

BMT Nigel Gee Ltd

**Design Considerations –
Installation of a Tier III
Compliant Exhaust
System on a Superyacht**

**Superyacht UK Seminar
12th January 2012**



IMO Tier III Superyacht

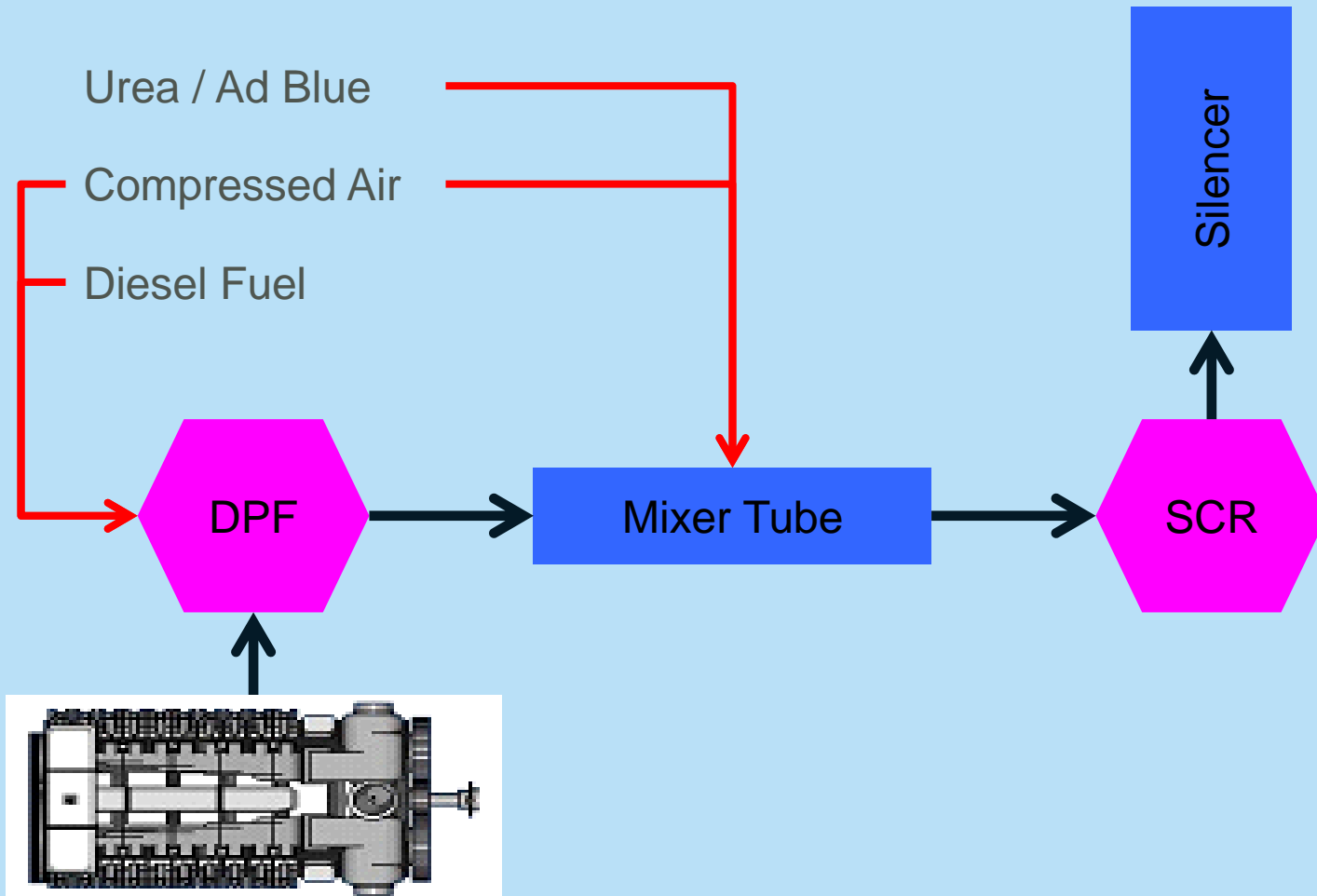
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- Example Installation
- Systems Considerations
- Material Considerations
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- Summary

IMO Tier III Superyacht - Introduction

- Design an IMO Tier III compliant system for a Superyacht in the range 100-120m LOA
- Selective Catalytic Reduction (SCR) used to achieve Tier III NO_x targets
- Diesel Particulate filters (DPF's) would be used on generator sets
- First designs considered in 2009, significant change to designs in two years

IMO Tier III Superyacht – SCR / DPF system

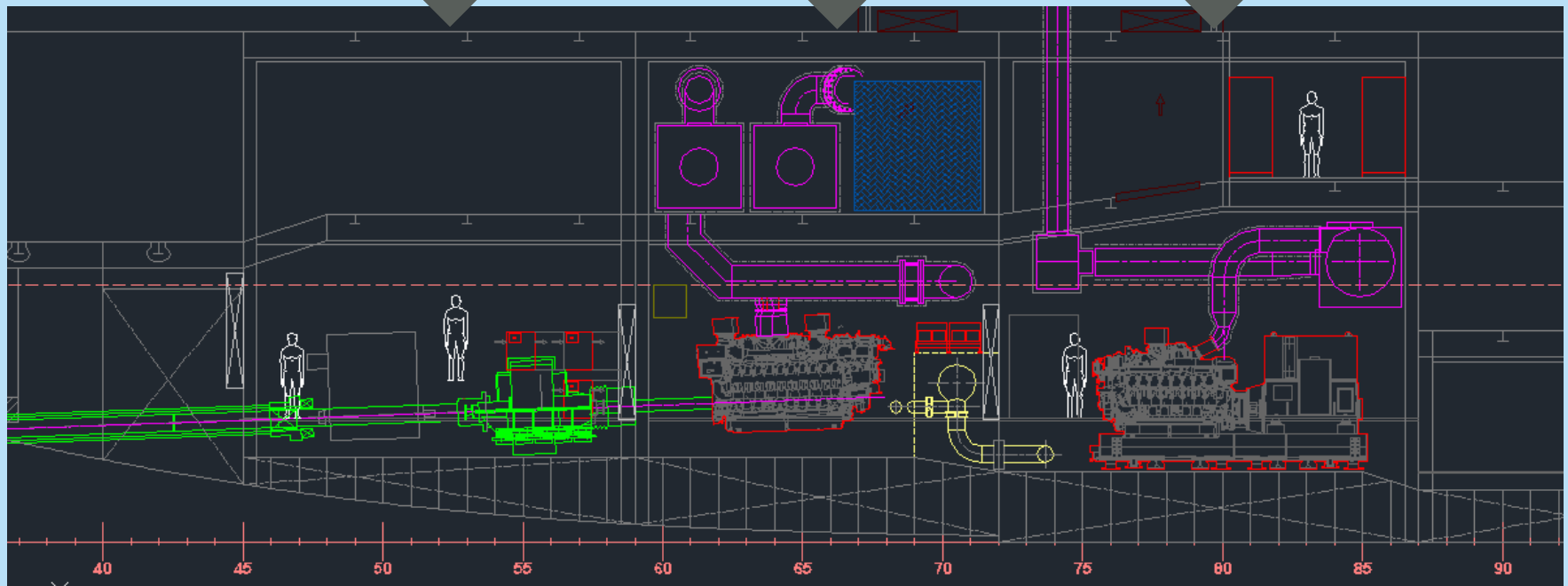
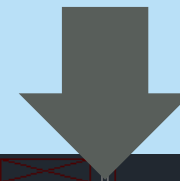
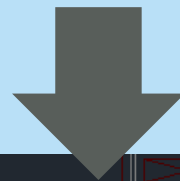


IMO Tier III Superyacht – Arrangement

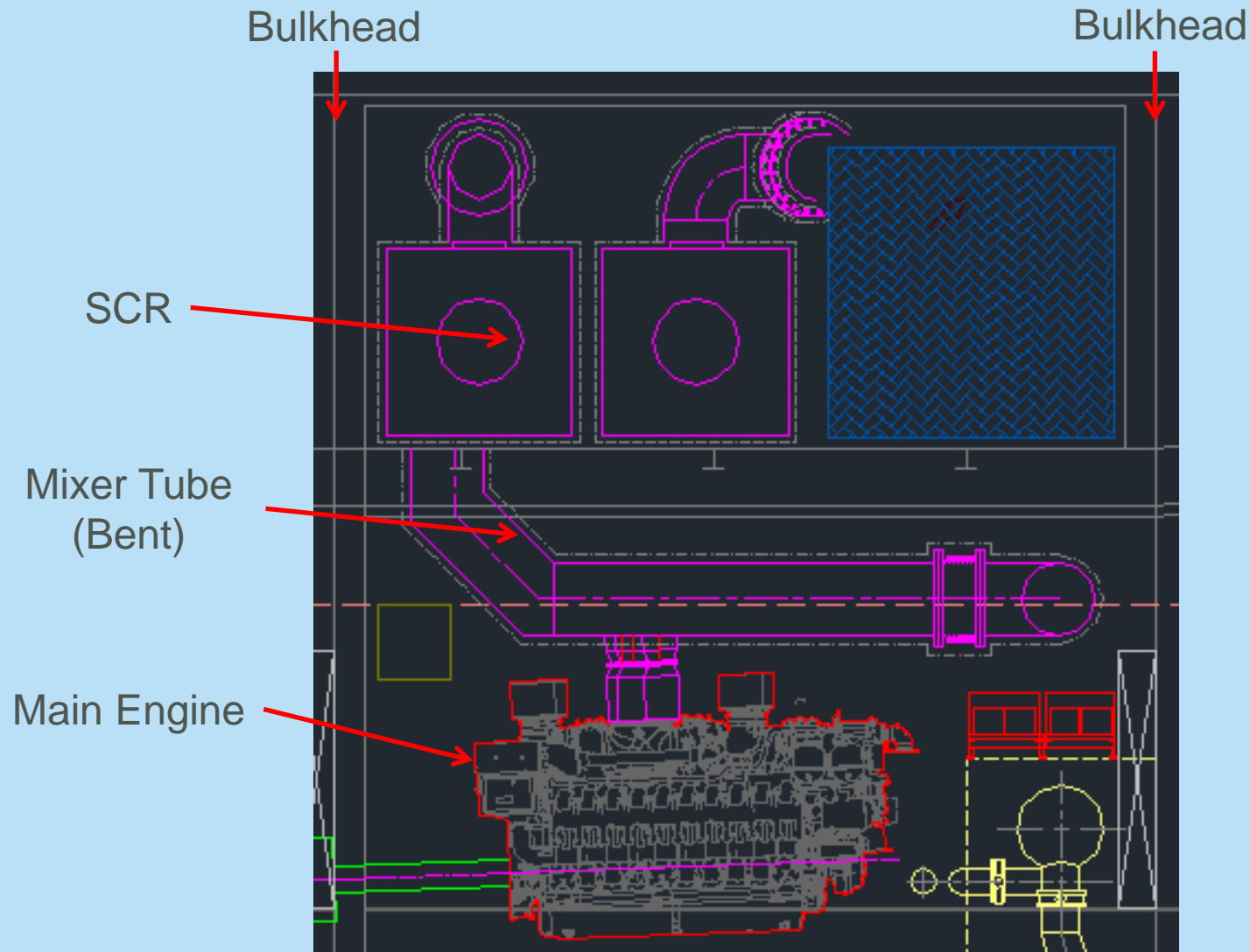
Gearbox Room

Engine Room

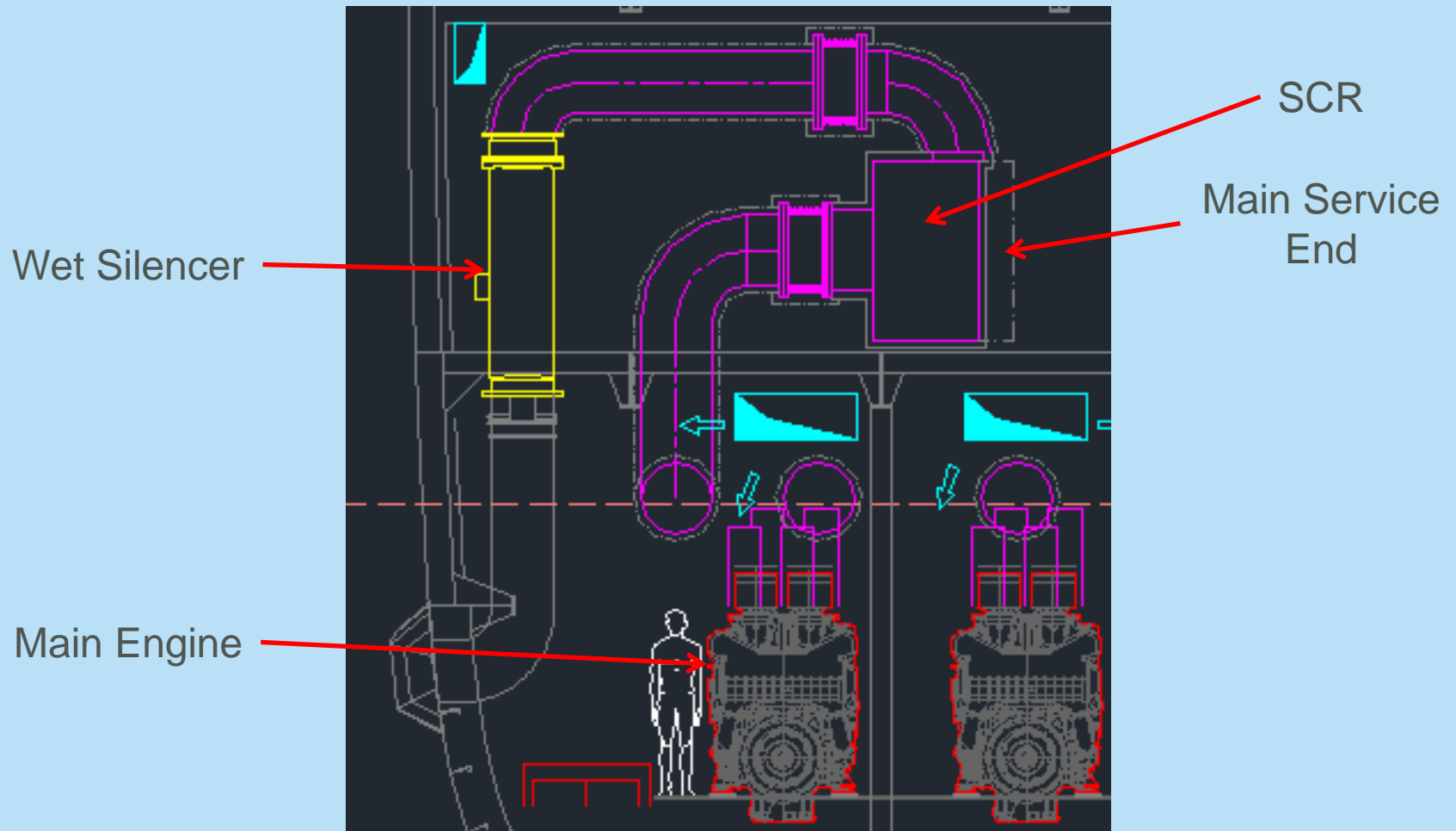
Generator Room



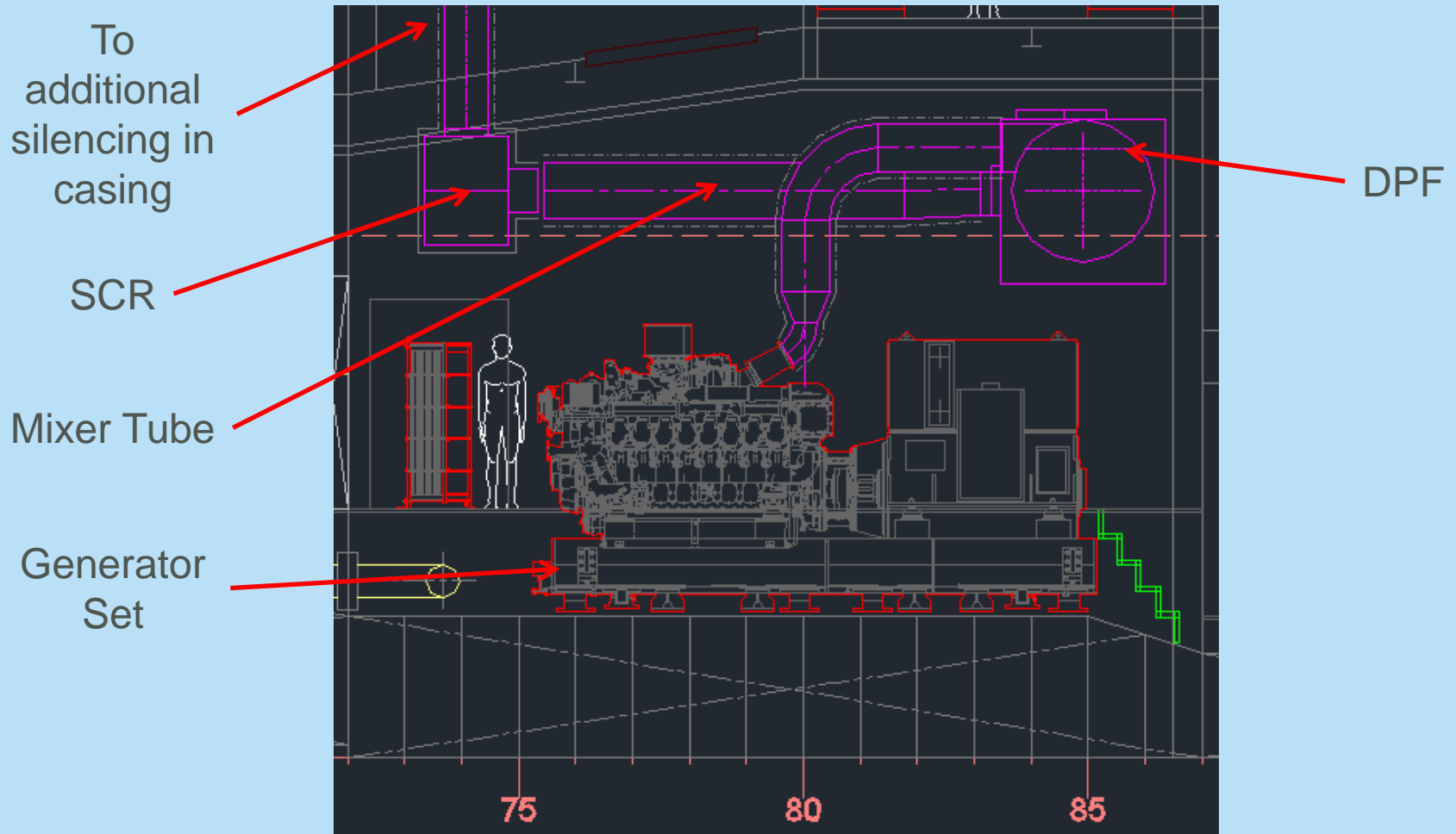
IMO Tier III Superyacht – Main Engines



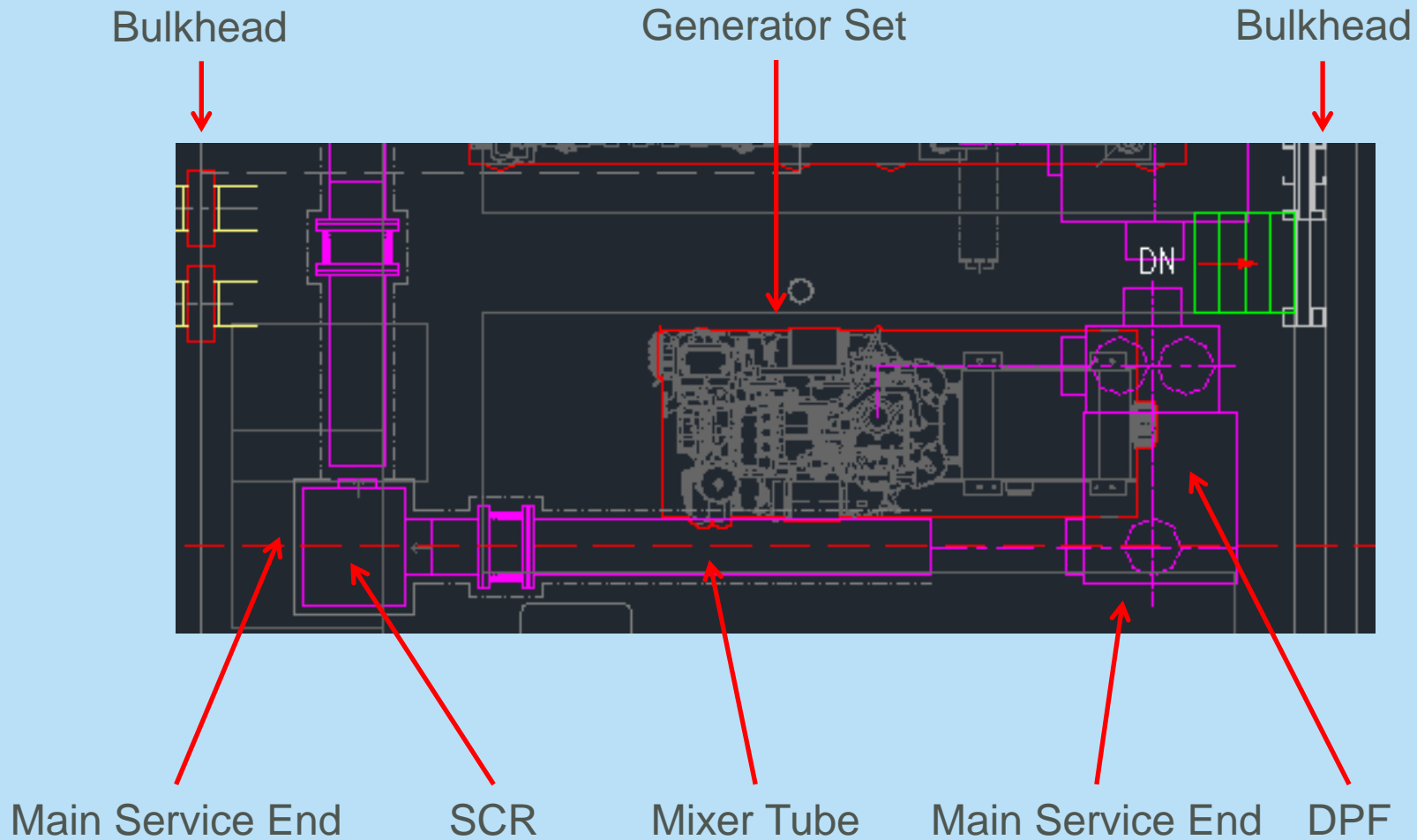
IMO Tier III Superyacht – Main Engines



IMO Tier III Superyacht – Generator Set



IMO Tier III Superyacht – Generator Set

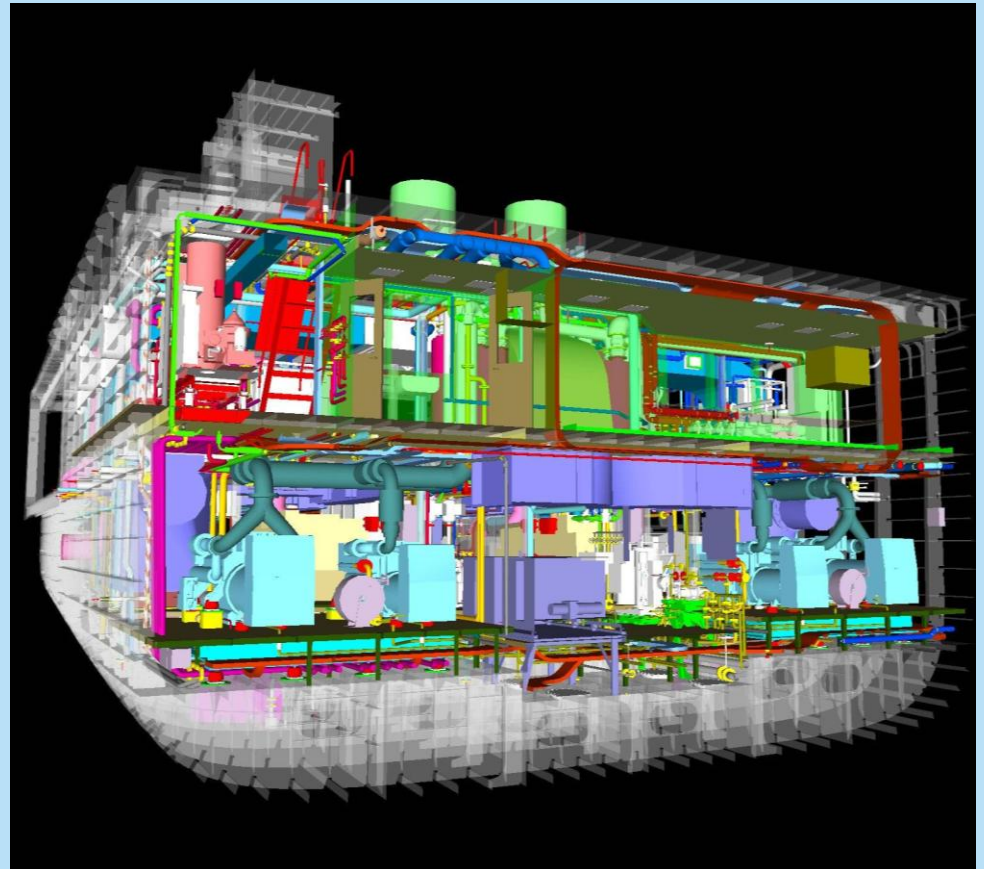


IMO Tier III Superyacht – Challenges

- Vessel Arrangement:
 - Large Tender Compartments +
 - Probabilistic and/or 2 Compartment Deterministic =
 - Significant Subdivision
- Length of mixer tube
 - Length (+no of mixing vanes) effects NO_x reduction effectiveness
- Back Pressure Limits
 - Equipment sizes large to achieve targets
- Serviceability of SCR and DPF's
- Attenuation – Additional silencing is likely

IMO Tier III Superyacht – Systems Issues

- For an SCR, the vessel will require:
 - Urea / Ad Blue storage and supply system:
 - Consumption 4-6% of fuel consumption (by volume)
 - The 100-120m yachts have 40-50 m³ tankage for Urea
 - Air supply system:
 - Substantial quantities are consumed
 - Greater demands than other vessel systems
 - Dedicated or Integrated with the vessels system?



IMO Tier III Superyacht – Materials Issues

- Materials issues are present:
 - Carbon Steels should not be in contact with AdBlue
 - Stainless Steels are suitable
- Therefore:
 - Piping & Equipment need to be selected correctly
 - Exhaust system materials need to be selected correctly
- Suitable tank coatings will need to be applied to built in carbon steel tanks or;
 - Free standing tanks used.



IMO Tier III Superyacht – Fuel Quality / Engines

- Fuel Grade is critical to performance:
 - Catalyst selection depends on sulphur levels
 - Discussions on-going about fuel grade and availability
- Engines:
 - Back pressure important – is enough available for the system
 - Ash content and lube oil consumption key to design of DPF's (serviceability and sizing) and Catalyst materials
 - Exhaust temperatures key to DPF and SCR performance. Modern high speed diesels should have high enough temperatures for the SCR



IMO Tier III Superyacht – Summary

- The systems are challenging to fit, even in 100m+yachts!
 - Size (may be increased by back pressure limits)
 - Serviceability
- Don't forget additional attenuation
- Material selection is important
- Fuel grades effect system design and performance
- Designs are changing rapidly
- Under proposed legislation, the engine supplier will be responsible for the performance of the engine and exhaust system together.



“Where will our knowledge take you?”

Thank you

Paul Shallcross
BMT Nigel Gee Ltd

