



# Watertight Doors in Passenger ship design

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- Founded in 1795
- 100% family owned
- 2 locations – 1 shipyard
  - Meyer Werft in Papenburg
  - Neptun Werft in Rostock



- 11 production halls
  - 2 covered building docks
  - 4 halls for unit and pipe production
  - 5 halls for laser welding and flow line for block production
- Largest covered shipbuilding hall in the world (504 m x 125 m)
- Europe's largest laser centre
- Crane capacity of up to 800 t per crane
- Own cabin production

## Cruise ships



Ships: 36 (+5)

## River cruise ships



Ships: 27 (+15)

## Research ships



Ships: 0 (+1)

## Gas tankers



Ships: 56

## Island ferries



Ships: 29

## Ferries / Cruise ferries



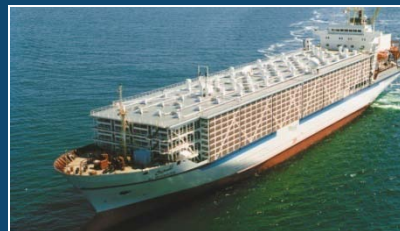
Ships : 32

## Passenger ships



Ships: 24

## Livestock carriers



Ships: 27

## Container ships



Ships: 4

## Meyer Werft, Papenburg



**Norwegian Cruise Line**  
**Norwegian Getaway**  
**2014**



**Royal Caribbean International**  
**Quantum of the Seas 2014**  
**Anthem of the Seas 2015**



**Research ship**  
**Sonne delivery 2015**



**Norwegian Cruise Line**  
**S. 693 delivery 2015**  
**S. 694 delivery 2017**

## Neptun Werft, Rostock



**16 River cruise vessels**  
**delivery until 2014**



2000 – Aurora

76,000 GT Purpose-built for British market



2001 – Radiance of the Seas

90,000 GT Gas turbine & pod propulsion



2001 – Norwegian Star

92,000 GT Freestyle design



2004 – Pont-Aven

41,000 GT High-speed cruise ferry



2005 – Norwegian Jewel

93,500 GT Largest panmax design



2007 – AIDAdiva

68,500 GT Compact „Club“ design



2008 – Celebrity Solstice

122,000 GT 1<sup>st</sup> ship with 1000+ balcony cabins



2010 – Disney Dream

130,000 GT Surprise for the industry



2013 – NCL Breakaway

146,600 GT Optimized industrialized design



2014 – Quantum of the Seas

167,000 GT Energy saving as a key element



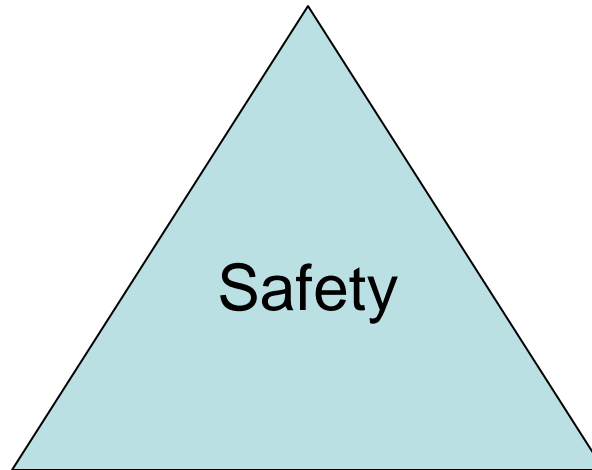
2015 – NCL Breakaway Plus

163,000 GT Evolution of Breakaway

- To achieve a good safety level a careful balance is needed

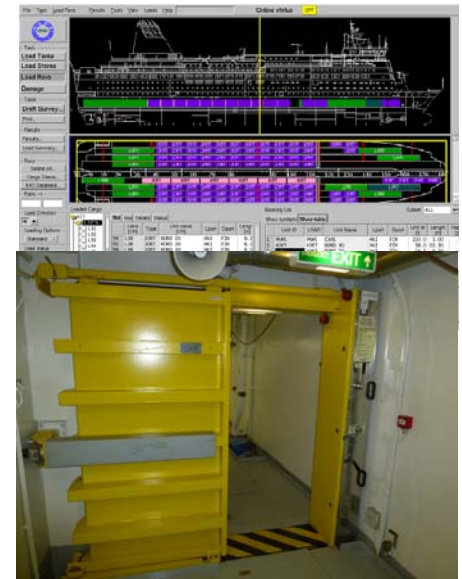
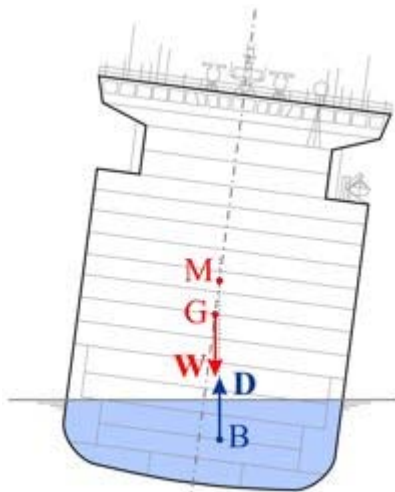


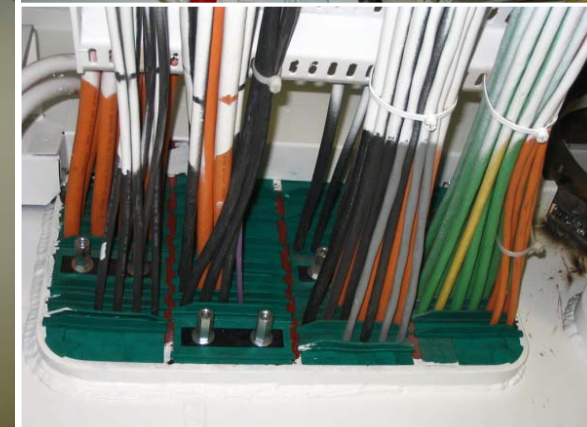
## Regulations



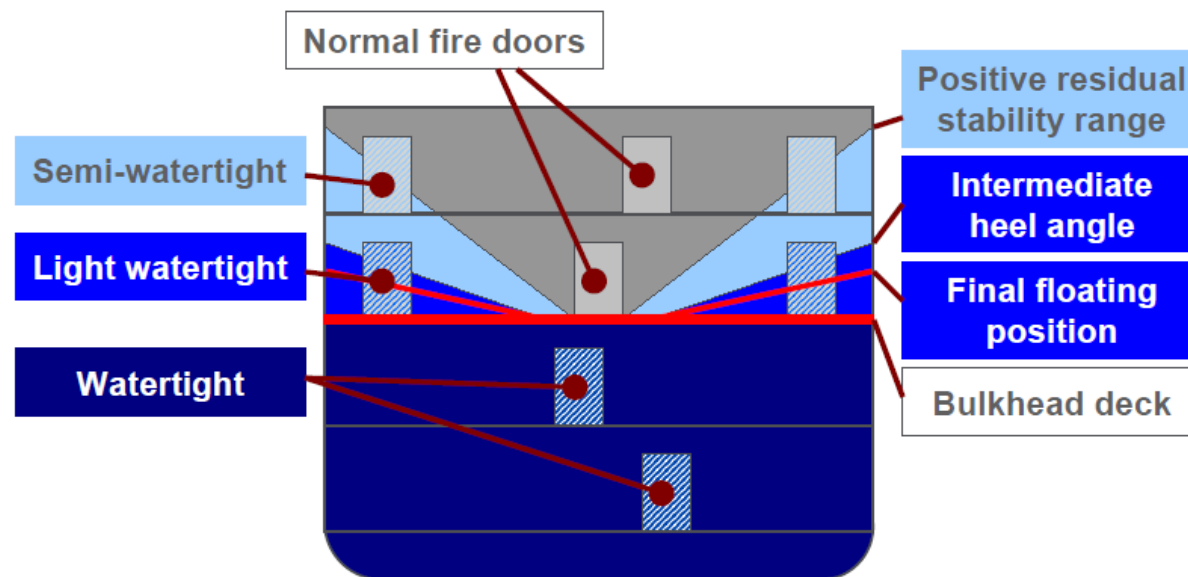
## Design

## Operation

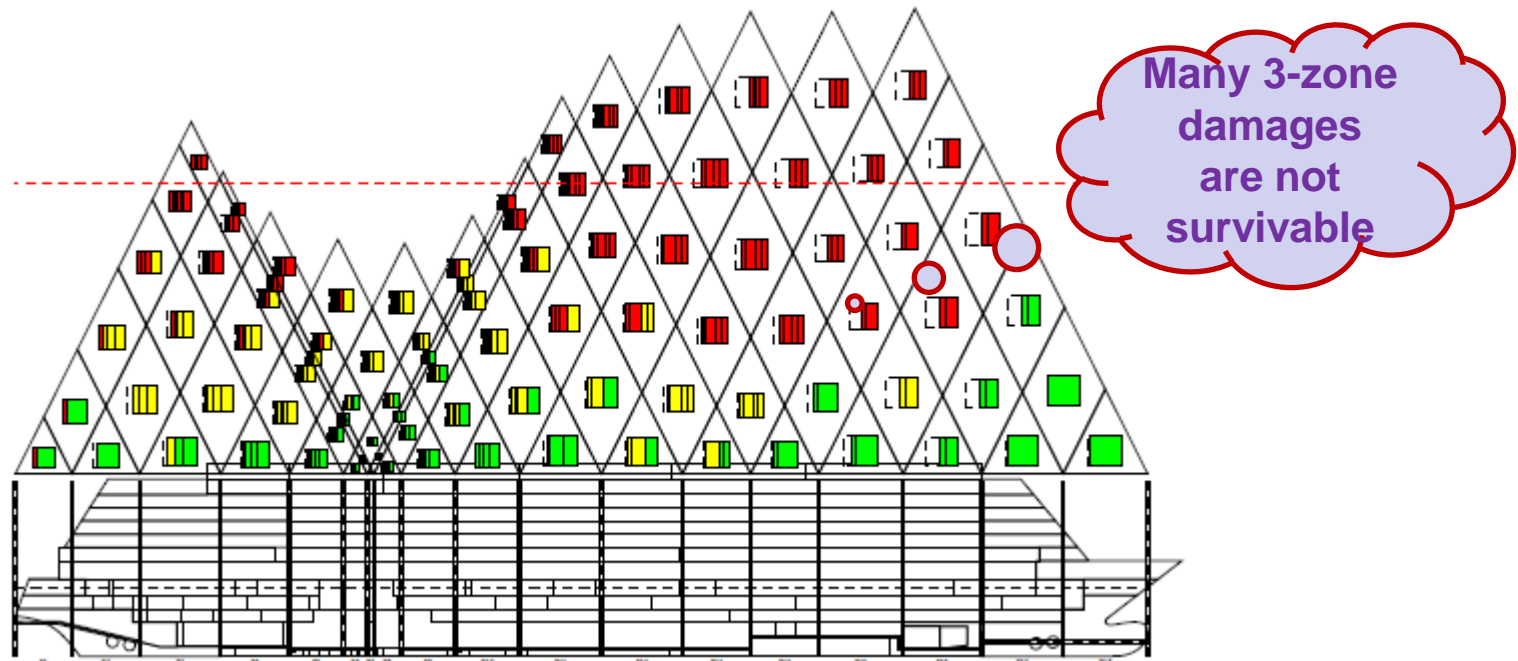


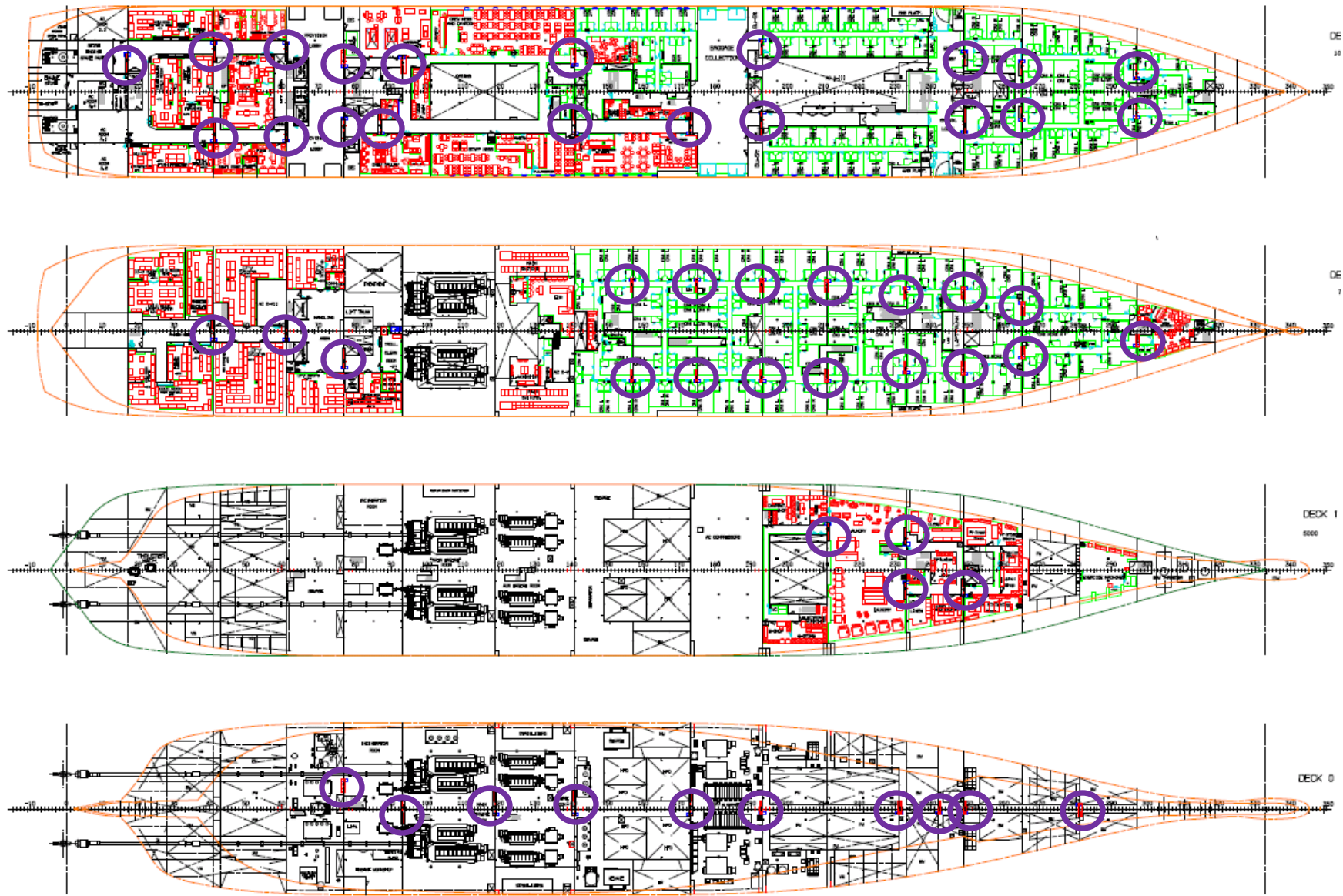


- Different type of doors used
  - Normal WTD below bulkhead deck
  - Light WTD with reduced scantlings, otherwise like normal WTD
  - Semi-watertight doors: to be used with GZ range only, not below immersion line
  - Fire doors
- Use of doors during navigation may be different
  - WTD always closed
  - Semi-WTD and fire doors may be kept open



- All damage stability calculations are based on **closed** water tight doors
- Operational needs are not considered carefully during design in the past
- Layout of the vessel may be in conflict with operational needs
- Many ships have exemptions to have WTDs open during navigation



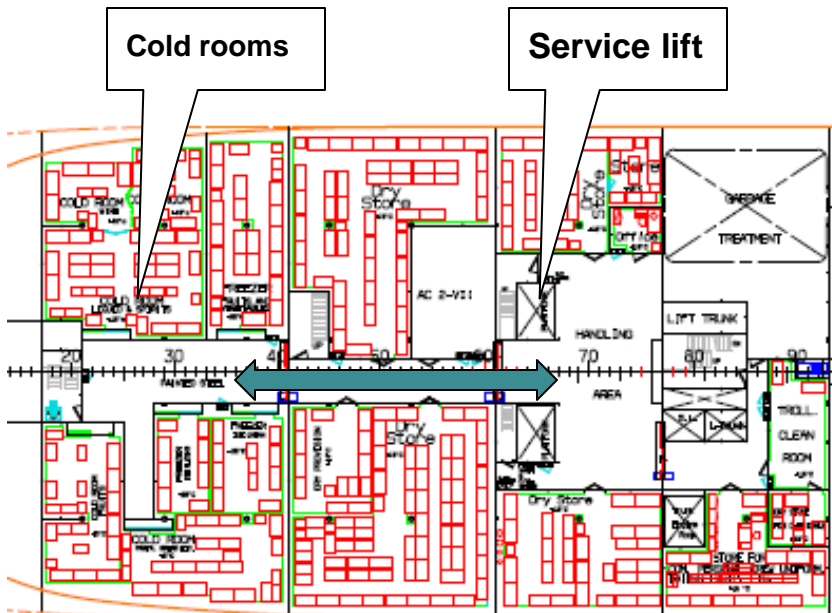
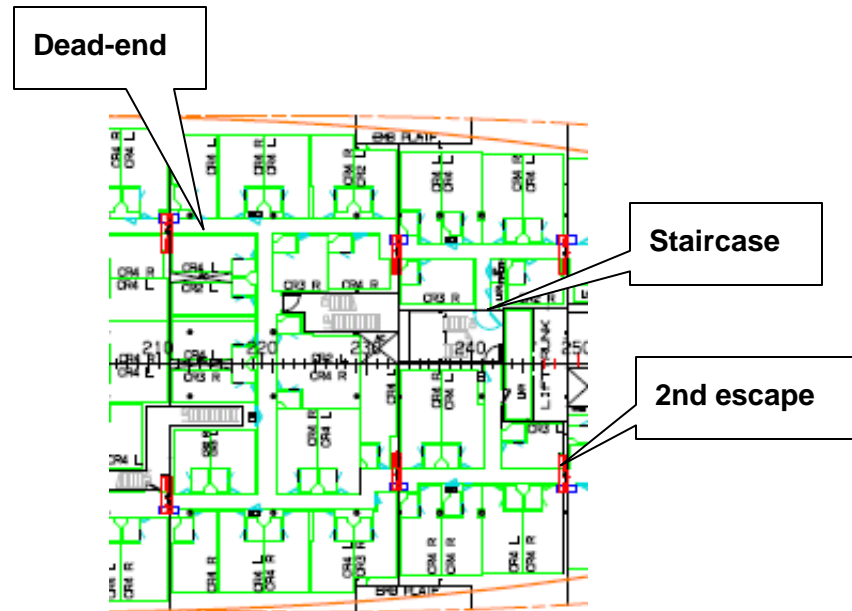


- **Why are ships built with watertight doors?**
  - effective use of the available space
- 2<sup>nd</sup> means of escape
- Avoiding dead-end corridors
- Used for transport of goods
- Maintenance and transport of spare parts

2<sup>nd</sup> means of escape

Avoiding dead-end corridors

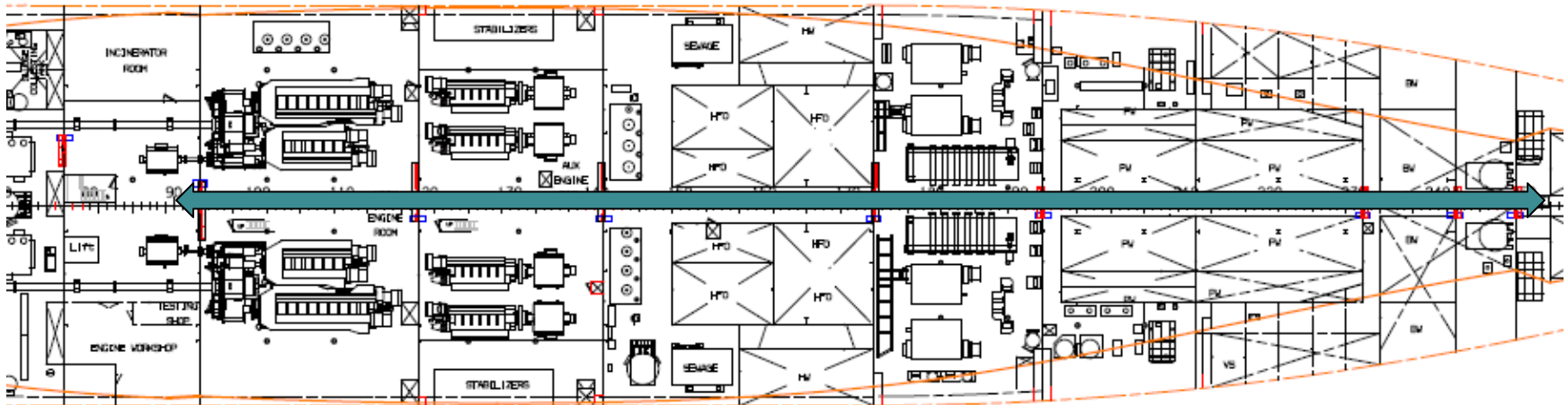
Used for transport of goods



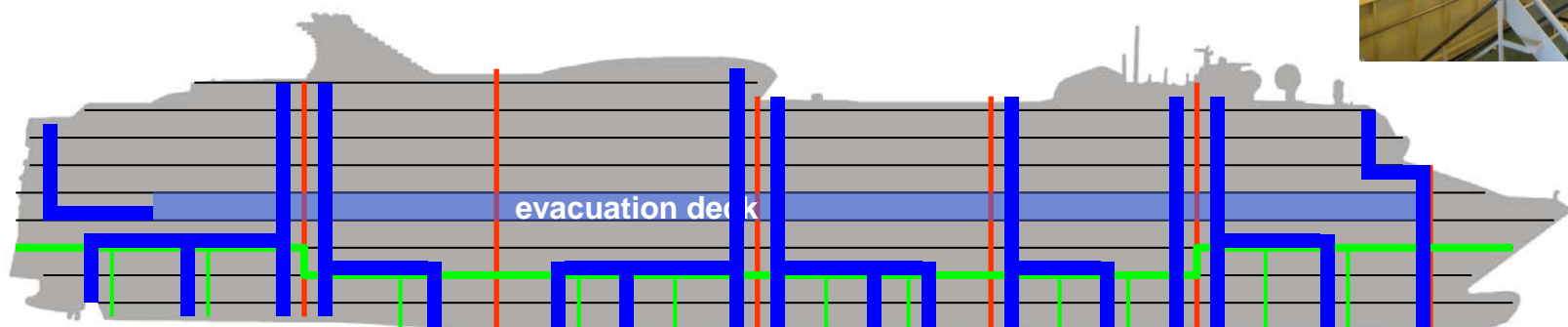
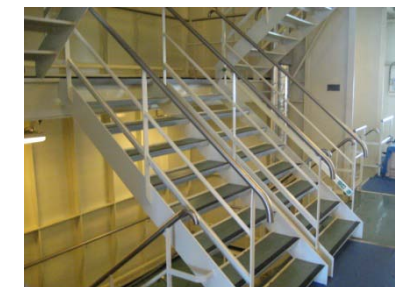
## Maintenance and transport of spare parts

easy connection of engine rooms is desired by many chief engineers

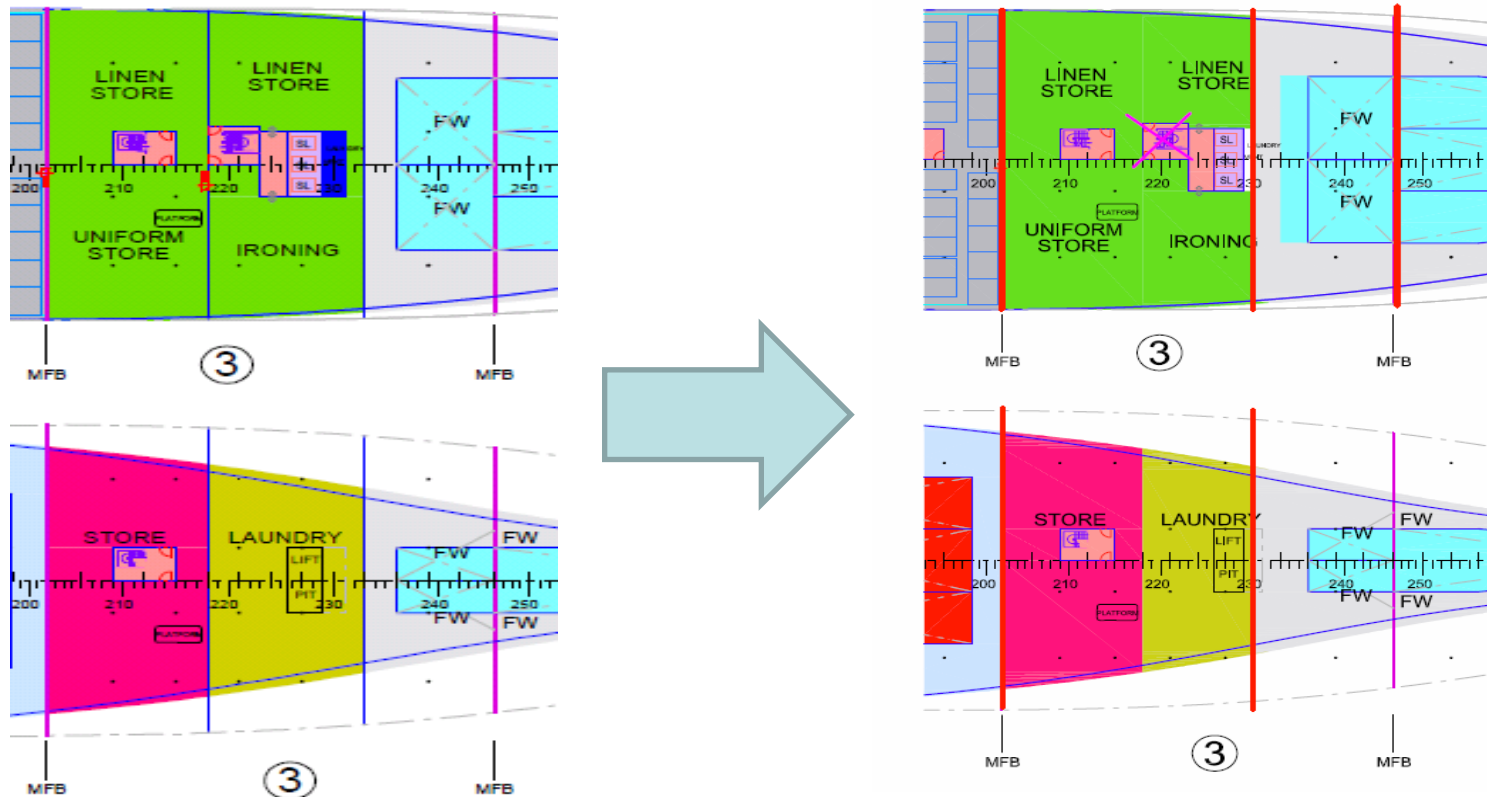
Ships have been designed in the past without the right balance between daily operation and damage stability



- Evacuation has a high priority in ship design
- Each main vertical zone has a well protected staircase leading to the life boat deck and assembly stations
- Each watertight compartment has a vertical escape to the boat deck inside a protected stair case
- Each space requires 2 independent means of escape

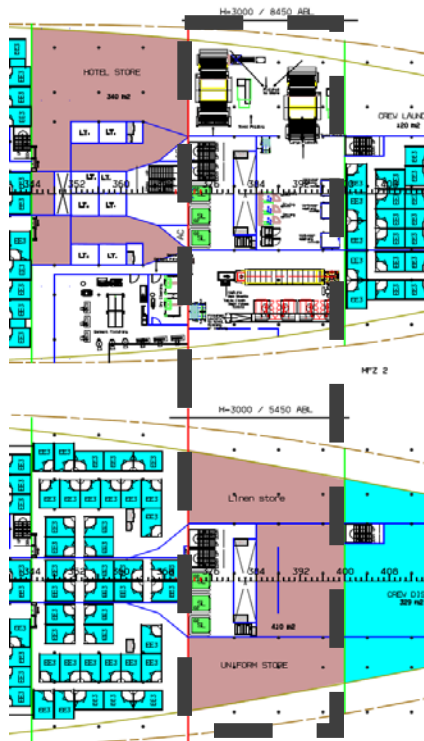


- Design can be adapted to keep WTDs closed
- To be considered at an early design stage
- Survivability (attained index A) may be reduced
- Example “Laundry” in larger compartment:

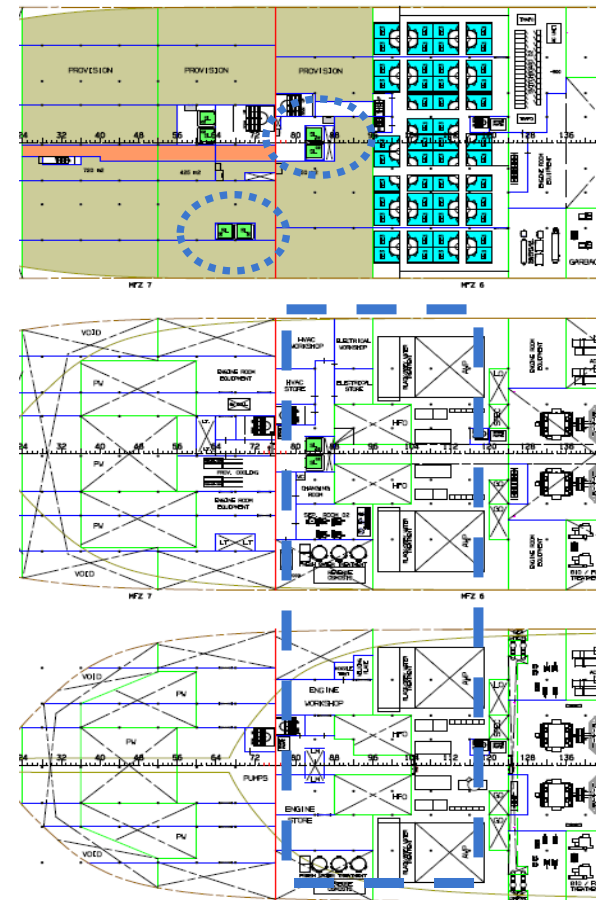


- Other examples

Laundry arrangement on  
two decks  
In one compartment

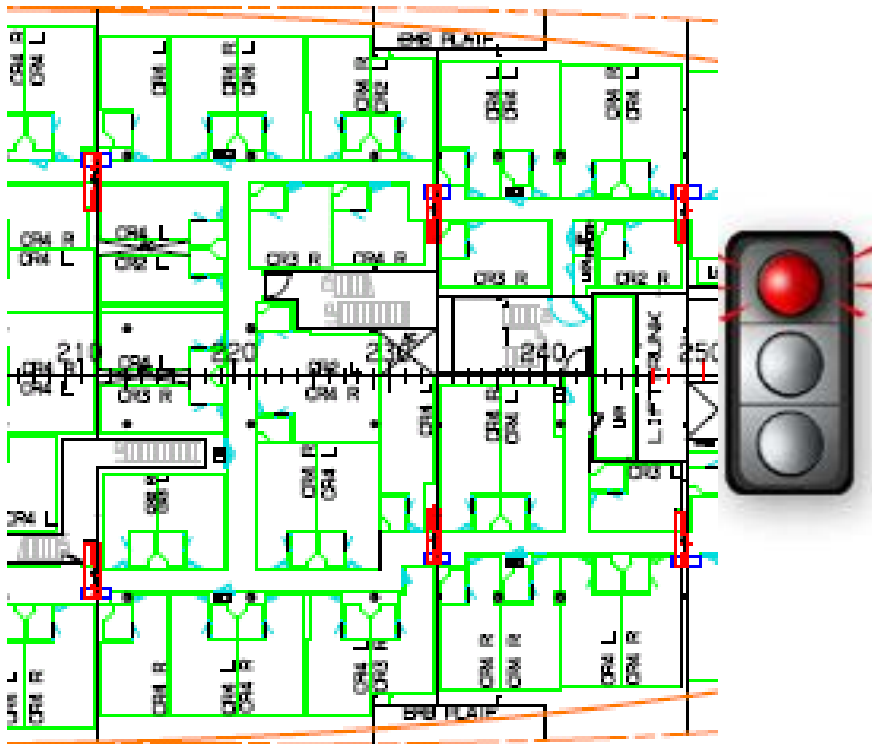


Workshops in one compartment  
Multiple lifts to access provision rooms

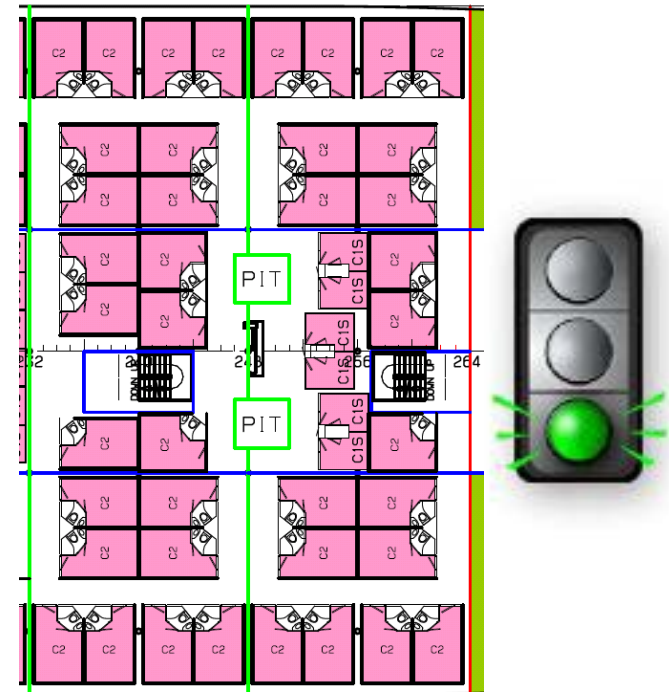


- Optimized cabin arrangement to minimize the number of doors

### Six WTD in 2 compartments



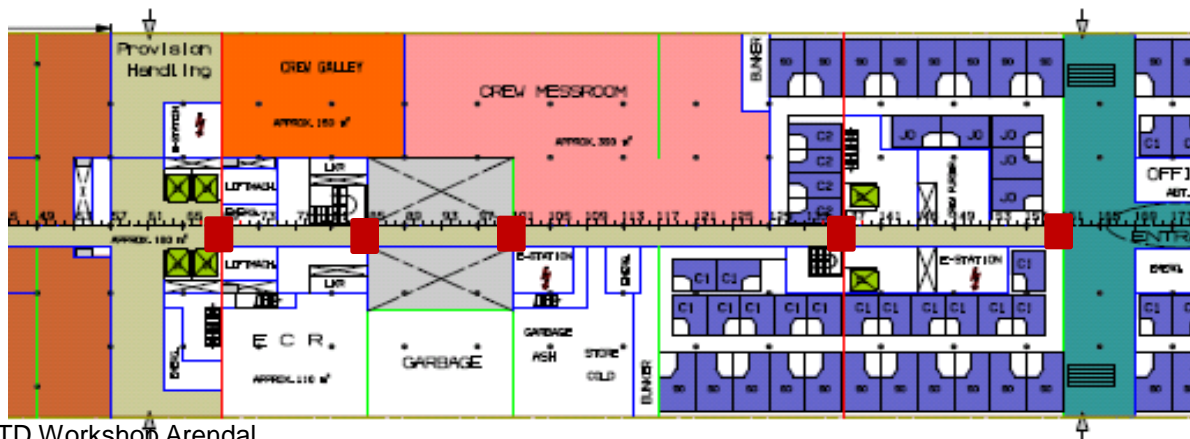
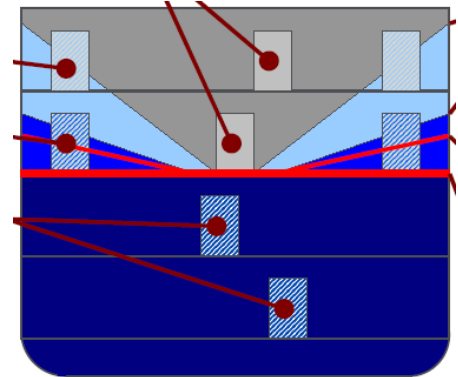
### One WTD in 2 compartments



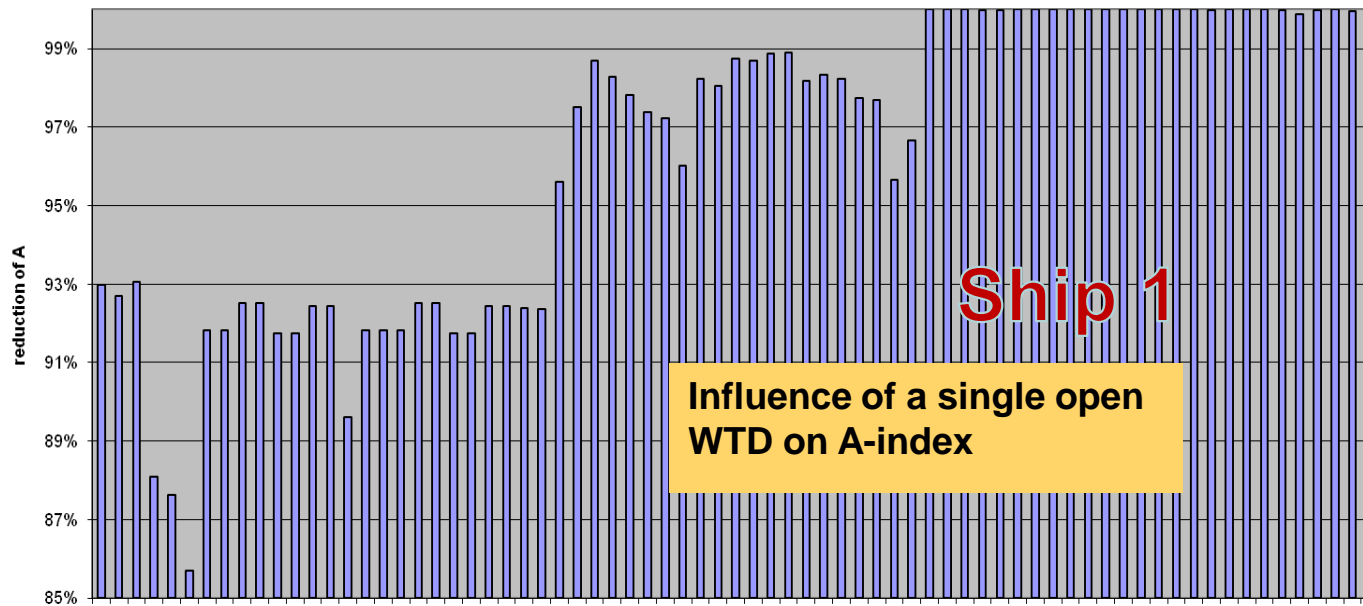
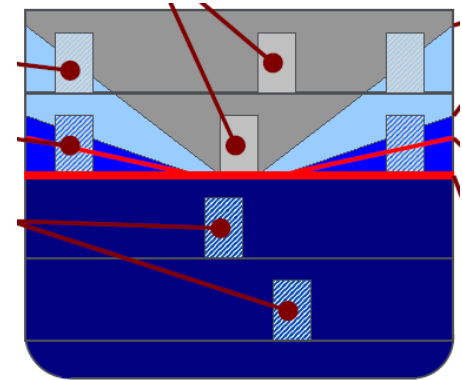
- Layout of bulkhead deck to meet many different requirements
  - Subdivision with partial bulkheads
  - Escape from watertight compartments
  - Longitudinal corridor for crew and goods
  - Control stations



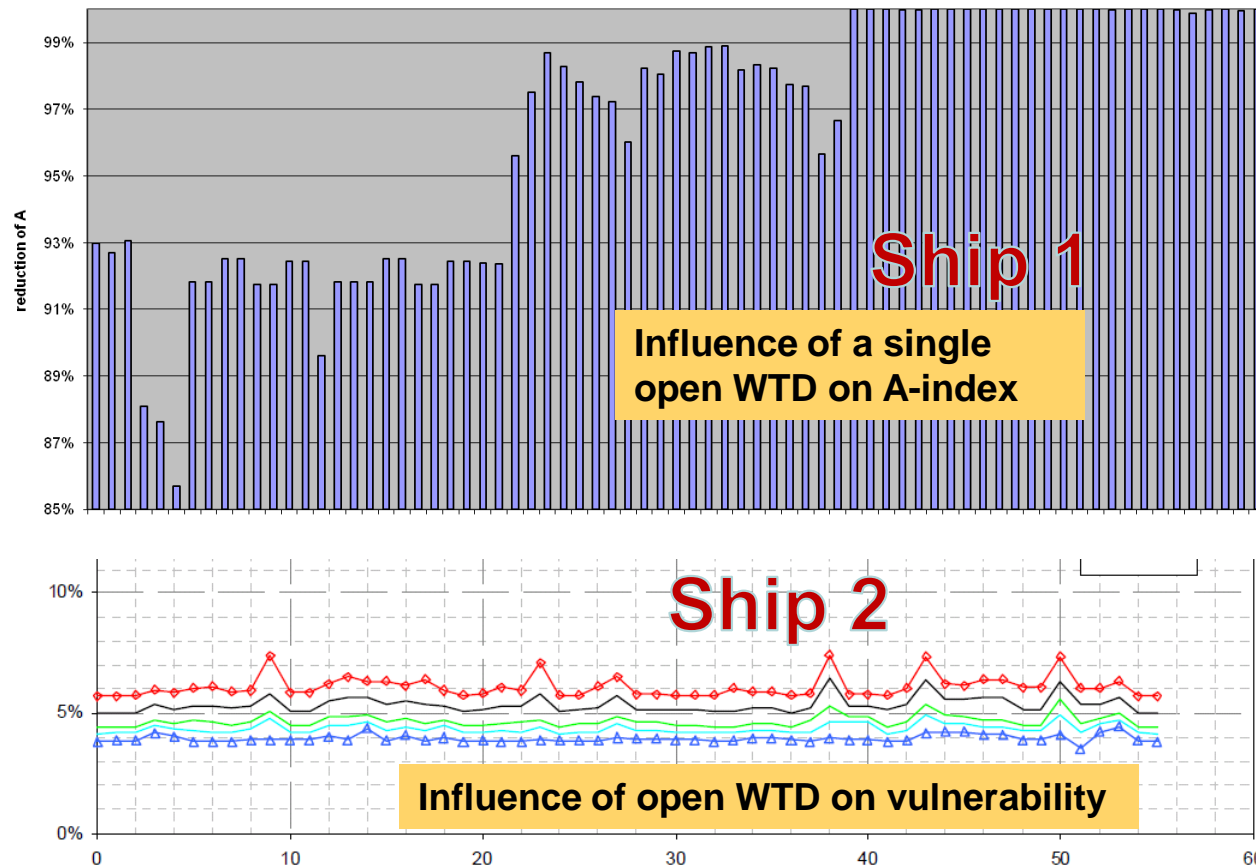
- Use of fire doors in way of central corridor
- Fire doors sustain 2.5m water level with only small leakage
- May be used to restrict progressive flooding on bulkhead deck
- Improves subdivision without the undermining overall risk
  - Fire doors may be used in escape ways
  - No risk for injuries like for WTD



- MSC Circ 1380 defines different categories of doors
- The categories need to be discussed, but
- Doors may have significantly different influence on survivability
- Acceptance to use water tight doors should reflect the influence on survivability



- Design should be optimized to minimize the influence of open water tight doors
- Number of doors to be further reduced
- Latest designs show equal vulnerability for open water tight doors



- Design and operation need to be aligned from early design
- All damage stability calculations assume all WTD closed
- Operation may require the connection between certain spaces
- Risk for injuries for crew and passengers is very high during closing of WTD
- Good example for a possible balanced approach between stakeholders
  - Designers: design subdivision following operational needs
  - Operators. Cooperate in early design stage, change traditional procedures to maintain watertight integrity
  - Academia: provide methods and tools to keep crew alerted
  - Regulators: force all designers and operators to keep doors closed for new ships



- Safety is one of the key objectives of passenger ship design
- Watertight doors are a vital component to achieve the desired survivability
- The cruise ship industry works pro-active
- Safety levels need to be continuously reviewed and adjusted if needed
- Only with close cooperation between operators, shipyards and administrations the good safety record can be further improved