

The installation of emission reduction technology on the RoPax-Ferry "Nils Dacke"

The installation of an exhaust gas cleaning system as an emission reduction technology on one of TT-Line's ferries was one activity of the "Green Bridge on Nordic Corridor" project, co-sponsored by the EU. Within this activity, an innovative technology was realized on a RoPax vessel with high power multi-engine machinery and very limited available onboard space. This technology allows for using high sulphur fuel while complying with new demanding environmental regulations for SOx Emission Control Areas (SECA) which entered into force on 01 January 2015.

Evaluation, planning and selection of a technical solution

Planning the installation of an exhaust gas cleaning system on board a RoPax ferry first needed careful evaluation of available technical options and their consequences for the ship, its operation and economy. This included the basic decision whether to install a dry or a wet system. Dry exhaust gas cleaning systems use calcium hydroxide granulates while wet systems utilize sea- or fresh water to clean diesel exhausts from sulphur oxides (SOx) and particles (PM).

After careful evaluation of the impact on the ship together with shipyard experts the final decision was made in favour of a wet hybrid exhaust gas cleaning system (also called 'hybrid scrubber'). Its characterization as a 'hybrid' system means that it can either run in open loop mode using seawater which - after being cleaned - is pumped back to the sea or operate closed loop, circulating water in the system. The latter mode of operation needs an alkaline substance added to the process.

The dry system option was rejected mainly because of its heavy top weight and related consequences on stability and deadweight. However, also the wet alternative had to be considered as an immature technology due to a lack of experiences and references on complex RoPax vessels with high power multi-engine machinery. Therefore, the planned installation was decided to be an innovative hybrid system satisfying highest technological and environmental standards.

Contracting, design and engineering

After selecting the manufacturer for the scrubber system and securing financing a contract was signed with the Finnish company Wärtsilä Oy on 25 October 2013 for turnkey delivery of a hybrid wet scrubber system on the RoPax ferry "Robin Hood" (now renamed to "Nils Dacke"). This included design, engineering and project management. Major objectives for engineering were minimizing the system weight, the space needed to install the system and shipyard time.

The system operates either in open loop or closed loop mode using seawater to remove SOx and PM from the exhausts. Exhaust gases from diesel engines enter the system and are sprayed with seawater in scrubbing units. Sulphur oxides in the exhaust gas react with the water thus being removed. When operating in open loop, chemicals are not required due to the natural alkalinity of the seawater. In closed loop mode, caustic soda is added to the

circulating water to increase its alkalinity. Wärtsilä guarantees full SECA requirement compliance while using fuel containing up to 3.5% sulphur.

The wash water from the system is cleaned and monitored to comply with applicable discharge criteria. The system is always operated in closed loop mode while the ship is in port or sailing on estuaries. In this mode of operation, bleed-off water is cleaned and finally pumped to a holding tank on board. No water is discharged over board during closed loop operation. Sludge from the water treatment system is also kept on board for disposal ashore.

Pre-production and installation at the shipyard

Pre-production ashore and pre-installation on board started in May 2014. Two new funnels were built at the shipyard and were already equipped with four scrubbing units well before the ship arrived at the yard. All necessary piping was prepared and two equipment rooms were pre-assembled in a workshop.

The ship was finally docked at shipyard Oresund Drydocks in Landskrona, Sweden, for an 18-days yard stay in July / August 2014. At this occasion all major system components including tanks, pumps, heat exchangers, water treatment systems and control cabinets were installed on board. The old funnels were removed and new funnels of 65 tons each including pre-installed scrubbers were mounted. The installation of the piping system included more than 700 meters of glass-fibre reinforced epoxy (GRE) pipes of various dimensions. Furthermore abt. 2,000 components such as bends, flanges, flaps and valves as well as abt. 17,500 meters of cables were installed.

After the ship was back in service on 09 August 2014, the system was completed during operation. The complete installation was supervised and authorized for use by the ship's Classification Society DNV GL and the Flag State Authority according to applicable rules and regulations.

Commissioning and demonstration of compliance with regulations

When the system was technically completed, commissioning started under real operational conditions. In parallel the engine crew received training in the operation of the system by the manufacturer. Accordingly, the system received final approval by DNV GL acting under the authority of the Flag State.

Experiences in real operation

After more than one year of continuous operation the exhaust gas cleaning system on board M/S "Nils Dacke" has proven to work up to expectations under all operational conditions. With scrubbers in operation, the engines were running on Heavy Fuel Oil with an average sulphur content of abt. 2.4 percent. At the same time, permanent analysis of the exhaust gas showed significantly lower SO_x emissions than if Marine Gas Oil with 0.1 percent sulphur would have been used. Only a maximum of abt. 30 ppm (0.003 percent) of SO_x was measured in the exhaust gas and the average is well below that figure.

The scrubber also proved to be an effective means to reduce particles in the exhaust gas. The combustion of Heavy Fuel Oil creates comparatively large particles which can effectively be captured in the scrubber. Reduction of particles was found to be abt. 80 percent. In this context it is worth to mention that the smaller particles typically found when burning Marine Gas Oil - the alternative SECA-compliance method - are identified to be more harmful to human health.

On the mechanical side, some issues with seaweed clogging the scrubber nozzles were experienced in the beginning. This problem was solved by the installation of another set of filters in the supply lines. Bunkering of caustic soda as well as disposal of sludge ashore turned out to be not a critical operation if safety procedures are strictly followed. The sludge is collected in an IBC-container on board. Full containers are removed from the ship for disposal ashore by an approved company and replaced by empty ones on regular basis.