Avoiding Adverse Air Quality in Hyperscale Data Centers Due to Re-Entrainment of Diesel Exhaust

Mission-Critical Data Centers are often equipped with back-up emergency power that is provided with large diesel-powered generators. When these generators operate, either under emergency power or during routine scheduled testing, they emit plumes that are both odorous and toxic. If this exhaust is re-entrained into the server rooms, it can create adverse health and odor issues and/or accelerate corrosion within the servers.

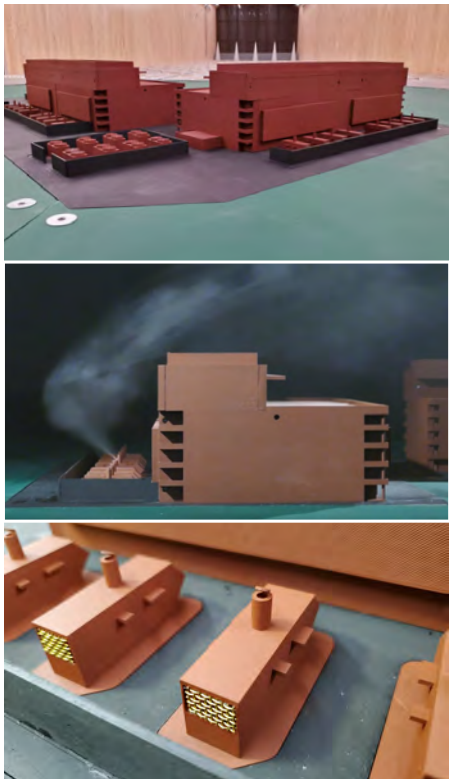
Using dispersion modeling, CPP Wind Engineering can help design teams minimize the potential for adverse air quality within the Data Center when diesel generators operate. As part of the assessment process, CPP can optimize generator placement, combustion exhaust stack height, and the selection of emission controls.

While CFD simulations are prevalent in the design of Hyperscale Data Centers to evaluate and optimize the thermal and airflow distributions within the server rooms, these models are ill-equipped to handle the complexity of atmospheric turbulence. Because of this, ASHRAE dissuades the use of CFD for plume dispersion assessments.

Therefore, CPP uses physical modeling in an atmospheric boundary layer wind tunnel to evaluate the dispersion of the diesel generator exhaust. Wind tunnel modeling provides the most accurate prediction of concentration levels in complex building environments. Mitigation measures, such as taller stack heights, intake placement, screen porosity, etc., can be quickly evaluated to define acceptable operating conditions.

Results compare maximum predicted intake concentrations against health limits and odor thresholds for various constituents of diesel exhaust for the different operating models. If criteria are exceeded, an additional analysis is conducted to define the probability of the adverse wind conditions which may create these exceedances.

Contact CPP today to ensure that the effects of wind and airflow are incorporated in your design.



Hyperscale data center in the wind tunnel - the model is placed on a turntable, so all possible wind directions can be evaluated.

MAXIMUM PREDICTED INTAKE CONCENTRATIONS WHEN MULTIPLE DIESEL GENERATORS ARE OPERATING

Source ID (24791 cfm @ 7891 fpm)	Stack Height Above Base (ft)	Receptor Identification	Wind Direction (Deg.)	Wind Speed (m/s)	Max Normalized WT-Measured Concentration (µg/m³)/(g/s)	Design Criteria (µg/m³)/(g/s)				Design Criteria Achieved?				Approximate Percent Time Design Criteria May Be Exceeded			
WEST DATA CENTER 3MW Diesel Generator - Combustion Exhaust Emergency Generators - All Generators Operating at 100% Full Load						Odor	w/ Filtration Odor	NO_2 NIOSH Health	NO_2 OSHA Health	Odor	w/ Filtration Odor	NO_2 NIOSH Health	NO_2 OSHA Health	Odor	w/ Filtration Odor	NO_2 NIOSH Health	NO_2 OSHA Health
DG-W-1 to DG-W-8	20.0	1 -AHU-W-1	200	1.0	5,290	43	214	1,710	13,500	x	x	x	✓	70%	63%	27%	-
DG-W-1 to DG-W-8	20.0	2-AHU-W-1	205	1.0	5,414	43	214	1,710	13,500	x	x	x	✓	80%	73%	23%	-
DG-W-1 to DG-W-8	20.0	3 -AHU-W-1	195	1.0	5,994	43	214	1,710	13,500	x	x	x	✓	81%	72%	28%	-
DG-W-1 to DG-W-8	20.0	4 -AHU-W-1	195	1.0	5,947	43	214	1,710	13,500	x	x	x	✓	65%	58%	38%	-
DG-W-1 to DG-W-8	20.0	5 -AHU-W-1	265	1.0	6,636	43	214	1,710	13,500	x	x	x	✓	53%	46%	18%	-

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