INTERNATIONAL MARITIME ORGANIZATION

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MARINE ENVIRONMENT PROTECTION COMMITTEE
65th session
Agenda item 4

MEPC 65/INF.10
8 February 2013
ENGLISH ONLY

AIR POLLUTION AND ENERGY EFFICIENCY

Supplementary Information to the final report of the Correspondence Group on Assessment of Technological Developments to Implement the Tier III NO_x Emission Standards under MARPOL Annex VI

Submitted by the United States

SUMMARY

Executive summary:	This document provides supplemental information in support of the final report on the work of the Correspondence Group on Assessment of Technological Developments to Implement the Tier III NO_x Emission Standards under MARPOL Annex VI
Strategic direction:	7.3
High-level action:	7.3.2
Planned output:	7.3.2.1
Action to be taken:	Paragraph 4
Related documents:	MEPC 62/24; MEPC 64/4/16, MEPC 64/INF.8 and MEPC 65/4/7

Introduction

1 MEPC 62 agreed to establish a correspondence group to carry out the review of the status of technological developments to implement the 2016 Tier III NO_x emission limits. MEPC 65/4/7 presents the final report of the correspondence group. This document provides supplemental information to that report. Specifically, annex 1 contains the collated comments of the correspondence group participants. These comments were solicited based on three rounds of questions distributed by the Coordinator of the correspondence group. The first round of questions (Q1 through Q14) was developed based on the Terms of Reference set out in paragraph 4.24 of document MEPC 62/24. Participants were requested to provide information and relevant support documents in response to the questions.

2 Based on the participant responses to the first round of questions, a set of second and third round of questions (QII-1 through QII-9 and QIII-1 through QIII-7, respectively) were sent to the members of the correspondence group to solicit additional information. Those comments are also contained in this document.

3 Additionally, several other annexes contain:

.1 lists of vessels with installed Selective Catalytic Reduction (SCR) systems (annex 2);

.2 a list of vessels with liquefied natural gas fuel engines (annex 3); and

.3 extended comments by one participant which could not easily be added to the summary table (annex 4).

Action requested of the Committee

4 The Committee is invited to note the information provided in this document in its consideration of document MEPC 65/4/7.

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ANNEX 1

Collated Comments

.1 Range of technologies (engine fitting, material, appliance, apparatus, other procedures, alternative fuels or compliance methods) that may be used to comply with the Tier III NO_x standards;	
Q1: What is the practical capability of each of these technologies (*selective catalytic reduction (SCR), operation on alternative fuels such as liquefied natural gas (LNG), and in-cylinder improvements combined with exhaust gas recirculation (EGR) or introduction of water into the combustion process*) for compliance with the Tier III NO_x standards?	
Canada	All technologies have been proven to work for onroad/offroad modes. We note that major marine engine manufacturers have indicated that Tier III standards will be achievable by 2016 through the implementation of SCR, EGR and other technologies.
Euromot	- SCR is able to meet Tier III limits. Constraints exist for part-load operation, however, technical issues can likely be overcome prior to the implementation date of Tier III. - Pure natural gas operation (spark ignition) is able to meet Tier III limits. Not all engines sizes will be available as spark ignition. We note, however, that this type of engine is currently not covered by the regulation. - Dual Fuel operation in gas mode (Natural gas operation with pilot fuel ignition) can meet Tier III limits but not on all engine types (particularly not on low-speed engines) and dependent on the amount of pilot fuel. - EGR has the potential to meet Tier III limits possibly with the support of additional measures. High speed EGR engine technology will not be able to be operated with anticipated qualities of marine fuel. - Introduction of water without additional measures is not capable to meet Tier III.
Finland	For time being SCR is the only available technology, as a single solution, which will lower the NO_x emissions below Tier III limit values, if diesel fuel will be used. LNG might be considered as a future alternative for some new-buildings in liner service, but however diesel fuel will still be the most relevant solutions for many years. For other technologies can be stated that those will not reduce the NO_x emissions below Tier III requirements used as a single solution, but by combining several(two) technologies Tier III requirements might be met. Direct water injection to the combustion chamber is also one solution that has been tested and might have some potential as a combined technology. HAM- method, developed by MAN-diesel, has been used and proved to be efficient but some technical issues are however connected to the method. These are mainly corrosion in scavenging air-receiver and –coolers. Wärtsilä has a similar solution as HAM which has been marketed as WET-PAC.
Germany	- SCR: NO_X reduction to or below the limits required by Regulation 13.5.1.1. can be achieved for all engine types. However, certain restrictions on fuel sulphur content need to be observed. Practical long-term in service experience is available. Reduction capability under low(est) load conditions seems to need some further investigation, including with regard to ammonia slip. - LNG: Ottocycle engines are not (yet) subject to Reg. 13; see Reg.2 Definitions Marine Diesel Engine Dual Fuel Engines using liquefied fuel (even Heavy Fuel Oil) as pilot fuel in order to trigger the ignition (Diesel process) have a limited NO_x reduction potential, dependent on amount of liquid fuel, engine size, or engine duty cycle. - EGR: High NO_x reduction potential, however, formation of PM must be observed under certain load conditions. Most likely, EGR should be applied in combination

	with other NO_x reducing measures, as mentioned in the part "Discussion" above. Small high-speed engines running on Ultra low sulphur fuel only might apply EGR technologies derived from the truck/automotive sector (e.g. recreational craft applications) These technologies most likely are not suitable for high speed, medium speed and low speed engines operated on MGO, MDO or heavier grades of Marine fuel. - Pre-combustion measures using water are considered not to have the potential to achieve Tier III standards. Experience from the past has also shown operational problems under long-term service conditions.
IACCSEA	As an association, IACCSEA supports the IMO in its progressive approach to novel and evolving technology, but urge that before any technology gains any credence it should be subjected to the rigors of a scientific process – that verifies its major claims. We wish to minimize the risk that bona fide technologies will have their reputations and potential markets disrupted by organizations whose claims will not be matched by proper verification. Such an approach would also help to ensure the maximum efficacy of ECAs. Additional comments: o SCR for HFO applications is not regarded as a challenge as long as the necessary exhaust gas temperatures are available o It is possible to combine SCR with scrubbers. There are several options: 1) pre-turbo SCR, 2) Dry scrubbing, 3) limit S-content in HFO to a level that, considering the exhaust gas temperatures allow for SCR operation. o Additional measures to avoid issues with SCR include a vessels' catalyst management program
Japan	Regarding SCR using urea and ammonia as reductant, it is considered highly feasible for compliance with the Tier III standards. For reference, the principle of SCR denitration equipment and its system conceptual diagram are shown in Attachment 1.[*referenced under "FURTHER INFORMATION PROVIDED"*]
Sweden	SCR: Able to meet Tier III limits. Ongoing development on part load operation to meet the requirement. Technical issues likely to be solved prior to the implementation date of Tier III. Smaller high speed engines cannot use the present solutions used for on road and non-road (land based) due to the high sulphur content of the marine fuel (including future ECA fuel) SCR technology is capable of reaching up to 95% reduction of NO_x. In our experience it would be wise to install the SCR with some "spare" capacity since the catalyst is deteriorating over time. LNG: Spark ignited engines can meet Tier III but not today covered by the regulation. Dual (gas engines with pilot fuel injection) fuel can for certain engine types meet Tier III depending on amount of pilot fuel and type of engine. As far as we know today smaller high speed dual fuel engines (automotive based) cannot meet the Tier III requirement without additional measures (SCR/EGR, etc.) and further low speed engines as of today cannot meet the requirements. EGR: High speed EGR engine technology will not be able to be operated with the marine fuel (sulphur content) including future ECA fuel. HAM needs to be combined with EGR, if possible to reach TIER III
United Kingdom	SCR can meet the Tier III requirements. With careful planning in advance, this technology can be applied to a wide range of engines/ship type. LNG fuel can be used to reduce emission of NO_x. Consideration of LNG supply chains is crucial for this technology.
United States	Perhaps the most common way in which the Tier III NO_x limits are expected to be met is through the use of SCR technology. This emission control technology is highly practical and, as described in the initial discussion document for the correspondence group, is currently available from several manufacturers. More

	than 500 vessels have been equipped with these systems and while many of these are retrofit systems ships are beginning to be built with SCR capacity. As with any new technology, a number of design considerations must be addressed in applying SCR technology to marine applications, and the experience with retrofits has been useful in identifying solutions for new ships purposely built to use this emission control technology. These considerations include finding ample space aboard the vessel for the system packaging and reagent storage and ensuring proper operation at low loads where lower exhaust temperatures are observed. With respect to space constraints, the majority of vessels using SCR today were not originally designed with SCR in mind. Rather the SCR system was retrofitted into the existing architecture. This meant that in most cases the SCR installation was constrained by available space. As new vessels are constructed in 2016 and later, the SCR system will be considered in the early stages of the ship development, and the necessary infrastructure will be incorporated into the initial ship design. This will greatly simplify any packaging issues. It should be noted that the Tier III NO_x standards only apply when the ship is operating in a NO_x ECA. For many ships, this may only be a small amount of their total operation, limiting the quantity of reagent that must be stored. A number of approaches have been used to maximize the effectiveness of SCR systems under low temperature conditions. Such engineering approaches have included changing the position of the SCR unit (e.g. upstream of the turbocharger where the exhaust temperature is higher), reducing the level of charge air cooling, modifying the injection timing, increasing the exhaust temperature with a burner system, using an SCR designed for the low-temperature NO_x conversion, the use of lower sulphur fuels (allowing for more active catalysts), and using a heated urea dosing system. A second technology that may be used to achieve the Tier III NO_x standards is the use of LNG engines. LNG is expected to be a highly practical strategy for many ship applications, including ferries, fishing vessels, and container ships as well as LNG tankers. There are already more than 20 vessels powered by LNG engines the worldwide cargo fleet, with many more on order [*1*] In addition to reducing NO_x emissions well below Tier III NO_x limits, LNG engine technology will provide significant savings in fuel costs, especially relative to the use of distillate fuel. At the same time, however, LNG is less energy dense than diesel fuel oil, and therefore LNG ships generally require additional fuel storage to maintain the same operating range. While the LNG distribution system for ports is still in the early stages of development, LNG fuelling facilities are expected to become more common with increased demand. These fuel storage and refuelling limitations mean that LNG technology is most practical today for ships operating on set routes, where refuelling facilities can be established and where the ship may be able to refuel more often. However, the technology will become increasingly attractive for long-haul shipping as LNG refuelling infrastructure expands to more ports. While EGR and water introduction strategies are not as developed as SCR or LNG, engine manufacturers are making significant headway in using these proven technologies to achieve emission reductions on the order of those needed to achieve the Tier III NO_x limits. While there are constraints that must be addressed, manufacturers continue to work on improving these technologies. Specifically, the use of EGR to achieve the Tier III NO_x limits may require the installation of a scrubber to remove sulphur and other impurities from the recirculated gas. The addition of such a scrubber has the disadvantage of requiring space on board the vessel for the scrubber and power to drive the water pumps used by the scrubber. Nevertheless, this approach may be preferred over an SCR system because it would not incur the operating costs associated with urea consumption. Water introduction strategies, on the other hand, require large amounts of fresh

	water to achieve Tier III NO_x levels. This water can be stored on board, by either re-purposing existing tankage or installing new tankage. Otherwise, increased frequency of bunkering water may be required. In either case, water injection strategies may be more practical for ships operating on shorter routes where water can be bunkered more frequently.
Q2: What other technologies (engine fitting, material, appliance, apparatus, other procedures, alternative fuels or compliance methods) should also be considered as part of this review?	
Canada	Scrubbers can also be considered. For example, we are aware that EcoSpec has developed a system called $CSNO_x$ that uses an Ultra Low Frequency Electrolysis System to treat seawater before injecting into the exhaust. The company has reported that in tests conducted onboard a 100,000-tonne oil tanker at 50% gas load, 99% SO2, 77% CO_2, and 66% NO_x were removed and has indicated that the technology is capable of achieving Tier III standards. The Canadian government is participating in the investigation of this technology.
France	Perhaps I might just give an answer for the Q2 or the Q8 to mention that the review would have to consider the potential interactions that may occur when applying any of the technologies mentioned to reach Tier III NO_x (except LNG) and at the same time applying an exhaust gas cleaning system technology for SO_x abatement (such as scrubber). It would be interesting to point out in this review if there are technical barriers to use both abatement technologies together.
Finland	Some promising results have been seen from two-stage turbo-charging in connection with extreme Miller timing and variable control of inlet valve timing and lift. This technology has been tested and developed by ABB-Turbochargers.
Germany	NO_x reduction using non-thermal plasma desorption → literature available. No own experience
IACS – Recognized Organizations	It would be noted that the NO_x Technical Code provides for certification against the reference conditions and requirements of the code. It is therefore not an "exit-from funnel" control regime and hence any considered methods must be confined to those which meet this fundamental principle.
ICOMIA	Following consultations with engine and catalyst manufacturers it is uncertain at present if production aftertreatment systems will be customized for all kinds of specialized craft. We recommend this CG monitors the development of SCR units and the likely implication of fitting SCR units in engine room arrangements.
Sweden	There is some work going on regarding methanol and conversion to Di Methyl Ether (DME)
Q3: What is the status of development of these technologies by marine engine manufacturers and emission control suppliers?	
Canada	Canada Steamship Lines is partnering with EcoSpec to install the $CSNO_x$ system on to one of CSL's ships.
Danish Maritime Authority	For a couple of examples on current state of Tier III development on low speed engines, please see references below. **EGR, Exhaust Gas Recirculation**. http://mandieselturbo.com/1016608/Press/Press-Releases/Trade-Press-Releases/Marine-Power/Low-Speed/First-Tier-III-EGR-Engine-Order-Landed.html MAN B&W, Hyundai Heavy Industries build 6S80ME-C9 with integrated EGR, 23MW low speed engine. First low speed engine designed for meeting Tier III with integrated EGR as the only emission reduction technology. 2nd generation EGR in service. Engine can be operated in Tier III mode on high sulphur residual fuels. The engine will be delivered from test bed in late 2012, and sea trial carried out early 2013. **SCR, Selective Catalytic Reduction**

	http://mandieselturbo.com/1015861/Press/Press-Releases/Trade-Press-Releases/Marine-Power/Low-Speed/World%e2%80%99s-First-Tier-III-Compliant%2c-Two-Stroke-Engine-Unveiled-in-Japan.html MAN B&W, Hitachi build 6S46MC-C8 with Hitachi SCR, 7MW low speed engine. Low speed engine designed for meeting Tier III with SCR as the only emission reduction technology. Tier III verified on test bed. Engine can be operated in Tier III mode on high sulphur residual fuels. Engine currently in service. The two emission reduction technology designs are expected to be developed to fit the entire existing engine programme, with engine sizes ranging approximately 4 to 84MW. http://viewer.zmags.com/publication/943fed6f#/943fed6f/50
Euromot	- SCR is currently being developed to meet Tier III in 2016 for all marine diesel engines and for the required engine load ranges. A particular challenge is the 25% point mode capping - Pure or pilot fuel natural gas engines are being developed to meet Tier III in 2016 for some engine types. - EGR is currently being investigated for its potential to meet Tier III on selected engine types and will not be available in general in 2016 for the majority of engine sizes. - Introduction of water is currently not being investigated as sole technology to meet Tier III limits.
Finland	All engine manufacturers are developing solutions for how to fulfil the future emission regulations.
Germany	- SCR: Practical experience available. Fuel dependent problems known. Operational guidance recommended. Lowest load operation seems necessary to be investigated further. - Dual Fuel: Experience in test-bed testing. Gathering In service operation underway. To be observed: Specification of on-board auxiliary (gas supply) systems, gas storage, bunkering process, LNG availability in ports, etc. - EGR: Still in testing phase for marine applications. Field experience outstanding at least for large bore engines. - Water: Experience with different method available. However, still major in service problems to overcome. Use of any wet technology most probably not to be used as long standing solution.
IACCSEA	SCR is a proven, commercially available technology. The industry is supported by well-developed, competitive supply chains. Experience of Marin SCR has been gathered in all major market segments including emission control of slow speed engines. Whilst specific segments are at different levels of technology development, it is anticipated that all will be served with commercially available SCR solutions by 2014. sDEMO projects with engine+SCR Tier III certification are currently underway.
ICOMIA	Today it is still under (economic) consideration whether manufacturers of marine engines and emissions reductions technologies will provide Tier III compliance to this niche market [*large yachts (LY) over 24 m loadline length*]. Currently, there is no production built system available specifically developed for a marine environment in a LY.
Japan	Japan conducted laboratory test of exhaust gas denitration on engines with low-speed, middle-speed and high-speed rotation fitted with SCR, and obtained result that complies with Tier III standard.
Sweden	SCR – is in general being developed to meet Tier III in 2016. Land based technology with noble metals to be avoided due to sulphur content. Specific challenge is to meet the requirement for the 25% load point. LNG – some engines types are being developed to meet Tier III in 2016 EGR – currently being investigated by the industry (in general) on selected engine

	types. Will not be available in 2016 for the majority of engine types. DME – work just been started
United Kingdom	SCR is proven and commercially available technology. A number of manufacturers worldwide has the knowledge and experience.
United States	Engine manufacturers and aftertreatment system manufacturers are making significant progress on the development and introduction of these systems. This is supported by the references attached to the initial discussion document for this correspondence group.
QIII-1: Is there any other information that should be considered regarding these other technologies?	
Sweden	Regarding HAM, there has been one installation in operation for the last 10 years without problems on Viking Lines m/s Mariella.
Q4: Provide any additional information and data is pertinent for this review, including support for your answers to Q1-3, or indicate what additional data is needed and how can it be obtained.	
Canada	Data related to Ecospec's $CSNO_x$ system is available on their website: www.ecospec.com.
Finland	See attached leaflet from ABB-TC. [*referenced under "FURTHER INFORMATION PROVIDED"*]
IACS Classification societies	It is recognized that Tier III will in general mark a departure from the means used to comply with Tiers I & II – in-engine and without consumables. IACS Members will adapt their individual class rules as necessary to the introduction of these new technologies and arrangements in order retain the level of mechanical and ship structure / system integrity required of those rules. IACS Members will frame those rules on either a goal based or prescriptive basis as they consider appropriate to their manner of operation. As has been the case in other areas where IACS Members see an overall benefit, the objective would be to ensure that those rules are aligned as far as possible between Members.
IACS Recognized Organizations	In order to ensure that the various technological options are reviewed on a common basis for compliance with the annex requirements additional, generic, direction is required as to how the given exhaust gas mass flow calculation (Appendix VI – NTC 2008 – q_{mew}) should be amended, and the constants to be used, in the case of: (a) gas fuelled only engines (if Annex VI is amended to include these within the scope of the term "marine diesel engine" (b) dual fuelled (gas / liquid) engines (c) engines with EGR (d) engines where additional water is added by emulsification, humidification or direct injection Together with direction as to how the wet/dry correction factor (k_{wr}) should be calculated in such cases and the applicability of the NO_x correction factor (k_{wr}). In this it may be the case that there is no change in either q_{mew} or k_{wr} (as with the SCR Guidelines) however that needs to be openly stated in order to be generally applied. Additionally, since the NTC 2008 was written principally with the focus on the Tier I / Tier II engines it would be appropriate to review the Code requirements in general to ensure that the more complex Tier III engines are subject to no lesser requirements than those which are currently applied.
ICOMIA	ICOMIA plans to make the results of a design study available. We expect this early 2012.

IPIECA	It will be useful to consider the compatibility of each of the options with sulphur abatement (scrubbing) technology.
Japan	In this review, Japan plans to provide data and information which were measured in the laboratory test of exhaust gas denitration on engines with low-speed, middle-speed and high-speed rotation fitted with SCR as below. 1. Object and brief overview of laboratory test 2. Participant in the laboratory test 3. Brief overview of testing facilities 4. Position of catalyst and NO_x measurement apparatus in SCR 5. Initial performance of denitration 6. Duration of the laboratory test 7. Result of operation and denitration performance in the laboratory test 8. Review on SV number [*offered in round 2*] See Attachment II-1 – Attachment II-4. .[*referenced under "FURTHER INFORMATION PROVIDED"*]
United Kingdom	Over 500 marine SCR systems have been installed over the last 20 years to reduce the NO_x emission. Any additional data in respect to the after treatment technology can be obtained by visiting www.iaccsea.com
United States	Further information on these technologies is provided in a technical support documents prepared by the U.S. Environmental Protection Agency regarding exhaust emission standards for diesel marine engines.[*2,3*] Other sources of information include technical papers on Tier III technologies from marine engine manufacturers such as those cited here. [*4,5,6,7,8,9,10,11*] [*referenced under "FURTHER INFORMATION PROVIDED"*]
QIII-2: Is there additional information which should be considered relative to the use of EGR alone or in combination with other strategies, especially regarding the use of EGR on high-speed engines with "higher" sulphur fuels? Does the expressed concern regarding higher speed engines and higher sulphur fuels actually apply to EGR, when used either solely or in conjunction with other emission reduction techniques, as a Tier III NO_x compliance strategy in NO_x Emission Control Areas where fuels will have a sulphur content of 1,000 ppm (0.1 per cent by weight)? If this concern is relevant to the use of 1,000 ppm sulphur fuel in NO_x Emission Control Areas, can it be addressed by the use of scrubber technology to clean the exhaust gases used for EGR?	
ICOMIA	Ammonium sulphate would be purged from the SCR if the catalyst temperature is raised to more than 400°C (engine load factor >~80% of full load) for a period of time. In addition to the points already made, the heat rejected to the coolant system is higher than normal on engines with cooled EGR. When modifying an engine to run with EGR the coolant circuit and the capacity of the coolant pump would need to be reviewed. The boosting system (turbochargers) may also have to be re-matched to suited the altered intake and exhaust flow rates, and in some cases this may mean moving to two-stages of turbocharging. Packaging two-stage turbochargers is likely to required additional space around the exhaust side of the engine, and attention to potentially hot surfaces.
Denmark	- Regarding EGR it is correctly stated that one engine designer is taking orders for high sulphur EGR-equipped low-speed engines. It should be noted that these engine cover a complete range of engines for main propulsion of large vessels, in the power range 3MW to 84MW. - EGR is the only NO_x reducing technology applied. - Regarding the stated concerns on formation of particulate matter in general or at certain load conditions, please find the attached document with information on particulate emission characteristics of such an engine.

	See MAN Diesel & Turbo, Exhaust Gas Recirculation on MAN B&W Tier III Low Speed Engine-Focus on Particulate Matter in the additional information submitted by the participant section.
IACS	No comment on this point although QIII-7 comment equally applies regarding the possible sulphur content of the fuel oil which could apply.
QII-1: What further information is available on these technologies, especially scrubbing, turbocharging, and non-thermal plasma desorption?	
IACS	With regard to the possible technologies listed, together with those under QII-2 & QII-3 and the various arrangements for applying SCR it is important to bear in mind that not only must the technologies exist in a marine deployable condition but that any such systems must be demonstrably compliant; both at the pre-certification stage and subsequently after installation on board over the engine + device service life. To this end it would be suggested that the CG should make mention in its report that where engine or NO_x reducing device system developers find instances where those technologies are not correctly or adequately covered by the calculation procedures given in the existing NO_x Technical Code 2008 then these should be promptly brought to the attention of MEPC in order that any amendments are considered on an informed and early basis and thereby provide a transparent and coherent way forward that can be applied consistently by all Administrations / Recognized Organizations.
European Commission	A very thorough summary on current/available scrubbing technologies has been provided by the Exhaust Gas Cleaning Systems Association EGCSA in their Handbook 2010. It introduces and describes current scrubber design concepts (freshwater, seawater and dry) as well as their most promising solutions (by manufacturer). In addition a comparison table is provided featuring each system performance overview.
QII-2: Please provide information on which engines can use dual-fuel LNG to meet Tier III, and what development is needed for wide application of this technology	
United States	Engines that can use dual-fuel LNG: 1. Wärtsilä reports that its 20 DF, 34DF, 50DF dual fuel engines are available from 0.8 – 17.5 MW with a speed range of 500-1200 rpm and are Tier III compliant today in gas mode. They have accumulated more than 1.5 million engine running hours with a total power installed of over 4,000 MW. [*15*] 2. MAN B&W reports that its 51/60DF meets Tier III (in gaseous fuel mode). These engines are four-stroke, and range in power from 6,000 kW – 18,000 kW.[*17*] MAN is currently testing the 4T50ME-GI and expects to have it available in 2012, this is a two-stroke engine that would also meet Tier III.[*18*] In addition, MAN is currently taking orders for EGR-equipped 6S80ME-C9 engines that meet Tier III emission standards. [*19*] 3. Rolls Royce reports that its Bergen Gas Engine: S.I. "Lean Burn" C23:33 & B32:35:40 meet IMO Tier III.[*20*] The engines range from over 1,500 kW to nearly 9,000 kW. More than 500 sold and over 20 million running hours; these engines have been in operation for over 20 years. 4. MaK reports that it is planning a dual-fuel product launch in 2014.[*21*] We have identified 23 vessels currently operating on LNG or dual fuelled, and 22 vessels on order that will operate on LNG. This does not include LNG carriers. A cited list of these vessels is attached and we welcome other participants to add additional information as appropriate. [*referenced under "FURTHER INFORMATION PROVIDED"*]

QII-3: What data are available on packaging multiple NO_x-reducing technologies: the overall combined effectiveness, design considerations, recommended pairings?	
United Kingdom	Because of its NO_x conversion efficiency, SCR technology can easily achieve Tier III limits of its own. The versatility of SCR is such that it can be combined with other NO_x reduction technologies such as EGR, Humid Air Motor (HAM) and Water in fuel emission (WFE) to help them achieve Tier III requirements.
United States	Both MAN and Wärtsilä are investigating EGR and water strategies for meeting Tier III emission limits. Wärtsilä has completed preliminary analyses of the economic viability of combinations of technologies (e.g. EGR and direct water injection), which is publically available.[*22*] There is also publically available data from Wärtsilä on "Extreme Low-NO_x tuning" (by means of high-pressure turbocharging).[*23*] MAN has released test results for EGR on a 7 MW engine suggesting that Tier III NO_x standards can be achieved through the application of EGR. [*24*] [*referenced under "FURTHER INFORMATION PROVIDED"*]
QIII-3: Is there additional information that should be considered regarding which engines can use dual-fuel LNG to meet Tier III, and what development is needed for wide application of this technology? Is there additional information on the engine models that are currently available or expected before the 2016 compliance date of the Tier III NO_x limits?	
Netherlands	Dual- fuel LNG is considered a valuable option for short sea shipping in 2016. More time is needed for the development of LNG technology for deep see shipping. A first precondition is LNG bunkering facilities. To better address the needs of marine customers, a system of small-scale and medium-scale terminals with feeder ships bringing LNG from the import terminal to these terminals and bunker ships, etc., must be established. A number of small-scale terminals are expected to be established in Denmark, Norway, Sweden, and Finland by 2020 as well as in Germany, Belgium, and the Netherlands. (For more details see: "North European LNG Infrastructure Project – A feasibility study for an LNG filling station infrastructure and test of recommendations", Danish Maritime Authority, Copenhagen, May 2012.) There is a need for clear testing procedures for dual fuel engines. Furthermore LNG bunkering procedures should be developed.
IACS	One issue which tends to confuse regarding natural gas fuel use (and other such fuels) is there is a marked difference in the effect on NO_x emissions as to whether such fuel is use in as directly injected into the combustion chamber or use "pre-mixed fuel" in the charge air. In the case of direct injection, the information provided to date indicates that there is some reduction from Tier II type levels but it is with pre-mixed fuel that the substantial reductions required to meet Tier III are achieved. Submitted on draft final report.
QIII-4 (QIII-6 of Qs): Should MARPOL Annex VI be amended to include engines solely fueled on LNG, CNG, and LPG to ensure compliance with the Regulation 13 emission standards?	
IPIECA	We are a bit confused by QIII-6, as we thought that Annex VI is fully applicable to ships solely fuelled on LNG, CNG or LPG. Regulation 2 defines: (9) Fuel oil means any fuel delivered to and intended for combustion purposes for propulsion or operation on board a ship, including distillate and residual fuels. Hence under this definition, LNG, CNG and LPG should all be considered to be "fuel oil" for the purpose of the annex. Consistent with this, regulation 18(4) lists some exemptions for gaseous fuels, such that e.g. it is not required to maintain a sample of the "fuel oil" on board per paragraph 8.1. The statement in paragraph 13 about proposing to apply regulation 13 of Annex VI to engines running on pure LNG would benefit from having a little bit

	more explanation to the regulatory background. The definition of fuel oil in Annex VI (Regulation 2.9) is very broad and encompasses LNG. In fact for this reason there are some exceptions to e.g. the need to store samples on board a ship for gaseous fuels (regulation 18.4). However, regulation 13 explicitly restricts the NO_x requirements to marine diesel engines and regulation 2(14) defines marine diesel engines as engines operating on liquid or dual fuel. Hence effectively regulation 13 does not apply to engines running on pure LNG, as the LNG will be gasified by the time it reaches the engine. Last comment submitted on draft final report.
IACS	No comment on the particular point of extending the scope of the term "marine diesel engine" as currently defined in reg 2.14. If it were to be decided that this term is to be revised the exact wording of any such revision would need to take into account whether the intent was to generally include such engines – in which case Tier II certification would be required outside ECA-NO_x – or only those which are used within ECA-NO_x – i.e. only Tier III operation. Additionally if this term was to be so revised then associated issues related to the NO_x Technical Code 2008 would need to be considered and resolved concurrently.
INTERTANKO	We agree that this question is valid and may require some additional consideration. It is noted in MARPOL VI regulation 4 "Equivalents": 1) The Administration of a Party may allow any fitting, material, appliance, or apparatus to be fitted in a ship or other procedures, alternative fuel oils, or compliance methods used as an alternative to that required by the Annex if such fitting...etc...are at least as effective in terms of emissions reductions as that required by this Annex, including any of the standards set forth in regulations 13 and 14. Reg 4 only refers to fuel oils, no specific mention is made of LNG, CNG or LPG and the alternative, again, specifies fuel oils (not gas). However Reg 13 and the NO_x tech code refer to marine diesel engines with no mention of the fuel type. So I suppose the question is whether or not a fuel other than fuel oil can simply be considered as an alternative compliance method as per Reg 4 in order to meet the requirements of Reg 13 providing it is at least as effective etc. Perhaps some additional clarification is required on this point? Recognizing that this doesn't present any answers, only additional questions, but hoping it is of use. Also, Reg. 2.9 (definitions) of MARPOL Annex VI reads: 9 Fuel oil means any fuel delivered to and intended for combustion purposes for propulsion or operation on board a ship, including distillate and residual fuels. It may literally mean that it covers LNG, CNG and LPG. However, it might be wise to run such an interpretation through IMO and check whether there are different opinions.
Netherlands	Yes, that has our preference.

Norway	Yes, we believe pure gas-fuelled engines also should be certified for compliance with reg.13.
Sweden	Yes, MARPOL Annex VI needs to be amended to ensure compliance to all fuels that can be used according to the IGF Code. – Low flash point fuels as methanol, ethanol and hydrogen will probably be used in order to comply with Regulation 13.
United States	MARPOL Annex VI should be amended to include engines solely fuelled on LNG, CNG, and LPG to ensure compliance with the Regulation 13 emission standards. The Committee should be invited to clarify and explore this option.
.2 The current use of these technologies on marine diesel vessels with a view towards characterizing the introduction and demonstration of these technologies in real world applications.	
Q5: What other marine vessels are using the Tier III NO_x technology described above (or other pertinent technology)?	
Finland	Tallink-Silja is using direct water injection (DWI) on two vessels, m/s Silja Serenade and m/s Silja Symphony, for reduction of NO_x emission by approx. 50%. Godby Shipping has installed DWI on board m/s Mistral and Misida. Viking-Line vessel m/s Mariella uses HAM-method with good results. Godby-Shipping has installed WET-PAC equipment onboard m/s Misana and m/s Misida.
Q6: What additional information and data can you provide on the introduction and demonstration of these technologies in real world applications?	
Euromot	Current SCR installations are not requested to comply with Tier III requirements and are operated under highly controlled conditions, such as high quality fuels, high quality reductant and regular maintenance. Furthermore, they are not representative in terms of the broad range of engine size and type. SCR applications for marine fuel oil burning medium and low speed engines suffer from operability for certain required engine load ranges due to insufficient exhaust gas temperature. Some SCR installations suffer from inadequately designed urea injection and mixing stages.
Germany	The majority of SCR systems (and other technologies) in operation to date have not been assessed or even certified against the NO_x Tier III standards including the applicable testing regimes as of the NO_x Technical Code chapter 5. First applications to be tested on a voluntary basis under NO_x TechCode requirements are expected in the nearest future.
IACCSEA	We encourage a holistic view that includes consideration of the incidental emissions attributable to each Tier III technology. In addition to ammonia, particulate matter (e.g. with EGR), methane (e.g. from Natural Gas Engines) and CO_2 (often seen as a proxy for fuel efficiency) should all be considered. With this in mind IACCSEA echoes the recommendations of both the Swedish and US delegations that support some level of continuous monitoring of the NO_x emissions from the SCR catalyst outlet.
IACS Recognized Organizations	Tier I and Tier II certification has generally not had to consider the aspect of deterioration of performance over time – in fact a basic premise of the Code is that engine component wear / lack of maintenance will in general result in a decrease in NO_x g/kW-h emissions (albeit at the cost of increased fuel consumption and particulate / smoke emissions). However with the systems where deterioration over time (i.e. fouling / deactivation of SCR blocks) would have the opposite effect and hence result in higher NO_x emissions it should be considered how this aspect should be addressed within the initial certification / in survey requirements.

Japan	Japan has conducted onboard trials of exhaust gas denitration on engines with low-speed, middle-speed and high-speed rotation fitted with SCR in commercial operation as shown in Attachment 2. [*referenced under "FURTHER INFORMATION PROVIDED"*] In this review, Japan plans to provide information and data of those trials as below. 1. Elements and brief overview of test vessels 2. Layout of engine room and SCR 3. Position of catalyst and NO_x measurement apparatus in SCR 4. Initial performance of denitration 5. Route and duration of operation for on-board trial 6. Result of operation and denitration performance in onboard trial 7. Review on SV number [*offered in round 2*] See Attachment II- 5 – Attachment II- 8. .[*referenced under "FURTHER INFORMATION PROVIDED"*]
Sweden	Current marine SCR installations are not requested to comply with Tier III requirements and are in general operated under highly controlled conditions with high quality fuel and high quality reductant with regular maintenance. SCR ammonia slip, NH3, shall be monitored continuously or at frequent intervals on ships with SCR-systems. Recommended levels is <10 ppm NH3. Measurements shall preferably be done as 15-30 minute average values. The grab sample method that is used for Swedish NO_x certificates is sensitive to sudden engine load changes which may sometimes require several measurements before a true value is obtained. One important thing that we've learned over the years is to have sufficient volume of catalysts in the SCR-reactor to keep the ammonia slip, NH3, below maximum permitted level AND provide the required NO_x-reduction. The NO_x-reducing capability of the catalyst decreases over time and this must be accounted for. The solution to this is to have enough catalyst from the start and/or a replacement strategy for it as is done in power plants. Otherwise the NH3 may react with components in the exhaust gas such as SO3 and may cause deposits on surfaces in the funnel AND result in urea just passing the SCR and going out the stack as wasted excessive NH3-slip. We have seen such deposits on the tubes of exhaust boilers where they decrease the boiler efficiency and require frequent cleaning of the boiler. This results in a bad reputation for the technology among operators and may ultimately lead to equipment being turned off to stop the problems. Having a sufficient volume of catalyst is also required for maintaining the safety margin in the SCR-reactor. It is not difficult to design a SCR-system that complies with required NO_x-reduction levels when it is new. The difficulty lies in designing a system that maintains its performance over time, AND doesn't give its owner any problems!
United Kingdom	SCR has been used in the road transportation vehicles and power plant
United States	In addition to marine applications, SCR and LNG are used in many land-based applications including power plants and highway vehicles. Within the United States, stringent NO_x standards have been established for a wide range of diesel mobile sources. Due to these standards, SCR is used in trucks today and will soon be used in nonroad applications including locomotives, farm and construction equipment, and marine vessels.[*12*] .[*referenced under "FURTHER INFORMATION PROVIDED"*]

QII-4: How can issues identified in SCR demonstration projects, such as fuel sulphur level, catalyst deterioration, and ammonia slip, be addressed in SCR installations?	
Japan	Anti-deterioration measure for catalyst: More catalyst stock / Exhaust gas heating / Soot blow / Recovery operation of denitration performance / Use of low sulfur fuel / Use of ammonia as reductant Anti-clogging measure for exhaust pipe and catalyst: Diffusion technology of the reductant into the catalyst / Use of ammonia as reductant Anti-ammonia slip measure: Exhaust gas heating / Moderate equivalent rate of the reductant / Capture of ammonia at the back of SCR system
United Kingdom	SCR is a proven technology and has been used successfully to achieve well over 80% reduction of NO_x in many exhaust gas conditions including those of low sulphur fuels and high sulphur fuels such as low-grade coal and HFO. Sulphur is not a poison to conventional SCR catalysts but where high sulphur fuel is used the operating conditions such as minimum operating temperature must be considered to avoid the formation of Ammonium Sulphates -- ABS – that can cause catalyst deactivation and blockage. Maintaining a failsafe temperature limit can prevent the formation of ABS. Where ABS does form it can be reversed by a sustained period of elevated temperature. Inevitably SCR Catalyst performance will deteriorate over time, become poisoned, etc. The rate of deactivation will depend largely on the exhaust content and conditions. Over the last 25 – 30 years much experience has been gained many types of installation, including marine SCR where data on activity was collated and analysed. Today, Catalyst manufacturers & SCR experts, can factor deactivating mechanisms into their sizing programs which means that deterioration can be considered at the design phase. Catalyst providers generally guarantee the operation of their product for a standard operating time such as 16000 hours. Ammonia slip also considers the chemistry of the catalyst and whilst is a major issue at high conversion level e.g. >95% it should be minimal at 80% conversions – courtesy of good catalyst management and via use of a closed loop model.
United States	Fuel sulfur level should not be of concern for SCR systems certified to IMO Annex VI. First, sulfur is not a poison to conventional SCR catalysts. Where sulfur oxides are present in significant amounts in exhaust gas, care must be taken to design system operating temperatures to prevent ammonium sulfates from condensing/precipitating and masking the catalyst and introducing backpressure. Should such masking occur, it is normally reversible without needing a catalyst replacement. The ECA fuel sulfur content, 1,000 ppm, should be sufficiently low to reduce the sensitivity of systems to ammonium sulfate deposition. We would expect most Tier III engines to utilize SCR when operating in designated ECAs. The reductant that is to be used on board a vessel utilizing urea-SCR is typical of the reductant used in land based power plant and mobile source applications. We expect the desired urea in water concentration to be in the 32.5 to 40 per cent range, determined by the manufacturer. Further we would expect SCR systems to have enough flexibility in design to adjust their reductant injection rate to account for different concentrations of urea in water solution. This can either be done via inputting the urea concentration into the SCR controller when delivery is taken on board or by actively monitoring NO_x reduction across the SCR catalyst and adjusting urea injection rates accordingly to ensure that the NO_x emissions are in compliance with the standard. It is not a fair argument to say that current SCR installations are not representative of the broad range of engine size and type across marine applications. We would again like to point out the use of SCR in land based power generation applications, whose engines closely resemble their marine

	counterparts. Here these engines have been utilizing SCR for the past two decades with a track record of success. It is understandable that there is the possibility that some SCR installations may suffer from inadequately designed urea injection systems and improper mixing. These specific concerns, along with the concern that the SCR system may be mis-installed, was why the United States was adamant at BLG 14, 15, and MEPC 62 (BLG 14/12/3 and MEPC 62/4/13) that confirmatory tests be performed across all of the certification speed and load points during the ship's sea trial to ensure that the combined engine and SCR system comply with the Regulation 13 NO_x requirements. This confirmatory test would have detected any issues regarding the combined engine and SCR system performance with respect to compliance with Regulation 13 of Annex VI, requiring corrective action before the ship was issued its IAPP. The requirement for confirmatory testing was pared back in the SCR certification guidelines that were finalized at MEPC 62 and as they currently stand, only the parent engine in an engine group has to undergo the confirmatory test, thus allowing hundreds of installations to go unchecked. It should be noted that Euromot, among others, was among those that argued against confirmatory testing of every installation. It has been pointed out by Germany that many SCR systems to date have not been assessed or certified against the MARPOL Annex VI Tier III NO_x standards, including certification to the NO_x Technical Code (NTC). While this may be true, we would like to point out that the NTC test procedures are based on ISO 8178-1. Thus it can be envisioned that many of the current SCR applications have used ISO 8178-1 to determine NO_x emissions. In regard to catalyst deterioration and ammonia slip, we believe that the catalyst manufacturers will properly dose urea based on the SCR catalyst volume to prevent ammonia slip. Since the Tier III NO_x reduction is about 80% when compared to Tier II levels, as long as the SCR catalyst is properly sized for the application, there should be no issue with overdosing of urea to get the maximum reduction out of the SCR system (99%). We believe that setting an ammonia slip limit of <10 ppm is reasonable for these engines, but we do not believe that ammonia emissions should be monitored continuously on-board the ship (see reason below). We believe that the best method for ensuring continued compliance with MARPOL Annex VI Regulation 13 is continuous monitoring of the NO_x emissions from the SCR catalyst outlet. Further this will guard against ammonia slip, as a properly functioning catalyst and dosing system will not slip ammonia above a 10 ppm limit, especially given the steady-state operating characteristics of marine engines. Technologies are readily available today to measure NO_x on board a ship for comparison to measurements made during the certification of the engine or combined engine/SCR system. These systems are discussed in an upcoming United States submission to BLG 16 (BLG 16/8/X). [*referenced under "FURTHER INFORMATION PROVIDED"*]

.3 Progress of engine and after-treatment manufacturers towards developing such technology and expectations for bringing Tier III NO_x technologies fully to market by 2016.	
Q7: What other additional engine and after-treatment manufacturers (*in addition to those listed in the first discussion document*) should be considered in this review?	
Euromot	Euromot covers the majority of globally operating manufacturers of engines for seagoing ships. Pls. find below a list of our members as of August 2011 AGCO SISU POWER BRIGGS & STRATTON CASE NEW HOLLAND CATERPILLAR POWER SYSTEMS GROUP CUMMINS ENGINES DAIMLER DEUTZ DOLMAR DRESSER WAUKESHA ENGINES EMAK FIAT POWERTRAIN TECHNOLOGIES GE JENBACHER GLOBAL GARDEN PRODUCTS HATZ HONDA EUROPE HUSQVARNA GROUP JCB POWER SYSTEMS JOHN DEERE KAWASAKI EUROPE KOMATSU ENGINES LIEBHERR LOMBARDINI – KOHLER GROUP MAN GROUP MHI EQUIPMENT EUROPE MOTEURS BAUDOUIN MTU GROUP (TOGNUM) MWM ROLLS-ROYCE SAME DEUTZ-FAHR SCANIA SOLO STEYR MOTORS STIHL TORO EUROPE VOLKSWAGEN INDUSTRIAL ENGINES VOLVO CONSTRUCTION EQUIPMENT VOLVO PENTA WACKER NEUSON WÄRTSILÄ YAMABIKO GROUP YANMAR GROUP
Finland	ABB-Turbochargers.
United Kingdom	There are many manufacturers in the market such as Johnson Matthey, Yarwil, Haldor, Topsoe, Hitachi-zosen and MHI. If permitted by them, their contribution is valuable.
United States	Yarwil and Wilhelmsen Technical Services also provide SCR systems for marine applications.
Q8: What additional information and data can you provide on the progress of engine and after-treatment manufacturers towards developing Tier III NO_x technologies and expectations for bringing these technologies fully to market by 2016?	
Euromot	SCR certification procedures based on the IMO guidelines as approved by MEPC 62 are currently under investigation.
Germany	It is expected that first engine/Scr systems are to be tested and certified under the NO_x TechCode and IMO SCR-Guideline regime within the nearest future. (of course, an EIAPP is not yet to be issued for Tier III compliance).
Japan	A study of safety measures regarding treatment of reductant including both urea and ammonia is being conducted in Japan. The result of this study of safety measures was reflected on the procedure of on-board trials mentioned above. Regarding anti-degradation measure of SCR, Japan conducted recovery test of the catalyst. After heating catalyst with degraded denitration efficiency at 300 degrees Celsius for several hours, the denitration efficiency was found to be almost recovered to that of new one.
QII-5: Please provide any available additional information regarding the progress of individual manufacturers towards bringing Tier III NO_x technologies to market.	
ICOMIA	ICOMIA is currently putting great effort into identifying the implications of compliance with IMO NO_x Tier III. The main work carried out is through a Working Group where engine and after-treatment system manufacturers, as well as shipyards are represented. As noted in our response to the first round of comments, there are no serial built after-treatment systems available today. The

	downsizing of SCR units will be heavily depending from engine and after-treatment manufacturers researching and developing in serial produced systems. The information received from engine manufacturers participating in our WG indicate that serial built integrated systems for Tier III compliance will be available close to the 1 January 2016 deadline set by IMO MARPOL. There are comparable exhaust emission limits set by the US EPA (Tier 4). For engines >2000kW, these limits will be phased in starting 2014, i.e. earlier than IMO Tier III. For those sectors of our industry that will be most heavily impacted by IMO Tier III we do not expect benefit or transfer of technology before 2016 – as EPA Tier 4 also regulates HC and PM, technologies chosen might differ from IMO Tier III and operation of vessels compliant with these limits will have to rely on use of ultra-low-sulphur fuels (15 ppm) which sets a different scenario than IMO compliance. Testing of prototypes and field validation notwithstanding. Part of our work has involved aftertreatment manufacturers, and following research we communicated a specification which is attached with our reply (Appendix I – Catalyst guidance note). This note is based on the scenario implementing today's available SCR technology (on the supply/after-market).
United Kingdom	The major engine OEMS and SCR system providers have gained considerable experience in Marine SCR. Many 4-stroke engines have had SCR systems installed. Work continues to improve and optimize the SCR system components. Experience of SCR in low speed - two stroke engines is also growing. There are number of SCR installed on the low speed engine.
United States	Experience with SCR is growing among manufacturers of low speed, two-stroke engines. Current demonstration projects indicate Tier III NO_x compliance is highly feasible. We have identified 340 vessels equipped with SCR. A cited list of these vessels is attached and we welcome other participants to add additional information as appropriate.[*referenced under "FURTHER INFORMATION PROVIDED"*]
.4 Identification of any sub-sets of marine diesel engines where there will not be technologies available to comply with the Tier III standards	
Q9: What sub sets of marine diesel engines should be considered, as part of this review, where there may not be technologies available to comply with the Tier III standards by 2016?	
Finland	Mainly problems will be raised by fitting SCRs to engines with wet exhaust gas lines and small marine-engines which are derived from industrial engines and where additional alterations are impossible to carry out as retrofit solution.
Germany	Germany is of the opinion that for all engine categories under consideration suitable and practical NO_x Tier III compliance options will be available for ship new buildings (keel laying on/after 1 Jan 2016) of any kind of ship type. In cases of "Major Conversion" of pre-2016 ship's engines (Regulation 13.2.2 (replacement engines, additional engines) guidelines still to be developed by the Organization are to be taken into account.
IADC	Towards this end, we submit the attached paper for consideration by the group.[referenced under "FURTHER INFORMATION PROVIDED"] The paper identifies practical and technological impediments that, given current technologies, we believe render infeasible the application of the Tier III standards to MODUs.
IACCSEA	SCR works successfully on a wide range of engine types, can cope with all common fuel types and operates over a wide range of engine conditions. Whilst SCR for slow speed engine is at a different level of technology development, it is anticipated that this engine sub set will be served with commercially available SCR solutions by 2014. With the variety of ships, engines and fuels operating on SCR today in maritime, and also considering the land based industry and automotive, we do not see any

	specific segment where SCR cannot be applied. SCR can be applied to all smaller vessels such as yachts, fishing vessels, barges, tugs, inland water ways vessels, etc. Where space (e.g. in the engine room) is an issue then compliance with Tier III 9, e.g. with SCR technology) needs to be considered at the design phase.
ICOMIA	ICOMIA is an NGO with consultative status at IMO and broadly supports the goal of a reduction in exhaust emissions from shipping. Our Association represents the worldwide recreational marine industry and in this case is specifically concerned with large yachts (LY) over 24 m loadline length. The recreational marine sector can often be misunderstood (keyword: rich man's toys) and overshadowed by the global shipping industry. The current fleet comprises about 5377 yachts above 24 m and the industry supporting this fleet is estimated to employ 60000 in shipyards, as crew, in support services or in marinas. Operation and maintenance value is estimated at €8 billion per annum. The vast majority of vessels in this category are below 300 GT (40% <200GT/23% 200-300GT) and operated as charter vessels in order to offset the costs for the owner which is a critical factor in their decision to order these yachts (charter income is €2.5 billion per annum). The size and quality of the interior accommodation is therefore critical to ensure that the yachts remain desirable to charter parties. It is acknowledged that after treatment technology will significantly develop in the coming years however many large yachts are semi-custom built whereby each model requires a large investment in standardisation of design, systems and tooling. In order to amortise this initial investment the models will frequently remain in production for a number of years so yacht builders are planning today for designs that will still be in production in 2016 and beyond. These are the main issues that could emerge: - The importance of the interior accommodation on the yachts means that engine room designs are functional but space constrained, in particular on smaller vessels. As previously mentioned our industry need to plan today for Tier III and the technology currently available may have a significant impact with regards to space, weight and cost. - When simply "clutching" a catalyst to a system, advanced engine controls (e.g. EPA Tier III compliant) would recognize an alien component and shut down. Therefore, any implementation of emissions reductions technology would have to happen in coordination with the engine manufacturer, MARPOL ANNEX VI certification procedures notwithstanding. Tier III technologies that will come into application on a large yacht will have to be derived from one of the established applications such as heavy duty vehicles or larger vessel technology. Large yacht engine installations will need to be "integrated systems", i.e. a production built engine/aftertreatment unit certified as one system by the engine manufacturer. This outcome can only be achieved as a result of engine manufacturer research or of a partnership with aftertreatment equipment suppliers. Today it is still under (economic) consideration whether manufacturers of marine engines and emissions reductions technologies will provide Tier III compliance to this niche market. Currently, there is no production built system available specifically developed for a marine environment in a large yacht. ICOMIA is putting great efforts in making a specification available to its members upon which shipyards can plan Tier III emission compliant vessels, the results are still uncertain.
Japan	Due to the lack of space, some small vessels may need small-sized Tier III engine in order to avoid safety hazard which may occur in installing ordinary Tier III engine such as eliminating a part of its hull structure. The status of technological development of small-sized Tier III engine should be followed during this review

	period, and the problems occurred in installing Tier III engine into small vessels should be considered as necessary.
Q10: What additional information and data can you provide on this issue, including support to your answer to Q9?	
IADC	We would also note that the vast majority of all engine-related emissions from MODUs occur during those periods of time that the unit is engaged in exploration for and exploitation of the sea-bed's mineral resources. During those times, in accordance with Article 2(5) of the Convention, the Administration of the MODU rests with the Government of the host coastal State, rather than the flag-State. As is the case in the United States, coastal State Governments have (and exercise) the authority to control emissions from MODU operations, irrespective of the standards adopted by the IMO. Examples of the case-by-case reviews of potential emissions from exploration and exploitation activities in the United States (including MODU operations) can be found at: http://www.epa.gov/region4/air/permits/OCSPermits/OCSpermits.html
ICOMIA	Our yards are working together with engine and aftertreatment manufacturers on design studies initially to understand the implications of Tier III. We would like to share this data with the CG when we receive results in early 2012 which will allow the CG to assess the implications of this research. Hence ICOMIA wishes to comment as follows to a selection of questions to the Correspondence Group (Q2, Q3 and Q4). [*see above*]
ICOMIA	[*initial remarks during round 2*] Initial remarks from ICOMIA: As stated in our response to round 1 we are supportive of IMO's move to cleaner engines and are doing our utmost to prepare our industry for Tier III. We are pleased that our initial comments from round 1 have been taken onboard by the correspondence group and welcome the opportunity to provide further input to this second round. We see one of the major benefits of IMO's Tier III emission limits that they are applicable to new built vessels only. However, in contrast to many other segments of this industry, the majority of large yachts by number are built from glass reinforced plastic (GRP). These yachts are series built and require significant investment in moulds which can be used for a number of years in order to amortise the large initial capital investment. In many cases yacht models that are built today will still be in production beyond 2016. One builder providing a precise figure identified 50% of his current product portfolio will still be in production in 2016. Existing moulds have not been designed to accommodate the extra space demanded by the SCR. Thus, we are being asked to apply Tier III retrospectively. It has been identified that, for the time being, Selective Catalytic Reduction is the only applicable technology for our industry. The yacht industry is working to understand the implications of Tier III and remains hopeful that rapid technical development will take place in the coming years. Today, however, there are significant space issues when assuming the installation of current technology in existing models. Based on implementing technology available today ICOMIA conducted a design study and we provide the conclusions of one typical builder. All examples investigated face the same principal issues: • Space requirements for after-treatment equipment impact on the accommodation space of the yacht, which is the key element for their economic viability • No means to assemble the large parts of system without change of assembly sequence due to closed engine room ceiling • Difficulties to support heavy and bulky system • Installation causes an increase in yacht displacement of 4-6%, change of trim, and a speed reduction estimated at 1,5-2 knots which has not been

	considered in the initial design • Engine room ventilation penalised (SCR heat implications not assessed at this stage) • Maintenance accessibility questionable • Access space between engines heavily reduced • Very complex shape of exhaust piping

QIII-5: Please provide specific examples of recreational vessels over 24 metres in length, which will be produced using existing moulds, where SCR installations may be space constrained to the extent it would be impossible to install a compliant SCR system without substantially affecting the ship's mission requirements, safety, or cost.

ICOMIA	A range of large yachts, including planing and semi-displacement vessels, will very likely be significantly impacted by the Tier III regulation. A provisional assessment shows that the range of vessels affected will be from 24 m loadline to approximately 400 GT. The definitive range of vessels critically affected by Tier III needs to be defined in more detail and these parameters are subject to the conclusions of ICOMIA's Design Study which will be available in early January 2013. It is expected the range of vessels critically affected by Tier III will represent at least 25% of the current large yacht fleet by unit numbers. For the 2012 business year, 58 high speed vessels <400 GT were under construction. These vessels would initially appear as being large enough to enable compliance with all hull space-demanding rules introduced during the recent years, in particular the ILO Maritime Labour Convention increasing crew cabin requirements and now IMO Tier III. While many might believe this sector is immune to financial considerations, research conducted among our member yards shows the requirement to significantly change vessel designs at the expense of guest cabin accommodation would severely reduce the attractiveness of these vessels to potential owners. These vessels often cover their operational costs by chartering out, so unattractive guest accommodation results in fewer vessels with the impact absorbed by the industry producing and operating these vessels, not their owners. The fact that Tier III enters into force in 3 years' time allows the opportunity for further technological developments in SCR technology and the potential to reduce the space requirements. However, this would require a market sufficiently large to support further investments in technology by SCR manufacturers which are subsequently offset by sales numbers. With current order books for these vessels not exceeding a number of 60/year it is unrealistic to expect such a targeted development. Furthermore it is essential for our industry to plan today for Tier III compliance, due to the tooling involved in building fibre reinforced plastic vessels. Many of the yards that ICOMIA represent are required to start planning and designing their 2016 production in 2013 and commercial decisions are being taken today. This will be demonstrated on the example of two of our member shipyards. One is based in the United Kingdom and the other in Italy, but both are representative of the whole sector which follows a very proactive approach towards Tier III and does their utmost to comply with the rules. In addition, ICOMIA has initiated Tier III implementation studies amongst a large number of its member yards in order to assess the impact of the regulation. These studies are currently being carried out and the outcome is expected in early 2013. Ideally, ICOMIA would provide further details at a later drafting stage of the report.

	See Annex 4 for case studies.
IACCSEA	IMO Tier III was very clearly written – several years ago – to signal future emissions control requirement for new-build vessels operating in NO_x Emission Control Areas. Part of this was to address concerns over vessel design. All sectors of the shipping community have had ample time – up to 8 years to incorporate IMO III requirements and compliance into 2016 designs. We encourage any sector/market segment seeking derogation to reinvigorate its efforts to find a technology solution to meet the emission requirement.
Netherlands	Technically it is feasible to install after treatment equipment on all recreational yachts. Only in the case of small yachts with high installed power, for example the semi displacement yachts, some space constraints can be found. In these cases it is not yet fully clear how the equipment can be installed. Probable some innovative ways need to be found to get the equipment fitted in these ships.

QIII-6: Can the space-related constraints described in QIII-7 for recreational vessels over 24 metres in length be overcome by providing more time for compliance, i.e. extending the date of compliance for these engines and vessels? If so, how much additional time might be needed?

ICOMIA	Recreational vessels over 24 metres in length are a relatively niche sector within the wider shipping industry and also have specific space constraints, comparatively low annual engine operating hours and spend a high percentage of the time operating at low engine load, which has been recognized as a concern for SCR operation. The unit numbers built each year are relatively low and it remains unlikely that the catalyst manufacturers will dedicate sufficient specific research and development effort to produce a SCR system optimized to meet these specific restrictions. An extension of the implementation date would be welcome however the pace of technological change is not clear so it is not possible to confirm a date by which a system will be in existence which will not incur a disproportionate impact on the sector. If a delay is the approach decided upon then it is recommended that this should be an absolute minimum of 5 years and, due to the uncertainty surrounding the pace of technological developments, should be followed by a review clause with the aim to ensure that the impact on the sector is in proportion to the environmental benefits.
Netherlands	The design and building process for new yachts can take up to 3 to 5 years. This means that ships being developed now will have to fulfill the 2016 requirements. Therefore it is of upmost importance that IMO give clarity in their decision whether or not more time will be given. Given the current state of technology, it seems feasible to equip all ships with after treatment, but in some cases, new innovative ways need to be developed to create space to install the extra equipment. This process needs time. Waiting longer with the decision by IMO, will shorten the design time and in that case it might be impossible to reach the 2016 goal.

<table>
<tr><th colspan="2">QIII-7: In the context of the concerns that were expressed regarding SCR and the use of high sulphur fuel in higher speed engines, what sulphur level is considered "high sulphur"? Further, is there any technical issue relative to the use of SCR technology in NO_x Emission Control Areas where fuels with 1,000 ppm or less sulphur will be required?</th></tr>
<tr><td>ICOMIA</td><td>Initially ICOMIA wishes to adjust one of the assumptions stated in an earlier submission on global availability of fuels for high speed engines. Following recent studies it is understood fuels below 1000 ppm will be globally available for the operation of high speed engines on board yachts; in some cases 500 ppm or less are stated. To our knowledge one engine manufacturer's initial design assumption will be based on limiting the maximum allowable amount of sulphur in fuels to 500 ppm. Since the main issue from Tier III for our industry is about finding enough space to fit catalysts, yacht operators will have to use fuels below the threshold set by the engine/system manufacturer. Alternatives to restricting the max allowable sulphur content inducing an additional space penalty such as SCR by-passing are not feasible on these vessels. From our research we understand the thresholds for sulphur sensitivity are set by use of substrates in catalysts and the factor driving the substrate selection is the maximum allowable engine exhaust temperature. In many cases and due to the concurrent implementation of other marine emission limits Tier III base engines are still at design stage. To accommodate Tier III, these engines will also have increased backpressure. Until tested under real life conditions engine manufacturers subsequently are unable to determine maximum exhaust temperatures. Depending on the latter, the selected catalyst substrates will set thresholds for fuels to be used either at 500 ppm or on-road quality fuels. Whether the latter are available globally is questionable. These two thresholds set a differing size scenario for SCR implementation and both have their pro and cons.

Is the statement in the interim report "the size of an SCR requiring onroad fuels would be comparable to onroad applications" appropriate for the yacht sector? Because of their low usage hours and compared to other commercial applications (e.g. marine and onroad heavy-duty), engines used in yachts are high-power density engines, i.e. smaller than comparable commercial engines. An engine with the same power but used in commercial applications will technically have to be larger and relative catalyst size as a function of engine size decreases. Subsequently, comparing catalyst sizes for engines in high power density and commercial ratings leaves the SCR for a high power density spec at a larger relative size even under the scenario of same catalyst substrate use and there is no comparison possible with onroad systems. The latter, due to expected difficulties in obtaining fuels with onroad quality globally, is from an operational point of view the worst case and would only be chosen if engine exhaust temperatures prove to be too high for catalyst substrates tolerant to fuels with up to 500 ppm sulphur fuels. These substrates require higher catalyst volumes. In combination with the above considerations on SCR relative size, the comparably very small market and, to this date, lack of initiatives by manufacturers and suppliers to commit to a compact solution ICOMIA's initial understanding of SCR size being above 30% of the engine volume remains unchanged. The assumption on urea availability in paragraph 2 of the SCR section is not applicable to the yacht sector. They neither follow standard routes nor operate from commercial ports. Urea availability is a very real concern and was a significant factor in the US EPA's decision to exempt yachts from their Tier IV Rule. While yachts operating within an ECA might stimulate the development of some urea infrastructure those coming to an ECA from other lands might struggle to source urea.</td></tr>
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	Note: ammonium sulphate would be purged from the SCR if the catalyst temperature is raised to more than 400°C (engine load factor >~80% of full load) for a period of time. Vanadium based catalysts. As part of our current assessment of Tier III technologies we have consulted engine and aftertreatment manufacturers, as well as a technology research institute on the likely implemented technology. All confirmed: - the likely use of Vanadium based catalysts as default technology, and - the sizes stated were consistent. Last comment submittal on draft final document.
IPIECA	We will leave it to the SCR suppliers to define what they consider as "high sulphur" fuel. However, our understanding is that an SCR does not need to be in operation outside of an ECA for NO_x. Assuming the SCR is bypassed at that point, there should be no issue with respect to high sulphur fuel. All ECA's for NO_x so far are also ECAs for SO_x, which implies that by 2016 fuel used inside these ECAs will be at 0.10% S and hence should in any case be compatible with the use of an SCR, unless of course the ship would elect to meet the ECA S requirement through the use of a scrubber. The latter however would seem unlikely for the small vessels concerned.
IACS	In this regard it would be noted that Annex VI provides for the possibility – as per Appendix III - that an area may be an ECA-NO_x but not an ECA-SO_x. If such an area were to be so established the relevant Annex VI fuel oil sulphur limit (on the basis of compliance on basis of fuel oil as loaded) would of course be 3.50 % max sulphur to 1.1.2020 and 0.50% max thereafter (subject to the 2018 completed review of that date). However, it would be further noted that because the Annex VI maximum sulphur limit is a certain value does not imply that other considerations, such as SCR design constraints, may not pose a tighter (user defined) limitation in certain applications.
United States	The comment relating to the need to accommodate high sulfur fuels appears to conflict with the fuel sulfur requirements in Emission Control Areas. Compliance with the Tier III NO_x limits is only required when a vessel operates in these areas if the keel of such a vessel was laid on or after 1 January 2016. The required sulfur content for distillate fuels that are used in these areas must not exceed 1,000 ppm sulfur beginning 1 January 2015. Therefore, SCR systems on smaller vessels will only need to be designed to operate on 1,000 ppm sulfur fuel, not on fuels with sulfur contents of 15,000 ppm.
Sweden	Not to our knowledge.
QII-6: Are Tier III engine or control systems currently installed on or under development for a recreational/passenger vessel greater than 24 meters in length?	
ICOMIA	The aftertreatment suppliers participating in the ICOMIA NO_x Tier III Working Group have confirmed that, to the best of their knowledge, there is not currently an SCR installation on a recreational vessel greater than 24 m designed to comply with IMO NO_x Tier III. SCR systems have been installed on a small number of recreational craft less than 24 m to comply with emission limits at a comparable level to Tier III (such as NO_x tax/Scandinavia and Lake

	Constance/Austria/Germany/Switzerland regulations). These systems all operate on clean (low- or ultra-low-sulphur) fuels with sulphur content between 100 and 10 ppm, which is available locally but not more widely. Availability of fuel is a key parameter in identifying the required catalyst size and, even assuming the use of clean fuel, a significant space impact was experienced. A key assumption in our ICOMIA Tier III study is the SCR system has to cope with globally available marine diesel fuel leading to a stepped approach of 15000 ppm (equivalent to 1.5% sulphur until the global 0.5% cap is in force 2020/2025) and 1000 ppm in SECAs (equivalent to 0.1% sulphur). We have been provided with indicative statements by SCR manufacturers that active reactor volume increases between 30 – 50% when choosing fuels used in a global operability scenario (15000 ppm fuel).
United Kingdom	Such vessels usually have high speed engines and use higher quality fuel. This provides better circumstances for SCR. The SCR systems can be more compact and possibly similar to those used in Heavy Duty Diesel applications e.g. trucks. The manufacturers should commence on-site study to facilitate the installation process.
United States	There are currently Tier III strategies installed on at least twenty passenger vessels (primarily "car/passenger" vessels) including LNG and SCR technologies. [*25,26,27,28,29,30*] Six of these passenger/ferry vessels have SCR installed; the remainder including passenger, car/passenger-ferries use LNG. [*referenced under "FURTHER INFORMATION PROVIDED"*]
QII-7: What additional technical data can you provide relative to the similarities and differences of applying Tier III NO_x technology to recreational versus commercial vessels greater than 24 metres in length?	
ICOMIA	Most commercial vessels operate on a predefined operational range which is reflected in the design specification. Recreational vessels have to assume global operability and hence a variety in fuel quality and sulphur content. Few commercial vessels see high production numbers as done with serial built recreational vessels. Although we do not represent other parties than builders of yachts, we assume few other industries will have to apply IMO NO_x Tier III to models that are in production today. Recreational vessels have very low engine operating hours when compared to commercial shipping. Large yachts, especially those involved in charter will spend a maximum time between 3 months (summer season only) and 6 months (those spending the winter season abroad) at sea of which a considerable period is at anchor. Privately owned yachts typically have much less operating hours (on average between 50 – 300 hours a year!).
QII-8: Are Tier III engine or control systems currently installed on or under development that could be used on Mobile Offshore Drilling Units?	
IACS	Ammonia slip, Since as yet this is not a controlled species under MARPOL Annex VI it would appear that, as is currently the case for smoke and particulate emissions, there is no mandate other than to urge that such emissions be minimized (noting that the recently completed SCR Guidelines – MEPC.198(62) – only give a general intent statement in this regard). As ammonia slip represents poor usage of urea (a purchased commodity) there will in any case be commercial pressures to minimizing and in this regard it should be recognized that statutory control, such as MARPOL Annex VI, is not the only elements influencing design – as pointed out by the US when developing the original Direct Measurement and Monitoring Guidelines.

	It would be noted that there are already the provisions under reg 3.3.4 of MARPOL Annex VI which exempt engines which are solely dedicated to sea bed mineral extraction. It is recognized that, particularly with the onset of Tier III, that this would be a factor in avoiding new building arrangements which use a common engine pool for all services – since in which case it would be understood that such exemption would not apply. As to the point raised in this particular question regarding low load running, as was pointed out by many of the Round 1 responders, Tier III was set very much with SCR in mind – hence the specific requirements of 3.1.4 of the NO_x Technical Code 2008. Therefore should it be found that the engine load applied, not only in MODU but in any ship is below the 25% mode point and that reactor outlet temperature is such that the SCR does not operate then it would be considered to be fully acceptable. (Note this differs, for example, to the Exhaust Gas Cleaning System Guidelines (MEPC.184(59) where it is specifically required that the system operates at all loads).
United Kingdom	Understand Heavy Duty Diesel engines have varied load cycles, this operation mode should also be looked into to find out the technical solution.
United States	Wärtsilä's 32 engine is commonly used on offshore support and drilling vessels.[*31*] Wärtsilä offers a Tier III compliant version of this engine, equipped with an SCR catalyst known as the Wärtsilä NOR (nitrogen oxide reducer).[*referenced under "FURTHER INFORMATION PROVIDED"*]
.5 Where relevant, the global availability of consumable products used by a certain technology to reduce emissions to the required standard in Tier III, including supply chain issues, e.g. restrictions on import, export and sale.	
Q11: Presumably, this point is referring to the use of urea with SCR systems. Are there other consumable products that should be considered in this review?	
Euromot	For some EGR applications, consumables to treat the wash water for the scrubbing process may be required as well as disposal of its wash water residues.
IACS classification societies	Ammonia could also be used as the reductant in SCR systems. Class rules have historically considered ammonia as a refrigerant and as such used within dedicated, gas tight, enclosed spaces outside the machinery spaces. It would be inconsistent to consider ammonia as a reductant in a different manner and hence this should be clearly recognized if so proposed as the reductant to be used.
Integer-Research	Urea solution is the most suitable reductant for tier III NO_x control systems. Anhydrous ammonia and aqueous ammonia are alternatives but both have disadvantages in terms of distribution, handling and storage on the vessel. SCR technology based on urea solution is now a well proven technology and offers a cost effective and efficient supply chain. An important point for marine vessels is the dissipation of ammonia. Note that "Anhydrous ammonia gas is lighter than air and will rise, so that generally it dissipates and does not settle in low-lying areas. However, in the presence of moisture (such as high relative humidity), the liquefied anhydrous ammonia gas forms vapours that are heavier than air. These vapours may spread along the ground or into low-lying areas with poor airflow where people may become exposed." Source: http://www.health.ny.gov/environmental/emergency/chemical-terrorism/ammonia-tech.htm
Japan	Other than urea, ammonia should also be considered as reductant to be used for SCR especially in large-sized vessels. Besides, availability of catalyst as consumable products should also be considered in this review.
Sweden	$CSNO_x$ and its consumables
United States	No. The only relevant consumable product used by Tier III NO_x emission control technology is urea used in SCR systems.

Q12: What additional information and data on the global availability of urea (or other relevant consumable products) can you provide, including supply chain issues, e.g. restrictions on import, export and sale?	
Canada	Environment Canada has assessed the current state of availability of urea-based diesel exhaust fluids (DEF) used SCR in on and off-road applications and has observed that DEF is becoming increasingly available in Canada through a variety of distribution networks. Canadian distribution networks follow the Waterloo-Quebec City corridor with major distribution points in Ontario and Quebec. DEF is also available on both coasts.
Euromot	Urea for SCR must be of significantly better quality than urea used for agricultural and industrial use; this has to be considered. Only high quality urea solution without impurities is suitable for SCR application.
Germany	It is considered necessary to have an international standard in place specifying urea quality. Operational problems (SCR break down) due to bad urea quality have been reported.
IACCSEA	For maritime SCR systems it's most common to use 40 % high quality urea-water solution. 32,5% urea solution(AdBlue/DEF)) has a freezing point at -11 °C whilst 40% urea solution has a freezing point at 0°C. Onboard vessels, the urea solution tank is located below sea surface level. Consequently, contrary to vehicles' urea storage, the product will rarely or never be exposed to temperatures below zero degrees and this allows for a higher concentration of urea in the solution. This yields better economy because one carries less water and more of the urea. An expert group in CEFIC has completed a joint proposal for an ISO standard for a maritime urea solution. This proposal is presented to ISO with the objective to establish a marine application ISO approved urea solution standard within 2012/2013. In the meantime the proposed specification Aus 40 will be used as a quality recommended by the stakeholder group. Within the shipping community, a concern has been raised whether there is adequate availability of urea solution for the coming maritime demand. Currently, land based SCR applications (automotive road/non-road, power production etc.) require some 20 million tons of urea solution. The total demand for urea solution in marine applications at present, is some 0,03 million tons, expected to peak towards approx. 1 million tons in 2020. Growth in demand from the maritime sector from 2016 (when the IMO Tier III kicks in) will be slow, because the regulation only affects new builds from 1 January 2016 for operation in ECAs (Emission Control Areas). Vessels also have substantially longer lifetime than trucks, so the replacement rate is much lower and it will take many years before a majority of the worlds' sailing fleet will require Aus 40. The supply is thus secure for the future Aus 40 demand, as the maritime sector will always be small compared to land based industries, and the maritime demand growth rate is slow. It is also advantageous for the Aus 40 market that the maritime segment is transparent and relatively predictable, enabling due time to plan for- and implement Aus 40 production escalations as required. As an example IACCSEA member Yarwil, a joint venture between Yara and Wilhelmsen Maritime Services, is today the largest supplier of urea to SCR systems in the maritime market, already delivering our NOxCare 40 to vessels in the Far East, Middle East, the Americas, Asia and Europe. The urea solution, NOxCare 40 Marine is provided from owner Yara, the world's largest urea producer. Yara is building up the availability of NOxCare 40 in line with the increasing demand. Yarwil has ambition to secure a global delivery network and ensure a reliable supply of high quality urea product worldwide for the maritime industry. The IMO Tier III regulation valid from 2016 only affects vessels operating in an ECA.

	For Europe, today's SECA (Sulfur Emission Control Area) in the North Sea and Baltic Sea is expected to be expanded to an ECA. The majority of the ships today using SCR technology are trading in this area where we already have a well-established storage and distribution network for AUS 40 /NOxCare 40. Canada and the United States have implemented IMO approved ECAs covering the east and the west coast 200 nm off land. The EPA Tier IV regulation valid from 2014 will require urea availability for the US market 2 years earlier that the IMO regulation. The product is already available in US and Yarwil together with Yara and Wilhelmsen will establish the storage and distribution network to meet the maritime demand. It is an advantage for the Aus 40 market that the regulation for the automotive industry is in front of the regulations for the maritime industry, ensuring that urea solutions are already available in Europe(AdBlue), America (DEF), Brazil(ARLA32 and in Asia. Large investments in production, storage and distribution network have been done to secure supply and distribution of the urea.
IACS Recognized Organization	ISO with regard to status of a standard specification for urea solutions – albeit at different water % (or dry powder) to be used in marine SCR units. IBIA / IAPH regarding the facilities / arrangements for urea delivery to ships
Integer-Research	Urea is widely available on a global basis and is traded as a commodity chemical on a large scale. Bulk shipments of 50,000 tonnes of urea are not uncommon. The price of urea is transparent and published in several weekly market reports. The price of urea depends on the global supply/demand balance, and on energy and crop prices. Some trade restrictions exist, for example prohibitive export taxes from China for part of the year (low agricultural season), or prohibitive import duties in the USA for urea imports from Russia. However, these do not affect the widespread availability of urea in any country because urea production is produced in about 58 countries. We believe that other submissions have addressed this issue adequately. We also attach a presentation regarding the urea market which may be useful to the CG. o Recent market developments o Demand has been the main force driving fertilizer markets of the last 5 years o Fertilizer prices have generally moved in a similar pattern over the last 5 years o Granular urea premium over prills is currently high, which brings new buyers into prilled urea market o In 2010, industrial urea represented around 12% of total urea use. This share is expected to stay stable going forward. This is mostly prills, but some granular product is also used in industrial markets o Part of the increase in nitrogen prices is due to increased energy costs o With the exception of 2009, even high cost nitrogen producers have made a profit o Cumulative nitrogen profits continued to rise as higher prices compensate for higher costs o The most important factor is the global cost curve for urea –margin producers affect floor price, and incentive prices drives cycle o Level of profitability greatly influenced by diverging energy prices o The Middle East and North Africa region is the leader for profit generation o Exploitation of shale gas has transformed nitrogen production economics in North America. Close proximity to customers provides added upside

	o Chinese capacity comes under extreme margin pressure due to domestic urea price ceiling and rising production costs o Europe is divided by gas, NW European producers who can buy spot have enjoyed a cost advantage over peers on oil-indexed contracts o Outlook o What factors are likely to influence fertilizer markets in general? Underlying demand fundamentals remain robust. Key long-term drivers: population growth, raising income growth, changing diets to more crop intensive, static land availability, higher crop yields required, fertilizers help to raise crop yields o Short term demand influences also positive o The supply side will be the key influence going forward. [more capacity, but capital cost inflation has been substantial and lead times are also a hurdle: 3-4 years] o Many new projects under construction or discussion o Supply investment likely to stimulate a period of surplus capacity o China remains the biggest wildcard among other uncertainties o Nitrogen outlook summary and implications for urea prices ▪ Right now the margin is low US$300 per tonne or equivalent fob Black Sea ▪ In the future it will be dependent on prevailing energy prices ▪ Higher oil prices steepen the cost curve ▪ Relative gas/coal prices
Japan	In Japan, the amount of supply of urea for vessels is expected to be sufficiently reserved. No restriction on import, export and sale exists. Information below is planned to be provided in the later round. 1. Infrastructure regarding delivery system of urea and ammonia 2. Case study of loading of reductant on ship 3. Price and running cost of reductant [*offered in round 2*] 1. Infrastructure regarding delivery system of urea and ammonia Supply infrastructure of Urea (Ad-blue: 32.5% solution) for automobiles would be expanded for marine use. As for ammonia (25% solution), it is in large-lot production for industry use and its supply for marine use would be sufficient. 2. Case study of loading of reductant on ship In the on-board trial, reductant was supplied from a tank truck to the test vessel. Other than this, reductant distribution facilities in ports including double pipe from tank to the vessel or supply barges could be considerable. Besides, from the standpoint of cost benefit and the availability of reductant, system of generating reductant on board from solid urea would be one of conceivable measures. 3. Price and running cost of reductant Price of reductant in Japan is shown as below; Urea (Ad-blue): 70~80 JPY/L Urea (40% solution): 30~40 JPY/kg Solid urea: 65~70 JPY/kg Ammonia (25% solution): 70~85 JPY/L Japan agrees to the idea of having international standard specifying the quality of reductant. IMO may ask ISO to set the standard regarding reductant including those listed above.
Sweden	Urea for SCR should be of high quality and handled correct in the supply chain taking into account transport and storage conditions.

	An ISO standard, similar to ISO22241 for AUS32, for 40% urea solution must be in place before any legislation enters force.
United Kingdom	SCR Grade urea is a global business. It is anticipated the first few years after the Tier III standard comes into force, the demand for urea would be small, but will grow in time. This allows the supporting industries putting themselves to cope.
United States	Urea is a widely-used chemical throughout the world. In addition to being used for agricultural and chemical applications, urea is used in SCR systems in both mobile-source and stationary plant applications today. As such, urea is available today for use in SCR systems, including more than 500 ships equipped with SCR. We have seen no indication that urea availability will be a significant issue in 2016. We are not aware of any supply chain issues related to restrictions on import, export and sale of urea. The urea industry is expected to be able to supply urea in the quantities needed for operating Tier III engines in designated ECAs. According to the International Fertilizer Industry Association (IFIA),[*13*] urea supply is projected to expand by 25% over the next five years. Currently, the total supply of urea is 155.6 million metric tonnes (Mt) compared to demand of 153.3 Mt, primarily for agricultural uses. By 2015, IFIA projects that total urea supply will be 190.5 Mt with a potential surplus in excess of 18 Mt in 2015. In comparison, the United States Environmental Protection Agency estimates the urea demand (in solution with water) for SCR-equipped ships operating in the North American ECA to be only about 0.4 Mt in 2020.[*14*] Even considering growth in SCR use as new ships are constructed beyond 2020 and the potential for increased urea demand in the event of the establishment of further NO_x ECAs in Europe and elsewhere, it appears that urea supply will be more than sufficient to meet demand in the marine market. As mentioned above, SCR-grade urea-water solutions are already available or are expected to become available in ports in many parts of the world. Land-side equipment including hostlers, trucks, rail, and various non-road equipment are or will be subject to stringent NO_x emission limits that are expected to be met through high-efficiency advanced aftertreatment technology like SCR. Therefore, these ports will already have urea facilities. It is possible to extend these facilities for ships; alternatively, new SCR distribution centres could be provided. Due to recent environmental standards for highway vehicles, there are more than 3,700 urea pumps at retail outlets in Europe and more than 3,600 locations providing urea in North America.[*15*] We expect that these urea distribution systems will expand to ports in response to urea demand for use on ships. This could occur from construction of urea distribution facilities for ships or through specially equipped barges.
QII-9: What information can you provide on the availability of consumable products that may be used with EGR or Exhaust scrubbers for NO_x control?	
IACS	It would be suggested that related NGOs attending MEPC be specifically invited to comment on these issues, for example ISO on the development of a marine urea specification (noting Sweden's Round 1 Q12 response) and IBIA on the potential for their members delivering both fuel oil and urea.
Japan	Magnesium Hydroxide (Mg(OH)2) may be used with EGR or Exhaust scrubber for NO_x control. It is easily procurable at low price, and would be consumed less than one-tenth of the fuel.
United Kingdom	At present, the urea is used in fertiliser at a high volume – 90% of world production. Once commence installing the SCR, the urea manufacturers would be able to figure out the demand and ramp up both the supply and the logistics supply chain.

Questions on Information Gathering, Collating, and Analysing	
Q13: What additional information would be helpful to carry out the analysis of technological developments to implement the Tier III NO_x emission standards?	
Germany	More input from user's experience would be appreciated.
IACS classification societies	Urea solutions have not historically been considered as engine room working fluids. The probability that their usage will become common-place will require consideration (as noted in general in the response to Q.4) as to whether class rules should address the ship structure / machinery system requirements relating to the storage and handling of urea solutions and whether specific requirements would be necessary for urea if loaded as dry bulk powder.
IACS Recognized Organizations	It would be seen that systems and arrangements complying with Tier III will, in many cases, require feedback controls on their operation / rate of consumable usage. These will typically be driven by NO_x sensors hence it would be important to have confidence that these control arrangement will be ready and suitable for that task within the marine environmental conditions which will be encountered in service.
IPIECA	Any constraints on fuel characteristics associated with any of the technologies being considered should be clearly identified.
Sweden	User's experience from suppliers and ship owners with 10 to 15 years of experience with SCR installations.
United Kingdom	It would be useful to hear the SCR user and manufacturers experience during the last 15 years
United States	The goal of this regulation 13.10 progress review should not be to review all or any specific NO_x technology, nor should it be prejudiced toward the use of any technology. This is because it is ultimately up to each engine manufacturer to determine which technology will be used to certify their engine models to the standards. Rather, the goal of this technology review should be to evaluate whether manufacturers are making progress toward certifying Tier III engines by the stated effective date of 2016. As noted above, marine engine manufacturers are already supplying engines capable of meeting the Tier III NO_x limits for marine and land-based applications, primarily through the use of SCR. This means that SCR technology is already being used today in a wide range of vessel types and other applications.
Q14: How can this additional information be obtained in a time period and a format that will be helpful for this Correspondence Group?	
IPIECA	The developers of each of the technologies being considered should be able to provide information on fuel requirements (other than customary fuel standards such as ISO 8217:2010 for residual and distillate fuels) for their technology.
Sweden	In this time frame it's impossible to gain further information on user's experience but Sweden believes that it would be of great interest to have some input from ship owners with 10 to 15 years of experience from SCR installations.
	Additional Information Provided by the Participants
Finland	(2010) "ABB Turbocharging: The Power2 miracle – NO_x down, power up, fuel down." http://www05.abb.com/global/scot/scot208.nsf/veritydisplay/19cddf7a478eaf29c12577ca00344be9/$file/abbtc_power2.pdf
IADC	(September 2011) "The Application of Selective Catalytic Reduction (SCR) Systems for Mobile Offshore Drilling Unit (MODU) Diesel-Electric Power Plants." IADC [*no web link provided; file circulated to CG after round 1*]
ICOMIA	"SCR Outline Information", ICOMIA and BMF 2011 [*no web link provided; file circulated to CG after round 2*]

INTER-TANKO	At this point we will go along and endorse the comments provided by Sweden [*referring to first round of comments*]
Japan	Attachment 1 [*http://www.jsmea.or.jp/images/Attachment9.pd; file circulated to CG after round 1*] Attachment 2 [*hppt:///www.jsmea.or.jp/images/Attachment10.pd; file circulated to CG after round 1*] Attachment II-1 Research and development of SCR technology using low speed engine [*http:///www.jsmea.or.jp/images/Attachment1.pd; file circulated to CG after round 2*] Attachment II-2 Research and development of SCR technology using middle speed engine [*http://www.jsmea,.or.jp/images/Attachment2.pd; file circulated to CG after round 2*] Attachment II-3 Research and development of SCR technology using high speed main engine [*http://www.jsmea,.or.jp/images/Attachment3.pd; file circulated to CG after round 2*] Attachment II-4 Research and development of SCR technology using high speed auxiliary engine [*http://www.jsmea,.or.jp/images/Attachment4.pd; file circulated to CG after round 2*] Attachment II-5 On-Board SCR trial using low speed engine [*http://www.jsmea,.or.jp/images/Attachment5.pd; file circulated to CG after round 2*] Attachment II-6 On-Board SCR test using middle speed engine [*http://www.jsmea,.or.jp/images/Attachment6.pd; file circulated to CG after round 2*] Attachment II-7 On-Board SCR trial using high speed main engine [*http://www.jsmea,.or.jp/images/Attachment7.pd; file circulated to CG after round 2*] Attachment II-8 On-Board SCR trial using high speed auxiliary engine [*http://www.jsmea,.or.jp/images/Attachment8.pd; file circulated to CG after round 2*]
United States	[1] DNV, A review of the world fleet of LNG fuelled ships, February 2011 http://blogs.dnv.com/lng/2011/02/a-review-of-the-world-fleet-of-lng-fuelled-ships/ [2] U.S. Environmental Protection Agency, "Regulatory Impact Analysis: Control of Emissions of Air Pollution from Category 3 Marine Diesel Engines," EPA420-R-09-019 (December 2009). Available from http://www.epa.gov/otaq/regs/nonroad/marine/ci/420r09019.pdf [3] U.S. Environmental Protection Agency. Proposal to Designate an Emission Control Area for Nitrogen Oxides, Sulphur Oxides and Particulate Matter; Technical Support Document. EPA-420-R-09-007. April 2009. http://www.epa.gov/otaq/regs/nonroad/marine/ci/420r09007.pdf [4] MAN Diesel and Turbo. Tier III Compliance; Low Speed Engines. July 2010. http://mandieselturbo.com/1015014/Press/Publications/Technical-Papers/Marine-Power/Low-Speed/Tier-III-Compliance-%E2%80%93-Low-Speed-Engines.html [5] MAN Diesel and Turbo. SCR: Selective Catalytic Reduction. http://www.mandieselturbo.de/files/news/filesof11812/SCR.pdf [6] MAN Diesel and Turbo. Technology for Ecology: Medium Speed Engines for Cleaner Air. http://www.mandiesel.de/files/news/filesof11812/Technology%20for%20ecology.pdf [7] Wartsila. Wartsila NOx Reducers – SCR System. Feb 2010. http://www.wartsila.com/en/environmental-technologies/air-emissions-control/NOR#_0_Brochures__undefined [8] Wartsila, IMO Tier III Solutions for Wartsila 2-Stroke Engines – Selective Catalytic Reduction (SCR). 2011. http://www.wartsila.com/en/environmental-

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	Powerful-Version-of-its-Wartsila-32-Engine-1590.aspx Spreadsheet titled "LNG-Fuelled Ships in Operation" [*no web link provided; file circulated to CG after round 2*] Spreadsheet titled "Vessels with SCR November 2011" [*no web link provided; file circulated to CG after round 2*]
Norway	Kolle, Lars, et. al., "NOx Fund Supported NOx Abatement from 2008 to 2011 User Experience," MARINTEK REPORT, MT22 F12-172, September 14, 2012. [*no web link provided; file circulated to CG after round 3]*
Denmark	MAN Diesel & Turbo, "Exhaust Gas Recirculation on MAN B&W Tier III Low Speed Engine-Focus on Particulate Matter," undated. [*no web link provided; file circulated to CG after round 3]*

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ANNEX 2

VESSELS WITH INSTALLED SCR SYSTEMS

This Annex consists of two lists of vessels with installed SCR systems.

Table 2-A contains a list of vessels that was compiled from various submittals to the Correspondence Group.

Table 2-B contains a list of vessels that was submitted by IACCSEA.

Table 2-C contains extended comments from ICOMIA on Round 3 questions.

Table 2-A: Vessels with Installed SCR Systems

Owner	*Ship Name*	*Ship Type*	*Fuel*	*Engine Model*	*Engine power (per engine)*	*NO_x Redux Tech*	*Date/Type of Date*	*Field of Application*	*Engine Manufacturer*	*SCR Manufacturer*	*Total Power (kW)*
A.P. Moeller	Sofie Maersk	Container	HFO	NA	1 x 3300	SINox SCR	2005/Delivery	Aux engine	MAN	NA	3300
ACE Link AS	Siluna	Passenger/Ferry	MGO	3 x Volvo Penta	3 x 640 kW	SCR / Oxi / Silencer	2007/Delivery	NA	Volvo	NA	1920
ACE Link AS	Simara	Passenger/Ferry	MGO	3 x Volvo Penta	3 x 640 kW	SCR / Oxi / Silencer	2007/Delivery	NA	Volvo	NA	1920
Aker Aukra	Skandi Flora	Platform Supply Vessel (PSV)	MGO	4 x 9L21/31	4 x 1.800 kW	SCR Systems	2008/Delivery	NA	MAN	NA	7200
Aker Aukra	NB 706	NA	MGO	2 x 16V32 4 x 8L26	2 x 8.000 kW 4 x 2.720 kW	SCR Reactors (only)	2008/09 - Delivery	NA	MAN B&W	NA	26880
Aker Aukra	NB 707	NA	MGO	2 x 16V32 4 x 8L26	2 x 8.000 kW 4 x 2.720 kW	SCR Reactors (only)	2008/09 - Delivery	NA	NA	NA	26880
Aker Aukra	NB 716	NA	MGO	4 x 9L27/38 1 x 16V4000	4 x 2.970 kW 1 x 2.008 kW	SCR Reactors + Mixers(only)	2008/Delivery	NA	NA	NA	13888
Aker Aukra	NB 722	NA	MGO	2 x 16V32 4 x 8L26	2 x 8.000 kW 4 x 2.720 kW	SCR Reactors (only)	2008/09 - Delivery	NA	NA	NA	26880
Aker Aukra	NB 732	NA	MGO	2 x 16V32 4 x 8L26	2 x 8.000 kW 4 x 2.720 kW	SCR Reactors (only)	2008/09 - Delivery	NA	NA	NA	26880
Aker Langsten	Far Samson	Offshore Supply Vessel	MGO	4 x C25:33L9A	4 x 2.610 kW	SCR Systems	2007/08 - Delivery	NA	Rolls Royce	NA	8640

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
Aker Langsten	Far Sapphire	Offshore Supply Vessel	MDO	xB32:40L8P	4 x 4.000 kW	SCR Systems	2007/Delivery	NA	Rolls Royce	NA	16000
Aker Langsten	Far Scorpion	Offshore Supply Vessel	MGO	2 x B32:40L9P	2 x 4.500 kW	SCR Systems	2008/Delivery	NA	Rolls Royce	NA	9000
Aker Langsten	Far Sagaris	Offshore Supply Vessel	MGO	2 x B32:40L9P	2 x 4.500 kW	SCR Systems	2008/Delivery	NA	Rolls Royce	NA	9000
Aker Langsten	Far Shogun	Offshore Supply Vessel	MGO	2 x B32:40L9P	2 x 4.500 kW	SCR Systems	2009/Delivery	NA	Rolls Royce	NA	9000
Aker Langsten	Far Saracen	Offshore Supply Vessel	MGO	2 x B32:40L9P	2 x 4.500 kW	SCR Systems	2009/Delivery	NA	Rolls Royce	NA	9000
Wärtsilä	1755	Drill Ship	LFO	6 x 16V32	6 x 7.680 kW	SCR Systems	2010/Delivery	NA	Wärtsilä	NA	46080
Aker Sovik	Skandi Arctic	Diving Support Vessel	LFO	6 x 7L32	6 x 3.220 kW	SCR Systems	2007/Delivery	NA	Wärtsilä	NA	19320
Solstad Shipping AS	Acergy Viking	Offshore Supply Vessel	MGO	NA	4 x 2540	SINox SCR	2007/Delivery	Ship Propulsion: 4 main engines	Cat	NA	10160
Polarcus	Adira	Seismic Vessel	MGO	4 x 9L26	4 x 2.925 kW	SCR Systems	2012/Delivery	NA	Wärtsilä	NA	11700
Staten Island Ferry	Alice Austin	Ferry	MDO	NA	2 x 1150	SINox SCR	2004/Delivery	Ship propulsion: 2 main engines	Cat	NA	2300
Polarcus	Alima	Seismic Vessel	MGO	4 x 9L26	4 x 2.925 kW	SCR Systems	2011 Delivery	NA	Wärtsilä	NA	11700
Polarcus	Amani	Seismic Vessel	MGO	4 x 9L26	4 x 2.925 kW	SCR Systems	2012/Delivery	NA	Wärtsilä	NA	11700
N/A	Aquila	Pilot Boat	N/A	ACERT C32	NA	SCR and DPF	2010 Delivery	NA	Cat	Hug	NA
Havyard Leirvik	AS HLE 102	NA	MGO	NA	4 x 1560	SINox SCR	2010/2010 - Delivery	4 main engines	MTU	NA	6240

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
Havyard Leirvik	AS HLE 106	NA	MGO	NA	2 x 1560 2 x 1840	SINox SCR	2010/2010 - Delivery	4 main engines	MTU	NA	6800
Polarcus	Asima	Seismic Vessel	MGO	6 x 9L20	6 x 1.800 kW	SCR Systems	2010/Delivery	NA	Wärtsilä	NA	10800
N/A	Aurora of Helsingborg	Passenger/Ferry	MDO	WV6R32	NA	SCR, OXI	1992	NA	Wärtsilä	NA	NA
Aker Sovik	AYA 705	NA	MGO	4 x 6L32/40 2 x 8L	4 x 2.880 kW 2 x 3.840 kW	SCR Reactors + Mixers	2008/Delivery	NA	Wärtsilä	NA	19200
Tallink Ferries	Baltic Princess	RoPax Ferry	HFO	4 x 16 V32	4 x 8.000 kW	SCR Systems	2008/Delivery	NA	MAN B&W	NA	32000
Tallink Ferries	Baltic Queen	Passenger	HFO	4 x 16V32	4 x 8.000 kW	SCR Systems	2009/Delivery	NA	MAN B&W	NA	32000
N/A	Balticborg (Volharding 528)	Sto-Ro	HFO	NA	NA	SCR, OXI	Ordered 2002	Main engine	Wartsila	Hug	9450
Bergen Tankers	Bergen Nordic	Tanker	LFO	1 x 6L27/38	1 x 2.040 kW	SCR System	2008/Delivery	NA	MAN B&W	NA	2040
Bergen Tankers	Bergen Star	Tanker	LFO	2 x C:25/33L6A	2 x 1.740 kW	SCR Systems	2008/Delivery	NA	Rolls Royce	NA	3480
Birka Line	Birka Exporter	RoRo	HFO	NA	1 x 5400	SINox SCR	2000/Delivery	Ship Propulsion: 1 main engine	Wärtsilä	NA	5400
Birka Line	Birka Paradise	Passenger	HFO	NA	4 x 5850 4 x 2760	SINox SCR	2004/Delivery	Ship Propulsion: 4 main and 4 aux engines	Wärtsilä	NA	34440
Birka Line	Birka Princess	Passenger	HFO, MDO	NA	4 x 4500 2 x 2250	SINox SCR	1998/Delivery	Ship Propulsion: 4 main and 2 aux, 1 aux engine	Wärtsilä	NA	22500
Birka Line	Birka Shipper	RoRo	HFO	NA	1 x 5400	SINox SCR	2001/Delivery	Ship Propulsion:	Wärtsilä	NA	5400

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
								1 main engine			
Birka Cargo AB Ltd.	Birka Transporter	RoRo	HFO	NA	1 x 5400	SINox SCR	2002/Delivery	Ship Propulsion: 1 main engine	Wärtsilä	NA	5400
Fitjar	Birkeland	Offshore Supply Vessel	HFO	1 x 9L32	1 x 4.320 kW	SCR Systems	2009/Delivery	NA	Wärtsilä	NA	4320
Pon Power	BMV-164	NA	MDO	4 x C280-12	4 x 3.800 kW	SCR Systems	2009/Delivery	NA	Cat	NA	15200
Kleven	BN353	NA	MDO	4 x 9L20	4 x 1.665 kW	SCR Systems	2012/Delivery	NA	Wärtsilä	NA	6660
N/A	Botniaborg (Volharding 529	Sto-Ro	HFO	NA	NA	SCR, OXI	Ordered 2002	Main engine	Wartsila	Hug	9450
Ulstein	Bourbon Mistral	Supply Vessel	LFO	NA	4 x 1665 1 x 340	SINox SCR	2006/Delivery	Ship Propulsion: 4 main, 1 aux engines	Wartsila, Cat	NA	7000
Ulstein	Bourbon Monsoon	Supply Vessel	LFO	NA	4 x 1665 1 x 340	SINox SCR	2006/Delivery	Ship Propulsion: 4 main, 1 aux engines	Wartsila, Cat	NA	7000
Ulstein	Bourbon Topaz	Supply Vessel	MDO	NA	4 x 1900	SINox SCR	2005/Delivery	Ship Propulsion: 4 main engines	Cat	NA	7600
Wärtsilä	Bro Sincero	Chemical Tanker	HFO	1 x 9L20	1 x 1.600kW	SCR System	2007/Delivery	NA	Wärtsilä	NA	1600
Factorias Vulcano	C535	Seismic Vessel	HFO	2 x 8L32/44CR 2 x 6L32/44CR	2 x 4.500 kW 2 x 3.000 kW	SCR Systems	2009/Delivery	NA	Wärtsilä	NA	15000
Swedish Navy	Carlskrona	Military Vessel	MGO	NA	4 x 1940 2 x 850 2 x 390	SINox SCR	2002/Delivery	Ship Propulsion: 4 main, 2 aux, 2 aux engines	Wartsila, Wartsila, Volvo Pentha	NA	10240

Owner	*Ship Name*	*Ship Type*	*Fuel*	*Engine Model*	*Engine power (per engine)*	*NO_x Redux Tech*	*Date/Type of Date*	*Field of Application*	*Engine Manufacturer*	*SCR Manufacturer*	*Total Power (kW)*
Reederei Braren	Cellus	Cargo Vessel	HFO	1 x 8M32	1 x 3.840 kW	Cat. Replacement	2006/Delivery	Ship Propulsion: 1 main and 1 aux engines	MAK	NA	3840
N/A	Cinderella	NA	HFO	6R32E	NA	SCR	Ordered 2003	Aux engine	Wärtsilä	Hug	2460
N/A	Cinderella	NA	HFO	NA	NA	SCR	Ordered 2003	Main engine	Sulzer	Hug	7200
Eastern Echo	Cook	NA	MDO	6 x 9L20	6 x 1.800 kW	SCR Systems	2008/Delivery	NA	Wärtsilä	NA	10800
N/A	Crown of Scandinavia	Car Ferry	HFO	6R32	NA	SCR, OXI	Ordered 2002	Aux engine	Wärtsilä	Hug	2460
Danish Navy	Diana	Oil Tanker		NA	2 x 2040	SCR	6/24/2010	NA	MTU	$BLUNO_X$ Digital AIrless Multipoint SCR by Dansk Teknologi	4080
n/A	Draco	Pilot Boat	N/A	ACERT C32	NA	SCR and DPF	2010 Delivery	NA	Cat	Hug	NA
N/A	Eco Ship	NA	HFO	NA	NA	SCR, OXI	Ordered 2003	Main engine	N/A	Hug	1110
Pon Power	Edda Fauna	Offshore Supply Vessel	MGO	6 x 3516 1 x 3508	6 x 2.130 kW 1 x 968 kW	SCR Systems	2007/Delivery	NA	Cat	NA	13748
Karmsund Maritime	Edda Flora	Survey Ship	MDO	5 x 3516 1 x 3508	5 x 2.188 kW 1 x 958 kW	SCR Reactors	2007/Delivery	NA	Cat	NA	11898
Fjellstrand	Eldborg	Supply Vessel	LFO	4 x MTU12V4000	4 x 1.380 kW	SCR Systems	2008/Delivery	NA	MTU	NA	5520
N/A	En Avant 4	Tugboat	MDO	NA	1 x 750	SINox SCR	2003/Delivery	Ship Propulsion: 1 main engine	MAN	NA	750
Pon Power	Endurer	NA	MDO	2 x 3516 C 3 x 3516 B	2 x 2.188	SCR SystemsSCR	2008/Delivery	NA	Cat	NA	10076

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
					kW 3 x 1.900 kW	Systems					
Viking Line	Gabriella	Passenger RoRo	MDO, HFO 0.5%S	1 x WV6R32	NA	SINox SCR	1997/Delivery	NA	Wartsila	NA	23760
Aker Soviknes	Enea	Supply Vessel	MGO	4 x 9L20 / 4 x 3516B	4 x 1.665 / 4 x 1.901 kW	SCRSystems	2009/Delivery	NA	Wärtsilä	NA	14264
San Francisco Water Emergency Transportation Authority	Taurus	Passenger/Ferry	Diesel	16V2000	1410 HP	SCR	2010 Delivery	NA	MTU	Engine, Fuel & Emissions Engineering of California	1410
STX St. Nazaire	Europa II	Passenger	HFO/MDO	2 x 6M43	2 x 6.000 kW	SCR Systems	2012/Delivery	NA	MAK	NA	12000
DSME/Exmar	Excelerate	LNG Tanker	LNG/HFO	Mitsubishi oil and gas-fired H2254/63 MB-4E-KS2	2 x 70 t	SINox SCR	2007/Delivery	NA	Mitsubishi, Regas-Boiler	Johnson Matthey	NA
DSME/Exmar	Excellence	LNG Tanker	LNG/HFO	NA	2 x 70 t	SINox SCR	2007/Delivery	2 boiler	Regas-Boiler	NA	NA
DSME/Exmar	Exemplar	LNG Tanker	LNG/HFO	NA	2 x 70 t 1 x 50 t	SINox SCR	2008/Delivery	Propulsion: 2 main boiler, 1 aux boiler	Regas-Boiler	NA	NA
DSME/Exmar	Expedient	LNG Tanker	LNG/HFO	NA	2 x 70 t 1 x 50 t	SINox SCR	2008/Delivery	Propulsion: 2 main boiler, 1 aux boiler	Regas-Boiler	NA	NA
DSME/Exmar	Explorer	LNG Tanker	LNG/HFO	NA	2 x 70 t 1 x 30 t	SINox SCR	2006/Delivery	Propulsion: 2 main boiler, 1 aux boiler	MHI	NA	NA
DSME/Exmar	Express	LNG Tanker	LNG/HFO	NA	2 x 70 t 1 x 30 t	SINox SCR	2007/Delivery	Propulsion: 2 main boiler, 1 aux boiler	MHI	NA	NA

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
DSME/Exmar	Exquisite	LNG Tanker	LNG/HFO	NA	2 x 70 t 1 x 50 t	SINox SCR	2008/Delivery	Propulsion: 2 main boiler, 1 aux boiler	Regas-Boiler	NA	NA
Gotland Rederi	Fast Ferry	Ferry	MDO	NA	4 x 9000 1 x 500	SINox SCR	2005/Delivery	Ship Propulsion: 4 main, 1 aux engines	Ruston, Man	NA	36500
Wärtsilä	Fiskeskjer	Trawler	MDO	1 x 12V32	1 x 5.040 kW	SCR System	2009/Delivery	NA	Wärtsilä	NA	5040
Solstad Shipping AS	Flekkefjord	NA	LFO	NA	4 x 3800 1 x 1020	SINox SCR	2006/Delivery	Ship Propulsion: 4 main, 1 aux engines	Wartsila	NA	16220
Reederei Braren	Forester	Cargo Vessel	HFO	1 x 8M32	1 x 3.840 kW 2 x 239 kW	Cat. Replacement	2007/Delivery	Ship Propulsion: 1 main and 2 aux engines	MAK	NA	4318
Danish Navy	Freja	Military Vessel		NA	2 x 2040	SCR	6/24/2010	NA	MTU	BLUNOX Digital AIrless Multipoint SCR by Dansk Teknologi	4080
N/A	FSG 721	NA	HFO	NA	NA	SCR, OXI	Ordered 2002	Aux engine	Man B&W Holeby	NA	1720
N/A	FSG 722	NA	HFO	NA	NA	SCR, OXI	Ordered 2002	Aux engine	Man B&W Holeby	NA	1720
N/A	FSG 723	NA	HFO	NA	NA	SCR, OXI	Ordered 2002	Aux engine	Man B&W Holeby	NA	1720
N/A	FSG 724	NA	HFO	NA	NA	SCR, OXI	Ordered 2002	Aux engine	Man B&W Holeby	NA	1720
N/A	FSG 725	NA	HFO	NA	NA	SCR, OXI	Ordered 2002	Aux engine	Man B&W Holeby	NA	1720
Greentop	Futura	Chemical Tanker	MDO	4 x MTU	4 x 600 kW	SCR Systems	2006/Delivery	NA	MTU	NA	2400
Tallink Ferries	Galaxy	RoPax Ferry	HFO	4 x 16V32	4 x 6.560 kW	SCR System	2006/Delivery	NA	MAN B&W	NA	26240
Pon Power	Geir	Fishing Vessel	MGO	3 x C-32	3 x 874 kW	SCR Systems	2010/Delivery	NA	Cat	NA	2622

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
Gotland Rederi	Gotland	Chemical Tanker	HFO	NA	4 x 12600 main 3 x 1530 aux	SINox SCR	2000/Delivery	Ship Propulsion: 4 main, 3 aux engines	Wärtsilä	NA	54990
Gotland Rederi	Gotland	Chemical Tanker	MDO	NA	4 x 7000 main 3 x 450 aux	SINox SCR	1998/Delivery	Ship Propulsion: 4 main and 3 aux engines	Ruston-Diesel, MTU	NA	29350
Gotland Rederi	Gotlandia II	Ferry	MDO	2 x MAN 2842	2 x 481 kW	SCR Systems	2007/08 - Delivery	NA	MAN	NA	962
Fiskerstrand	Gunnar Langva	Fishing Vessel	LFO	1 x B30:40L9	1 x 4.500 kW	SCR System	2009/Delivery	NA	Rolls Royce	NA	4500
Pon Power	H07 +Volst	Survey Ship	LFO	4 x 3516B	4 x 1.900 kW	SCR Systems	2008/Delivery	NA	Cat	NA	7600
Pon Power	H07 +Volst	Survey Ship	LFO	4 x 3516B	4 x 1.900 kW	SCR Systems	2008/Delivery	NA	Cat	NA	7600
Fitjar	Hardhaus	Trawler	MGO	1 x 9L32	1 x 4.500 kW	SCR System	2009/Delivery	NA	Wärtsilä	NA	4500
Wärtsilä	Havbris	Trawler	MDO	1 x 6L32	1 x 2.760 kW	SCR System	2009/Delivery	NA	Wärtsilä	NA	2760
Danish Navy	Havfruen	Military Vessel		NA	2 x 2040	SCR	6/24/2010	NA	MTU	BLUNOX Digital AIrless Multipoint SCR by Dansk Teknologi	4080
Solstrand	Havila Borg	Supply Vessel	LFO	4 x MTU	4 x 1.380 kW	SCR Systems	2008/Delivery	NA	MTU	NA	5520
Havyard	Havila Foresight	Offshore Supply Vessel	MGO	NA	4 x 2340	SINox SCR	2007/Delivery	Propulsion: 4 main engines	Cat	NA	9360
Havyard	Havila Jupiter	Anchor Handling Tug Supply (AHTS)	LFO	2 x 12VM32 4 x 3516C	2 x 6.000 kW 4 x 2.150	SCR Systems	2008/09 - Delivery	NA	MAK	NA	20600

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)*** kW	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
Havyard	Havila Neptun	Anchor Handling Tug Supply (AHTS)	MGO	2 x 12VM 32 2 x C-18	2 x 6.000 kW 2 x 601 kW	SCR Systems	2007/Delivery	NA	MAK	NA	13202
Havyard	Havila Saturn	Anchor Handling Tug Supply (AHTS)	MGO	2 x 12VM 32 2 x C-18	2 x6.000 kW 2 x 601 kW	SCR Systems	2007/Delivery	NA	MAK	NA	13202
Havyard	Havila Venus	Anchor Handling Tug Supply (AHTS)	LFO	2 x 12VM32 4 x 3516C	2 x 6.000 kW 4 x 2.150 kW	SCR Systems	2008/09 - Delivery	NA	MAK	NA	20600
Baatbygg	Havskjer	Trawler	MGO	1 x12V32	1 x 5.520 kW	SCR System	2009/Delivery	NA	MAN	NA	5520
N/A	Havyard Leirvik	NA	HFO	NA	NA	SCR, OXI	Ordered 2002	Aux engine	Rolls Royce	Hug	5300
N/A	Havyard Leirvik	NA	HFO	NA	NA	SCR, OXI	Ordered 2002	Main engine	Cummins	Hug	5300
NSS-Poland	Henri Dyroy	NA	MDO	1 x 3612	1 x 3.460 kW	SCR System	2010/Delivery	NA	Cat	NA	3460
Fiskerstrand	Heroyhav	NA	MDO	1x9M32 2x3508	1 x 4.320 kW 2 x 760 kW	SCR Systems	2010/Delivery	NA	MAK	NA	5840
Fosen Trafikklag	Hertug Skule	RoRo	MDO	NA	920	SINox SCR	1997/Delivery	Ship Propulsion	NA	NA	920
Aker Soviknes	Hi Prince	NA	MGO	4 x 9L20 / 4 x 3516B	4 x 1.665 / 4 x 1.901 kW	SCRSystems	2008/Delivery	NA	Wärtsilä	NA	14264
Havyard	Hull 101	NA	MGO	6 x 3516C	6 x 2.188 kW	SCR Systems	2009/Delivery	NA	Cat	NA	13128

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
Pon Power	Hull 104	NA	MGO	4 x 3512	4 x 1.424 kW	SCR Systems	2009/Delivery	NA	Cat	NA	5696
Pon Power	Hull 123	NA	MGO	4 x 3512	4 x 1.424 kW	SCR Systems	2010/Delivery	NA	Cat	NA	5696
BMV	Hull 167	NA	MDO	4 x 8L32	4 x 3.800 kW	SCR Systems	2010/Delivery	NA	Wärtsilä	NA	15200
Pon Power	Hull 295	NA	MGO	2 x 9M32C 2 x 6M25C	2 x 4.500 kW 2 x 1.800 kW	SCR Systems	2012/Delivery	NA	MaK	NA	12600
Ulstein	Hull 703	Platform Supply Vessel (PSV)	MDO	4 x 6L21/31	4 x 1.320 kW	SCR Systems	2011/Delivery	NA	MAN	NA	5280
STX Aukra	Hull 764	Platform Supply Vessel (PSV)	MGO	2 x 3516 C	2 x 2.350 kW	SCR Systems	2011/Delivery	NA	Cat	NA	4700
FOSEN	Hull 87/88	RoPax Ferry	HFO/MDO	4 x 10L32/44CR 2 x 6L21/31 1 x 7L21/31	4 x 5.600 kW 2 x 1.320 kW 1 x 1.540 kW	SCR Systems	2012/Delivery	NA	Wärtsilä	NA	26580
FOSEN	Hull 87/88	RoPax Ferry	HFO/MDO	4 x 10L32/44CR 2 x 6L21/31 1 x 7L21/31	4 x 5.600 kW 2 x 1.320 kW 1 x 1.540 kW	SCR Systems	2011/Delivery	NA	Wärtsilä	NA	26580
Otto Marine	Hull no. H7063	NA	MGO	4 x 9M25 2 x 6M25	4 x 2.850 kW 2 x 1.900	SCR Systems	2009/Delivery	NA	MaK	NA	15200

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
					kW						
Swedish Navy	IB ATLE	NA	HFO	NA	NA	SCR, OXI	Ordered 1996	Main engine	Pielstick	Hug	3680
Swedish Navy	IB ATLE	NA	Diesel	NA	NA	SCR, OXI	Ordered 1996	Aux engine	Wartsila	Hug	662
Swedish Navy	IB ATLE	NA	Diesel	NA	NA	SCR, OXI	Ordered 1996	Aux engine	Wartsila	Hug	353
N/A	Icebreaker 2000-I	Supply vessel/icebreaker	Diesel	NA	NA	SCR, OXI	Ordered 1998	Main engine	MAK	Hug	3840
N/A	Icebreaker 2000-I	Supply vessel/icebreaker	Diesel	NA	NA	SCR, OXI	Ordered 1998	Main engine	MAK	Hug	2880
N/A	Icebreaker 2000-I	Supply vessel/icebreaker	Diesel	NA	NA	SCR, OXI	Ordered 1998	Aux engine	MAK	Hug	534
N/A	Icebreaker 2000-II	Supply vessel/icebreaker	Diesel	NA	NA	SCR, OXI	Ordered 1998	Main engine	MAK	Hug	3840
N/A	Icebreaker 2000-II	Supply vessel/icebreaker	Diesel	NA	NA	SCR, OXI	Ordered 1998	Main engine	MAK	Hug	2880
N/A	Icebreaker 2000-III	Supply vessel/icebreaker	Diesel	NA	NA	SCR, OXI	Ordered 1998	Main engine	MAK	Hug	3840
N/A	Icebreaker 2000-III	Supply vessel/icebreaker	Diesel	NA	NA	SCR, OXI	Ordered 1998	Main engine	MAK	Hug	2880
Nippon Yusen Kabushiki Kaisha (NYK Line),	Initial Salute	NA	NA	MHI 6UEC60LSII	11,000	SCR	2011 Delivery	NA	Mitsubishi	NA	11,000
N/A	Jingling 507	NA	HFO	NA	NA	SCR, OXI	Ordered 2004	Main engine	MAN B&W	Hug	2380
N/A	Jingling 507	NA	HFO	NA	NA	SCR, OXI	Ordered 2004	Main engine	MAN B&W	Hug	2380
N/A	Jingling 508	NA	HFO	NA	NA	SCR, OXI	Ordered 2004	Main engine	MAN B&W	Hug	2380
N/A	Jingling 508	NA	HFO	NA	NA	SCR, OXI	Ordered 2004	Main engine	MAN B&W	Hug	2380
N/A	Jingling 509	NA	HFO	NA	NA	SCR, OXI	Ordered 2004	Main engine	MAN B&W	Hug	2380
N/A	Jingling 509	NA	HFO	NA	NA	SCR, OXI	Ordered 2004	Main engine	MAN B&W	Hug	2380
N/A	Jingling 510	NA	HFO	NA	NA	SCR, OXI	Ordered 2004	Main engine	MAN B&W	Hug	2380
N/A	Jingling 510	NA	HFO	NA	NA	SCR, OXI	Ordered	Main engine	MAN B&W	Hug	2380

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
							2004				
Aker Soviknes	Kandi Acergy	NA	MGO	4 x 6L32/40 2 x 8L32/40	4 x 2.880 kW 2 x 3.840 kW	SCR Systems	2007/Delivery	NA	Wärtsilä	NA	19200
MAN B&W	Knudsen	NA	HFO	1 x 6L48/60	1 x 6.300 kW	SCR System	2009/Delivery	NA	MAN B&W	NA	6300
Kleven	KP344	Platform Supply Vessel (PSV)	MDO	4 x 9L20	4 x 1.665 kW	SCRSystems	2010/Delivery	NA	Wärtsilä	NA	6660
Kleven	KP345	Platform Supply Vessel (PSV)	MDO	4 x 9L20	4 x 1.665 kW	SCR Systems	2011/Delivery	NA	Wärtsilä	NA	6660
Fitjar	Krossfjord	Trawler	MGO	1 x 9L27/38	1 x 3.060 kW	SCR System	2011/Delivery	NA	Wärtsilä	NA	3060
Wärtsilä	Liafjord	Purse Seiner/Trawler	LFO	1 x 16V32	1 x 6.560 kW	SCR System	2010/Delivery	NA	Wärtsilä	NA	6560
Wärtsilä	Liafjord	Trawler	MDO	1 x 6L32 1 x 9L20	1 x 3.000 kW 1 x 1.665 kW	SCR Systems	2011/Delivery	NA	Wärtsilä	NA	4665
Wärtsilä	Libas	Purse Seiner/Trawler	LFO	1 x 12V32	1 x 6.000 kW	SCR System	2009/Delivery	NA	Wärtsilä	NA	6000
Fitjar	Mogsterfjord	Trawler	MDO	1 x 6L32	1 x 2.760 kW	SCR System	2009/Delivery	NA	Wärtsilä	NA	2760
Fitjar	Mogsterhav	Trawler	MDO	1 x 6L32	1 x 2.760 kW	SCR System	2009/Delivery	NA	Wärtsilä	NA	2760
Matson	Mokihana	Container	NA	NA	NA	SCR	2009	Generator	NA	NA	NA
Pon Power	Mokster	Platform Supply Vessel (PSV)	MDO	4 x 3516C	4 x 2.350 kW	SCR Systems	2011/Delivery	NA	Cat	NA	9400
Pon Power	Mokster	NA	MDO	4 x 3516C	4 x	SCR	2011/Delivery	NA	Cat	NA	9400

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
					2.350 kW	Systems					
Kleven	MT 6009	NA	MGO	4 x 3512B	3 x 1.424 kW	SCR Systems	2011/Delivery	NA	Cat	NA	4272
Aker Soviknes	NA	Supply Vessel	MGO	4 x 9L20 / 4 x 3516B	4 x 1.665 / 4 x 1.901 kW	SCRSystems	2009/Delivery	NA	Wärtsilä	NA	14264
Wärtsilä	NA	Bulk Carrier	HFO	1 x 8L32	1 x 3.680 kW	SCR System	2009/11 - Delivery	NA	Wärtsilä	NA	3680
Wärtsilä	NA	Bulk Carrier	HFO	1 x 8L32	1 x 3.680 kW	SCR System	2009/11 - Delivery	NA	Wärtsilä	NA	3680
Wärtsilä	NA	Bulk Carrier	HFO	1 x 8L32	1 x 3.680 kW	SCR System	2009/11 - Delivery	NA	Wärtsilä	NA	3680
Wärtsilä	NA	Bulk Carrier	HFO	1 x 8L32	1 x 3.680 kW	SCR System	2009/11 - Delivery	NA	Wärtsilä	NA	3680
Wärtsilä	NA	Bulk Carrier	HFO	1 x 8L32	1 x 3.680 kW	SCR System	2009/11 - Delivery	NA	Wärtsilä	NA	3680
Wärtsilä	NA	Bulk Carrier	HFO	1 x 8L32	1 x 3.680 kW	SCR System	2009/11 - Delivery	NA	Wärtsilä	NA	3680
Wärtsilä	NA	Bulk Carrier	HFO	1 x 8L32	1 x 3.680 kW	SCR System	2009/11 - Delivery	NA	Wärtsilä	NA	3680
Wärtsilä	NA	Bulk Carrier	HFO	1 x 8L32	1 x 3.680 kW	SCR System	2009/11 - Delivery	NA	Wärtsilä	NA	3680
Kleven	NA	Anchor Handling Tug Supply (AHTS)	MGO	2 x 16V32 2 x 3516	2 x 8.000 kW 2 x 2.188 kW	SCR Systems	2008/09 - Delivery	NA	MAN B&W, Cat	NA	20376
Kleven	NA	Anchor Handling Tug Supply (AHTS)	MGO	2 x 16V32 2 x 3516	2 x 8.000 kW	SCR Systems	2008/09 - Delivery	NA	MAN B&W, Cat	NA	20376

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
					2 x 2.188 kW						
Kleven	NA	Anchor Handling Tug Supply (AHTS)	MGO	2 x 16V32 2 x 3516	2 x 8.000 kW 2 x 2.188 kW	SCR Systems	2008/09 - Delivery	NA	MAN B&W, Cat	NA	20376
Kleven	NA	Anchor Handling Tug Supply (AHTS)	MGO	2 x 16V32 2 x 3516	2 x 8.000 kW 2 x 2.188 kW	SCR Systems	2008/09 - Delivery	NA	MAN B&W, Cat	NA	20376
Kleven	NA	Anchor Handling Tug Supply (AHTS)	MGO	2 x 16V32 2 x 3516	2 x 8.000 kW 2 x 2.188 kW	SCR Systems	2008/09 - Delivery	NA	MAN B&W, Cat	NA	20376
Kleven	NA	Anchor Handling Tug Supply (AHTS)	MGO	2 x 16V32 2 x 3516	2 x 8.000 kW 2 x 2.188 kW	SCR Systems	2008/09 - Delivery	NA	MAN B&W, Cat	NA	20376
Kleven	NA	Anchor Handling Tug Supply (AHTS)	MGO	2 x 16V32 2 x 3516	2 x 8.000 kW 2 x 2.188 kW	SCR Systems	2008/09 - Delivery	NA	MAN B&W, Cat	NA	20376
Kleven	NA	Anchor Handling Tug Supply (AHTS)	MGO	2 x 16V32 2 x 3516	2 x 8.000 kW 2 x 2.188 kW	SCR Systems	2008/09 - Delivery	NA	MAN B&W, Cat	NA	20376
Kleven	NA	Anchor Handling Tug Supply (AHTS)	MGO	2 x 16V32 2 x 3516	2 x 8.000 kW 2 x 2.188 kW	SCR Systems	2008/09 - Delivery	NA	MAN B&W, Cat	NA	20376

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
Kleven	NA	Anchor Handling Tug Supply (AHTS)	MGO	2 x 16V32 2 x 3516	2 x 8.000 kW 2 x 2.188 kW	SCR Systems	2008/09 - Delivery	NA	MAN B&W, Cat	NA	20376
STM	NA	NA	HFO	4 x 10L32/44	4 x 5.600 kW	SCR Systems	2009/Delivery	NA	Wärtsilä	NA	22400
Pon Power	NA	Platform Supply Vessel (PSV)	MGO	4 x 3512	4 x 1.424 kW	SCR Reactors	2007/Delivery	NA	Cat	NA	5696
Wärtsilä	NA	Drill Ship	LFO	6 x 16V32	6 x 7.680kW	SCR Systems	2008/Delivery	NA	Wärtsilä	NA	46080
Eastern Echo	NA	Seismic Vessel	MDO	6 x 9L20	6 x 1.800 kW	SCR Systems	2007/08 - Delivery	NA	Wärtsilä	NA	10800
Eastern Echo	NA	Seismic Vessel	MDO	6 x 9L20	6 x 1.800 kW	SCR Systems	2008 - Delivery	NA	Wärtsilä	NA	10800
Eastern Echo	NA	Seismic Vessel	MDO	6 x 9L20	6 x 1.800 kW	SCR Systems	2007/08 - Delivery	NA	Wärtsilä	NA	10800
Eastern Echo	NA	Seismic Vessel	MDO	6 x 9L20	6 x 1.800 kW	SCR Systems	2007/08 - Delivery	NA	Wärtsilä	NA	10800
Alaska Taner Co. LLC	NA		MDO/HFO	NA	1 x 7200	CRAT	2008/Delivery	1 propulsion engine	MAN	NA	7200
N/A	NA	Workboat	Diesel	NA	NA	SCR, OXI	Ordered 1998	Main engine	Nohab	Hug	2600
National Maritime Administration (Sweden?)	NA	NA	Diesel	NA	NA	SCR, OXI	Ordered 1994	Main and aux engine(s)	2 SAAB, 1 Hedem	Hug	1723
Scandinavian Ferry Line	NA	NA	Diesel	NA	NA	SCR, OXI	Ordered 1991	Main engine	Wartsila	Hug	2500
UK Royal Navy	NA	NA	Diesel	NA	NA	SCR, OXI	Ordered 1995	Main engine	Paxman	Hug	1300
Karstensens	NA	Trawler	HFO	1 x 12V32	1 x 6.000 kW	SCR Systems	2009/Delivery	NA	Wärtsilä	NA	6000

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Pon Power	NA	Standby Vessel	MGO	1 x 3516- 2 x 3508 2 x C-18	1 x 2.350 kW- 2 x 958 kW 2 x 601 kW	SCR Systems	2008/Delivery	NA	Cat	NA	3667
Pon Power	NA	Standby Vessel	MGO	1 x 3516 2 x 3508 2 x C-18	1 x 2.350 kW 2 x 958 kW 2 x 601 kW	SCR Systems	2007/Delivery	NA	Cat	NA	5468
Pon Power	NA	Trawler	MGO	1 x 9M32 2 x 3516B	1 x 4.320 kW 2 x 1.901 kW	SCR Systems	2010/Delivery	NA	MAK	NA	8122
Mecmar	NA	PX 105	MGO	4 x 3512	4 x 1.790 kW	SCR Systems	2008/09 - Delivery	NA	Cat	NA	7160
Mecmar	NA	PX 105	MGO	4 x 3512	4 x 1.790 kW	SCR Systems	2008/09 - Delivery	NA	Cat	NA	7160
Mecmar	NA	PX 105	MGO	4 x 3512	4 x 1.790 kW	SCR Systems	2008/09 - Delivery	NA	Cat	NA	7160
Mecmar	NA	PX 105	MGO	4 x 3512	4 x 1.790 kW	SCR Systems	2008/09 - Delivery	NA	Cat	NA	7160
Polarcus	NA	Seismic Vessel	MGO	4 x 9L26	4 x 2.925 kW	SCR Systems	2009/Delivery	NA	Wärtsilä	NA	11700
City of Vallejo, CA	NA	Passenger-only fast-ferry	NA	MTU/DDC 16V-4000	4500	SCR	Winter 2003-2004	NA	MTU	NA	4500
Polarcus	Nadia	Seismic Vessel	MGO	4 x 9L20 2 x 9L26	4 x 1.800 kW 2 x 2.850 kW	SCR Systems	2009/Delivery	NA	Wärtsilä	NA	12900

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
Polarcus	Naila	Seismic Vessel	MGO	4 x 9L20 2 x 9L26	4 x 1.800 kW 2 x 2.850 kW	SCR Systems	2010/Delivery	NA	Wärtsilä	NA	12900
Danish Navy	Najaden	Military Vessel	NA	NA	2 x 2040	SCR	6/24/2010	NA	MTU	BLUNOX Digital AIrless Multipoint SCR by Dansk Teknologi	4080
Simek AS	NB 122	NA	MGO	2 x KTA 50 2 x QSK60	2 x 1.291 kW 2 x 1.900 kW	SCR System	2009/Delivery	NA	Cummins	NA	6382
Fjellstrand	NB 1681	NA	LFO	4 x MTU12V4000	4 x 1.380 kW	SCR Systems	2009/Delivery	NA	MTU	NA	5520
Fjellstrand	NB 1682	NA	LFO	4 x 3512	4 x 1.424 kW	SCR Systems	2009/Delivery	NA	Cat	NA	5696
Fitjar	NB 32	NA	MGO	4 x 9L27/38	4 x 3.150 kW	SCR Reactors (only)	2007/Delivery	NA	Wärtsilä	NA	12600
Kleven	NB 349PSV	Platform Supply Vessel (PSV)	MGO	4 x 3516C 4 x 3516C	4 x 2.350 kW	SCR SystemsSCR Systems	2011/Delivery	NA	Cat	NA	9400
Kleven	NB 350	Platform Supply Vessel (PSV)	MGO	4 x 3516C 4 x 3516C	4 x 2.350 kW	SCR SystemsSCR Systems	2011/Delivery	NA	Cat	NA	9400
Kleven	NB 351	NA	MGO	4 x 3516C	4 x 2 350 kW	SCR Systems	2012/Delivery	NA	Cat	NA	9400
MAN Ferrostaal	NB 379	NA	HFO	4 x 8M25	4 x 2.530 kW	SCR Systems	2009/Delivery	NA	MaK	NA	9400
MAN Ferrostaal	NB 380	NA	HFO	4 x 8M25	4 x 2.530 kW	SCR Systems	2009/Delivery	NA	MaK	NA	9400
STX Langsten	NB 749	NA	MGO	3 x 7L27/38	3 x 2.450 kW	SCR Systems	2011/Delivery	NA	MAN	NA	7350

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
STX Vietnam	NB 750	NA	MGO	3 x 7L27/38 3 x 7L27/38	3 x 2.450 kW	SCR SystemsSCR Systems	2011/Delivery	NA	MAN	NA	7350
STX Vietnam	NB 751	NA	MGO	3 x 7L27/38 3 x 7L27/38	3 x 2.450 kW	SCR SystemsSCR Systems	2011/Delivery	NA	MAN	NA	7350
STX Langsten	NB 753PSV	Platform Supply Vessel (PSV)	MGO	4 x 9L21/31 4 x 9L21/31	4 x 1.900 kW	SCR SystemsSCR Systems	2011/Delivery	NA	MAN B&W	NA	7600
STX Langsten	NB 754	Platform Supply Vessel (PSV)	MGO	4 x 9L21/31 4 x 9L21/31	4 x 1.900 kW	SCR SystemsSCR Systems	2011/Delivery	NA	MAN B&W	NA	7600
Pon Power	NB 76	Platform Supply Vessel (PSV)	MGO	4 x 3516 C	4 x 2.350 kW	SCR Systems	2010/Delivery	NA	Cat	NA	9400
STX Langsten	NB 767	NA	MDO	3 x C25:33L9P	3 x 2.880 kW	SCR Systems	2011/Delivery	NA	Rolls Royce	NA	8640
STX Vietnam	NB 770	NA	MGO	3 x 7L27/38	3 x 2.450 kW	SCR Systems	2012/Delivery	NA	MAN	NA	7350
STX Sovik	NB 771	NA	MGO	4 x 6L32	4 x 2.880 kW	SCR Systems	2011/Delivery	NA	Wärtsilä	NA	11520
STX Brattvaag	NB 783	NA	MGO	2 x 9L20 2 x 6L20	2 x 1.665 kW 2 x 1.055 kW	SCR Systems	2011/Delivery	NA	Wärtsilä	NA	5440
Pon Power	NB 88	NA	LFO	8 x 3516C	8 x 2.188 kW	SCR Systems	2009/Delivery	NA	Cat	NA	17504
Ulstein Verft AS	NB292	NA	MGO	4 x 9L202 x 9L26	4 x 1.800 kW 2 x 3.080 kW	SCR Systems	2011/Delivery	NA	Wärtsilä	NA	13360
Ulstein Verft AS	NB293	NA	MGO	4 x 9L20 2 x 9L26	4 x 1.800 kW 2 x 3.080 kW	SCR Systems	2011/Delivery	NA	Wärtsilä	NA	13360

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
Bergen Gr. Fosen	NB89	NA	MDO	6 x 6L32 1 x 9L20	6 x 2.88ß kW 1 x 1.665 kW	SCR Systems	2012/Delivery	NA	Wärtsilä	NA	18945
Emitech	Nieuwe Maze	Catamaran	LFO	2 x MTU	2 x 820 kW	SCR Systems	2007/Delivery	NA	MTU	NA	1640
TT-Line	Nils Dacke	Passenger	MDO	NA	NA	SINox SCR	1995/Delivery	Ship Propulsion	MaK	NA	4.5
Alcatraz Cruises	Hornblower Hybrid	Ferry	NA	NA	NA	SCR	2009 Delivery	NA	NA	NA	NA
NSS-Poland	Nordenveg	NA	MDO	1 x 3612	1 x 3.460 kW	SCR System	2010/Delivery	NA	Cat	NA	3460
NSS-Poland	Nordenvon	NA	MGO	1 x 8M32	1 x 3.840 kW	SCR System	2010/Delivery	NA	MAK	NA	3840
Pon Power	Nordstar	NA	MGO	1 x 8M32	1 x 3.520 kW	SCR System	2009/Delivery	NA	MAK	NA	3520
Solstad Shipping AS	Normand Skipper	Standby Vessel	MDO	NA	4 x 2430	SINox SCR	2004/Delivery	Ship Propulsion: 4 main engines	Wartsila	NA	9720
Solstad Shipping AS	Normand Subsea	Offshore Supply Vessel	MDF	NA	4 x 3840	SINox SCR	2007/Delivery	Ship Propulsion: 4 main engines	Wartsila	NA	15360
Danish Navy	Nymfen	Patrol Vessel		NA	2 x 2040	SCR	6/24/2010	NA	MTU	BLUNOX Digital AIrless Multipoint SCR by Dansk Teknologi	4080
N/A	Obbola	NA	HFO	NA	NA	SCR, OXI	Ordered 2004	Main engine	MAK/Mitsubishi	Hug	4050
N/A	Obbola	NA	HFO	NA	NA	SCR, OXI	Ordered 2004	Main engine	MAK/Mitsubishi	Hug	4050
Ulstein Verft AS	Olympic Hera	Offshore Supply Vessel	MGO	2 x 9L32	2 x 4.500 kW	SCR Systems	2009/Delivery	NA	Wärtsilä	NA	9000

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
Ulstein Verft AS	Olympic Zeus	Offshore Supply Vessel	MGO	2 x 9L32	2 x 4.500 kW	SCR Systems	2008/Delivery	NA	Wärtsilä	NA	9000
n/A	Orion	Pilot Boat	N/A	ACERT C32	NA	SCR and DPF	2010 Delivery	NA	Cat	Hug	NA
Gorthon Lines	Ortviken	Cargo Vessel	HFO, MDO	NA	2 x 4050 3 x 610	SINox SCR	1999/Delivery	Ship Propulsion: 2 main and 3 aux engines	MaK, Mitsubishi	NA	9930
CAT/Finanzauto	Östensjö	NA	MGO	2 x 9M25C 2 x 6M25C	2 x 3.000 kW 2 x 2.000 kW	SCR Systems	2012/Delivery	NA	MaK	NA	10000
Fitjar	Ostervold	Trawler	MGO	1 x 9L32	1 x 4.500 kW	SCR System	2009/Delivery	NA	Wärtsilä	NA	4500
N/A	Östränd	NA	HFO	NA	NA	SCR, OXI	Ordered 2004	Main engine	Mitsubishi	Hug	4050
Danish Navy	P525	NA		NA	2 x 2040	SCR		NA	MTU	Dansk Teknologi	4080
N/A	Pearl of Scandinavia	NA	HFO	6R32	NA	SCR, OXI	Ordered 2002	Aux engine	Wärtsilä	Hug	2460
PMZ	Pomerania	RoPax Ferry	MDO	2 x 6AL25-30	2 x 816 kW	SCR System	2005/Delivery	NA	Sulzer	NA	1632
N/A	Princess of Scandinavia	NA	HFO	NA	NA	SCR, OXI	Ordered 2003	Aux engine	RAIV	Hug	950
MHIMHI	S 2291S	NA	HFO	6 x 8L32 6 x 8L32	6 x 3.840 kW	SCR Systems	2012/Delivery	NA	Wärtsilä	NA	23040
MHIMHI	S 2292	NA	HFO	6 x 8L32 6 x 8L32	6 x 3.840 kW	SCR Systems	2012/Delivery	NA	Wärtsilä	NA	23040
Lindenau	S 285	NA	MGO	2 x S6R	2 x 515 kW	SCR Systems	2008/Delivery	NA	Mitsubishi	NA	1030
Fiskerstrand	Saebjorn	Trawler	LFO	1 x B30:40L8	1 x 3.530 kW	SCR System	2009/Delivery	NA	Rolls Royce	NA	3530
Polarcus	Samur	Seismic Vessel	MGO	6 x 9L20	6 x 1.800 kW	SCR Systems	2011 Delivery	NA	Wärtsilä	NA	10800

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
N/A	Sandhamm	Ferry	NA	NA	NA	SCR	NA	NA	Volvo	STT Emtec	NA
NA	Scandinavia	NA	HFO/MDO	4 x K45GUC 3 x F212	4 x 5369 3 x 1545	SINox SCR		Main and aux engine(s)	Burmeister & Wain Diesel, Nohab Diesel	NA	26111
Havyard	Sea Lion	Supply Vessel/Tug	MGO	2x12VM32 1 x C – 18 1 x 3508	2 x 6.000 kW 1 x 550 kW 1 x 1.070 kW	SCR Systems	2008/Delivery	NA	MaK	NA	13620
CNP Freire	Sea4	Supply Vessel	MGO	6 x 9L21/31	6 x 1.800 kW	SCR Systems	2009/Delivery	NA	MAN B&W	NA	10800
CNP Freire	Sea4	Supply Vessel	MGO	6 x 9L21/31	6 x 1.800 kW	SCR Systems	2009/Delivery	NA	MAN B&W	NA	10800
Kleven	Siem Dorado	Supply Vessel	MGO	4 x 3516	4 x 2.188 kW	SCR Systems	2008/Delivery	NA	Cat	NA	8752
Kleven	Siem Marlin	Offshore Supply Vessel	MGO	4 x 3516	4 x 2.188 kW	SCR Systems	2008/Delivery	NA	Cat	NA	8752
N/A	Sietas I	NA	HFO	NA	NA	SCR, OXI	Ordered 1999	Main engine	MAK	Hug	6100
Wagenborg Shipping	Spaarne	RoRo Cargo Ship	HFO	NA	NA	SCR	1999	Main engines	Sulzer	NA	10920
Wagenborg Shipping	Schie	RoRo Cargo Ship	HFO	NA	NA	SCR	2004	Main engines	Sulzer	NA	10920
Wagenborg Shipping	Slingeborg	RoRo Cargo Ship	HFO	NA	NA	SCR	2000	Main engines	Sulzer	NA	10920
Wagenborg Shipping	Baltic	RoRo Cargo Ship	NA	NA	NA	SCR	2004	NA	Wärtsilä	NA	9450
Wagenborg Shipping	Bothniaborg	RoRo Cargo Ship	NA	NA	NA	SCR	2004	NA	Wärtsilä	NA	9450
N/A	Sietas I	NA	Diesel	NA	NA	SCR, OXI	Ordered 1999	Aux engine	Cat	Hug	534
N/A	Sietas II	NA	HFO	NA	NA	SCR, OXI	Ordered 1999	Main engine	MAK	Hug	6100
N/A	Sietas II	NA	Diesel	NA	NA	SCR, OXI	Ordered 1999	Aux engine	Cat	Hug	534

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
N/A	Sietas III	NA	HFO	NA	NA	SCR, OXI	Ordered 1999	Main engine	MAK	Hug	6100
N/A	Sietas III	NA	Diesel	NA	NA	SCR, OXI	Ordered 1999	Aux engine	Cat	Hug	534
Gotland Rederi	Sigyn	NA	MGO	NA	2 x 1170 main 2 x 485 aux 1 x 370 aux	SINox SCR	2002/Delivery	Ship Propulsion: 4 main and 2 aux engines	B&W alpha Poyaud Volvo	NA	3040
N/A	Silja Serenade	Passenger/Ferry	HFO 0.5%S	WV8R32	NA	SCR	1995	NA	Wärtsilä	NA	NA
N/A	Silja Symphony	Passenger/Ferry	HFO 0.5%S	WV8R33	NA	SCR	1996	NA	Wärtsilä	NA	NA
Silja Line	Silja Europa	RoPax Ferry	HFO	4 x MAN	4 x 7.950	Cat. Replacement	2007/Delivery	Ship Propulsion: 4 main engines	MAN	NA	31800
Havyard	Sjobris	Passenger/Ferry	MGO	1 x KVBM	1 x 2.200 kW	SCR System	2010/Delivery	NA	Rolls Royce Bergen	NA	2200
Aker Yards	Skandi Bergen	Offshore Supply Vessel	MGO	4 x 6L32	4 x 2.880 kW	SCR Systems	2007/Delivery	NA	Wärtsilä	NA	11520
KVE 317/DOF	Skandi Mongstad	Supply Vessel/Tug	MGO	NA	2 x 3000 2 x 1200	SINox SCR	2007/Delivery	Ship Propulsion: 2 main and 2 aux engines	MAN	NA	8400
Fitjar	Skandi Olympia	Supply Vessel	MGO	4 x 3512	4 x 1.424 kW	SCR Systems	2009/Delivery	NA	Cat	NA	5696
Aker Soviknes	Skandi Seven	Offshore Supply Vessel	MGO	4 x 9L27/38 1 x 16V4000	4 x 2.970 kW 1 x 2.080 kW	SCR Systems	2007/08 - Delivery	NA	Wärtsilä, MTU	NA	13960
N/A	Slettholmen	Purse Seiner	NA	NA	NA	SCR	NA	Main engine	NA	Proventia	NA
Havyard Ship Serv.	Smaragd	Trawler	MDO	1 x 9M32	1 x 4.320 kW	SCR System	2010/Delivery	NA	Wärtsilä	NA	4320

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
Bylink	Solano	Passenger-only high speed catamaran		MTU16V-4000M70	3110 hp	SCR	NA	NA	MTU	Steuler Anlagenbau	3110
LNG Golar	Spirit	NA	LNG/HFO	NA	2 x 77 t/h	SINox SCR	2008/Delivery	2 boiler	Mitsubishi, Regas-Boiler	NA	NA
Aker Wismar	Stena Britanica	RoPax Ferry	HFO	2 x 8L48/60 2 x 6L48/60 1 x 7L21/31 3 x 6L21/31	2 x 9.600 kW 2 x 7.200 kW 1 x 1.540 kW 3 x 1.320 kW	SCR Systems	2009/Delivery	NA	MAN	NA	39100
Wärtsilä(Stena)	Stena Carron	Drill Ship	LFO	6 x 16V32	6 x7.680 kW	SCR Systems	2007/Delivery	NA	MAN B&W	NA	46080
SHI Korea	Stena Forth	Drill Ship	HFO	2 x 9L48/60B 2 x 7L21/31	2 x 10.800 kW 2 x 1.540 kW	SCR Systems	2009-Delivery	NA	MAN	NA	24680
Aker Wismar	Stena Hollandica	RoPax Ferry	HFO	2 x 8L48/60 2 x 6L48/60 1 x 7L21/31 3 x 6L21/31	2 x 9.600 kW 2 x 7.200 kW 1 x 1.540 kW 3 x 1.320 kW	SCR Systems	2009/Delivery	NA	MAN	NA	39100
SHI Korea	Stena Ropax	RoPax Ferry	HFO	2 x 9L48/60B 2 x 7L21/31	2 x 10.800 kW 2 x 1.540 kW	SCR Systems	2009/10 - Delivery	NA	MAN	NA	24680
N/A	Stena RoRo I	RoRo	HFO	NA	NA	SCR, OXI	Ordered 1997	Main engine	Sulzer	Hug	4610
N/A	Stena RoRo I	NA	HFO	NA	NA	SCR, OXI	Ordered 1997	Aux engine	Sulzer	Hug	928
N/A	Stena RoRo II	RoRo	HFO	NA	NA	SCR, OXI	Ordered 1997	Main engine	Sulzer	Hug	4610

Owner	*Ship Name*	*Ship Type*	*Fuel*	*Engine Model*	*Engine power (per engine)*	*NO_x Redux Tech*	*Date/Type of Date*	*Field of Application*	*Engine Manufacturer*	*SCR Manufacturer*	*Total Power (kW)*
N/A	Stena RoRo II	NA	HFO	NA	NA	SCR, OXI	Ordered 1997	Aux engine	Sulzer	Hug	928
N/A	Baltic 2	NA	HFO	NA	NA	SINox SCR	1999/Delivery	Ship Propulsion: 1 main engine	MAN	Siemens SINox	3360
N/A	Stena RoRo III	RoRo	HFO	NA	NA	SCR, OXI	Ordered 1998	Main engine	Sulzer	Hug	4610
N/A	NA	Oil Platform	Diesel	NA	NA	SINox SCR	2002/Delivery	Gen Set - 8 engines	NA	NA	28800
N/A	Stena RoRo III	NA	HFO	NA	NA	SCR, OXI	Ordered 1998	Aux engine	Sulzer	Hug	928
N/A	Stena RoRo IV	RoRo	HFO	NA	NA	SCR, OXI	Ordered 1998	Main engine	Sulzer	Hug	4610
N/A	Stena RoRo IV	NA	HFO	NA	NA	SCR, OXI	Ordered 1998	Aux engine	Sulzer	Hug	928
N/A	Steno Ro-Pax	RoPax	HFO	NA	NA	SCR, OXI	Ordered 2001	Main engine	MAN B&W	Hug	6480
N/A	Steno Ro-Pax	RoPax	HFO	NA	NA	SCR, OXI	Ordered 2001	Aux engine	MAN B&W	Hug	6480
N/A	Stora I	NA	HFO	NA	NA	SCR, OXI	Ordered 1998	Main engine	Wartsila - NSD	Hug	10920
N/A	Stora I	NA	HFO	NA	NA	SCR, OXI	Ordered 1998	Aux engine	Wartsila - NSD	Hug	990
N/A	Stora II	NA	HFO	NA	NA	SCR, OXI	Ordered 1998	Main engine	Wartsila - NSD	Hug	10921
N/A	Stora II	NA	HFO	NA	NA	SCR, OXI	Ordered 1998	Main engine	Wartsila - NSD	Hug	10922
N/A	Stora II	NA	HFO	NA	NA	SCR, OXI	Ordered 1998	Aux engine	Wartsila - NSD	Hug	990
N/A	Stora II	NA	HFO	NA	NA	SCR, OXI	Ordered 1998	Aux engine	Wartsila - NSD	Hug	990
Wärtsilä	Strand Senior	Trawler	MDO	1 x 12V32	1 x 5.040 kW	SCR System	2009/Delivery	NA	Wärtsilä	NA	5040
Simek AS	Stril Mariner	Supply Vessel	MGO	4 x KTA 50	4 x 1.291 kW	SCR Systems	2009/Delivery	NA	Cummins	NA	5164
Simon Møkster Shipping	Stril Poseidon	Supply Vessel/Tug	MGO	NA	3 x 910	SINox SCR	2002/Delivery	Gen Set - 3 engines	Cat	NA	2730
Havyard	Stril Challenger	Anchor Handling Tug Supply	MGO	2 x 12VM 32 2 x C-18	2 x 6.000	SCR Systems	2008/Delivery	NA	MAK	NA	13202

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
		(AHTS)			kW 2 x 601 kW						
Havyard	Stril Commander	Anchor Handling Tug Supply (AHTS)	MGO	2 x 12VM 32 2 x C-18	2 x 6.000 kW 2 x 601 kW	SCR Systems	2008/Delivery	NA	MAK	NA	13202
Samsung SHI/Leif Höegh	Suez Cape Ann	Tanker	LNG/HFO	NA	2 x 100 t/h 2 x 11400	SINox SCR	2008/Delivery	2 boiler, 2 engines	Regas-Boiler	NA	NA
Samsung SHI/Leif Höegh	Suez Neptune	Tanker	LNG/HFO	NA	2 x 100 t/h 2 x 11400	SINox SCR	2008/Delivery	2 boiler, 2 engines	Regas-Boiler	NA	NA
Mecmar	SX 130	NA	MGO	4 x 3516B	4 x 1.901 kW	SCR Systems	2008/Delivery	NA	Cat	NA	7604
Mecmar	SX 130	NA	MGO	4 x 3516B	4 x 1.901 kW	SCR Systems	2008/Delivery	NA	Cat	NA	7604
Eastern Echo	Tasman	General Cargo Vessel	MDO	6 x 9L20	6 x 1.800 kW	SCR Systems	2008/Delivery	NA	Wärtsilä	NA	10800
Havyard	Teigenes	Fishing Vessel	MGO	2 x 3512	2 x 1.420 kW	SCR Systems	2010/Delivery	NA	Cat	NA	2840
Gesab	Ternvag	Chemical Tanker	HFO/MGO	1 x 6L46C 3 x aux. engines	1 x 6.300 kW 3 x 700 kW	SCR Systems	2011/Delivery	NA	Wärtsilä	NA	8400
Gotland Rederi	Thjelvar	Passenger/Ferry	MDO	2x WV4R32 + 4xWV12V32	4 x 3720 main 2 x 1240 aux	SINox SCR	1997/Delivery	Ship Propulsion: 4 main and 2 aux engines	Wärtsilä	NA	17360
Reederei Braren	Timbus	Cargo Vessel	HFO	1 x 8M32	1 x 3.840 kW, 3 x 450	Cat. Replacement	2006/Delivery	Ship Propulsion: 1 main and 1 aux engines	MAK	NA	5190

Owner	***Ship Name***	***Ship Type***	***Fuel***	***Engine Model***	***Engine power (per engine)***	***NO_x Redux Tech***	***Date/Type of Date***	***Field of Application***	***Engine Manufacturer***	***SCR Manufacturer***	***Total Power (kW)***
Pon Power	Travler Brennholm	NA	MGO	1 x 3616 1 x 3512 1 x 3416	1 x 5.060 kW 1 x 1.424 kW 1 x 277 kW	SCR Systems	2007/Delivery	NA	Cat	NA	6761
Moen Slip	Tronderbas	Trawler	MDO	1 x 12V32	1 x 5.520 kW	SCR System	2010/Delivery	NA	Wärtsilä	NA	5520
Swedish Navy	Trossö	Military Vessel	MDO	NA	2 x 1130 2 x 390	SINox SCR	2003/Delivery	Ship Propulsion: 2 main and 2 aux engines	Russkiy, Volvo Penta	NA	3040
Bomlo Skipsserv.	Trygvason	Trawler	MGO	1 x 8M32	1 x 2.640 kW	SCR System	2010/Delivery	NA	MAK	NA	2640
Pon Power	Vea	NA	MDO	1 x 6M32	1 x 2.880 kW	SCR System	2010/Delivery	NA	MAK	NA	2880
Fitjar	Vendla	Trawler	MGO	1 x 8M32	1 x 3.840 kW	SCR System	2009/Delivery	NA	MAK	NA	3840
Sandfrakt	Nordholm	Bulk Carrier	MGO-MDO	NA	2030	SCR	Retrofit in 2011	NA	Cat	BLUNOX Digital AIrless Multipoint SCR by Dansk Teknologi	NA
Karmsund Maritime	Vessel 1	Anchor Handling Tug Supply (AHTS)	MGO	2 x 16V32 2 x 3516	2 x 8.000 kW 2 x 2.188 kW	SCR Systems	2008/Delivery	NA	MAN B&W, Cat	NA	20376
Karmsund Maritime	Vessel 2	Anchor Handling Tug Supply (AHTS)	MGO	2 x 16V32 2 x 3516	2 x 8.000 kW 2 x 2.188 kW	SCR Systems	2008/Delivery	NA	MAN B&W, Cat	NA	20376

Owner	*Ship Name*	*Ship Type*	*Fuel*	*Engine Model*	*Engine power (per engine)*	*NO_x Redux Tech*	*Date/Type of Date*	*Field of Application*	*Engine Manufacturer*	*SCR Manufacturer*	*Total Power (kW)*
Tallink	Victoria	Trawler	HFO	NA	4 x 6560	SINox SCR	2004/Delivery	Ship Propulsion: 4 main engines	All Wartsila	NA	26240
Eidesvik AS	Viking Avant	Supply Vessel/Standby Ship	MGO	NA	4 x 1900	SINox SCR	2004/Delivery	Ship Propulsion: 4 main engines	Cat	NA	7600
Wärtsilä Iberica SA	Viking Line	NA	HFO	2 x 8L46F 3 x 6L20	2 x 10.000 kW 3 x 1.080 kW	SCR Systems	2008/Delivery	NA	Wärtsilä	NA	23240
Ulstein Verft AS	Viking Poseidon	Offshore Supply Vessel	MGO	4 x 9M25 2 x 9M20	4 x 2.850 kW 2 x 1.530 kW	SCR Systems	2008/Delivery	NA	MaK	NA	14460
Viking Line	Viking XPRS	NA	HFO	4 x 8L46 F 3 x 8L20	4 x 10.000 kW 3 x 1.414 kW	SCR Systems	2008/Delivery	NA	MAN	NA	44242
Gotland Rederi	Visborg	Military Vessel	MDO	NA	4 x 5200 main 3 x 1435 aux	SINox SCR	1997/Delivery	Ship Propulsion: 4 main and 3 aux engines	MAN, Wartsila	NA	25105
Gotland Rederi	Visby	NA	HFO	NA	4 x 12600 main 3 x 1530 aux	SINox SCR	2000/Delivery	Ship Propulsion: 4 main, 3 aux engines	Wärtsilä	NA	54990
Ferus Smit	Visby Wave	Tanker	HFO	1 x 8M32	1 x 3.840 KW	SCR System	2009/Delivery	NA	MAK	NA	3840
Baatbygg	Volstad	Trawler	MDO	1 x 3612	1 x 3.800 kW	SCR System	2008/Delivery	NA	Cat	NA	3800
Pon Power	Volstad Princess	Supply Vessel	MGO	4 x 3516 B 1 x 3508	4 x 1.901 kW	SCR Systems	2007/Delivery	NA	Cat	NA	8572

Owner	*Ship Name*	*Ship Type*	*Fuel*	*Engine Model*	*Engine power (per engine)*	*NO_x Redux Tech*	*Date/Type of Date*	*Field of Application*	*Engine Manufacturer*	*SCR Manufacturer*	*Total Power (kW)*
					1 x 968 kW						
STX	Volstad Supplier	Supply Vessel	MGO	4 x 3516B 1 x 3508	4 x 1.900 kW 1 x 968 kW	SCR Systems	2011/Delivery	NA	Cat	NA	8568
Boa Offshore AS	VS 491 059	NA	MDO	2 x 16V32 2 x 3516C	2 x 8.000 kW 2 x 2.188 kW	SCR Reactors (only)	2008/Delivery	NA	MAN B&W, Cat	NA	20376
Boa Offshore AS	VS 491 060	NA	MDO	2 x 16V32 2 x 3516C	2 x 8.000 kW 2 x 2.188 kW	SCR Reactors (only)	2008/Delivery	NA	MAN B&W, Cat	NA	20376
Boa Offshore AS	VS 491 061	NA	MDO	2 x 16V32 2 x 3516C	2 x 8.000 kW 2 x 2.188 kW	SCR Reactors (only)	2008/Delivery	NA	MAN B&W, Cat	NA	20376
Boa Offshore AS	VS 491 062	NA	MDO	2 x 16V32 2 x 3516C	2 x 8.000 kW 2 x 2.188 kW	SCR Reactors (only)	2008/Delivery	NA	MAN B&W, Cat	NA	20376
LNG Golar	Winter	NA	LNG/HFO	NA	2 x 77 t/h	SINox SCR	2009/Delivery	2 boiler	Mitsubishi, Regas-Boiler	NA	NA
Wijgula	Synthese 11	Tanker	Diesel	NA	1 x 781	SINox SCR	2003/Delivery	Ship Propulsion: 1 main engine	NA	NA	781
Silver Dollar City	Branson Belle	Showboat	NA	NA	NA	SCR	2011	NA	Cummins	NA	NA
Stena Line AB	Stena Jutlandica	Passenger/Ferry	NA	9L40/54	NA	SCR	2006	Main Engines	MAN	NA	25920

Table 2-B: Vessels with Installed SCR Systems – Submitted by IACCSEA

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
1	HH-Ferries A/S	Mercandia VIII	RoPax		NTA-855-G2	295	SCR	1987		Cummins
2	USS-POSCO	M/V Pacific Success	Cargo		2stroke	7.9	SCR	1989	Main	
3	USS-POSCO	M/V Pittsburg	Cargo		2stroke	7.9	SCR	1989	Main	
4	HH-Ferries	Mervandia IV	RoPax		NTA-855-G2	295	SCR	1989		Cummins
5	Scandinavian Ferry Line	Aurora	Ferry Line	Diesel			SCR	1991		Wärtsilä
6	Scandinavian Ferry Line			Diesel			SCR, OXI	1991	Main engine	Wartsila
7	USS-POSCO	M/V Delta Pride	Cargo		2stroke	7.9	SCR	1991	Main	
8	USS-POSCO	M/V New Horizon	Cargo		2stroke	7.9	SCR	1992	Main	
9		Aurora of Helsingborg	Passenger/Ferry	MDO	WV6R32		SCR, OXI	1992	NA	Wärtsilä
10	National Maritime Administration, Retrofit	Scandica	Supply/Ice Breaker	Diesel			SCR	1994		SAAB, Hedem.
11	National Maritime Administration (Sweden?)			Diesel			SCR, OXI	1994	Main and aux engine(s)	2 SAAB, 1 Hedem
12	Silja Line	M/S Serenade	Ferry		4stroke	3	SCR	1994	Aux	

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
13	Silja Line	M/S Silja Symphony	Ferry		4stroke	3	SCR	1994	Aux	
14	UK Royal Navy			Diesel			SCR, OXI	1995	Main engine	Paxman
15	Nils Dacke - TT-Line			Diesel /MDO		4.5		1995	Ship propulsion	MaK
16	Great Lakes Dredge & Dock Ok Brook (IL, USA)		dredger barge	diesel		1,900	DeNOx-Cat	1995		
17	Swedish Navy	IB ATLE		HFO			SCR, OXI	1996	Main engine	Pielstick
18	Stena Line	M/S Stena Jutlandia	Ferry		4stroke	4 x 6.5	SCR	1996	Main x 4	
19	AESA 78	Finnclipper	RoPax	HFO			SCR	1997		Sulzer
20	AESA 79	Finneagle	RoPax	HFO			SCR	1997		Sulzer
21	Stena RoRo II	Stena Hollandica	RoPax	HFO			SCR	1997		Sulzer
22		Stena RoRo I	RoRo	HFO			SCR, OXI	1997	Main engine	Sulzer
23		Stena RoRo II	RoRo	HFO			SCR, OXI	1997	Main engine	Sulzer
24	Viking Line	Gabriella		Diesel /MDO		2		1997	Ship genset	Wärtsilä
25	Fosen Trafikklag	Hertug Skule		Diesel /MDO		920		1997	Ship propulsion	Normo
26	Gotland Rederi	Thjelvar		Diesel /MDO		4x 3,720, 2x 1,240		1997	Ship propulsion, 4 main engines, 2 aux. Engines	
27	Gotland Rederi	Visborg		Diesel /MDO		4x 5,200, 3x 1,435		1997	Ship propulsion, 4 main engines, 3 aux. Engines	
28		M/V Rostock	PASSENGER VESSEL		2 x WV4R32 + 4 x WV12V32		SCR	1997		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
29		Stena RoRo III	RoRo	HFO			SCR, OXI	1998	Main engine	Sulzer
30		Stena RoRo IV	RoRo	HFO			SCR, OXI	1998	Main engine	Sulzer
31		Icebreaker 2000-I	Supply vessel/icebreaker	Diesel			SCR, OXI	1998	Main engine	MAK
32		Icebreaker 2000-II	Supply vessel/icebreaker	Diesel			SCR, OXI	1998	Main engine	MAK
33		Icebreaker 2000-III	Supply vessel/icebreaker	Diesel			SCR, OXI	1998	Main engine	MAK
34	Workboat	Constructor	Workboat	Diesel			SCR	1998		Nohab
35			Workboat	Diesel			SCR, OXI	1998	Main engine	Nohab
36		Stora I		HFO			SCR, OXI	1998	Main engine	Wartsila - NSD
37		Stora II		HFO			SCR, OXI	1998	Main engine	Wartsila - NSD
38	Birka Line	Birka Princess		HFO/ MDO		4x 4,500, 2x 2,250		1998	Ship propulsion, 4 main engines, 2 aux. Engines, 1 aux. Engine	
39	Gotland Rederi	HSC Gotland		Diesel /MDO		4x 7,000, 3x 450		1998	Ship propulsion, 4 main engines, 3 aux. Engines	
40	Roerd Braren	MS Cellus		HFO/ MDO		1x 3,840, 1x 540		1998	Ship propulsion, 1 main engine, 1aux. Engine	
41	Catamaran (Norway)		Propulsion	diesel-gas		4.065 each	DeNOx-Cat	1998		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
42	Catamaran (Norway)		Propulsion	diesel-gas		4.065 each	DeNOx-Cat	1998		
43	Catamaran (Norway)		Propulsion	diesel-gas		4.065 each	DeNOx-Cat	1998		
44	Catamaran (Norway)		Propulsion	diesel-gas		4.065 each	DeNOx-Cat	1998		
45	Sietas I	Anke Ehler	Container	Diesel			SCR	1999		Caterpillar / MAK
46	Sietas III	Dalsland	Container	HFO			SCR	1999		MAK
47	Sietas II	Elisabeth	Container	HFO			SCR	1999		MAK
48	Wagenborg	Schieborg	RoRo	HFO			SCR	1999		Sulzer
49	Balder Viking, Leirvik	Balder Viking	Supply/ Ice Breaker	Diesel			SCR	1999		MAK
50	Leirvik 282	Tor Viking	Supply/ Ice Breaker	Diesel			SCR	1999		MAK
51		Sietas I		HFO			SCR, OXI	1999	Main engine	MAK
52		Sietas II		HFO			SCR, OXI	1999	Main engine	MAK
53		Sietas III		HFO			SCR, OXI	1999	Main engine	MAK
54		MS Baltic 2		HFO		1x 3,360		1999	Ship propulsion, 1 main engine	
55	Roerd Braren	MS Forester		HFO/ MDO		1x 3,840, 2x 239		1999	Ship propulsion, 1 main engine, 2 aux. Engines	
56	Gorthon Lines	MS Ortviken		HFO/ MDO		2x 4,050,		1999	Ship propulsion, 2 main engines, 3 aux. Engines	

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
						3x 610				
57	Roerd Braren	MS Timbus		HFO/ MDO		1x 3,840, 3x 450		1999	Ship propulsion, 1 main engine, 1 aux. Engine	
58		M/V Shcieborg	GENERAL CARGO VESSEL	HFO + MDO	1 x 7RTA52U + 2 x W6L20		SCR	1999		
59		M/V Spaarneborg	GENERAL CARGO VESSEL	HFO + MDO	1 x 7RTA52U + 2 x W6L20		SCR	1999		
60		Sea Diamond	PASSENGER VESSEL	HFO	4 x WV12V32 + 2 x WV6R32 + 1 x WV4R32		SCR	1999		
61	Wagenborg Shipping	Spaarne	RoRo Cargo Ship	HFO			SCR	1999	Main engines	Sulzer
62	Supply ship, (Norway)		Propulsion	diesel		5,800	DeNOX-Cat	1999		
63	Slingeborg, Wagenborg	Slingeborg	RoRo	HFO			SCR	2000		Sulzer
64	Vidar Viking, Leirvik 284	Vidar Viking	Supply / Ice Breaker	Diesel			SCR	2000		MAK
65	Birka Cargo AB Ltd.	Birka Exporter		HFO		1x 5,400		2000	Ship propulsion,	
66	Gotland Rederi	Visby		HFO		4x 12,600, 3x 1,530		2000	Ship propulsion, 4 main engines, 3 aux. Engines	

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
67		M/V Slingeborg	GENERAL CARGO VESSEL	HFO + MDO	1 x 7RTA52U + 2 x W6L20		SCR	2000		
68	Wagenborg Shipping	Slingeborg	RoRo Cargo Ship	HFO			SCR	2000	Main engines	Sulzer
69	Vaagland , Mikal With	Mikal With	Cargo	Diesel			SCR	2001		MAK 6M20
70	Fiskerstrand, Nordfjord	Nordfjord	Ferry	Diesel			SCR	2001		VP D49A MT
71		Steno Ro-Pax	RoPax	HFO			SCR, OXI	2001	Main engine	MAN B&W
72	Steno Ro-Pax	Stena Britannica	RoPax	HFO			SCR	2001		MAN B&W
73	Birka Cargo AB Ltd.	Birka Shipper		HFO		1x 5,400		2001	Ship propulsion, 1 main engine	
74	Gotland Rederi	Gotland		HFO		4x 12,600, 3x 1,530		2001	Ship propulsion, 4 main engines, 3 aux. Engines	
75	Silja Line	M/S Festival	Ferry		4stroke	4 x 6	SCR	2001	Main x 4	
76	Navion ASA (now Teekay Shipping)	Navion Spirit	LPG tanker		2stroke	4.3	SCR	2001	Main	
77		Crown of Scandinavia	Car Ferry	HFO	6R32		SCR, OXI	2002	Aux engine	Wärtsilä
78	Stena	Stena Adventurer	RoPax	HFO			SCR	2002		MAN B&W
79	FSG 724	Tor Begonia	RoRo	HFO			SCR	2002		MAN B&W Holeby

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
80	FSG 725	Tor Freesia	RoRo	HFO			SCR	2002		MAN B&W Holeby
81	FSG 721	Tor Magnolia	RoRo	HFO			SCR	2002		MAN B&W Holeby
82	FSG 722	Tor Petunia	RoRo	HFO			SCR	2002		MAN B&W Holeby
83	FSG 723	Tor Primula	RoRo	HFO			SCR	2002		MAN B&W Holeby
84	Sto-Ro vessel Volharding 528	Balticborg	Sto-Ro	HFO			SCR	2002		Wärtsilä
85	Sto-Ro vessel Volharding 529	Bottniaborg	Sto-Ro	HFO			SCR	2002		Wärtsilä
86		Havyard Leirvik		HFO			SCR, OXI	2002	Main engine	Cummins
87		Pearl of Scandinavia		HFO	6R32		SCR, OXI	2002	Aux engine	Wärtsilä
88	Birka Cargo AB Ltd.	Birka Transporter		HFO		1x 5,400		2002	Ship propulsion, 1 main engine	
89	Swedish Navy	HMS Carlskrona		MGO		4x 1,940, 2x 850, 2x 390		2002	Ship propulsion, 4 main engines, 2 aux. Engines, 2 aux. Engines	
90	Gotland Rederi	MS Sigyn		MGO		2x 1,170, 2x 485, 1x 370		2002	Ship propulsion, 2 main engines, 2 aux. Engines, 1 aux. Engine	
91	Simon Mokster Shipping	Stril Poseidon Simon Møkster Shipping		MGO		3x 910		2002	Gen Set, 3 engines	
92		FSG 721		HFO			SCR, OXI	2002	Aux engine	Man B&W

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
										Holeby
93		FSG 722		HFO			SCR, OXI	2002	Aux engine	Man B&W Holeby
94		FSG 723		HFO			SCR, OXI	2002	Aux engine	Man B&W Holeby
95		FSG 724		HFO			SCR, OXI	2002	Aux engine	Man B&W Holeby
96		FSG 725		HFO			SCR, OXI	2002	Aux engine	Man B&W Holeby
97	DFDS Retrofit	Princess of Scandinavia	Cruise Ferry	HFO			SCR	2003		RAIV
98	Havyard Leirvik	Havila Troll	Supply	HFO			SCR	2003		Cummins
99		Cinderella		HFO			SCR	2003	Main engine	Sulzer
100		Eco Ship		HFO			SCR, OXI	2003	Main engine	N/A
101		En Avant 4		MDO		1x 750		2003	Ship propulsion, 1 main engine	
102	Swedish Navy	HMS Trossö		MDO		2x 1.130, 2x 390		2003	Ship propulsion, 2 main engines, 2 aux. Engines	
103	Wijgula	Synthese 11		Diesel		1x 781		2003	Ship propulsion, 1 main engine	
104	Östrand Retrofit	Östrand	RoRo	HFO			SCR	2004		MAK
105	Jinling 507	Bro Deliverer	Tanker	HFO			SCR	2004		MAN B&W

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
106	Jinling 509	Bro Deliverer	Tanker	HFO			SCR	2004		MAN B&W
107		Jingling 507		HFO			SCR, OXI	2004	Main engine	MAN B&W
108		Jingling 508		HFO			SCR, OXI	2004	Main engine	MAN B&W
109		Jingling 509		HFO			SCR, OXI	2004	Main engine	MAN B&W
110		Jingling 510		HFO			SCR, OXI	2004	Main engine	MAN B&W
111		Obbola		HFO			SCR, OXI	2004	Main engine	MAK/Mitsu bishi
112		Alice Austen Staten Island Ferry		MDO		2x 1.150		2004	Ship propulsion, 2 main engines	
113	Birka Line	Birka Paradise		HFO		4x 5,850, 4x 2,760		2004	Ship propulsion, 4 main engines, 4 aux. Engines	
114		Normand Skipper Solstad Shipping AS		MDO		4x 2430		2004	Ship propulsion, 4 main engines	
115	Tallink	Victoria		HFO		4x 6,560		2004	Ship propulsion, 4 main engines	
116		Viking Avant Eidesvik AS		MGO		4x 1900		2004	Ship propulsion, 4 main engines	
117	City of Vallejo, CA		Passenger-only fast-		MTU/DDC 16V-	4500	SCR	2004	NA	MTU

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
			ferry		4000					
118	Wagenborg Shipping	Baltic	RoRo Cargo Ship				SCR	2004	NA	Wärtsilä
119	Wagenborg Shipping	Schie	RoRo Cargo Ship	HFO			SCR	2004	Main engines	Sulzer
120	Baylink Ferries, Vallejo, CA (USA)		High Speed Catamaran	diesel		10.500 each	DeNOx-Cat	2004		
121	Baylink Ferries, Vallejo, CA (USA)		High Speed Catamaran	diesel		10.500 each	DeNOx-Cat	2004		
122	PMZ	Pomerania	RoPax Ferry	MDO	2 x 6AL25-30	2 x 816 kW	SCR System	2005		
123	Aker Rauma 448	Transpaper	RoRo	HFO			SCR	2005		MAN B&W
124	Aker Rauma 450	Transtimber	RoRo	HFO			SCR	2005		MAN B&W
125	Aker Rauma 449	Transpulp	RoRo	HFO			SCR	2005		MAN B&W
126	Jinling 508	Bro Designer	Tanker	HFO			SCR	2005		MAN B&W
127	Jinling 510	Bro Developer	Tanker	heavy fuel			SCR	2005		MAN B&W
128	Jinling 509	Bro Distributer	Tanker	HFO			SCR	2005		MAN B&W
129		Bourbon Topaz Ulstein		MDO		4x 1900		2005	Ship propulsion, 4 main engines	
130	Gotland Rederi	Fast Ferry		MDO		4x 9.000, 1x 500		2005	Ship propulsion, 4 main engines, 1 aux. Engine	
131	A.P. Moeller	Sofie Maersk		HFO		1x 3300		2005	Ship propulsion,	

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
									1 aux. Engine	
132	Seastreak NYC		Ferry		4stroke		SCR	2005		
133	Reederei Braren	Cellus	Cargo Vessel	HFO	1 x 8M32	1 x 3.840 kW	Cat. Replacement	2006		
134	Reederei Braren	Timbus	Cargo Vessel	HFO	1 x 8M32	1 x 3.840 kW	Cat. Replacement	2006		
135	Tallink Ferries	Galaxy	RoPax Ferry	HFO	4 x 16V32	4 x 6.560 kW	SCR System	2006		
136	Greentop	Futura		MDO	4 x MTU	4 x 600 kW	SCR Systems	2006		
137	Munters Europe AB, MV Mokihana	Mohikana	Container RoRo	HFO			SCR	2006		MAN
138	Retrofit Container	Mokihana	Container/ RoRo	HFO			SCR	2006		MAN
139	Scandlines Retrofit	Aurora of Helsingborg	RoPax	Diesel			SCR	2006		Wärtsilä
140	Scandlines Retrofit	Hamlet	RoPax	Diesel			SCR	2006		Wärtsilä
141	Scandlines Retrofit	Tycho Brahe	RoPax	Diesel			SCR	2006		Wärtsilä
142	DFDS	Tor Ficaria	RoRo	HFO			SCR	2006		MAN
143	Brevik 47	Far Seeker	UT 751 E	Diesel			SCR	2006		Bergen
144	Aker Brevik 46	Island Challenger	UT 776 E	Diesel			SCR	2006		Bergen

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
145		Bourbon Mistral Ulstein 275		LFO		4x 1665, 1x 340		2006	Propulsion, 4 main, 1 aux. engines	
146		Bourbon Monsoon Ulstein 276		LFO		4x 1665, 1x 340		2006	Propulsion, 1 main, 1 aux. engines	
147	Solstad	Flekkefjord 186		LFO		4x 3.800, 1x 1020		2006	Propulsion, 4 main engines, 1 aux. Engine	
148	DSME / Exmar	H2254 Explorer		LNG/ HFO		2x 70 t, 1x 30 t		2006	Propulsion, 2 main boiler, 1 aux. Boiler	
149	Coast Guard, Sweden		engine on ship	diesel		6100; 1,350	DeNOx-Cat	2006		
150	Coast Guard, Sweden		engine on ship	diesel		6100; 1,351	DeNOx-Cat	2006		
151	Coast Guard, Sweden		engine on ship	diesel		6100; 1,352	DeNOx-Cat	2006		
152	Coast Guard, Sweden		engine on ship	diesel		6100; 1,353	DeNOx-Cat	2006		
153	Coast Guard, Sweden		engine on ship	diesel		6100; 1,354	DeNOx-Cat	2006		
154	Coast Guard, Sweden		engine on ship	diesel		6100; 1,355	DeNOx-Cat	2006		
155	Coast Guard, Sweden		engine on ship	diesel		6100; 1,356	DeNOx-Cat	2006		
156	Coast Guard, Sweden		engine on ship	diesel		6100; 1,357	DeNOx-Cat	2006		
157	Coast Guard, Sweden		engine on ship	diesel		6100; 1,358	DeNOx-Cat	2006		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
158	Coast Guard, Sweden		engine on ship	diesel		6100; 1,359	DeNOx-Cat	2006		
159	Coast Guard, Sweden		engine on ship	diesel		6100; 1,360	DeNOx-Cat	2006		
160	Coast Guard, Sweden		engine on ship	diesel		6100; 1,361	DeNOx-Cat	2006		
161	Aker Soviknes	Skandi Acergy	AYS 154	MGO	4 x 6L32/40, 2 x 8L32/40	4 x 2.880 kW, 2 x 3.840 kW	SCR Systems	2007		
162	Wärtsilä		Bro Sincero	HFO	1 x 9L20	1 x 1.600 kW	SCR System	2007		
163	Reederei Braren	Forester	Cargo Vessel	HFO	1 x 8M32	1 x 3.840 kW	Cat. Replacement	2007		
164	Emitech	Nieuwe Maze	Catamaran	LFO	2 x MTU	2 x 820 kW	SCR Systems	2007		
165	Wärtsilä (Stena)	Stena Carron	Drill Ship	LFO	6 x 16V32	6 x 7.680 kW	SCR Systems	2007		
166	Pon Power	Volstad Princess	Hull 129	MGO	4 x 3516 B, 1 x 3508	4 x 1.901 kW, 1 x 968 kW	SCR Systems	2007		
167	Aker Soviknes	Skandi Seven	Hull 703	MGO	4 x 9L27/38,	4 x 2.970	SCR Systems	2007		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
					1 x 16V4000	kW, 1 x 2.080 kW				
168	Aker Langsten		Hull 704	MGO	4 x C25:33L9A	4 x 2.610 kW	SCR Systems	2007		
169	Pon Power	Edda Fauna	Hull No. 117	MGO	6 x 3516, 1 x 3508	6 x 2.130 kW, 1 x 968 kW	SCR Systems	2007		
170	Havyard	Havila Saturn	Hull No. 92	MGO	2 x 12VM 32, 2 x C-18	2 x 6.000 kW, 2 x 601 kW	SCR Systems	2007		
171	Havyard	Havila Neptun	Hull No. 94	MGO	2 x 12VM 32, 2 x C-18	2 x 6.000 kW, 2 x 601 kW	SCR Systems	2007		
172	Aker Langsten	Far Saphire	NB 212	MDO	4 x B32:40L8P	4 x 4.000 kW	SCR Systems	2007		
173	Fitjar		NB 32	MGO	4 x 9L27/38	4 x 3.150 kW	SCR Reactors (only)	2007		
174	Silja Line	Silja Europa	RoPax Ferry	HFO	4 x MAN	4 x 7.950	Cat. Replacement	2007		
175	Aker Yards	Skandi Bergen	ROV AYA	MGO	4 x 6L32	4 x	SCR	2007		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
			152			2.880 kW	Systems			
176	Karmsund Maritime	Edda Flora	ROV BN 29	MDO	5 x 3516, 1 x 3508	5 x 2.188 kW, 1 x 958 kW	SCR Reactors	2007		
177	Pon Power	Brennholm	Trawler	MGO	1 x 3616, 1 x 3512, 1 x 3416	1 x 5.060 kW, 1 x 1.424 kW, 1 x 277 kW	SCR Systems	2007		
178	Gotland Rederi	HSC Gotlandia II		MDO	2 x MAN 2842	2 x 481 kW	SCR Systems	2007		
179	ACE Link AS	MS Simara		MGO	3 x Volvo Penta	3 x 640 kW	SCR / Oxi / Silencer	2007		
180	ACE Link AS	Siluna		MGO	3 x Volvo Penta	3 x 640 kW	SCR / Oxi / Silencer	2007		
181	Aker Sovik (DOF)	Skandi Arctic (702)		LFO	6 x 7L32	6 x 3.220 kW	SCR Systems	2007		
182	Matson Retrofit	Mahimahi	Container	HFO			SCR	2007		MAN
183	Matson Retrofit	Manoa	Container	HFO			SCR	2007		MAN
184	Birka Cargo Retrofit	Baltic Excellent	RoRo	HFO			SCR	2007		Wärtsilä
185	Cleanest Ship, Breko	Cleanest Ship "Victoria"	Tanker	Diesel			SCR	2007		MTU
186	Usmed 02	Prima	Tanker	HFO			SCR	2007		MAK

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
187	Aker Brevik 63	Far TBN	UT 751 CD	Diesel			SCR	2007		Bergen
188	Aker Brevik 49/ Farstad	Far Searcher	UT 751 E	Diesel			SCR	2007		Bergen
189	Havyard Leirvik 86	Havila Mercury	UT 786 CD	Diesel			SCR	2007		Bergen
190	Solstad Shipping	Normand Subsea Flekkefjord 190		MDF		4 x 3840		2007	4 engines	Wärtsilä
191	Solstad Shipping	Acergy Viking Flekkefjord 187		MGO		4x 2540		2007	Propulsion, 4 main engines	
192	Exmar	Excellence DSME LNG I		LNG/ HFO		2 x 70 t/h		2007	2 boiler	Regas-Boiler
193	DSME / Exmar	H2263 Express		LNG/ HFO		2x 70 t, 1x 30 t		2007	Propulsion, 2 main boiler, 1 aux. Boiler	
194		Harvila Foresight Havyard Hull N. 091		MGO		4x 2340		2007	Propulsion, 4 main engines	
195		Skandi Mongstad KVE 317 / DOF		MGO		2x 3000, 2x 1200		2007	Propulsion, 2 main, 2 aux. engines	
196		Normand Ferking	ANCH HAND TUG SUP.	MDO	4 x 8L32 + 1 x 6L20		SCR	2007		
197	Pon Power		PSV	MGO	4 x 3512	4 x 1.424 kW	SCR Reactors	2007		
198	KVE 317/DOF	Skandi Mongstad	Supply Vessel/Tug	MGO	NA	2 x 3000 2 x 1200	SINox SCR	2007	Ship Propulsion: 2 main and	MAN

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
									2 aux engines	
199	Karmsund Maritime		AHTS Vessel 1	MGO	2 x 16V32, 2 x 3516	2 x 8.000 kW, 2 x 2.188 kW	SCR Systems	2008		
200	Karmsund Maritime		AHTS Vessel 2	MGO	2 x 16V32, 2 x 3516	2 x 8.000 kW, 2 x 2.188 kW	SCR Systems	2008		
201	Kleven		AHTS Vessels	MGO	2 x 16V32, 2 x 3516	2 x 8.000 kW, 2 x 2.188 kW	SCR Systems	2008		
202	Aker Sovik		AYA 705	MGO	4 x 6L32/40+ 2x8L	4 x 2.880 kW+2x3 .840 kW	SCR Reactors + Mixers	2008		
203	Pon Power		BMV - 163	MDO	2 x 3516 C, 3 x 3516 B	2 x 2.188 kW, 3 x 1.900 kW	SCR Systems	2008		
204	Ulstein Verft		BN 281	MGO	4 x 9M25, 2	4 x 2.850	SCR Systems	2008		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
					x 9M20	kW, 2 x 1.530 kW				
205	Ulstein Verft		BN282 + BN284	MGO	2 x 9L32	2 x 4.500 kW	SCR Systems	2008		
206	Kleven		BN323/326	MGO	4 x 3516	4 x 2.188 kW	SCR Systems	2008		
207	Wärtsilä		Drill Ship	LFO	6 x 16V32	6 x 7.680 kW	SCR Systems	2008		
208	Pon Power		Hull 007 + 008	LFO	4 x 3516B	4 x 1.900 kW	SCR Systems	2008		
209	Aker Aukra		Hull 124	MGO	4 x 9L21/31	4 x 1.800 kW	SCR Systems	2008		
210	Havyard		Hull 99 / 100	LFO	2 x 12VM32, 4 x 3516C	2 x 6.000 kW, 4 x 2.150 kW	SCR Systems	2008		
211	Havyard		Hull No. 93	MGO	2 x 12VM 32, 2 x C-18	2 x 6.000 kW, 2 x 601 kW	SCR Systems	2008		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
212	Havyard		Hull No. 95	MGO	2x 12VM32, 1 x C – 18, 1 x 3508	2 x 6.000 kW, 1 x 550 kW, 1 x 1.070 kW	SCR Systems	2008		
213	Havyard		Hull No. 98	MGO	2 x 12VM 32, 2 x C-18	2 x 6.000 kW, 2 x 601 kW	SCR Systems	2008		
214	Aker Soviknes		NB 727	MGO	4 x 9L20 /4x3516B	4 x 1.665 /4 x 1.901 kW	SCR Systems	2008		
215	Fjellstrand		NB 1680 / 81	LFO	4 x MTU12V 4000	4 x 1.380 kW	SCR Systems	2008		
216	Aker Aukra		NB 706 707 722 732	MGO	2 x 16V32, 4 x 8L26	2 x 8.000 kW, 4 x 2.720 kW	SCR Reactors (only)	2008		
217	Aker Langsten		NB 711	MGO	2 x B32:40L9 P	2 x 4.500 kW	SCR Systems	2008		
218	Aker Langsten		NB 712	MGO	2 x B32:40L9	2 x 4.500	SCR Systems	2008		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
					P	kW				
219	Aker Aukra		NB 716	MGO	4 x 9L27/38, 1 x 16V4000	4 x 2.970 kW, 1 x 2.008 kW	SCR Reactors + Mixers (only)	2008		
220	Aker Soviknes		NB 728	MGO	4 x 9L20 /4x3516B	4 x 1.665 /4 x 1.901 kW	SCR Systems	2008		
221	Solstrand		NB 85	LFO	4 x MTU	4 x 1.380 kW	SCR Systems	2008		
222	Mecmar		PX 105	MGO	4 x 3512	4 x 1.790 kW	SCR Systems	2008		
223	Tallink Ferries	Baltic Princess	RoPax Ferry, 1361	HFO	4 x 16 V32	4 x 8.000 kW	SCR Systems	2008		
224	Lindenau		S 285	MGO	2 x S6R	2 x 515 kW	SCR Systems	2008		
225	Eastern Echo		Seismic Vessels	MDO	6 x 9L20	6 x 1.800 kW	SCR Systems	2008		
226	Pon Power		Stand by Vessel	MGO	1 x 3516- 2 x 3508, 2 x C-18	1 x 2.350 kW- 2 x 958 kW,	SCR Systems	2008		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
						2 x 601 kW				
227	Mecmar		SX 130	MGO	4 x 3516B	4 x 1.901 kW	SCR Systems	2008		
228	Bergen Tankers	Bergen Nordic	Tanker	LFO	1 x 6L27/38	1 x 2.040 kW	SCR System	2008		
229	Bergen Tankers	Bergen Star	Tanker	LFO	2 x C:25/33L 6A	2 x 1.740 kW	SCR Systems	2008		
230	Baatbygg		Travler F/T Volstad	MDO	1 x 3612	1 x 3.800 kW	SCR System	2008		
231	Wärtsilä Iberica SA		Viking Line	HFO	2 x 8L46F, 3 x 6L20	2 x 10.000 kW, 3 x 1.080 kW	SCR Systems	2008		
232	Boa Offshore AS		VS 495,I	MDO	2 x 16V32, 2 x 3516C	2 x 8.000 kW, 2 x 2.188 kW	SCR Reactors (only)	2008		
233	Boa Offshore AS		VS 495,II	MDO	2 x 16V32, 2 x 3516C	2 x 8.000 kW, 2 x 2.188	SCR Reactors (only)	2008		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
						kW				
234	Boa Offshore AS		VS 495,III	MDO	2 x 16V32, 2 x 3516C	2 x 8.000 kW, 2 x 2.188 kW	SCR Reactors (only)	2008		
235	Boa Offshore AS		VS 495,IV	MDO	2 x 16V32, 2 x 3516C	2 x 8.000 kW, 2 x 2.188 kW	SCR Reactors (only)	2008		
236	Viking Line	Viking XPRS		HFO	4 x 8L46 F, 3 x 8L20	4 x 10.000 kW, 3 x 1.414 kW	SCR Systems	2008		
237	Havenbedrijf Rotterdam	RPA15	Pilot Boat	Diesel			SCR	2008		Caterpillar
238	Havenbedrijf Rotterdam	RPA14	Pilot Boat	Diesel			SCR	2008		Caterpillar
239	F N Marin 159	Sea Cloud Hussar	Supply	HFO			SCR	2008		MAK
240	Zamakona 667 / Viking Supply		Supply	Diesel			SCR	2008		MAK
241	Medylmaz 08	Medylmaz 08	Tanker	HFO			SCR	2008		MAK
242	Usmed 03	Usmed 03	Tanker	HFO			SCR	2008		MAK
243	Aker Brevik 65	Iland Chieftain	UT 776 CD	Diesel			SCR	2008		Bergen
244	Aker Brevik 64	Island	UT 776 CD	Diesel			SCR	2008		Bergen

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
		Commander								
245	Samsung SHI/Leif Höegh	H1688 GDF Suez Neptune		LNG / HFO		2 x 100 t/h, 2 x 11.400		2008	2 engines, 2 boiler	Regas-boiler
246	Samsung SHI/Leif Höegh	H1689 GDF Suez Cape Ann		LNG / HFO		2 x 100 t/h, 2 x 11.400		2008	2 boiler, 2 engines	Regas-boiler
247	DSME / Exmar	H2270 Exquisite		LNG/ HFO		2x 70 t/h, 1x 50 t/h		2008	Propulsion, 2 main boiler, 1 aux. Boiler	
248	DSME / Exmar	H2271 Expedient		LNG/ HFO		2x 70 t/h, 1x 50 t/h		2008	Propulsion, 2 main boiler, 1 aux. Boiler	
249	DSME / Exmar	H2272 Exemplar		LNG/ HFO		2x 70 t/h, 1x 50 t/h		2008	Propulsion, 2 main boiler, 1 aux. Boiler, 2 boilers	
250		LNG Golar Spirit		LNG/ HFO		2 x 77 t/h		2008	2 boiler	MHI regas-boiler
251	Alaska Tanker Co. LLC			MDO/ HFO		1 x 7.200		2008	1 propulsion engine	MAN
252	Jura Volvo			Diesel		250	SCR	2008		
253	Centrale Mauro			Gas		360	SCR / Oxi	2008		
254	Fantoni Osoppo			Dual Fuel		42'000	SCR / Oxi	2008		
255		Stena Drillmax III	DRILLSHIP	MDO	6 x 16V32		SCR	2008		
256		Astilleros de Sevilla 001		HFO	2 x 8L46F + 3 x		SCR	2008		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
					6L20					
257		Viking ADCC			2 x WV4R32 + 4 x WV12V32		SCR	2008		
258	Marcore Group Ace-Link	Pernille	Passenger		TAMD120	250	SCR	2008		VP
259	VTAB	Amanda	Special purpose			250	SCR	2008		VP
260	Coast Guard, Sweden		engine on ship	diesel		6100; 1,362	DeNOx-Cat	2008		
261	Coast Guard, Sweden		engine on ship	diesel		6100; 1,363	DeNOx-Cat	2008		
262	Coast Guard, Sweden		engine on ship	diesel		6100; 1,364	DeNOx-Cat	2008		
263	Coast Guard, Sweden		engine on ship	diesel		6100; 1,365	DeNOx-Cat	2008		
264	Coast Guard, Sweden		engine on ship	diesel		6100; 1,366	DeNOx-Cat	2008		
265	Fitjar		"Birkeland"	HFO	1 x 9L32	1 x 4.320 kW	SCR Systems	2009		
266	Wärtsilä		"Fiskeskjer"	MDO	1 x 12V32	1 x 5.040 kW	SCR System	2009		
267	Fitjar		"FV Mogsterfjord"	MDO	1 x 6L32	1 x 2.760 kW	SCR System	2009		
268	Fitjar		"FV	MDO	1 x 6L32	1 x	SCR	2009		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
			Mogsterhav "			2.760 kW	System			
269	Fiskerstrand		"Gunnar Langva"	LFO	1 x B30:40L9	1 x 4.500 kW	SCR System	2009		
270	Fitjar		"Hardhaus"	MGO	1 x 9L32	1 x 4.500 kW	SCR System	2009		
271	Wärtsilä		"Havbris"	MDO	1 x 6L32	1 x 2.760 kW	SCR System	2009		
272	Baatbygg		"Havskjer"	MGO	1 x 12V32	1 x 5.520 kW	SCR System	2009		
273	MAN B&W		"Knudsen"	HFO	1 x 6L48/60	1 x 6.300 kW	SCR System	2009		
274	Wärtsilä		"Libas"	LFO	1 x 12V32	1 x 6.000 kW	SCR System	2009		
275	Fitjar		"Ostervold"	MGO	1 x 9L32	1 x 4.500 kW	SCR System	2009		
276	Fiskerstrand		"Saebjorn"	LFO	1 x B30:40L8	1 x 3.530 kW	SCR System	2009		
277	Wärtsilä		"Strand Senior"	MDO	1 x 12V32	1 x 5.040	SCR System	2009		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
						kW				
278	Kleven		Anchor Handling Tug Supply (AHTS)	MGO	2 x 16V32 2 x 3516	2 x 8.000 kW 2 x 2.188 kW	SCR Systems	2009	NA	MAN B&W, Cat
279	Pon Power		BMV - 164	MDO	4 x C280-12	4 x 3.800 kW	SCR Systems	2009		
280	Wärtsilä		Bulk Carrier	HFO	1 x 8L32	1 x 3.680 kW	SCR System	2009		
281	SHI Korea	Stena Forth	Drill Ship	HFO	2 x 9L48/60B 2 x 7L21/31	2 x 10.800 kW 2 x 1.540 kW	SCR Systems	2009	NA	MAN
282	Havyard		Hull 101	MGO	6 x 3516C	6 x 2.188 kW	SCR Systems	2009		
283	Pon Power		Hull 104	MGO	4 x 3512	4 x 1.424 kW	SCR Systems	2009		
284	Otto Marine		Hull no. H7063	MGO	4 x 9M25, 2 x 6M25	4 x 2.850 kW, 2 x	SCR Systems	2009		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
						1.900 kW				
285	Simek AS		NB 121	MGO	4 x KTA 50	4 x 1.291 kW	SCR Systems	2009		
286	Simek AS		NB 122	MGO	2 x KTA 50, 2 x QSK60	2 x 1.291 kW, 2 x 1.900 kW	SCR System	2009		
287	Fjellstrand		NB 1682	LFO	4 x 3512	4 x 1.424 kW	SCR Systems	2009		
288	MAN Ferrostaal		NB 379/380	HFO	4 x 8M25	4 x 2.530 kW	SCR Systems	2009		
289	Polarcus		NB 66 + 67	LFO	6 x 9L20	6 x 1.800 kW	SCR Systems	2009		
290	Polarcus		NB 69 + 70	MGO	4 x 9L26	4 x 2.925 kW	SCR Systems	2009		
291	Aker Langsten		NB 713	MGO	2 x B32:40L9 P	2 x 4.500 kW	SCR Systems	2009		
292	Aker Langsten		NB 714	MGO	2 x B32:40L9 P	2 x 4.500 kW	SCR Systems	2009		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
293	Pon Power		NB 88	LFO	8 x 3516C	8 x 2.188 kW	SCR Systems	2009		
294	Fitjar		NB31	MGO	4 x 3512	4 x 1.424 kW	SCR Systems	2009		
295	Aker Wismar (2 ship sets)		Ropax 159/164	HFO	2 x 8L48/60, 2 x 6L48/60, 1 x 7L21/31, 3 x 6L21/31	2 x 9.600 kW, 2 x 7.200 kW, 1 x 1.540 kW, 3 x 1.320 kW	SCR Systems	2009		
296	SHI Korea	Stena Ropax	RoPax Ferry	HFO	2 x 9L48/60B 2 x 7L21/31	2 x 10.800 kW 2 x 1.540 kW	SCR Systems	2009	NA	MAN
297	Tallink Ferries		Ropax, 1365	HFO	4 x 16V32	4 x 8.000 kW	SCR Systems	2009		
298	Polarcus		Seis. Vessels, 71/72	LFO	4 x 9L20, 2 x 9L26	4 x 1.800 kW, 2 x 2.850	SCR Systems	2009		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
						kW				
299	Factorias Vulcano		Seismic Vessel C535	HFO	2 x 8L32/44CR, 2 x 6L32/44CR	2 x 4.500 kW, 2 x 3.000 kW	SCR Systems	2009		
300	SHI Korea		Stena Ropax	HFO	2 x 9L48/60B, 2 x 7L21/31	2 x 10.800 kW, 2 x 1.540 kW	SCR Systems	2009		
301	CNP Freire		Supply Vessel	MGO	6 x 9L21/31	6 x 1.800 kW	SCR Systems	2009		
302	Ferus Smit		Tanker	HFO	1 x 8M32	1 x 3.840 KW	SCR System	2009		
303	Karstensens		Trawler	HFO	1 x 12V32	1 x 6.000 kW	SCR Systems	2009		
304	STM		Vessel	HFO	4 x 10L32/44	4 x 5.600 kW	SCR Systems	2009		
305				MGO	1 x 8M32	1 x 3.840 kW	SCR System	2009		
306	MS de Wending	MS de Wending	Pilot Boat	Diesel			SCR	2009		Caterpillar

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
307	Aker Brevik 69	Normand TBN	PSV/ROV 06 CD	Diesel			SCR	2009		Caterpillar
308	Zamakona 668 / Viking Supply	not known	Supply	Diesel			SCR	2009		MAK
309	Zamakona 669	not known	Supply/ VS	Diesel			SCR	2009		MAK
310	Zamakona 670	not known	Supply/VS	Diesel			SCR	2009		MAK
311	Zamakona 669	not known	Supply/VS	Diesel			SCR	2009		MAK
312		LNG Golar Winter		LNG/ HFO		2 x 77 t/h		2009	2 boiler	MHI regas-boiler
313	Anda Rheinschiff			Diesel		1'250	burner Control	2009		
314	Ikea Italy			Bio Fuel		2 x 900	SCR	2009		
315	Ikea Rimini Italy			Bio Fuel		2 x 900	SCR	2009		
316	Royal Danish Navy	P525 Rota	Patrol Vessel		4stroke	2 x 2	SCR	2009	Main x 2	MTU
317		Wilson Narvik	GENERAL CARGO VESSEL	HFO	1 x 8L32		SCR	2009		
318		Wilson Nice	GENERAL CARGO VESSEL	HFO	1 x 8L32		SCR	2009		
319		Wilson North	GENERAL CARGO VESSEL	HFO	1 x 8L32		SCR	2009		
320	Pon Power		"Nordstar"	MGO	1 x 8M32	1 x 3.520	SCR System	2009		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
						kW				
321	Swedish Coast Guard	KBV 001 Poseidon	Search & Rescue Vessel		3516B	1370	SCR	2009		Cat
322	Swedish Coast Guard	KBV 002 Triton	Search & Rescue Vessel		3516B	1370	SCR	2009		Cat
323	Østerbris AS	Østerbris	Stern Trawler		9M32	4317	SCR	2009		MAK
324	Marintec (University)	Marintek	Test rig			500	SCR	2009		Vickmann
325	Alcatraz Cruises	Hornblower Hybrid	Ferry				SCR	2009	NA	NA
326	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
327	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
328	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
329	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
330	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
331	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
332	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
333	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
334	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
335	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
336	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
337	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
338	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
339	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
340	"Cooperation		engine on	diesel			DeNOx-	2009		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
	partner"		ship				Cat Oxi-Cat			
341	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
342	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
343	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
344	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
345	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
346	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
347	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
348	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
349	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-	2009		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
							Cat			
350	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
351	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
352	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
353	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
354	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
355	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
356	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
357	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
358	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
359	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
360	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
361	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
362	"Cooperation partner"		engine on ship	diesel			DeNOx-Cat Oxi-Cat	2009		
363	San Francisco Water Emergency Transportation Authority	Taurus	Passenger/Ferry	Diesel	16V2000	1410 HP	SCR	2010		MTU
364	Pon Power		"Geir"	MGO	3 x C-32	3 x 874 kW	SCR Systems	2010		
365	Wärtsilä		"Liafjord"	LFO	1 x 16V32	1 x 6.560 kW	SCR System	2010		
366	Wärtsilä		Drill Ship, 1755	LFO	6 x 16V32	6 x 7.680 kW	SCR Systems	2010		
367	BMV		Hull 167	MDO	4 x 8L32	4 x 3.800 kW	SCR Systems	2010		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
368	Pon Power		Travler	MGO	1 x 9M32, 2 x 3516B	1 x 4.320 kW, 2 x 1.901 kW	SCR Systems	2010		
369	Fiskerstrand	Heroyhav		MDO	1x9M32 2x3508	1 x 4.320 kW 2 x 760 kW	SCR Systems	2010	NA	MAK
370				MGO	1 x KVBM	1 x 2.200 kW	SCR System	2010		
371				MGO	1 x 8M32	1 x 2.640 kW	SCR System	2010		
372				MDO	1 x 6M32	1 x 2.880 kW	SCR System	2010		
373				MDO	1 x 3612	1 x 3.460 kW	SCR System	2010		
374				MDO	1 x 3612	1 x 3.460 kW	SCR System	2010		
375				MGO	1 x 8M32	1 x 3.840 kW	SCR System	2010		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
376				MDO	1 x 9M32	1 x 4.320 kW	SCR System	2010		
377				MDO	1 x 12V32	1 x 5.520 kW	SCR System	2010		
378				MDO	1x9M32, 2x3508	1 x 4.320 kW, 2 x 760 kW	SCR Systems	2010		
379				MGO	2 x 3512	2 x 1.420 kW	SCR Systems	2010		
380				MGO	4 x 3512	4 x 1.424 kW	SCR Systems	2010		
381				MDO	4 x 9L20	4 x 1.665 kW	SCR Systems	2010		
382				MGO	4 x 3516 C	4 x 2.350 kW	SCR Systems	2010		
383		Aquila	Pilot Boat		ACERT C32		SCR and DPF	2010	NA	Cat
384		Draco	Pilot Boat		ACERT C32		SCR and DPF	2010	NA	Cat
385		Orion	Pilot Boat		ACERT C32		SCR and DPF	2010	NA	Cat

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
386	Havyard Leirvik AS HLE 106			MGO		2 x 1560 2 x 1840		2010	4 main engines	MTU
387	Havyard Leirvik AS HLE 102			MGO		4 x 1560		2010	4 main engines	MTU
388	Arba II Switzerland			Diesel		200	SCR	2010		
389	Powership 6 Turkey			HFO		6 x 34'000	SCR	2010		
390	Castelnuovo			Bio Fuel		3800	SCR close loop controlled	2010		
391	Bornholmstrafikken A/S	M/S Hammerodde	Ferry		4stroke	0.6	SCR	2010	Aux	Caterpillar
392	Royal Danish Navy	P521 Freja	Patrol Vessel		4stroke	2 x 2	SCR	2010	Main x 2	MTU
393	Royal Danish Navy	P524 Nymfen	Patrol Vessel		4stroke	2 x 2	SCR	2010	Main x 2	MTU
394	Stena AB	Stena Jutlanica	RoPax		9L40/54	6480	SCR	2010		MAN
395		Wilson Newport	GENERAL CARGO VESSEL	HFO	1 x 8L32		SCR	2010		
396		Wilson Norfolk	GENERAL CARGO VESSEL	HFO	1 x 8L32		SCR	2010		
397	Global Offshore (Garware)	Beaucephalus	PSV		3512C	1512	SCR	2010		Cat

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
398	KBV (Swedish Coast Guard)	KBV 003 Amfitrite	Search & Rescue Vessel		3516B	1940	SCR	2010		Cat
399	Hargun Havfiske AS	Hargun	Stern Trawler		8M32	3840	SCR	2010		MAK
400	Kleven	KP344	Platform Supply Vessel (PSV)	MDO	4 x 9L20	4 x 1.665 kW	SCRSystems	2010	NA	Wärtsilä
401	Moen Slip	Tronderbas	Trawler	MDO	1 x 12V32	1 x 5.520 kW	SCR System	2010	NA	Wärtsilä
402	Bomlo Skipsserv.	Trygvason	Trawler	MGO	1 x 8M32	1 x 2.640 kW	SCR System	2010	NA	MAK
403	NSS-Poland	Henri Dyroy		MDO	1 x 3612	1 x 3.460 kW	SCR System	2010	NA	Cat
404	NSS-Poland	Nordenvon		MGO	1 x 8M32	1 x 3.840 kW	SCR System	2010	NA	MAK
405	Gesab	Ternvag	Chemical Tanker	HFO/ MGO	1 x 6L46C 3 x aux. engines	1 x 6.300 kW 3 x 700 kW	SCR Systems	2011	NA	Wärtsilä
406	STX St. Nazaire	Europa II	Passenger	HFO/ MDO	2 x 6M43	2 x 6.000 kW	SCR Systems	2011	NA	MAK

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
407	Ulstein	Hull 703	Platform Supply Vessel (PSV)	MDO	4 x 6L21/31	4 x 1.320 kW	SCR Systems	2011	NA	MAN
408	STX Aukra	Hull 764	Platform Supply Vessel (PSV)	MGO	2 x 3516 C	2 x 2.350 kW	SCR Systems	2011	NA	Cat
409	Kleven	KP345	Platform Supply Vessel (PSV)	MDO	4 x 9L20	4 x 1.665 kW	SCR Systems	2011	NA	Wärtsilä
410	STX Langsten	NB 753PSV	Platform Supply Vessel (PSV)	MGO	4 x 9L21/31 4 x 9L21/31	4 x 1.900 kW	SCR SystemsSCR Systems	2011	NA	MAN B&W
411	STX Langsten	NB 754	Platform Supply Vessel (PSV)	MGO	4 x 9L21/31 4 x 9L21/31	4 x 1.900 kW	SCR SystemsSCR Systems	2011	NA	MAN B&W
412	STX	Volstad Supplier	Supply Vessel	MGO	4 x 3516B 1 x 3508	4 x 1.900 kW 1 x 968 kW	SCR Systems	2011	NA	Cat
413	Kleven	MT 6009		MGO	4 x 3512B	3 x 1.424 kW	SCR Systems	2011	NA	Cat
414	STX Langsten	NB 749		MGO	3 x 7L27/38	3 x 2.450 kW	SCR Systems	2011	NA	MAN

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
415	STX Vietnam	NB 750		MGO	3 x 7L27/38 3 x 7L27/38	3 x 2.450 kW	SCR SystemsSCR Systems	2011	NA	MAN
416	STX Vietnam	NB 751		MGO	3 x 7L27/38 3 x 7L27/38	3 x 2.450 kW	SCR SystemsSCR Systems	2011	NA	MAN
417	STX Langsten	NB 767		MDO	3 x C25:33L9P	3 x 2.880 kW	SCR Systems	2011	NA	Rolls Royce
418	STX Vietnam	NB 770		MGO	3 x 7L27/38	3 x 2.450 kW	SCR Systems	2011	NA	MAN
419	STX Sovik	NB 771		MGO	4 x 6L32	4 x 2.880 kW	SCR Systems	2011	NA	Wärtsilä
420	STX Brattvaag	NB 783		MGO	2 x 9L20 2 x 6L20	2 x 1.665 kW 2 x 1.055 kW	SCR Systems	2011	NA	Wärtsilä
421				MGO	16 x KTA 50	16 x 1.253 kW	SCR Reactors	2011		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
422				MGO	1 x KTA 50	1 x 1.253 kW	SCR System	2011		
423				MGO	1 x 9L27/38	1 x 3.060 kW	SCR System	2011		
424				MDO	1 x 6L32, 1 x 9L20	1 x 3.000 kW, 1 x 1.665 kW	SCR Systems	2011		
425				HFO	1 x 6L46C	1 x 6.300 kW	SCR Systems	2011		
426				MGO	2 x 9L20, 2 x 6L20	2 x 1.665 kW, 2 x 1.055 kW	SCR Systems	2011		
427				MGO	2 x 3516 C	2 x 2.350 kW	SCR Systems	2011		
428				MGO	4 x 3512B	3 x 1.424 kW	SCR Systems	2011		
429				MGO	3 x 7L27/38	3 x 2.450 kW	SCR Systems	2011		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
430				MGO	3 x 7L27/38	3 x 2.450 kW	SCR Systems	2011		
431				MGO	3 x 7L27/38	3 x 2.450 kW	SCR Systems	2011		
432				MDO	3 x C25:33L9 P	3 x 2.880 kW	SCR Systems	2011		
433				MDO	4 x 6L21/31	4 x 1.320 kW	SCR Systems	2011		
434				MDO	4 x 9L20	4 x 1.665 kW	SCR Systems	2011		
435				MGO	4 x 9L20, 2 x 9L26	4 x 1.800 kW, 2 x 3.080 kW	SCR Systems	2011		
436				MGO	4 x 9L21/31	4 x 1.900 kW	SCR Systems	2011		
437					4 x 9L21/31	4 x 1.900 kW	SCR Systems	2011		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
438				MGO	4 x 3516B, 1 x 3508	4 x 1.900 kW, 1 x 968 kW	SCR Systems	2011		
439				MDO	4 x 3516C	4 x 2.350 kW	SCR Systems	2011		
440				MDO	4 x 3516C	4 x 2.350 kW	SCR Systems	2011		
441				MGO	4 x 3516C	4 x 2.350 kW	SCR Systems	2011		
442				MGO	4 x 3516C	4 x 2.350 kW	SCR Systems	2011		
443				MGO	4 x 6L32	4 x 2.880 kW	SCR Systems	2011		
444				HFO/ MDO	4 x 10L32/44 CR	4 x 5.600 kW	SCR Systems	2011		
445	JX Shipping C0., Ltd.	SANTA VISTA	General Cargo - 38GC		6S46MC-C	6780	SCR - pre turbo charger	2011		Hitachi Zosen
446	Netherlands			MFO		500	SCR	2011		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
447	Olympus Sweden			MDO		1 x 9'500 3 x 1800	SCR integrated in Boiler	2011		
448	Sandfrakt AS	M/V Norholm	Bulk carrier		4stroke	2	SCR	2011	Main	Caterpillar
449	Royal Danish Navy	P520 Diana	Patrol Vessel		4stroke	2 x 2	SCR	2011	Main x 2	MTU
450	Royal Danish Navy	P522 Havfruen	Patrol Vessel		4stroke	2 x 2	SCR	2011	Main x 2	MTU
451	Royal Danish Navy	P523 Najaden	Patrol Vessel		4stroke	2 x 2	SCR	2011	Main x 2	MTU
452		Wilson Nanjing	GENERAL CARGO VESSEL	HFO	1 x 8L32		SCR	2011		
453		Wilson Newcastle	GENERAL CARGO VESSEL	HFO	1 x 8L32		SCR	2011		
454		Arctia Fennica	ICEBREAKER	MGO	2 x 16V32 + 2 x 12V32		SCR	2011		
455		Baltija 901	TUG BOAT		3 x 8L20		SCR	2011		
456		Baltija 902	TUG BOAT	MGO	4 x 8L20		SCR	2011		
457	KBV (Swedish Coast Guard)	KBV 031	Patrol Vessel		16V2000 M60	802	SCR	2011		MTU
458	KBV (Swedish Coast Guard)	KBV 032	Patrol Vessel		16V2000 M60	802	SCR	2011		MTU
459	Silver Dollar City	Branson Belle	Showboat				SCR	2011	NA	Cummins

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
460	Fitjar	Krossfjord	Trawler	MGO	1 x 9L27/38	1 x 3.060 kW	SCR System	2011	NA	Wärtsilä
461	Nippon Yusen Kabushiki Kaisha (NYK Line),	Initial Salute			MHI 6UEC60L SII	11,000	SCR	2011	NA	Mitsubishi
462	FOSEN	Hull 87/88	RoPax Ferry	HFO/ MDO	4 x 10L32/44 CR 2 x 6L21/31 1 x 7L21/31	4 x 5.600 kW 2 x 1.320 kW 1 x 1.540 kW	SCR Systems	2012	NA	Wärtsilä
463	Bergen Gr. Fosen	NB89		MDO	6 x 6L32 1 x 9L20	6 x 2.88ß kW 1 x 1.665 kW	SCR Systems	2012	NA	Wärtsilä
464	CAT/Finanzauto	Östensjö		MGO	2 x 9M25C 2 x 6M25C	2 x 3.000 kW 2 x 2.000 kW	SCR Systems	2012	NA	MaK

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
465	MHIMHI	S 2291S		HFO	6 x 8L32 6 x 8L32	6 x 3.840 kW	SCR Systems	2012	NA	Wärtsilä
466	MHIMHI	S 2292		HFO	6 x 8L32 6 x 8L32	6 x 3.840 kW	SCR Systems	2012	NA	Wärtsilä
467				MGO	1 x 8L32	1 x 4.000 kW	SCR System	2012		
468				MDO	1 x 6L32, 1 x 9L20	1 x 3.000 kW, 1 x 1.665 kW	SCR Systems	2012		
469				MGO	1 x 8M32C, 1 x 8M25C	1 x 4.000 kW, 1 x 2.540 kW	SCR Systems	2012		
470				HFO/ MGO	1 x 6L46C, 3 x aux. Engines	1 x 6.300 kW, 3 x 700 kW	SCR Systems	2012		
471				MDO	2 x 3512 CDA, 2 x C32	2 x 1.424 kW, 2 x 994 kW	SCR Systems	2012		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
472				HFO/ Gas	2 x 12V50DF, 2 x 6L50DF	2 x 11.700 kW, 2 x 5.850 kW	SCR Systems	2012		
473				MGO	2 x 16V4000 M70	2 x 2.320 kW	SCR Systems	2012		
474				MGO	2 x 3516C, 2 x C32	2 x 2.350 kW, 2 x 994 kW	SCR Systems	2012		
475				MGO	2 x 9M25C, 2 x 6M25C	2 x 3.000 kW, 2 x 2.000 kW	SCR Systems	2012		
476				MGO	2xB32:40 L9	2 x 4.500 kW	SCR Systems	2012		
477				MGO	2 x 9M32C, 2 x 6M25C	2 x 4.500 kW, 2 x 1.800 kW	SCR Systems	2012		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
478				MGO	2 x B32:40L9, 2 x B32:40L9	2 x 4.500 kW, 2 x 4.500 kW	SCR Systems	2012		
479				HFO/ MDO	2 x 6M43	2 x 6.000 kW	SCR Systems	2012		
480				MGO	2 x B32:40V12P, 3 x C25:33L9A	2 x 6.000 KW, 3 x 2.880 kW	SCR Systems	2012		
481				MGO	3 x 7L27/38	3 x 2.450 kW	SCR Systems	2012		
482				MDO	3 x C25:33L9P	3 x 2.880 kW	SCR Systems	2012		
483				MDO	3 x 9L26	3 x 2.925 kW	SCR Systems	2012		
484				MDO	3 x 9L26	3 x 2.925 kW	SCR Systems	2012		
485				MDO	4 x 8L20	4 x 1.600 kW	SCR Systems	2012		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
486				MDO	4 x 9L20	4 x 1.665 kW	SCR Systems	2012		
487				MGO	4 x 8L21/31	4 x 1.760 kW	SCR Systems	2012		
488				MGO	4 x 3516C	4 x 2 350 kW	SCR Systems	2012		
489				MDO	4 x 3516C	4 x 2.095 kW	SCR Systems	2012		
490				MDO	4 x 3516C, 1 x C32	4 x 2.350 kW, 1 x 994 kW	SCR Systems	2012		
491				MGO	4 x 6L32	4 x 2.880 kW	SCR Systems	2012		
492				MDO	4 x 6M20C, 2 x C18	4 x 825 kW, 2 x 438 kW	SCR Systems	2012		
493				MDO	6 x 6L32, 1 x 9L20	6 x 2.88ß kW, 1 x 1.665 kW	SCR Systems	2012		

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
494				HFO	6 x 8L32	6 x 3.840 kW	SCR Systems	2012		
495	Skårungen	Malene S	trawler/purse seiner		4 stroke	4.3	SCR	2012	Main	Caterpillar
496		Offshore Construction Vessel	OFFSHORE CONSTRUCTION VESSEL	MDO	1x8L20 + 2x9L32-D + 2x12V32-D		SCR	2012		
497		Offshore Research vessel	RESEARCH VESSEL	MGO	2x9L32 + 2x7L32 + 2x9L20		SCR	2012		
498		Trawler	TRAWLER		1 x 8L26 + 1 x 9L32		SCR	2012		
499		Trawler	TRAWLER		1x9L32		SCR	2012		
500		Metalships			4x9L32		SCR	2012		
501		Strand Sea Service		MGO	1x9L32		SCR	2012		
502	Atlantic Offshore (Sartor)	Ocean Responce	AHTS			1500	SCR	2012		Wartsila
503	Eggesbø JB	Eros	Fishing vessel		8M32C	4000	SCR	2012		Cat
504	Saevik K	Kings Bay	Fishing vessel		8M32C	4000	SCR	2012		Cat
505	Larvik Shipping	Yara Embla	General Cargo Ship		6M25	1900	SCR	2012		MAK
506	Larvik Shipping	Yara Froya	General Cargo Ship		6M25	1900	SCR	2012		MAK

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
507	Solvtrans rederi as	Sølvtrans	Live Fish Carrier (Well Boat)		C25:33A	1900	SCR	2012		BE
508	KBV (Swedish Coast Guard)	KBV 033	Patrol Vessel		16V2000 M60	802	SCR	2012		MTU
509	KBV (Swedish Coast Guard)	KBV 034	Patrol Vessel		16V2000 M60	802	SCR	2012		MTU
510	Island Offshore	Island Contender	PSV		C25:33L6 P	2000	SCR	2012		BE
511	Island Offshore	Island Crusader	PSV		C25:33L6 P	2000	SCR	2012		BE
512	Atlantic Offshore (Sartor)	Ocean Pride	PSV		3512C	1765	SCR	2012		Cat
513	Sjoborg Supply (PF Supply)	Torsborg	PSV		12V4000 M33S	1560	SCR	2012		MTU
514	Hull 110	Vestland Mira	PSV		3512C	1800	SCR	2012		Cat
515	Norwegian Coastal Administration	Utvær	Special purpose		3516TA	1900	SCR	2012		Cat
516	Fiskebas AS	Fiskebas	Fishing vessel		C25-33L9P	2880	SCR	2013		BE
517	Island Offshore	STX Brevik H-1796	PSV		C25:33L6 P	2000	SCR	2013		BE
518	Troms Offshore	Troms Sirius	PSV		3512C	1800	SCR	2013		Cat
519	Norwegian Coastal Administration	Skomvær	Special purpose		3516TA	1900	SCR	2013		Cat

#	Ship Owner Operator	Ship Name	Ship Type	Fuel	Engine Model	Engine power (per engine)	NOx Redux Tech	Date of installation	Field of Application	Engine Manufact'r
520		Slettholmen	Purse Seiner				SCR		Main engine	NA
521	Bylink	Solano	Passenger-only high speed catamaran		MTU16V-4000M70	3110 hp	SCR			MTU
522		Sandhamm	Ferry				SCR			Volvo
523	Royal Danish Navy		6 Patrol Vessels		2 x MTU 2040 kW	2 x 2040 kW				MTU
524		Norwegian Bulk Carrier M/V Norholm		MGO - MDO		3606 - 2030 kW	SCR retrofit			Caterpillar
525				MGO	3 x aux. engines	3 x 700 kW				
526				HFO	6 x 8L32	6 x 3.840 kW				
527			NB 726							
528		Scandinavia		HFO/ MDO	4 x K45GUC 3 x F212	4 x 5369 3 x 1545	SINox SCR		Main and aux engine(s)	Burmeister & Wain Diesel, Nohab Diesel

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ANNEX 3

VESSELS WITH LIQUEFIED NATURAL GAS FUELLED ENGINES

Ship Name (Model)	Ship Type	Vessel Owner (Orderer)	Engine Manufacturer	Engine Model	Notes	Vessel Build Date
Glutra	Car/Passenger Ferry	Fjord1	Rolls Royce	C26:33L9AG	Lean Burn	2000
Bergensfjord	Car/Passenger Ferry	Fjord1	Rolls Royce	C26:33L9AG	Lean Burn	2006
Stavangerfjord	Car/Passenger Ferry	Fjord1	Rolls Royce	C26:33L9AG	Lean Burn	2007
Raunefjord	Car/Passenger Ferry	Fjord2	Rolls Royce	C26:33L9AG	Lean Burn	2007
Mastrafjord	Car/Passenger Ferry	Fjord3	Rolls Royce	C26:33L9AG	Lean Burn	2007
Fanafjord	Car/Passenger Ferry	Fjord4	Rolls Royce	C26:33L9AG	Lean Burn	2007
Moldefjord	Car/Passenger Ferry	Fjord5	Rolls Royce	C26:33L9AG	Lean Burn	2009
Fannefjord	Car/Passenger Ferry	Fjord6	Rolls Royce	C26:33L9AG	Lean Burn	2010
Romsdalsfjord	Car/Passenger Ferry	Fjord7	Rolls Royce	C26:33L9AG	Lean Burn	2010
Korsfjord	Car/Passenger Ferry	Fjord8	Rolls Royce	C26:33L9AG	Lean Burn	2010
Tresfjord	Car/Passenger Ferry	Fjord9	Rolls Royce	C26:33L9AG	Converted from diesel to diesel and LNG hybrid	Built 1991, Converted in 2010
Viking Queen	Offshore Supply Vessel	Eidesvik	Wartsila	20DF/34DF	Dual Fuel.	2008
Tideprinsen	Car/Passenger Ferry	Tide Sjø	Mitsubishi	DPMG400-50		2009
Tidekongen	Car/Passenger Ferry	Tide Sjø	Mitsubishi	DPMG400-50		2009

Tidedronningen	Car/Passenger Ferry	Tide Sjø	Mitsubishi	DPMG400-50		2009
Viking Energy	Offshore Supply Vessel	Eidesvik	Wartsila	6L32DF	Dual Fuel	2003
Viking Lady	Offshore Supply Vessel	Eidesvik	Wartsila	20DF/34DF	Dual Fuel.	2009
Selbjørnsfjord	Car/Passenger Ferry	FosenNamsos	Mitsubishi	GS12R, GS16R	Lean Burn	2010
M/S Stril Pioner	Platform Supply Vessel	Simon Møkster Rederi AS	Wartsila	6L32DF	Dual Fuel	2003
KV Barentshav	Patrol Vessel	Norwegian Coast Guard	Mitsubishi	GS16R	LNG (lean burn) and diesel hybrid power	2010
KV Bergen	Patrol Vessel	Norwegian Coast Guard	Mitsubishi	GS16R	LNG (lean burn) and diesel hybrid power	2010
KV Sortland	Patrol Vessel	Norwegian Coast Guard	Mitsubishi	GS16R	LNG (lean burn) and diesel hybrid power	2010
NA	Tugboat	Wuhan Ferry Company	NA	NA	30% diesel 70% LNG hybrid	2011
Bit Viking	Chemical Tanker	Wartsila	Tarbit Shipping	50DF	Duel Fuel Convesion	2011

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ANNEX 4

CASE STUDIES OF SCR FOR LARGE YACHTS

(Excerpted from ICOMIA Response to the Third Round of Questions to the Correspondence Group)

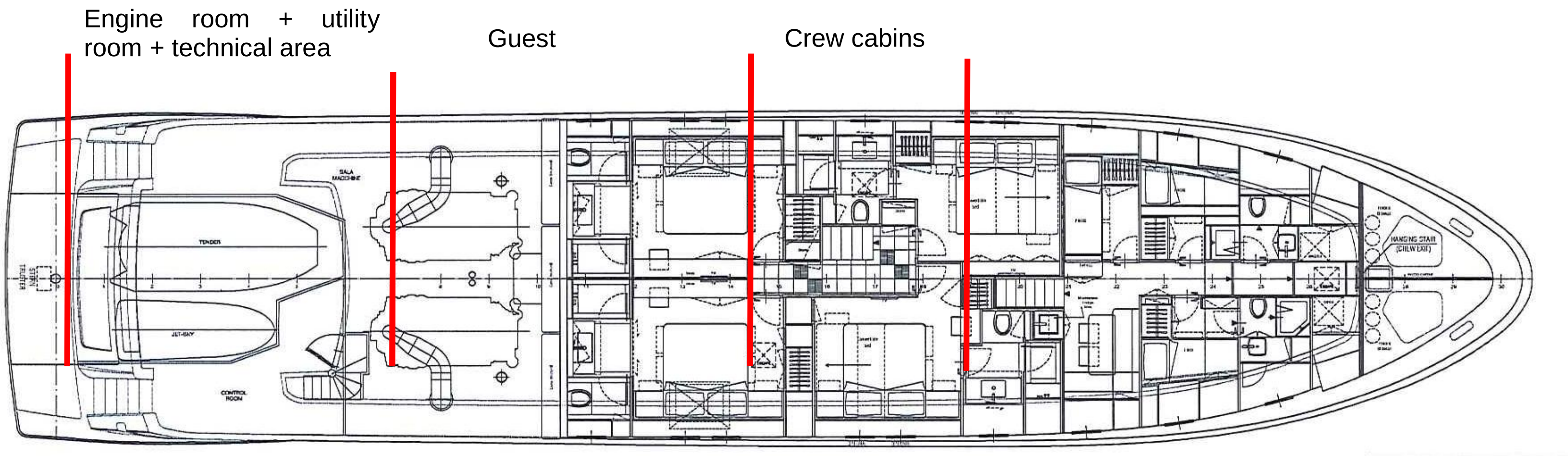
Many of the yards that ICOMIA represent are required to start planning and designing their 2016 production in 2013 and commercial decisions are being taken today. This will be demonstrated on the example of two of our member shipyards. One is based in the United Kingdom and the other in Italy, but both are representative of the whole sector which follows a very proactive approach towards Tier III and does their utmost to comply with the rules.

Case 1 – Technical Implementation of Tier III

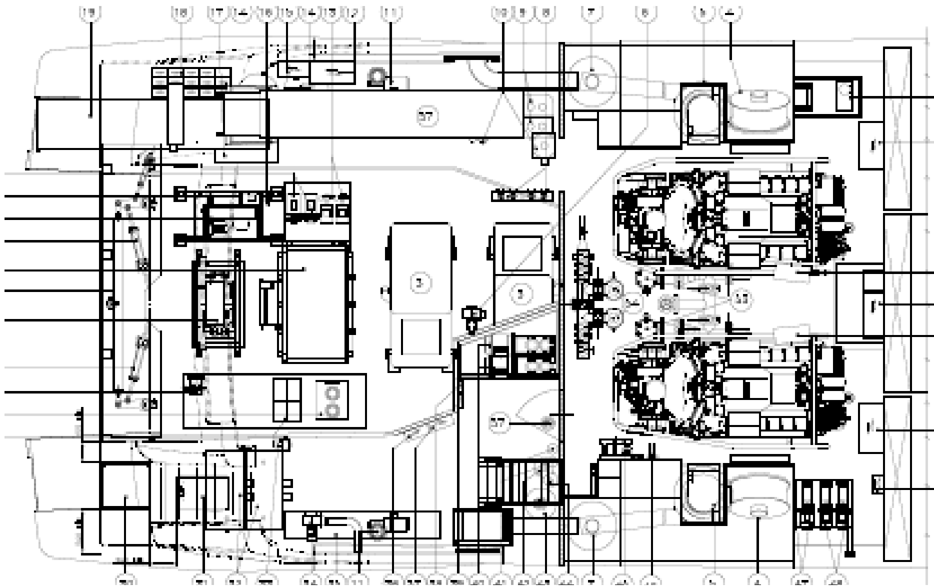
Typically on vessels above 24 m, communal rooms and the owner's cabin are allocated on the upper deck. The lower deck houses crew accommodation, guest cabins, the engine-room and a combined utility room/technical area housing tender storage and engineering equipment. Tender size is kept to a minimum but also needs to reflect market demands. While the majority of the vessels in this size range operate on daily cruises mostly within short range of their home port, the sizes for crew cabins are fixed through the MLC and cannot be reduced. The above share of areas can be divided in the following approximate percentages:

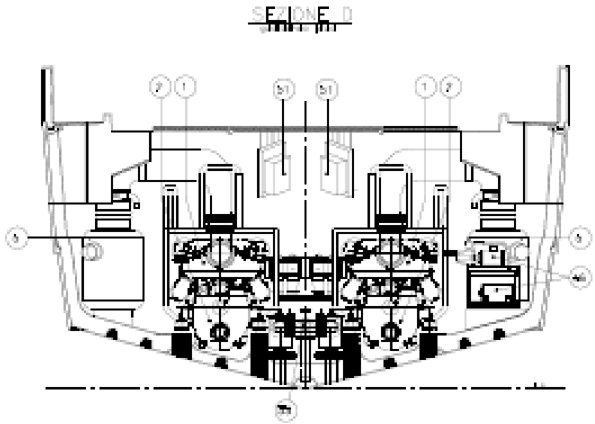
Crew cabins:	23.7%
Guest cabins:	36.0%
Engine room:	22.4
Utility room/technical area:	17.9%

A typical lower deck layout looks as follows:



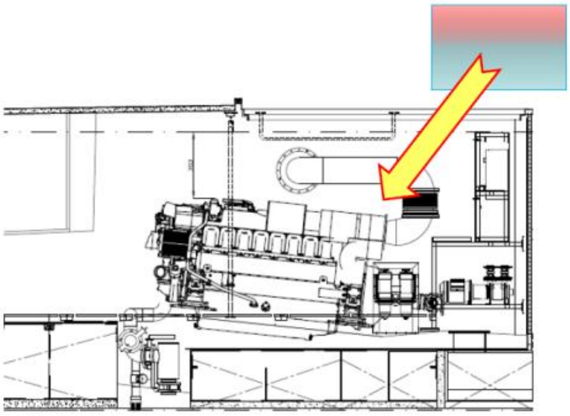
Engine rooms are located on all vessels between guest cabins and utility rooms and are already reduced to a minimum still fulfilling safety and maintainability requirements. In addition to the propulsion engines the space is occupied by combined wet exhausts/silencers (which due to comfort requirements in the low-frequency range are very large), generators, water calorifiers/sewage treatment plants, air conditioning equipment, batteries, tanks and control units. The figure below gives an example of a typical engine room arrangement:



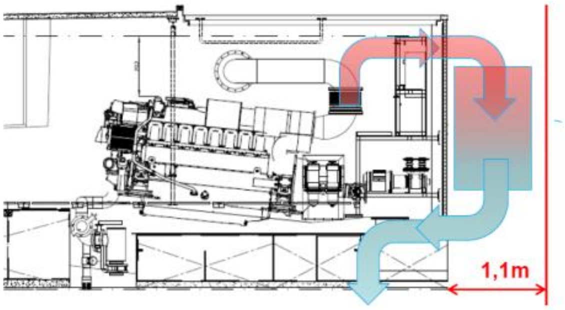


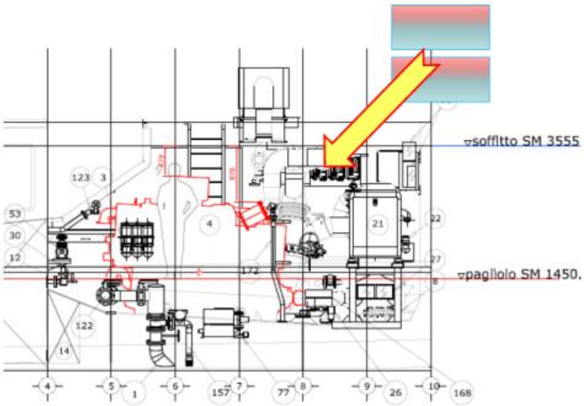
Any appliances added to an engine room such as SCR systems require re-designing of the entire arrangement. In order to minimize space impact, SCR units would be ideally mounted on top of the engine, requiring a minimum height of the engine room which does not exist on the majority of the vessels of this category. SCRs cannot be supported off the deckhead since this would generate undesired vibrations in the passenger area (engine mounting of SCR units appears feasible on models where the engine room height exceeds one deck, notwithstanding re-assessment of the vessel stability). Subsequently, on vessels in the range >24m and circa <400GT[1], engine room size will have to be increased by moving bulkheads. For comparison, on a vessel powered with twin engines, the total volume required to fit the SCR reactor and mixing pipe equals fitting a third engine. Drawings produced by a yard explain the consequences on the guest accommodation:

1 Parameters subject to results of ICOMIA Design Study.

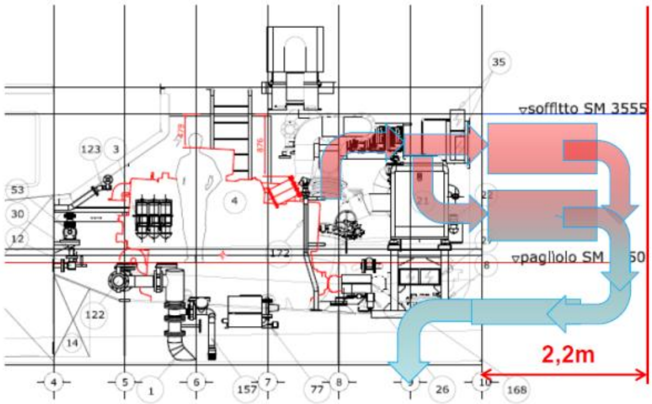


Result from preliminary study : **1.1 m** increase of engine room lenght =
10,7% reduction of guest accomodation space lower deck





Result from preliminary study : **2,2 m** increase of engine room lenght =
19,3% reduction of guest accomodation space lower deck



As the examples show, depending on the number of catalysts (single/double per engine) and their arrangement the reduction of guest cabin space is likely to be in the range of 10-20 per cent; a very high price which many of our members correctly see as threatening the attractiveness of these vessels to potential owners. Case 2 will explain in more detail how companies face this scenario by considering discontinuing the market segment of yachts in the range >24 m and circa <400 GT.

Considering the potentially very high impact on our industry ICOMIA wishes to add another remark. We acknowledge all sectors in the maritime industries need to commit and contribute to further emissions reductions and ICOMIA does not expect to be treated in a special way. However, it should be considered whether implementing Tier III in yacht designs for our sector including installing a Tier III compliant system that is certified on a test bench provides evidence for IMO that the emissions reduction achieved in our sector is significant enough to justify its high impact to both existing and new models.

Typically engine hours aggregated by these vessels are below 100 in private operation and below 500 in charter, a fraction of the 4,000 – 8,000 hours for commercial shipping. Within these figures the table below describes the typical operational profiles:

Yellow = private use Green=

Semi-planing yachts	engine hours/year	Percentage of engine hours spent at				
		0-20 % of load	20-40 % of load	40-60 % of load	60-80 % of load	80-100 % of load
104' n.1	402	94,3%	2,2%	2,6%	0,8%	0,1%
100' n.4	389	93,5%	3%	1,6%	1,6%	0,3%
108' n.3	97	52,1%	3,%	9,2%	35,2%	0,5%

Engine exhaust gas temperature is a key element determining optimal NO_x conversion in SCR systems. In order to protect the catalyst from irreversible damage urea injection will only take place on optimal conditions for the catalytic conversion. Without urea injection the catalyst effectively is de-activated. On cross-referencing the values of engine operation and load with engine exhaust temperatures, it becomes evident the SCR system may be shut down during a large percentage of the vessel's operation which can be seen in the table below:

Intensive use

Exhaust temperature after engine	Percentage of engine hours spent at			
	<200 °C	200- 250°C	250-300°C	>300°C
104' n.1	50,3%	44,2%	2%	3,5%
104' n.4	84,5%	9%	3%	3,5%

Private use

Exhaust temperature after engine	Percentage of engine hours spent at			
	<200 °C	200- 250°C	250-300°C	>300°C
108' n.3	48,7%	3,4%	3%	44,9%

In summary, SCR systems operating on yachts will likely be deactivated during 50 per cent of a vessels typical operational time, in particular when maneuvering at reduced speeds near shorelines (which is a primary target area for air quality improvements) or in harbours due to low exhaust gas temperatures. We acknowledge that technical solutions exist to raise temperatures but it is unclear if they can be implemented in marine use due to additional complexity and legal requirements excluding low engine loads.

The potential emissions reduction claimed when comparing IMO Tier II with III limits (75%) does not reflect the above observations under operational conditions. Furthermore, the majority of the vessels in our sector with an engine power < 3.7 MW will very likely be supplied until the end of 2015 with engines that comply with US EPA Tier 3 standards which meet a combined HC + NO_x limit of 5.8 g/kWh with NO_x emissions likely in the range of 4.5 g/kWh. Compliance with the EPA Tier 3 standard is guaranteed throughout the engine operational profiles equaling a potential compliance with IMO's Tier III 1.98 g/kWh standard over half of a vessels operation as demonstrated previously with potential SCR deactivation.

Case 2 – Yard Business Decisions in view of Tier III

The decision to purchase a large yacht is predominantly at the discretion of an individual and not for a specific business need or benefit, although in certain cases the owner will offset some of the operating costs by chartering for limited periods of the year. The purchase is therefore discretionary and will only proceed if the owner can procure the features wanted in the yacht within their budget. The yachts are therefore designed to meet this specification including performance requirements, maximized guest accommodation space and luxury, in addition to the provision of sufficient leisure activity equipment such as tenders and personal watercraft, as the market demands.

As previously highlighted many yachts of a certain size must accommodate the leisure activity equipment, machinery spaces, guest accommodation and crew accommodation on the single lower deck. In order to meet the owners' requirements the machinery space is optimized and considerable design effort is undertaken to achieve a practical machinery arrangement within a minimum volume. There is, therefore, virtually no spare volume within these machinery spaces to accommodate the additional equipment required to meet the requirements of MARPOL Annex VI Tier III, hence the forward or aft machinery space bulkhead will need to be moved to meet the extra space demands. In addition the provisions of the Maritime Labour Convention (MLC) will come into force in August 2013 and in the majority of designs will require a significant increase in the area designated for crew accommodation.

The combined demands of the MLC and Tier III will result in a severe impact on the volume available for either guest accommodation or for the storage of tenders, two of the key drivers when an owner is considering a purchase. This has the potential to render certain models unattractive to owners and hence economically unviable with the related loss of revenue for the yards and associated supply chain.

The impact of the Tier III requirements is relevant to both existing designs which will remain in production in 2016 and beyond but also to new designs. An argument frequently mentioned is why the yacht builders cannot simply make their designs longer. The builders could indeed make the yachts longer to provide additional space however this introduces an artificial gap in the market. The yachts within the length bracket in which it is impractical to fit the Tier III equipment would remain economically unviable so the only options for potential owners is to purchase a smaller yacht beneath 24 m, find the considerable extra budget for a larger yacht or to withdraw from yacht ownership altogether. In addition a length increase on these designs may demand an increase in beam and depth. This increases the yacht's weight and would require an increase in installed power, hence increased size of SCR equipment, to meet the performance requirements dictated by the owner leading to a downward spiral of interlocking demands.

Certain yards are already considering major changes to their yacht range and even discontinuing models within a given length bracket because it is anticipated that the Tier III requirements will render these models unattractive to owners and hence economically unviable. These business decisions have the potential to significantly impact revenue and employment within the sector.

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