Challenges in complying with NOx Tier III and the use of Selective Catalytic Reduction

SCR design criteria depend on the engine exhaust gas temperature and the sulphur content in the fuel.

Temperature variations
The exhaust gas temperature is important for the function of an SCR. This will affect the ability for the SCR to work properly in harbours when the engine load is low.

The exhaust gas temperature for large two stroke engines is an issue that still is unsolved.
For ship navigating in ice and in severe sea state, the engine load might vary rapidly. It is challenging for a control system to cope with these changes and keep the functionality of the SCR.

Sulphur content of fuel design criteria
The catalytic structure of the SCR is designed in regard of the sulphur content of the fuel. According to MARPOL, DM (distillate fuel) is to be used for the pre-certification. There are very little documented in regard of how much the sulphur content may fluctuate without jeopardizing the function of the SCR.

Neither has it been described how to proceed when choosing high sulphur (3.5 %) outside SECA/NECA and low sulphur (0.10 %) within.

The use of SCR and sulphur scrubbing technology
The combination of SCR and sulphur scrubbing technology needs to be done as such that the scrubber would be after SCR in the exhaust gas flow. This moves the scrubber further up the smoke stack with an increased negative effect on stability as a result.

Vanadium
According to a Swedish study, the content of Vanadium in the fuel will make some of the SO_2 from the combustion to convert to SO_3. Combined with water vapours, this creates sulphuric acid. How will this affect the exhaust gas piping, exhaust gas boilers? What effect will this have on the sulphur scrubber performance and durability?

Ammonia slip
The amount of ammonia in the exhaust gases depends on the amount of urea injected into the exhaust gases and the function of the catalytic converter. What happens with the ammonia slip in sudden changes of load (such as in heavy sea state and during ice navigation)? Will a decreased function of the catalytic converter increase the ammonia slip?