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Introduction

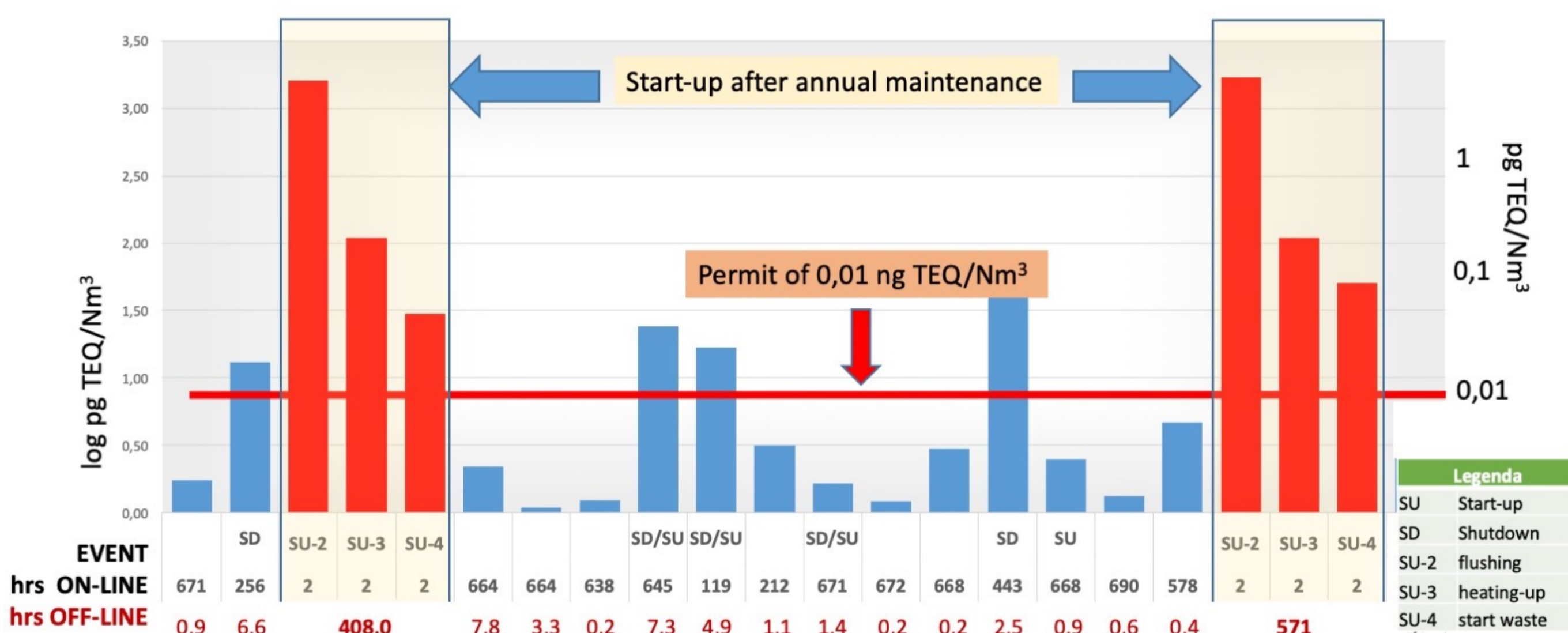
Emissions of dioxins are studied in a long-term sampling program of more than 2 years. This study's objective was to measure POPs continuously with a long-term sampling of the AMESA. The start-up and shutdown of waste incinerators are Other Than Normal Conditions (OTNOC) are moments of not optimally functioning air pollution control devices, APCDs, and incomplete combustion, resulting in unintended production and emission of persistent organic pollutants, UPOPs.

Methods

Continuous sampling of flue gas is performed with the Adsorption Method for Sampling, abbreviated as AMESA (Environnement). Analyses on PCDD/F/di-PCBs, PBB, PBDE, PBDD/F, PFOS, PFOA and PAH in long-term sampling cartridges were performed by Eurofins, Hamburg, Germany. Short-term measurements of start-up events (2016 and 2017) by 'OmgevingsDienst Regio Arnhem' (ODRA), the Netherlands, and dioxins analysed with HR/GC/MS by AI-West, Deventer, the Netherlands and PAHs by Agrolab, Deventer, the Netherlands.

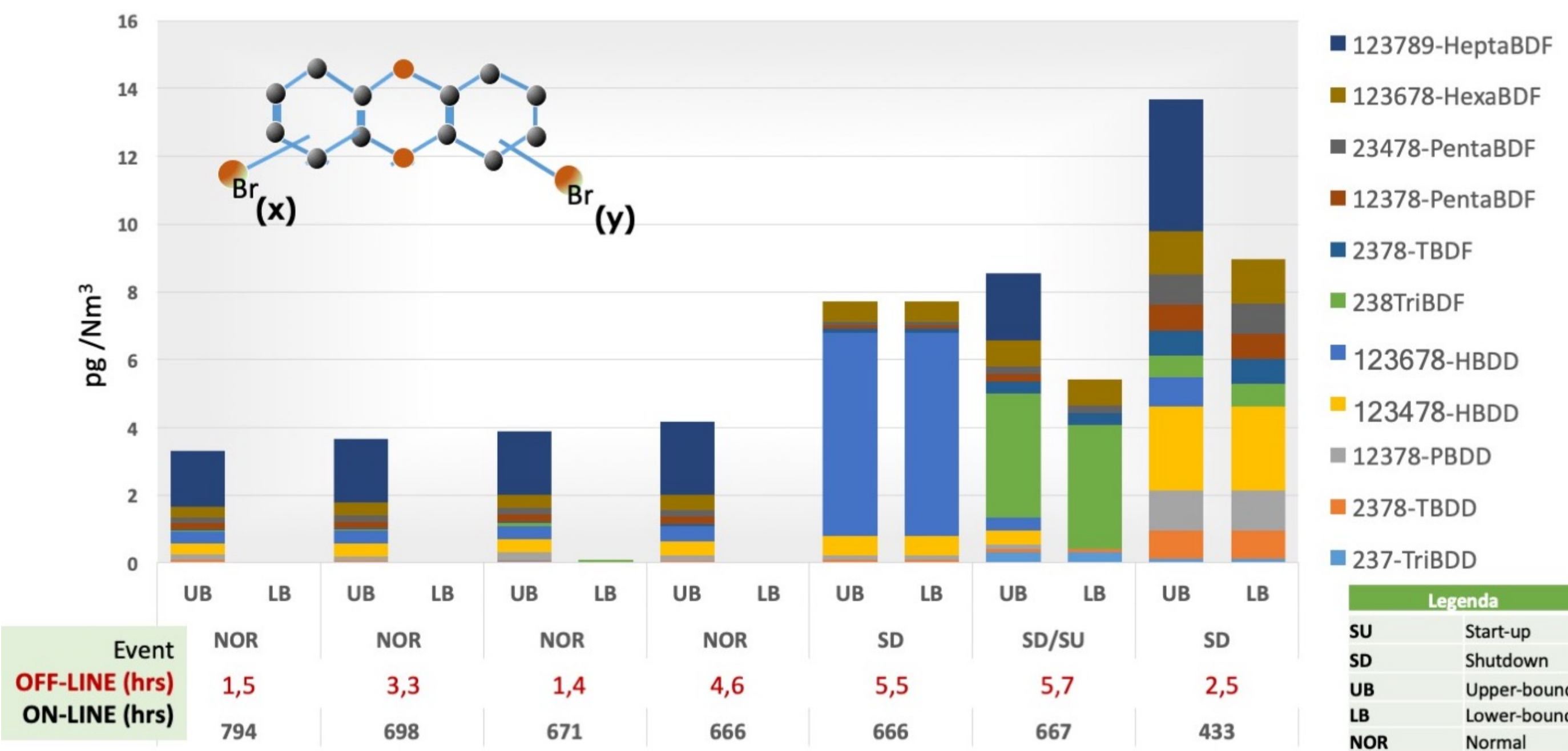
Results

Polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) emissions (18 months)



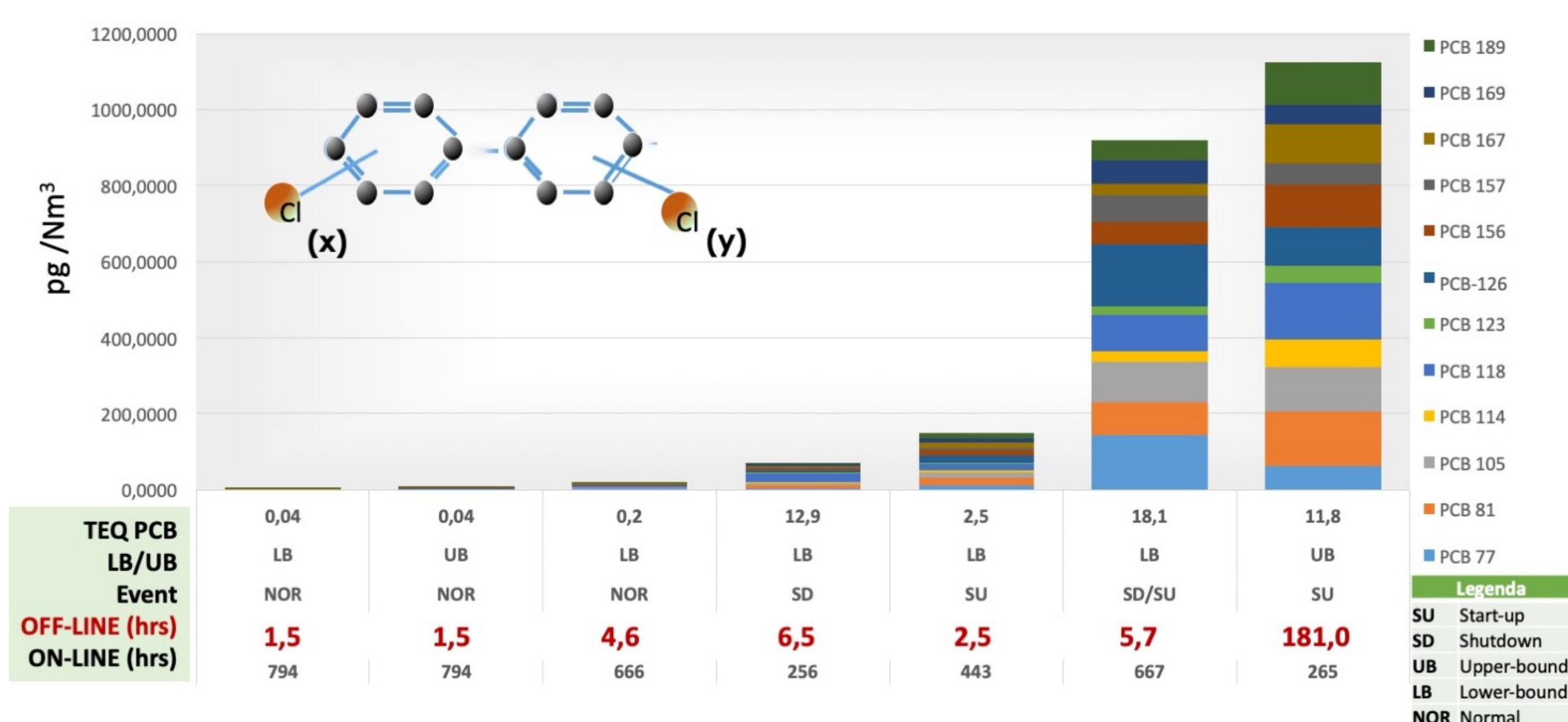
Long-term sampling with an uptime of > 95%, could measure under ideal condition emission levels of 0.2 pg TEQ PCDD/F /Nm³ (794 hours). However, during start-ups levels of dioxins were found to be much higher: 1.7 ng TEQ/Nm³. In the figure above levels of PCDD/Fs are shown during the different stages of start-up (red) of flushing (SU-2), heating-up (SU-3) and start waste feed (SU-4). High PCDD/F levels are observed, when without waste combustion cleaning operation are performed and no air pollution control devices are obliged.

Polybrominated dibenzodioxins and -furans (PBDD/F) emissions



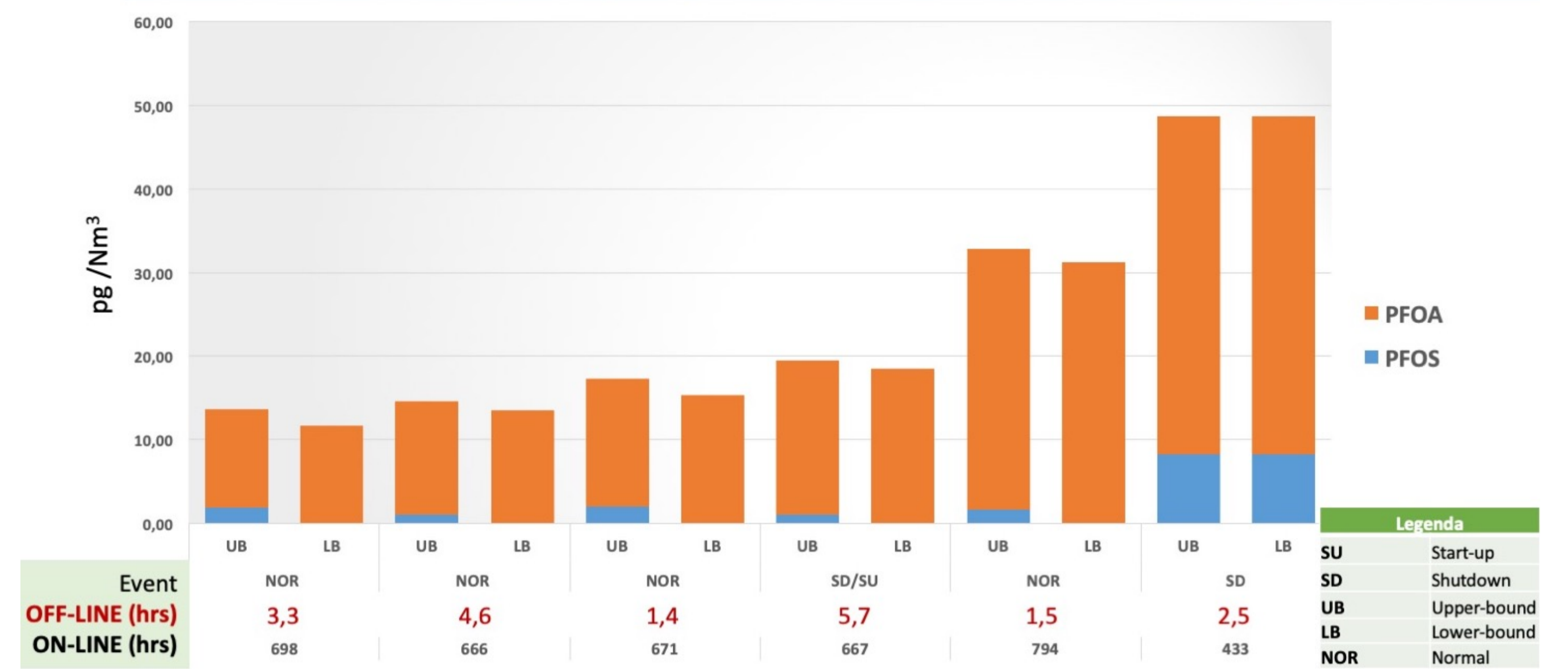
Elevated levels of PBDD/F are found in transient stages of start-ups and shutdowns and characterised with interruptions of sampling.

Emissions dioxin-like polychlorinated biphenyls during 7 months



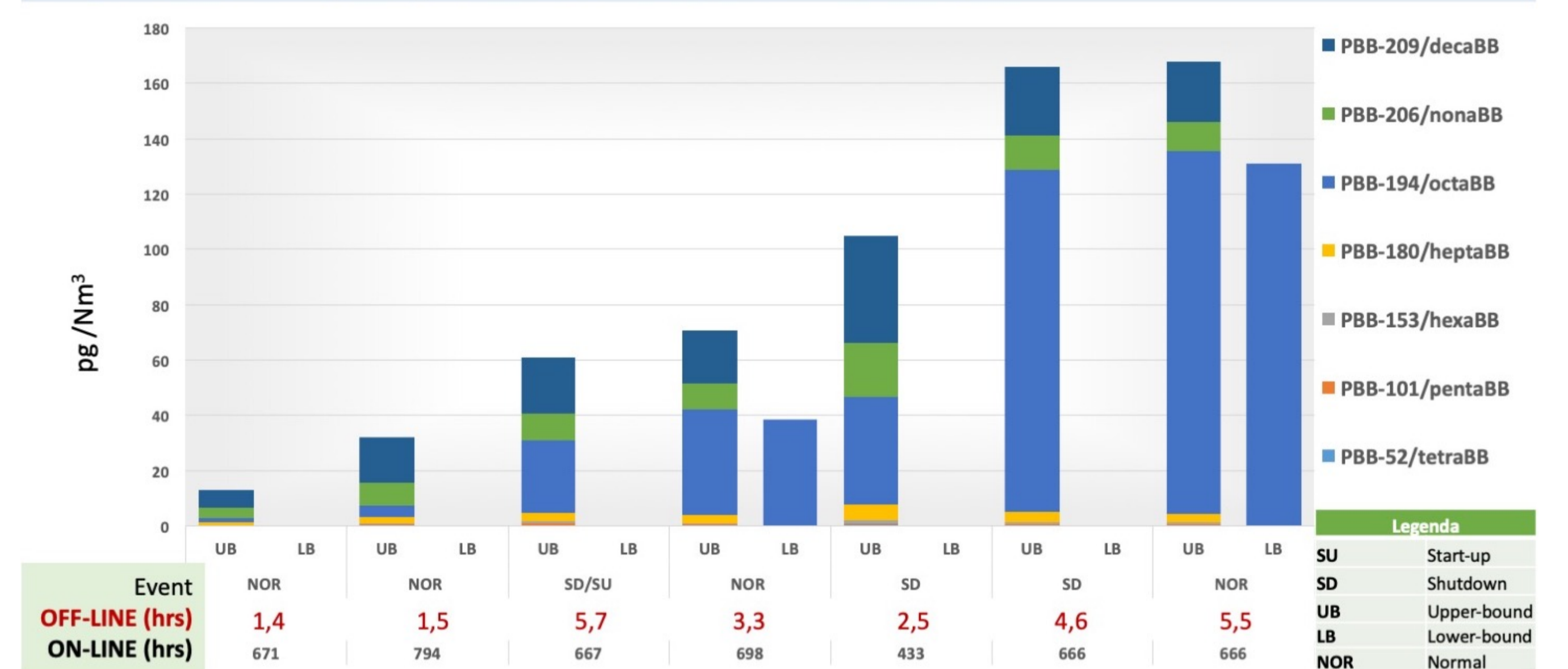
The high emission of dl-PCBs by incineration can be due to a high PCB-input or incapability of the installation (too low temperature) to destroy PCBs effectively. Comparable researches show a factor 3 lower PCB emissions.

Perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) emissions



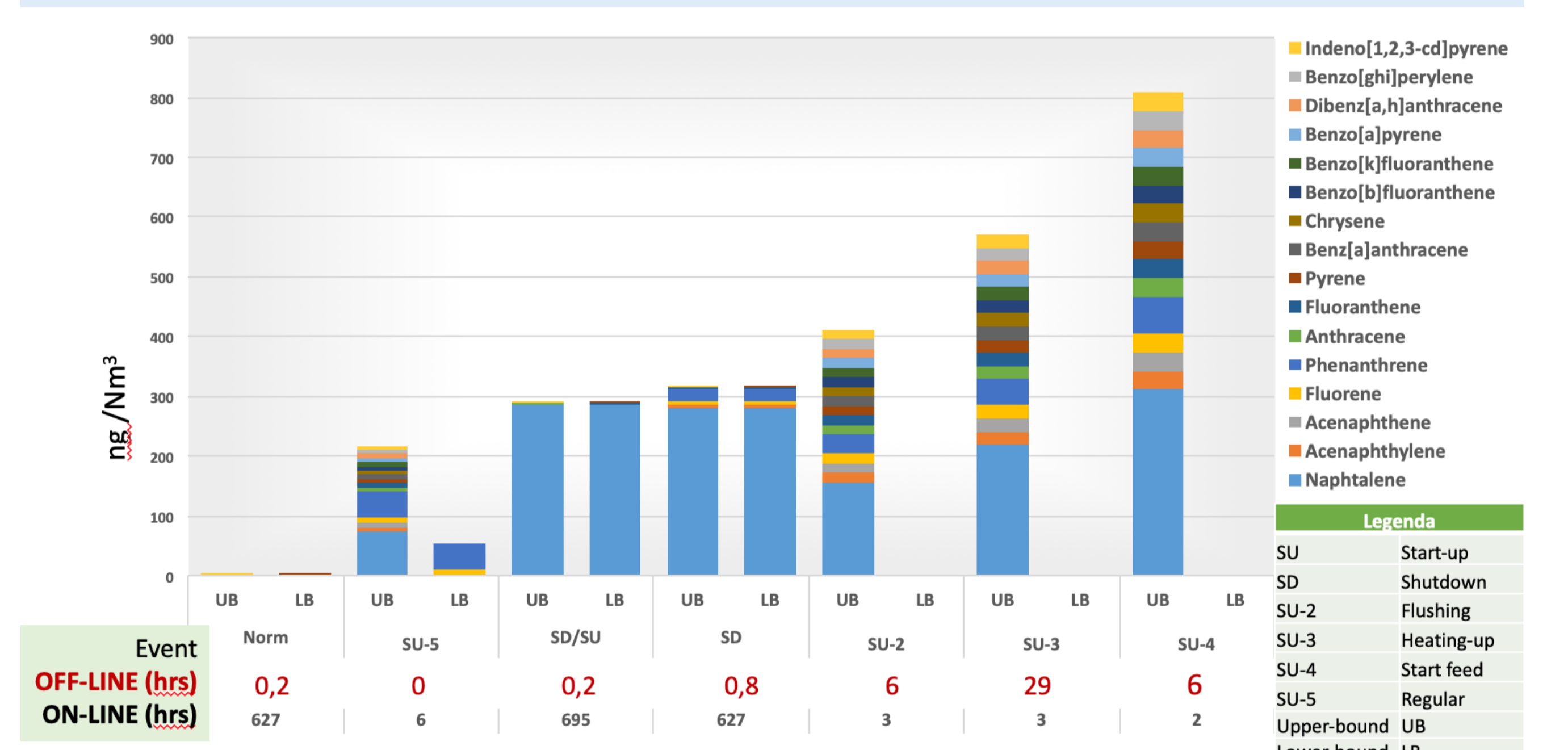
PFOA is recently prioritized in the Stockholm Convention May 2019, to be eliminated in production and use because of its extreme hazardous characteristics. PFOA as a waste product wasn't discussed, because of a lack of data. The results of PFOA are indicative and are possibly underestimated by sampling obstruction. PFOA found in the environment show a linear correlation with dioxins and dl-PCBs. Recently EFSA adjusted the toxicity of PFOA with a factor 1500 more, urging considering every emission of PFOA.

Polybrominated biphenyls emissions from waste incineration



Polybrominated biphenyls (PBBs) are found during steady state in the flue gas. This can be an indication for incomplete combustion. However, no correlation found with start-ups or shutdowns. Normally PBBs decompose around 300^o C.

Polycyclic aromatic hydrocarbon emissions from waste incineration



Highest level of PAH is 808,8 ng/Nm³, substantial lower than the permit for PAH emitting installation, 50 ug/Nm³. Failures, start-ups, shutdowns and findings of high levels of PAH in the environment, could not be related to the emissions of the incinerator.

Conclusions

The obligatory short-term sampling of dioxin emissions underestimates the actual dioxin emissions during incineration. Transient phases, such as start-up and shutdown, are vulnerable to increased emissions, not only from PCDD / Fs but also from a broad scale of other UPOPs. The full extent of these UPOPs emissions, however, could not be measured by the long-term sampling of AMESA due to interruptions in sampling during start-up and shutdown. More research is needed to know the actual extent of these emissions and other UPOPs should also be included, to comply with the Stockholm Convention. Emission regulations must be applied to a wider range of UPOPs and must also be applied if no waste is incinerated.

Acknowledgements

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References

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