

Diesel Powered Generators for STOR & Balancing Market: NO_x Modelling & Impact Assessment Guidance

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Why is detailed modelling required?

- ➔ For Tranche A and B generators
- ➔ High to very high NO_x emissions with potential to breach NO_2 limit values
- ➔ To quantify the impacts
- ➔ Where necessary, put in place controls, eg operational hour restrictions
- ➔ To safeguard the public health

Existing dispersion modelling guidance

- ➔ Generator guidance should be used in conjunction with existing EA guidance on gov.uk
- ➔ Air emissions risk assessment for your environmental permit (<https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit>)
- ➔ Environmental permitting: air dispersion modelling reports (<https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports>)

Site setting description

- ➔ Location and expected operational life
- ➔ Number and thermal capacity of generators
- ➔ Local Authority and any neighbouring authorities within 1km
- ➔ Air Quality Management Areas for NO₂ within 1km
- ➔ Any other existing generator arrays operating more than 50 hours per year

Assessment criteria

- ➔ Environmental standards for air human health:
 - ➔ 40 $\mu\text{g}/\text{m}^3$ annual mean
 - ➔ 200 $\mu\text{g}/\text{m}^3$ hourly mean, not be exceeded more than 18 times (99.79th percentile) per calendar year
- ➔ Protected conservation areas:
 - ➔ EA air emissions risk assessment guidance
 - ➔ Screening distances
 - ➔ Critical levels (annual and daily mean concentrations)
 - ➔ Critical loads (nutrient nitrogen and acid deposition)
- ➔ Maximum hourly (100th percentile) prediction

Sensitive human receptors & public exposure

- ➔ Public exposure are locations where members of the public:
 - ➔ Have access
 - ➔ Are regularly present
 - ➔ Likely to be exposed for the averaging time of the standard
- ➔ LAQM technical guidance (TG16) gives some examples of public exposure for different averaging times
- ➔ Location and case specific

Emissions

- ⇒ NO_x is of primary concern from generators
- ⇒ Very high NO_x emissions from diesel generators
- ⇒ Over 2000 mg/Nm³ (273.15 K, dry, 15% O₂)
- ⇒ Vary depending on engine age and tuning
- ⇒ Measure emissions from Tranche A generators (existing)
 - ⇒ BS EN 14792 and follow the Environment Agency Method Implementation Document (MID)
- ⇒ Tranche B generators must achieve 190 mg/Nm³
- ⇒ If run on liquid fuels other than gas oil, SO₂ and PM₁₀ need to be considered too

Background concentrations

- ➔ Representative ambient background concentrations required
- ➔ Calculate Predicted Environmental Concentration (PEC)
- ➔ Can vary spatially depending on location of sensitive receptors in relation to other sources of pollution e.g. urban and industrial environments
- ➔ Important for NO_x to NO_2 conversion

NO_x to NO₂ conversion

- ➔ 'Worst case', conservative approach
 - ➔ 35% short term, 70% long term
- ➔ Very high NO_x emissions might need case specific ratios
- ➔ Atmospheric chemistry methods and models
- ➔ Valid and representative input data required:
 - ➔ Primary NO₂ to NO_x ratio (measured or assumed)
 - ➔ Background NO₂, NO and O₃ (varies spatially and temporally)
 - ➔ Sunlight (UV radiation)

Other model treatments

- ➔ Short stacks or no stacks are common
- ➔ Building downwash effects if:
 - ➔ Stack height less than 2.5 times height of building
 - ➔ Distance of building from stack is $5L$ (where L is lesser of building height and maximum projected width)
- ➔ Terrain effects if:
 - ➔ Slope gradients are greater than 1:10 (10%)



Operating envelope

- ➔ Must be fully described in AQ assessment
- ➔ When the generators are required to operate, e.g.
 - ➔ Anytime of the year
 - ➔ Specified times of year or times of day
- ➔ Will be permitted as such
- ➔ Must be as flexible as needed for operations
- ➔ Can be modelled using temporally varying emissions e.g. using hourly emissions file

Results and impact assessment

- ➔ Process Contributions (PCs)
 - ➔ To understand significance of impact
 - ➔ Annual mean PCs can be scaled based on the operating hours and operating envelope
- ➔ Predicted Environmental Concentrations (PECs) i.e. PC plus background concentrations
- ➔ Short term statistical analysis required if modelling indicates potential exceedances

Short term statistical analysis

- ➔ Required if predictions indicate 19 or more hours exceed 1 hour standard of $200 \mu\text{g}/\text{m}^3$
- ➔ Valid statistical method is required e.g.
 - ➔ Hypergeometric probability distribution
 - ➔ Monte Carlo method
- ➔ Key information for statistical analysis
 - ➔ Number of PEC exceedance hours
 - ➔ Number of operational hours
 - ➔ Operating envelope

Short term statistical analysis

- ➔ Likelihood of short term exceedance:
 - ➔ Probabilities less than 1% exceedances are highly unlikely
 - ➔ Probability of 5% exceedance unlikely, provided site operating lifetime is no more than 20 years
 - ➔ Probabilities greater than or equal to 5% indicates there is potential for the exceedances and may not be considered acceptable on a case-by-case basis.

What next?

- ➔ Circulation of draft guidance to stakeholders for comment.
- ➔ Some aspects still under review
 - ➔ Distance and operational hour criteria where no detailed dispersion modelling is required for Tranche Bs
 - ➔ Probability threshold for unlikely exceedances