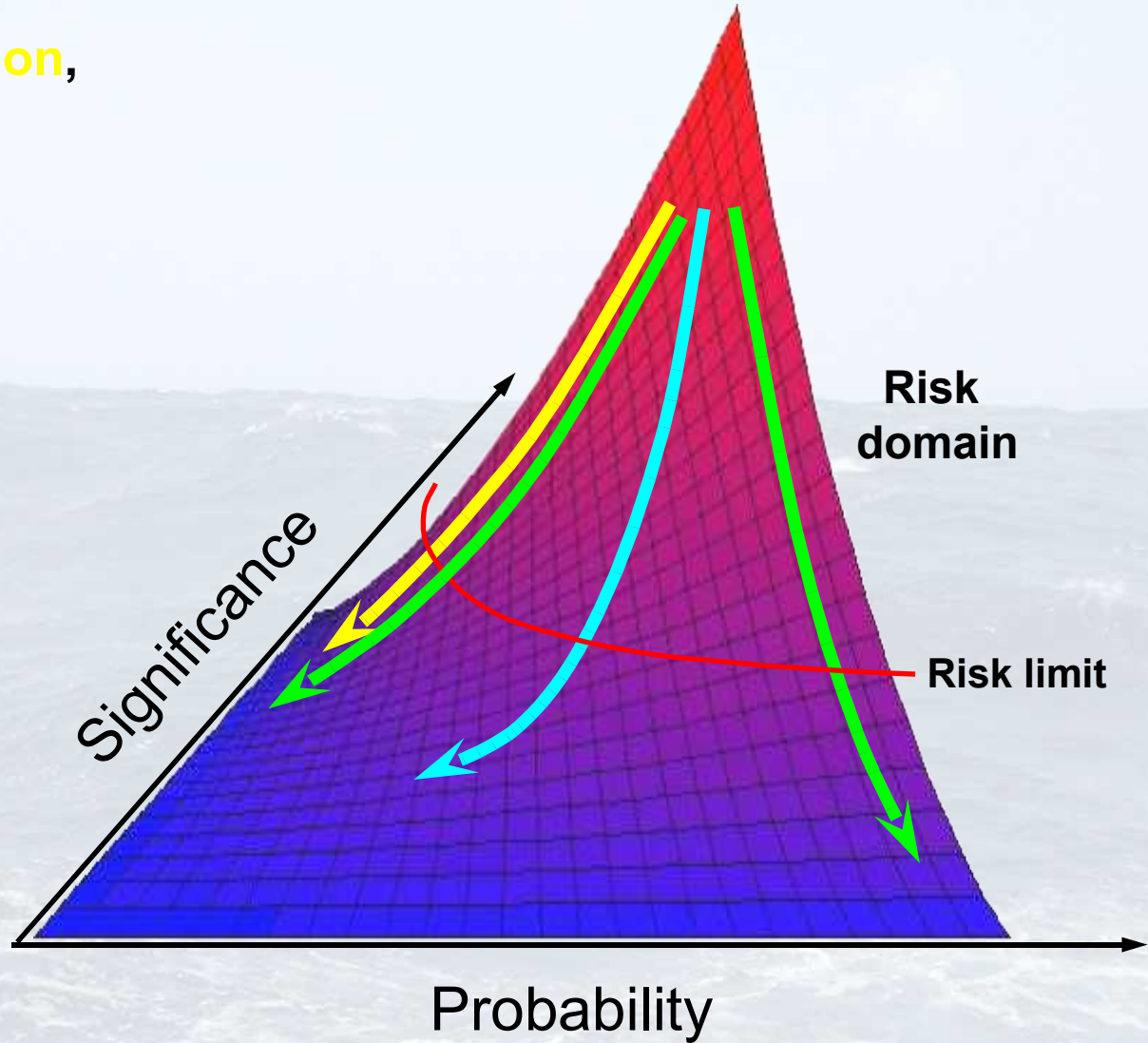
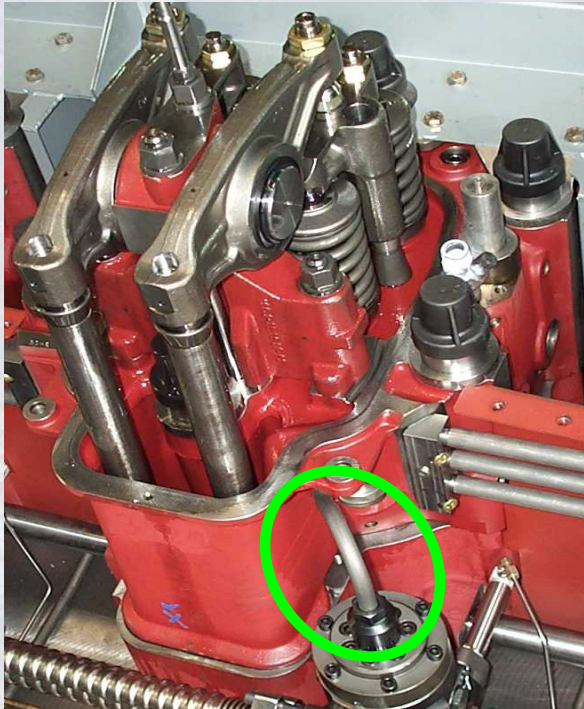


Among 4000 studied failures, half may be critical ...

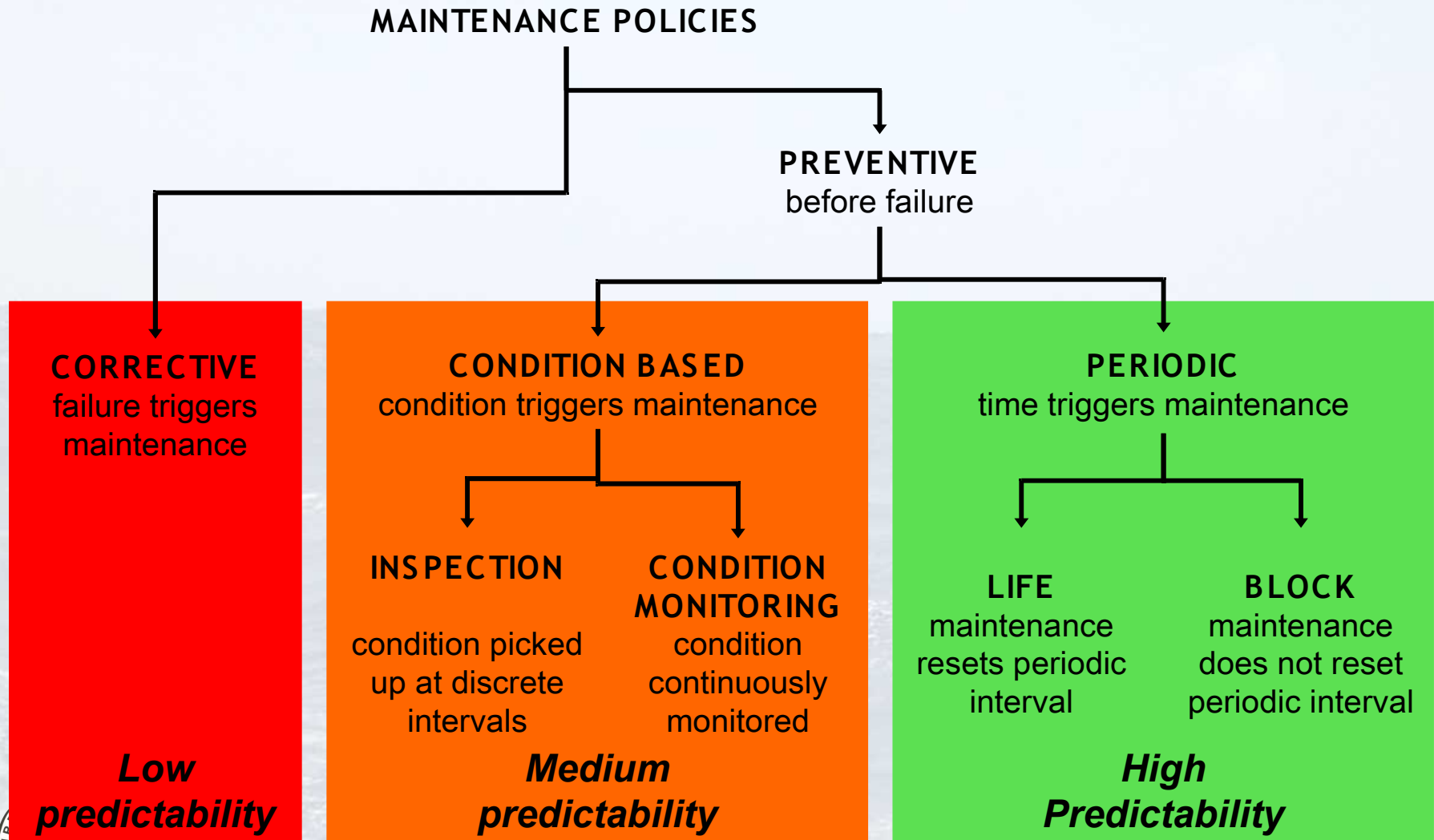


# Risk Assessment - 5. Risk Reduction

- Maintenance application,
- Design Modification,
- Combination.



# Risk Assessment - 5. Risk Reduction by Maintenance



## The risk analysis leads to:

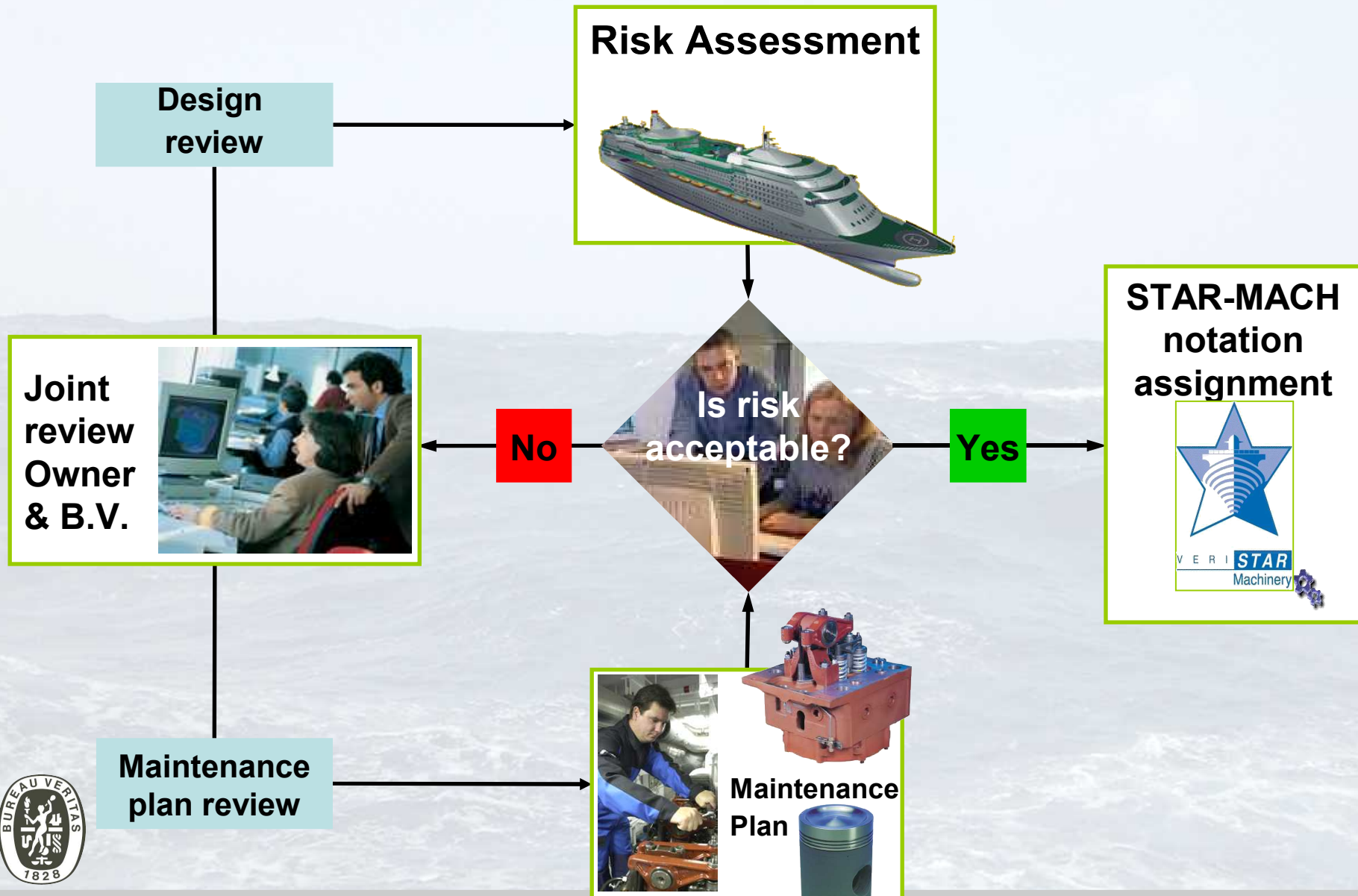
- Identification of critical equipment onboard
- Validation of the ship maintenance plan
- Proposals of maintenance modifications :  
adjustment of existing preventive maintenance intervals, addition of preventive maintenance
- Issuance of a report.

## The risk analysis can be carried out:

- In the scope of classification, by means of an additional class notation STAR-MACH
- Outside the scope of classification as a consultancy service.



# Classification - STAR-MACH notation assignment



## > Risk Assessment

- Ship Risk analysis carried out,
- Ship maintenance plan validated.

## > Approval of CMMS\*

- Required software functionalities approved for audits purposes (NR496 DTM).

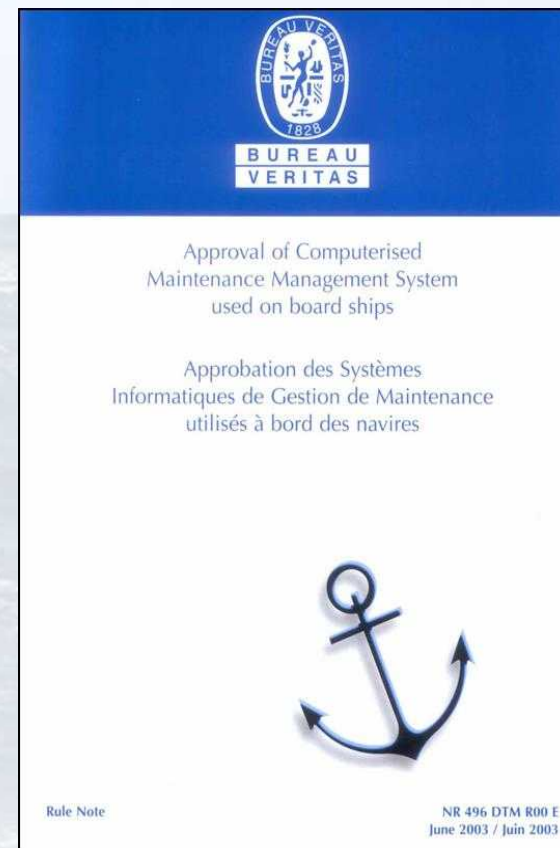
## > On board Implementation survey

- Procedures and supporting tools ready for operation,



**Crew familiar with the CMMS\*.**

**\*CMMS: Computerised Maintenance Management System**



# Classification - STAR-MACH notation maintenance

The maintenance of the STAR-MACH notation is based on the PMS\* survey system:



Ship in service

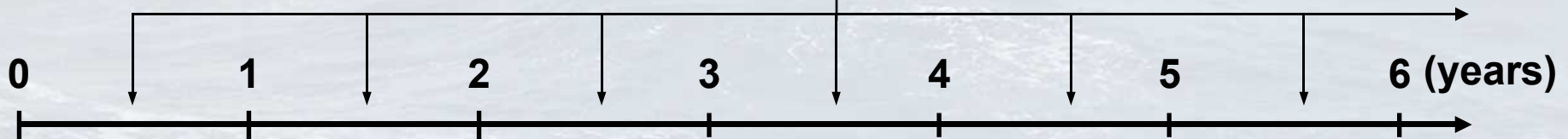
Surveys may be conducted by the Ch. Eng. at an interval which is stated in the maintenance plan and may be based on equipment running hours, and are then credited by a BV Surveyor.

The Ch. Eng. is allowed to carry out inspections on behalf of BV except for:  
• pressure vessels, boiler, tail shaft

## Ship board Audit



Ship board audits are carried out at the same time as Annual Machinery Surveys to verify the effective implementation of maintenance plan by auditing the CMMS.



\* PMS : Class Renewal Survey (Planned Maintenance Scheme)

# Classification - STAR-MACH notation maintenance

Need of maintenance tuning:

- Effective service life of equipment is different than forecasts made during the risk assessment,
- Changes in ship operational profile: routes, fuel oil quality...



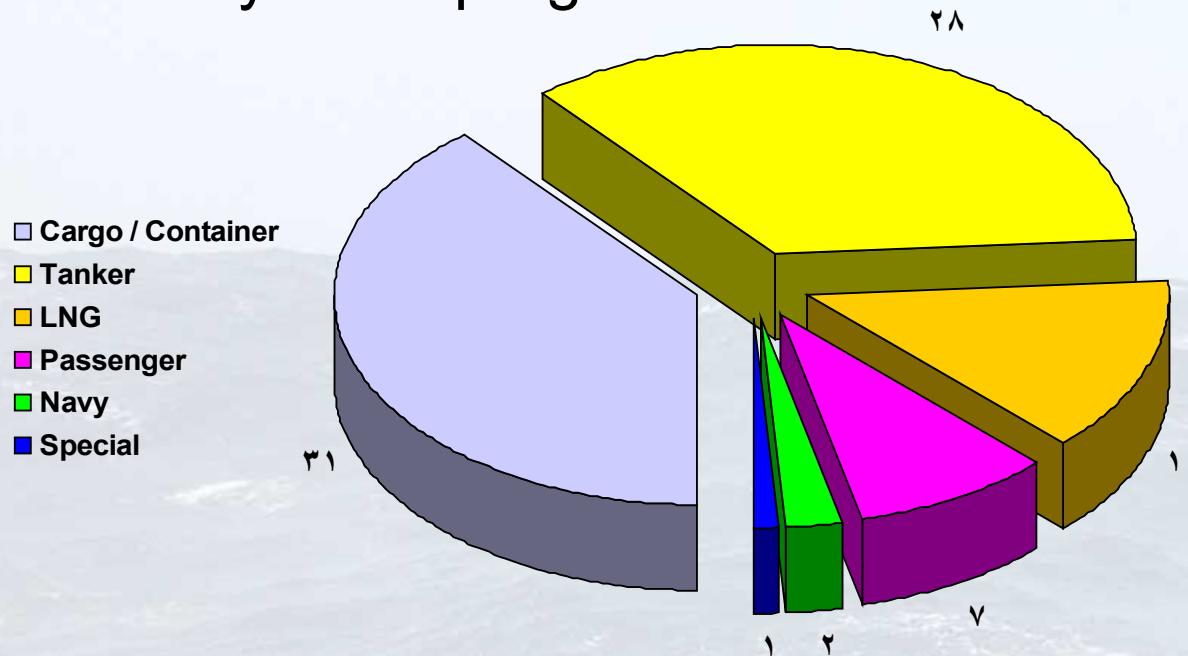
**Ship in service**

The maintenance of the STAR-MACH notation includes an additional annual audit at ship owner's office:

- Equipment performance deviation,
- Failures and maintenance records,
- Ship specific database up-date,
- Risk assessment review if necessary,
- Maintenance plan tuning,
- Statistics comparison between ships.



67 risk analyses completed,  
13 risk analyses in progress.



15 are non-BV classed vessels.



## VeriSTAR-Machinery exhibits owner's commitment to safety:

- Critical items identified by means of risk analysis,
- Implementation of maintenance procedure,
- Records to demonstrate effective implementation.

## Ship is maintained:

- to its highest value (global reliability),
- in compliance with rules with a minimum of ship down time.



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Machinery 



THANK YOU FOR YOUR ATTENTION

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