



# Grote installaties en EMC

## Scheepvaart

Standaardisatie

**IEC / NEN**

**TC 18**

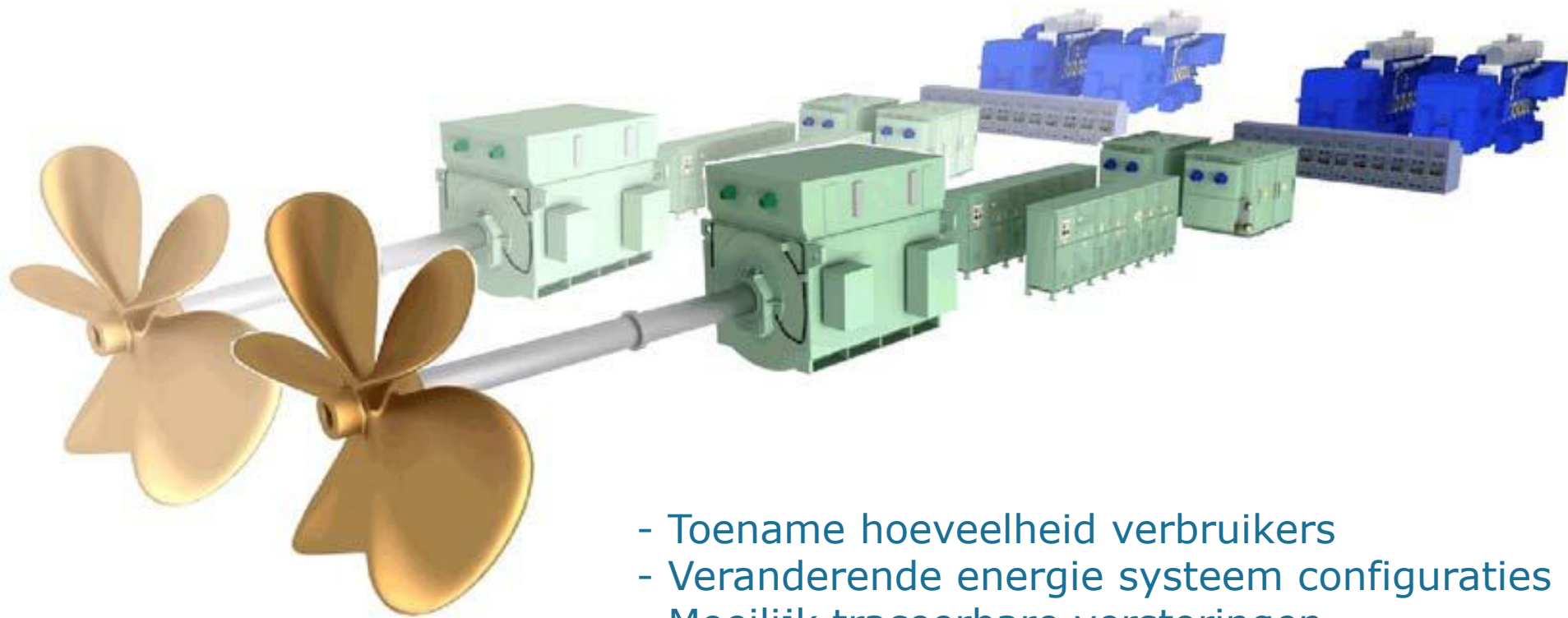
**IEC 60092 serie**

Elektrische installaties aan boord van schepen

A.J. Blokland IEC/TC 18



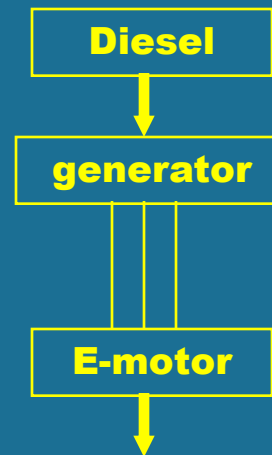
# Geïntegreerde energie systemen en EMC ?



- Toename hoeveelheid verbruikers
- Veranderende energie systeem configuraties
- Moeilijk traceerbare verstoringen



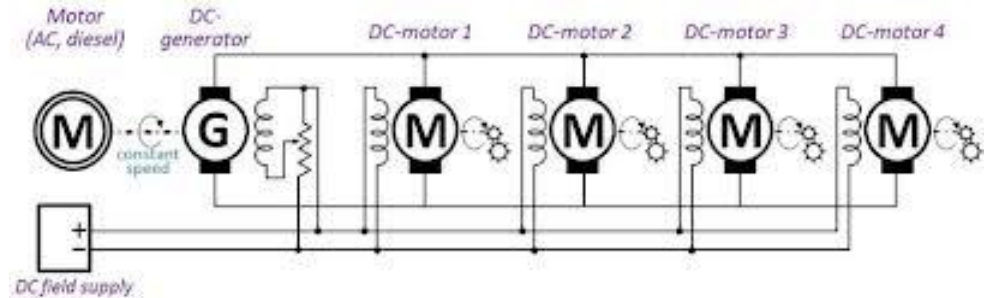
# Elektrische as 1890 - heden



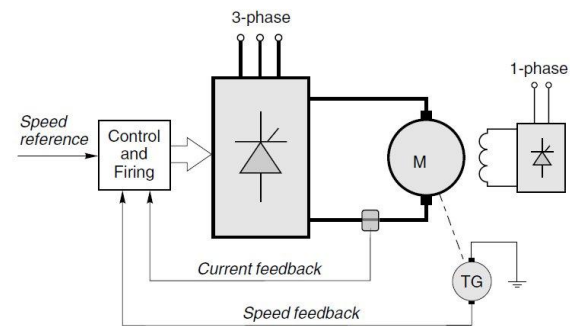
$$N = (60 \times f) / p$$



**Buyskes / Blommendal 1972**



**Tydeman 1975 (introdunctie vermogens elektronica)**



# 6.6 kV AC & frequentie geregeld



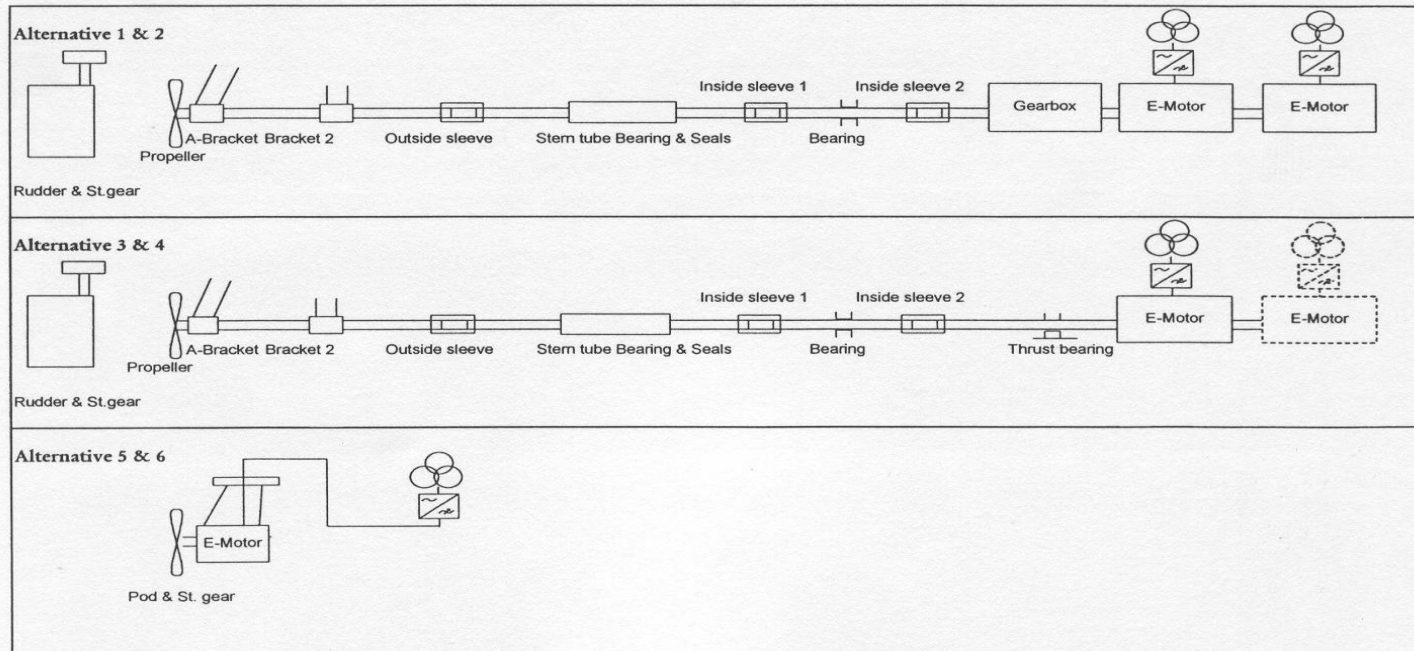
## Elektrische voortstuwing



**LPD1 1998**

**LPD2 2005**

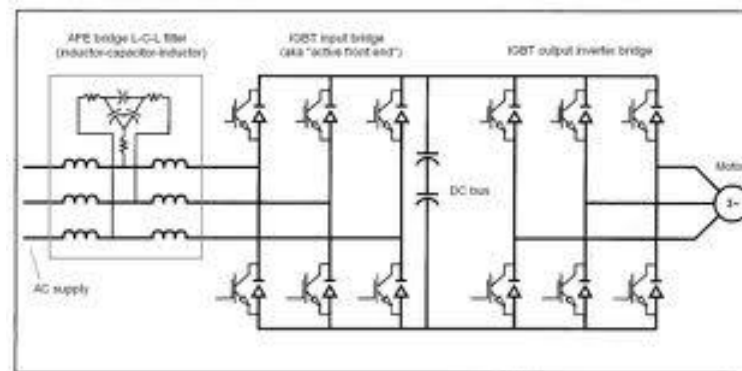
**JSS 2014**

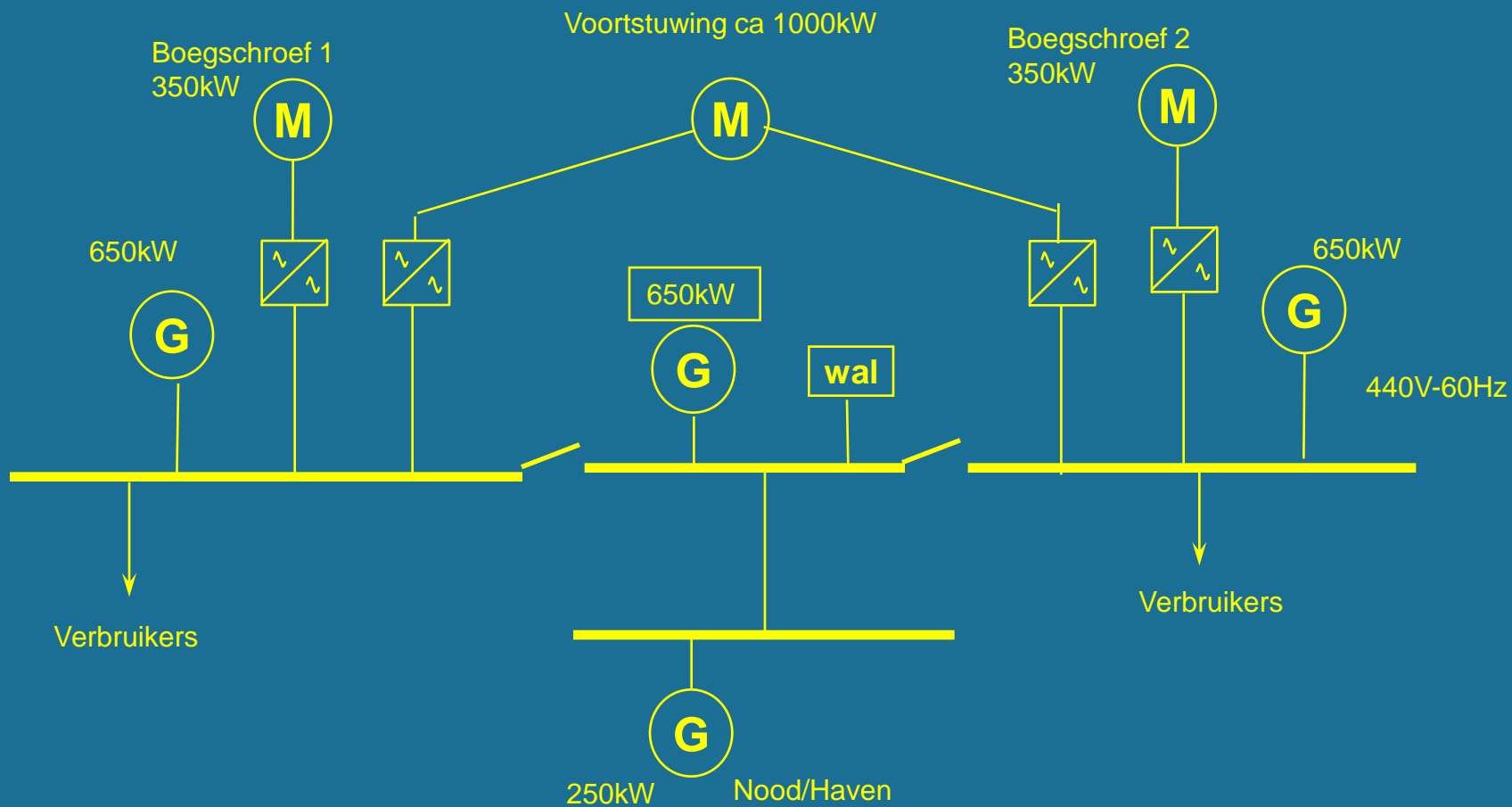


# AFE (Active Front End) 2003 HOV



## Elektrische voortstuwing





## HOV AFE

## Toekomst schepen DC grid

2 DC Busses

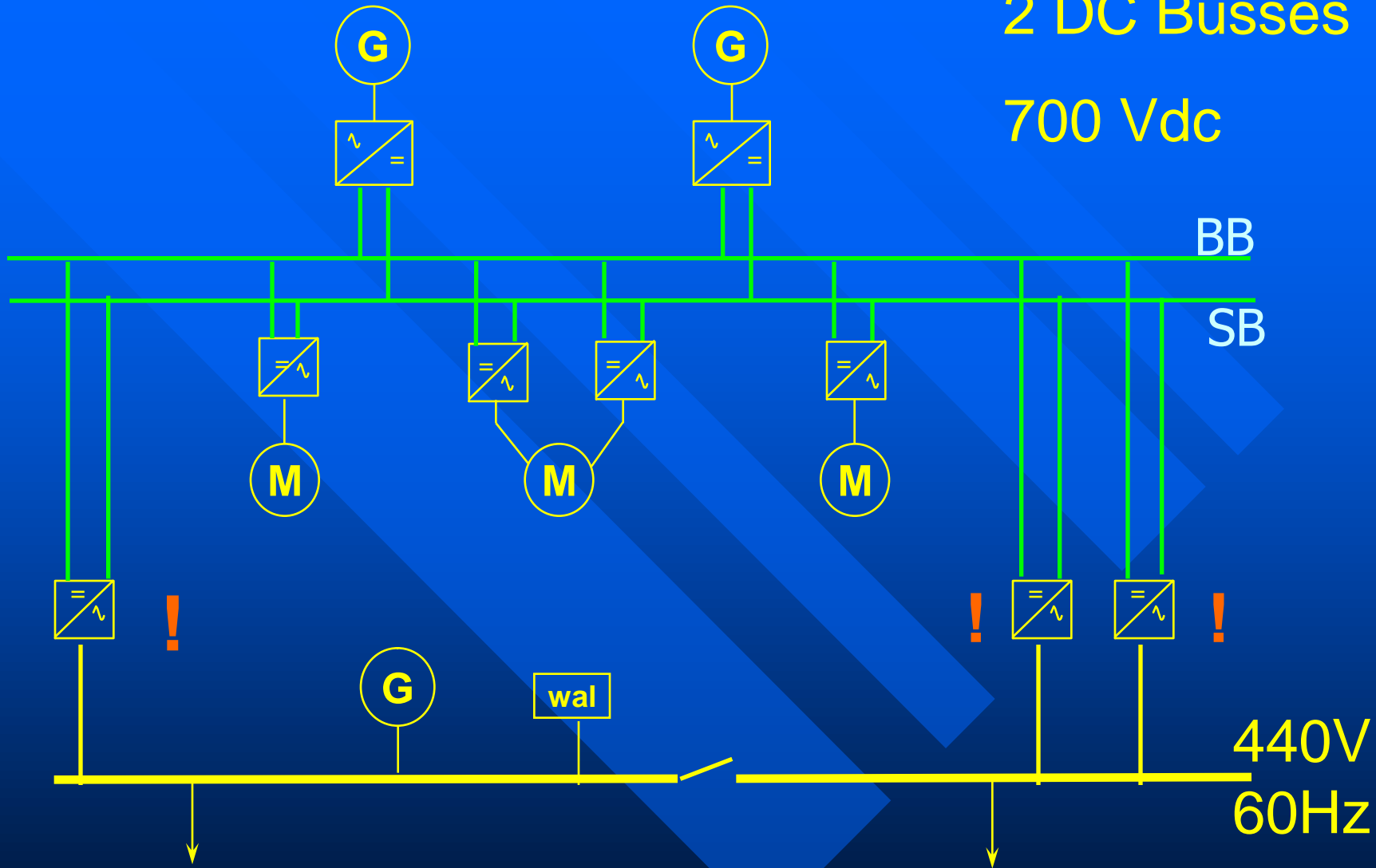
700 Vdc

BB

SB

440V  
60Hz

Gelijkspanning







# Grote geïntegreerde systemen en EMC? Klassieke oplossingen

Meervoudige gelijkrichting (12, 24, pseudo 48 puls) / benodigd zware transformatoren

Netfilters

EMC plan (IEC 533)

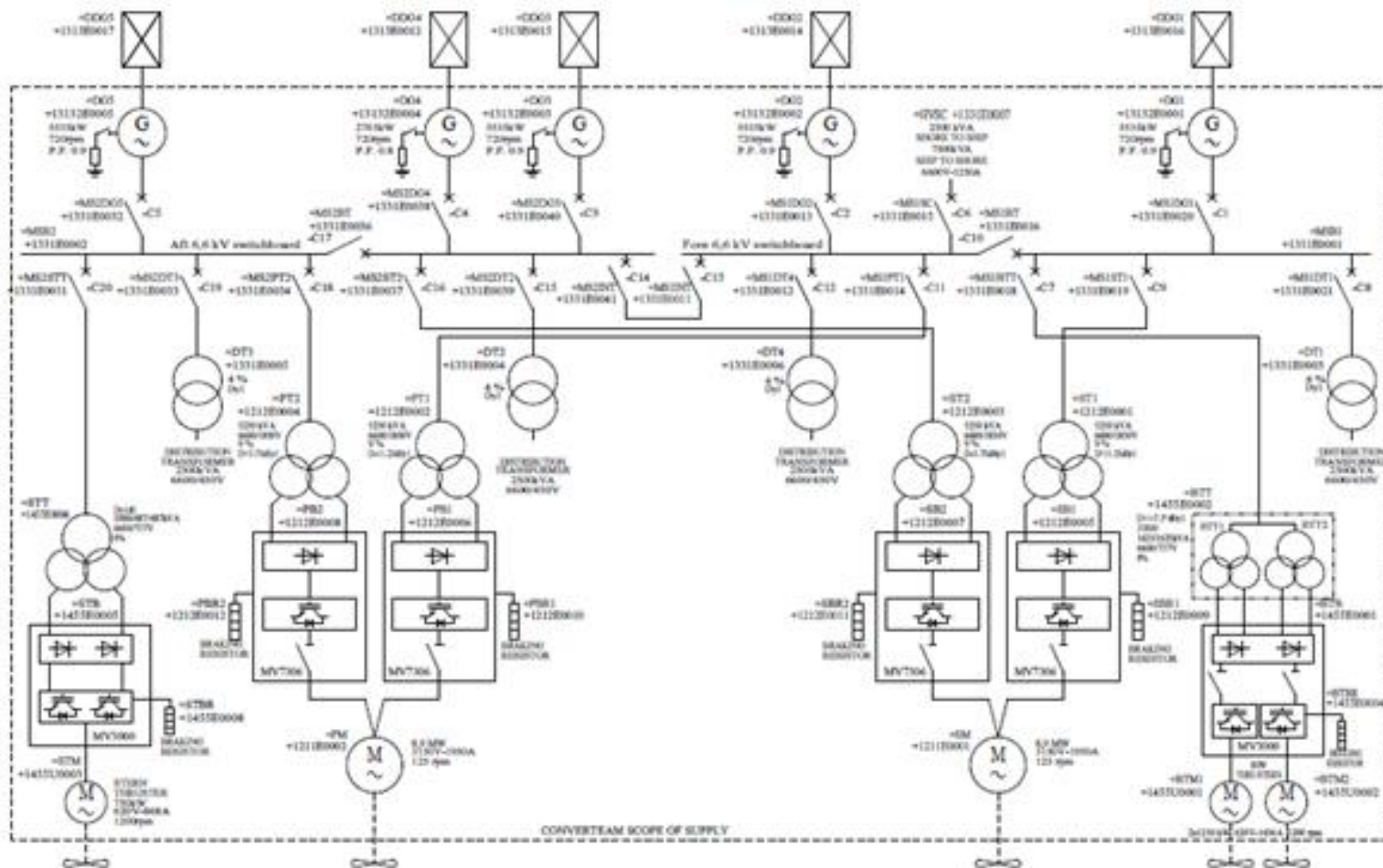
- EMC Zones
- EMC test plan (FAT, HAT, SAT) (uitvoerbaar?)
- Kabelseparatie

Nadelen:

- Voor DC netten geen totale oplossing met klassieke maatregelen
- EMC norm lastig te controleren / aan te tonen



# E-SYSTEMEEM JSS





## Integrated Vessel Electric Plant JSS (IVEP)

Generatoren	(4 st.+1 st., 6,6 kV, 60 Hz)
Main switch boards	(2 st.)
Distribution transformers	(4 st. 2,5 MVA, 450 V 60 Hz)
Propulsion transformers	(4 st./ 2 per as)
Frequency converters	(4 st./ 2 per motor)
Propulsion motors	(8,9 MW, 125 rpm, bi-directional)
Thruster drives	(2 x 1.250 kW + 1 x 750 kW)



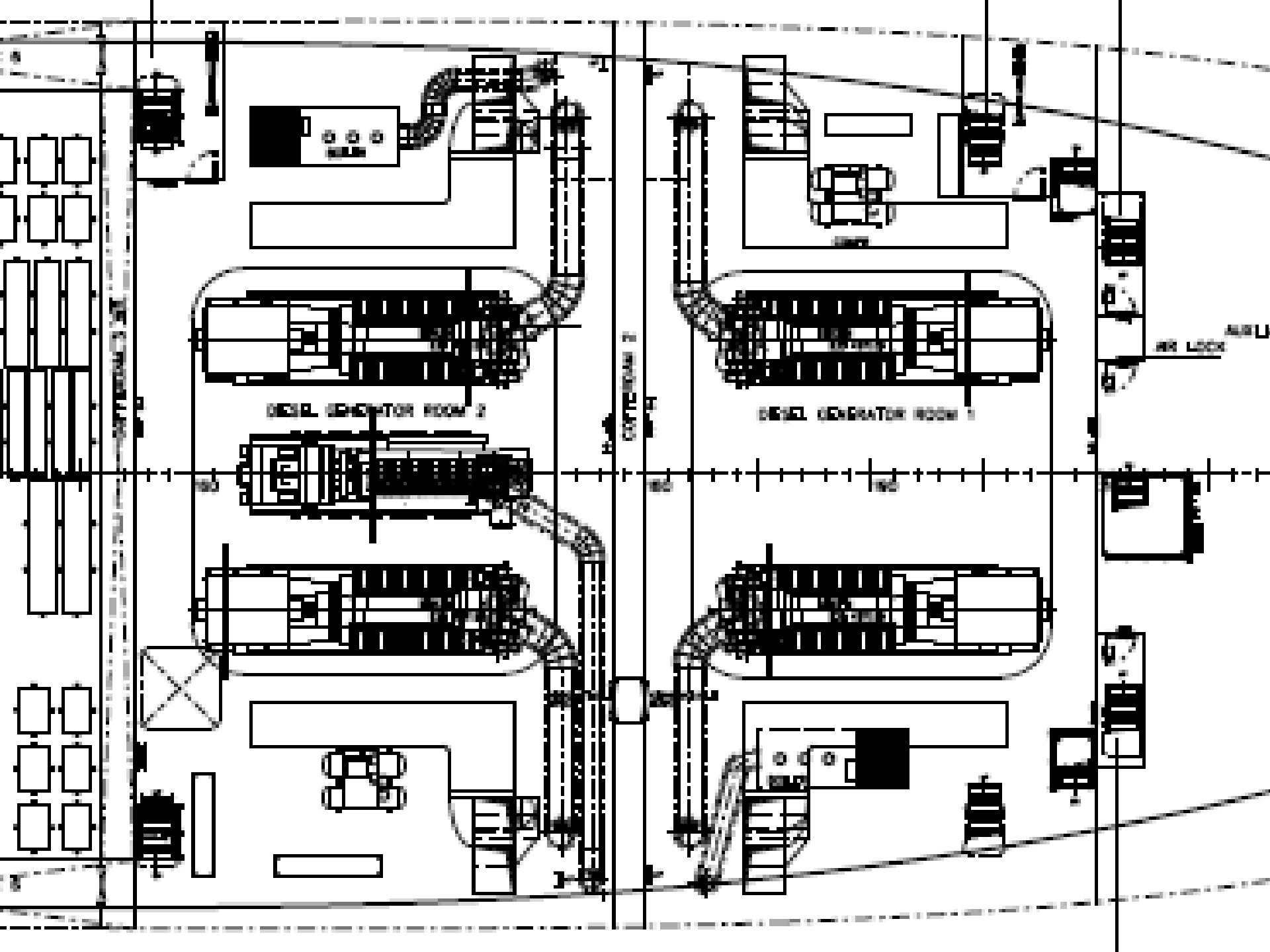
## Diesel Generatoren

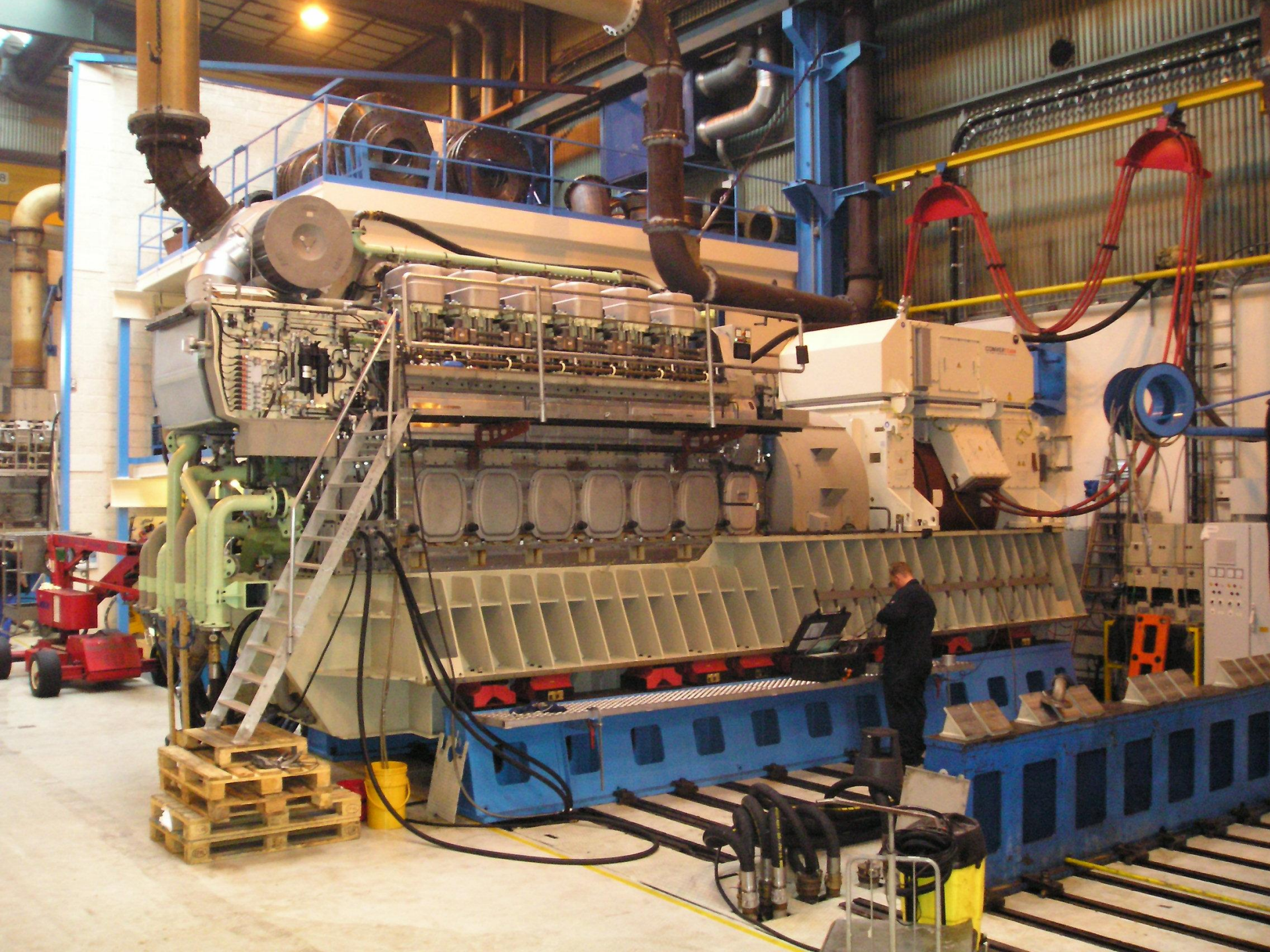
B32:40V12A (MCR =) 5.765 kW

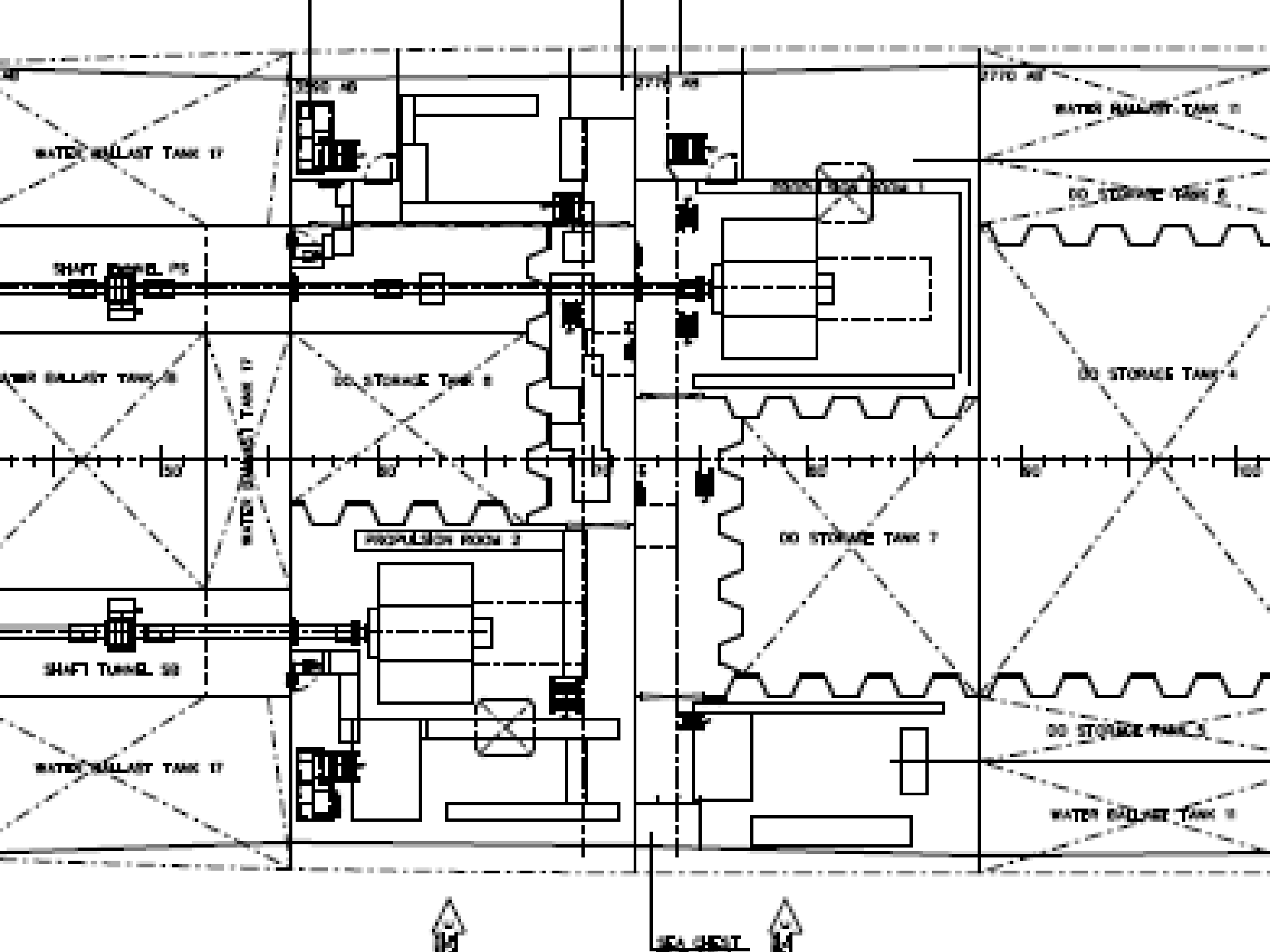
B32:40L6A (MCR =) 2.880 kW

Geinstalleerd vermogen = 25.940 kW

Kortsluitvermogen = ca. 168 MVA



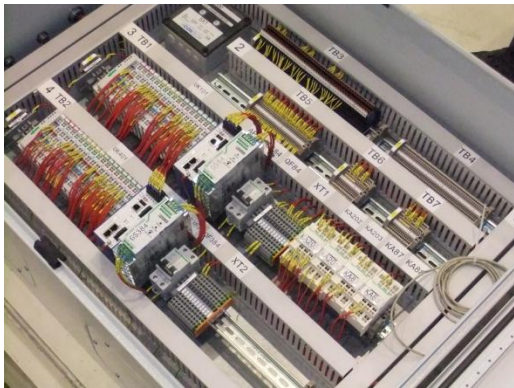












## Gescheiden hoogspanning, en control & monitoring



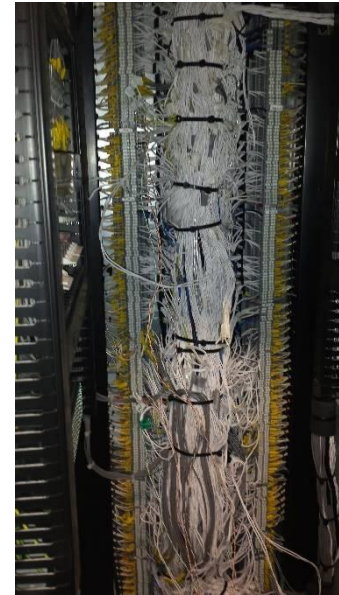
## EMC maatregelen



product



Veel transformatoren  
(zwaar / groot)



Kabelseparatie





## Spanningsdip & harmonics

### Spanningsdips:

1 st. 6150 kVA	- 25,3 %
1 st. 6150 kVA + 3456 kVA	- 18,3 %
2 st. 6150 kVA	- 15,1 %

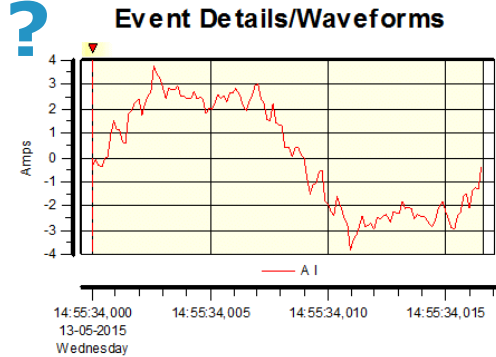
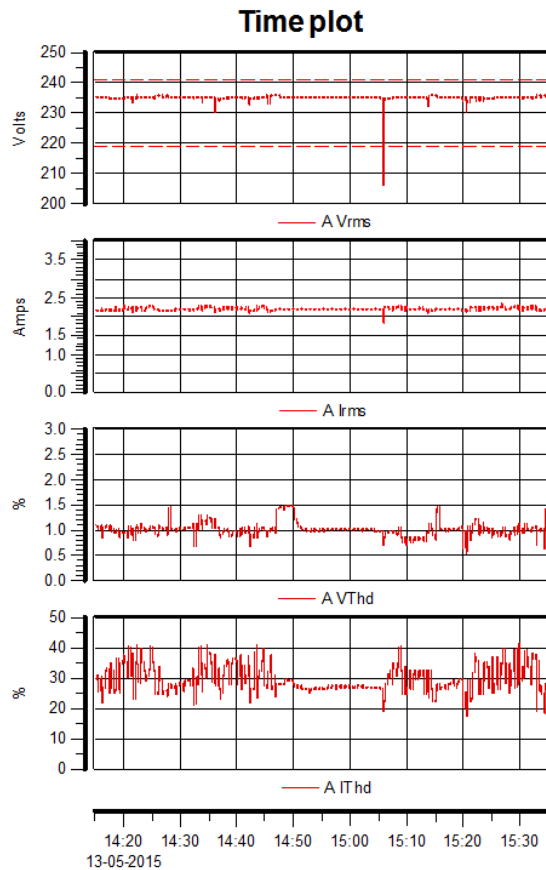
Bij inschakelen transformatoren 2 st. DG on line

### Harmonics 6,6 kV niveau afh. snelheid

100 %	3,5 %
70 %	5,4 % (1/2 motor operation)

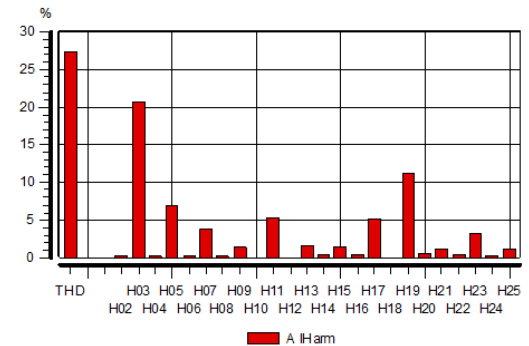


# VOLTAGE DIP & HARMONICS 230 V NIVEAU ?



Event #309 at 13-05-2015 14:55:34,000  
Timed event

### Waveform harmonics



Lokale verstoringen  
Lagere MTBF componenten



# Grote geïntegreerde scheepssystemen & EMC

Productnormen zijn beschikbaar

Echter een schip is een samenstel van producten!

Benodigd standaardisatie (o.a. IEC 60092 serie)

- Systeem EMC normen
- Systeem test en controle