Crawley Campus Data Centre – Best Available Technique (BAT) Assessment

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Introduction

The Digital Realty Crawley Campus Data Centre site is a data centre with diesel fired emergency back-up generators. This combustion installation has an aggregated thermal rated input of >50MWth and therefore requires a bespoke environmental permit. Part of the application process requires the operator to assess how they comply with the indicative Best Available Techniques (BAT) in the operation of their site. This BAT assessment has been compiled using the 'Combustion Activities (EPR 1.01)' document and the Data Centre FAQ Document which focuses on the management, operation, emissions and monitoring of the site. Although the 'Combustion Activities (EPR 1.01)' document has been withdrawn in 2018.

DIGITAL REALTY

BAT Assessment

Section	Requirement	Crawley Campus Site
1.1 Energy Efficiency	1. Demonstrate that the proposed or current situation represents BAT where there are other considerations involved, e.g. recovering energy from waste affects the energy efficiency of the process. **Boilers and furnaces** 2. Carry out regular checks to minimize leakage of air into units operating below atmospheric pressure. 3. Ensure good design, operation and maintenance of burners. **Steam turbines** 4. Replace existing turbines with more efficient turbines. 5. Increase cycle efficiency by measures such as reheating steam between stages, improving the vacuum on condensers and using very high, including supercritical, pressures to increase the working temperature difference and cycle efficiency. 6. Take steam from between stages or from a backpressure exhaust for use in, for example, process or building heating. **Gas turbines**	Not applicable to the Crawley Campus site, no furnaces, steam turbines or gas turbines on site. Reciprocating engines are turbo charged but are used solely for emergency standby generation therefore no constant heat load to recover.

	7. In large installations, consider installing more than one smaller turbine to allow for more efficient load following. 8. Consider measures to improve the efficiency of the turbine: increasing the combustion temperature, but balanced against increase NOx levels and amounts of excess air required using concentric shafts to connect different stages of compression and expansion - this is common in aero derivative machines intercooling between stages of air compression and reheating between stages of expansion. Such features are normally incorporated at the design stage and may not be relevant to retrofits 9. The exhaust from even the most efficient gas turbines contain large amounts of heat that should be recovered, and used for process or building heating (CHP), or steam may be fed to a steam turbine to provide additional power in a combined cycle (CCGT). Supplementary fuel may also be fired in the heat recovery boiler to meet the heat demands. The design of the system needs to optimize the characteristics of the turbines and boiler to achieve the best overall performance. **Reciprocating engines** 10.Maximise engine efficiency by measures such as turbo charging and air intercooling. However, this should be balanced against increased NOx emissions. 11.Recover exhaust gas heat for process or building heating or absorption chilling. 12.Recover lower-grade heat from engine coolants. 13.Where additional heat is required, supplementary fuel may be fired into the boiler, although this can be complicated by the pulsating exhaust and size limitations.	

	(These features are usually incorporated at the design stage).	
1.2 Avoidance, recovery and disposal of wastes	1. Store, handle and transport all waste streams to prevent the release of waste, dust, VOC, leachate or odour.	As part of the site's ISO14001 environmental management system, all hazardous and non-hazardous waste streams are identified. Appropriate waste bins are provided on site to store the different waste streams e.g. WEEE, batteries, used spill material, paper, and plastics. Licensed waste carriers are contracted for each waste stream/type and all associated licences and permits have been secured and documentary evidence filed. Only licensed waster carriers remove waste streams from site. Consignment notes for each disposal operation are held on site.
	2. Store bottom ash and fly ash separately. This provides flexibility to re-use the different ash fractions. 3. Where scale allows, store ash fractions and other dusty residues in closed silos fitted with high level alarms and dust abatement plant. 4. Explore markets for waste streams, for example: • bottom ash for aggregate	Not applicable to the Crawley Campus site.

	• PFA for cement manufacture and construction products • FGD gypsum and fused slags for construction products 5. Recycle materials back into the process whenever possible, e.g. re-using partially reacted lime. 6. Where recycling or re-use is not possible, then consider regeneration of other materials or return to the manufacturer e.g.: • ion exchange resins • reverse osmosis membranes • molecular sieves • catalysts	
2.1 Operation – liquid fuels	Solids removal from the fuel may be required. Efficient atomisation of oil fuels is necessary and fuel viscosity at the burners is a primary consideration. Oil (including bitumen) emulsions and many heavy fuel oils have high sulphur contents and may have high vanadium and nickel contents. The use of oil fuels containing sulphur will result in some sulphur trioxide releases, as well as sulphur dioxide. Where low sulphur oils (below 1% w/w sulphur) are used, this may preclude the need for flue gas desulphurisation (FGD).	Ultra-low sulphur gas oil is used on site. The stored fuel undergoes fuel polishing processes where laboratory testing shows whether there is a requirement to remove sediment and microbial contamination.
3.1 Point source emissions to water	**Oil storage** 1.Fit a high-level alarm to oil tanks. 2.Drain decanted water from oil storage tanks and storm water from bunded areas to a water treatment plant or direct it to an appropriate disposal facility. You should deal with liquid effluents generated during periodic tank cleaning in a similar way.	Integrally bunded aboveground storage tanks (ASTs) are located external to the main building. Pipework systems from the bulk fuels tanks to the day tanks in

	3.Use oil removal facilities such as partition chambers or plate separators for water contaminated with oil.	located in the generator housing. A leak detection/ alarm system is located within each generator and tank system. The generators and associated tanks are inspected for leaks by the site team and third-party providers on a regular basis. Oil interceptors are located in the site’s drainage system and capture any oils prior to discharge into the local sewerage system. The interceptors are cleaned on an annual basis.
	Coal storage 4.Where there is a significant risk of pollution of water or groundwater, you should collect and treat leachate. **De-ionisation effluent** 5.Neutralise water de-ionisation plant regeneration effluent before discharge.	Not applicable to the Crawley Campus site.
	Process water (e.g. wet scrubbing) 6.Chemically treat, neutralise and settle the effluent from wet scrubbing before discharge.	Not applicable to the Crawley Campus site.

	7.Quantify organics, including dioxins, furans and PAHs in the treated effluent. At low levels they are normally most effectively treated in a biological plant, usually by the sewerage undertaker. 8.Discharge volumes for sea water scrubbing make most treatment impracticable. Since contaminants are likely to be present in very low concentrations, focus your effort on minimising mass releases where practicable.	
	Ash handling 9.Handle ashes in a solid state and not as slurry. Hydraulic transport of ashes produces a wastewater stream that is likely to contain metal salts and organic compounds. If there is a market for the ash, you should not use a handling technique that will prevent its re-use.	Not applicable to the Crawley Campus site.
	Cleaning liquids 10.Neutralise or treat wash waters and cleaning-out solutions to produce an acceptable waste before discharge or disposal. 11.Boiler cleaning wastes require appropriate disposal.	Not applicable to the Crawley Campus site.
	Site drainage including rainwater 12.Use an efficient oil/water separation/interceptor system. Further treatment may be required to remove dissolved hydrocarbons. 13.Direct discharge to controlled waters will only be allowed where discharges will meet discharge requirements under all conditions.	Oil interceptors are located in the drainage system on site and capture any oils prior to discharge into the local sewerage system. The interceptors are cleaned on an annual basis.

	Wastewater treatment 14.On-site wastewater treatment plant effluent must meet discharge standards.	Any wastewater from cleaning is directed through the interceptors on-site, prior to discharge to sewer.
	Cooling tower purge 15.Optimise the dosing regime for biocides in evaporative cooling towers to minimise their use. 16.Chemically treating the main cooling water circuit may allow reduced use of biocides. Do not release accidental overdoses of biocides into the environment.	Any biocides used on site are stored in bunded and ventilated containment to prevent accidental releases into the environment.
	Thermal plumes 17. In terms of the overall energy efficiency of an installation, the use of once-through systems is an appropriate measure. It may be acceptable to use water from a river or an estuary for once-through cooling, provided that: • fish can still migrate through the extended heat plume in the receiving water • the cooling water intake minimises fish entrainment • heat load does not interfere with other users of the receiving surface water.	Not applicable to the Crawley Campus site, no river water used.
3.2 Point source emissions to air – NOx control	1. Control emissions of NOx by a combination of the following, as applicable: • combustion control systems • combustion temperature reduction • low NOx burners • over fire air (OFA)	All generator sets are turbo charged which increases the engine efficiency. There are currently no other emission reduction controls on the generators.

	• flue/exhaust gas recycling • reburn • selective catalytic reduction (SCR) • selective non-catalytic reduction (SNCR).	
	2.Use low NOx burners for coal- and oil-fired plant.	Not applicable to the Crawley Campus site.
	3.Use OFA or equivalent for existing coal-fired plant above 100 MWth).	Not applicable to the Crawley Campus site.
	4.Use dry low NOx burners in new natural gas-fired gas turbines. For natural gas-fired gas turbines, use water/steam injection, or convert to dry low NOx burning.	Not applicable to the Crawley Campus site.
	5.Where air quality standards or other environmental standards must be met, you must use SCR or SNCR for smaller plant (<100 MW).	The site is not located within a local authority air quality management zone, but one is in close proximity. The site has turbo charged generators solely used for standby generation. The impact of the routine testing schedule is currently being modelled by a detailed air modelling assessment. In line with the provisional Environment Agency working draft guide on the approach to permitting data centres, a more

		detailed BAT would consider improved flue gas dispersion, equipment and operational controls.
	6.For new coal and oil-fired plant above 100MW, use SCR or primary measures to achieve equivalent NOx levels.	Not applicable to the Crawley Campus site.
	7.Only combustion optimisation and SCR are feasible on >500MW PF plant firing low volatile coal. In these cases, you need SCR for new plant. You need a site-specific assessment for existing plant.	Not applicable to the Crawley Campus site.
	8.Provide detail / justifications for: a. Types, size and configuration of units b. 2g-TA Luft / US EPA tier 2 specifications c. Fuel type	Unit 1 Crawley has one spare landlord generator and 2 spare generators per datahall. Unit 2 Crawley has expanded the number of generators in 2 phases when the datahall demand increased to current levels. The Unit 2 Crawley generators are larger in size and thermal capacity, so there are fewer in number than older legacy sites. All the generators across the campus are above the 2000mg/m3 threshold. The

		latest emission standard for NOx level is 2000mg/m3. The fuel type for the generators is diesel/gas oil, which in comparison to natural gas, has a higher efficiency range of 30-48% and shorter start up time. Using diesel/gas oil provides a steady power supply which is important for data centres and provides power resilience. Diesel/gas oil fuel, does not require spark plugs or wires which reduces maintenance costs. The generators can be built in modular form in acoustic housing to reduce noise. Although diesel generators are expensive to purchase, they have a lower maintenance cost. The fuel can be stored in large quantities and be sourced from various suppliers in the event of emergencies.
SOx control	1.Use low sulphur fuels as a primary measure.	The site uses ultra-low sulphur gas oil.

	2.For large coal or oil-fired plant, use wet limestone scrubbing or seawater scrubbing for flue gas desulphurisation (FGD).	Not applicable to the Crawley Campus site.
	3.Consider dry sorbent injection for pulverised and liquid fuel furnaces which are too small to justify FGD.	Not applicable to the Crawley Campus site.
	4. For fluidised bed combustors, consider in-bed sulphur capture.	Not applicable to the Crawley Campus site.
	5. Consider IGCC for new large-scale solid and liquid fuel fired plant.	Not applicable to the Crawley Campus site.
Particulate Matter Control	1.For coal and oil-fired plant above 100 MWth, electrostatic precipitators (EP) are required. At smaller scale plant, other methods may be acceptable to meet emission limits.	Not applicable to the Crawley Campus site.
	2.For 'opted in' 2 plant FGD is an appropriate measure, and therefore particulate abatement is FGD+EP	Not applicable to the Crawley Campus site.
	3.For large (>100 MW) existing plant and where FGD is not required (not 'opted in') EP is an appropriate measure.	Not applicable to the Crawley Campus site.
	4.Where low sulphur fuel is used with EPs, use sulphur trioxide injection to improve particulate control.	Not applicable to the Crawley Campus site.
CO_2, CO and Volatile Organic	Use of catalytic oxidation in the exhaust gas stream	Not applicable to the Crawley Campus site.

Compounds (VOCs) control		
Metals and their compounds	Use of low ash content fuels	Not applicable to the Crawley Campus site.
Halogens	Techniques used for abating sulphur dioxide will reduce hydrogen chloride and hydrogen fluoride	Not applicable to the Crawley Campus site.
Dioxins	By reducing particulate matter emissions will also reduce dioxins. Flue gas desulphurisation (FGD) and selective catalytic reduction (SCR) can enhance dioxin removal	All generator sets are turbo charged which increases the engine efficiency. There are currently no other emission reduction controls on the generators.
3.3 Fugitive emissions	1.Windbreaks should be created by natural terrain, banks of earth or planting of long grass and evergreen trees in open areas. This has aesthetic benefits and such vegetation is able to capture and absorb dust without suffering long-term harm. Hydro seeding should be used to rapidly establish vegetation on waste tips, slag heaps or other apparently infertile ground.	Not applicable to the Crawley Campus site.
	2.Where materials are delivered by sea and dust releases could be significant, use self-discharge vessels or enclosed continuous unloaders.	Not applicable to the Crawley Campus site.
	3.Minimise dust generated by grab-type ship unloaders by ensuring adequate moisture content of the material as delivered, minimising drop heights and using water sprays or atomised mist at the mouth of the ship unloader hopper.	Not applicable to the Crawley Campus site.

	4.Fugitive emissions from fly ash should be prevented by dust suppression, or by enclosing its handling and storage.	Not applicable to the Crawley Campus site.
	5.Intercept rainwater run-off from open areas, especially coal and raw materials stocking areas, and remove the suspended solids by settlement or other techniques. Where there are potentially vulnerable receptors, monitor the quality of the water discharged from the storage and blending areas.	There are no open raw material storage areas. Spills from oil tanks not fully captured by spill kits are prevented from entering the sewerage system by the oil interceptors located in the drainage system onsite. There is no direct run off to controlled waters or vulnerable receptors.
	6.Plant used to pre-treat and store raw materials should be totally enclosed, with extraction and arrestment plant as appropriate, to prevent emissions to atmosphere. For some gasification processes coal is milled to a very fine dust and needs to be handled with an inert gas blanket.	Not applicable to the Crawley Campus site.
	7.Gasifiers should be coal-charged using a double lock system, whereby the gases released from the reactor during charging are contained within the lock hopper. After closure of the charge valve, they are routed either to recompression for re-injection into the crude gas stream or to a vent treatment system. Alternatively, a wet feed (slurry) system may be used with comparable features.	Not applicable to the Crawley Campus site.

	8.You should demonstrate that the potential risks of contamination of land by deposition of dust, leachate or run-off are not significant and that you can comply with the requirements of the Groundwater Directive.	Oil interceptors are present in the drainage system, which will capture any particles from site run off prior to discharge into the local sewerage system. The interceptors are cleaned out on an annual basis. The site is covered by good quality concrete hardstanding preventing direct contamination of the ground.
3.4 Monitoring	**1.Emissions to air** Many plants in this sector will be subject to the detailed monitoring requirements of Annex VIII of the Large Combustion Plant Directive (LCPD). For plants co-incinerating waste, the provisions of Articles 10, 11 and Annexes II and III of the Waste Incineration Directive (WID) should also apply. The monitoring requirements of the LCPD and WID are considered to represent appropriate measures for this sector. The LCPD requires that: **For existing plant** using continuous emission monitors the emission limit values shall be regarded as having been complied with if the evaluation of the results indicates, for operating hours within a calendar year, that: (a) none of the calendar monthly mean values exceeds the emission limit values; and (b) in the case of: sulphur dioxide and dust: 97% of all the 48 hourly mean values do not exceed 110% of the emission limit values	The site is not subject to Annex VIII of the Large Combustion Plant Directive.

	nitrogen oxides: 95% of all the 48 hourly mean values do not exceed 110% of the emission limit values. **For new plants**, emission limit values shall be regarded, for operating hours within a calendar year, as complied with if: (a) no validated daily average value exceeds the relevant figures set out in part B of Annexes III to VII, and (b) 95% of all the validated hourly average values over the year do not exceed 200% of the relevant figures set out in part B of Annexes III to VII. For both existing and new plants, start-up and shut-down periods shall be disregarded. Installations that do not fall within the scope of WID or LCPD should meet the benchmark standards except where you can clearly demonstrate that this is not the appropriate measure. We may require you to monitor and report releases more frequently than required by WID or LCPD where it is considered appropriate to do so. You should process the readouts from continuous emission monitors using software that reports monitoring compliance, to enable direct comparison with the emission limit values specified in relevant European legislation and in this guidance. In order to relate emission concentrations to mass releases, you will need to measure or otherwise determine the stack gas flow rate. In order to relate measurements to reference conditions, you will need to determine temperature and pressure. Determination of oxygen or water vapour content may also be required. All such measurements should be recorded.	

	2.Emissions to water and sewer For combustion plants, co-incinerating waste and operating air pollution control equipment with an aqueous discharge, you should comply with Article 8 and Annexes III and IV of the Waste Incineration Directive (WID).	Not applicable to the Crawley Campus site.
	Process variables solid and liquid fuel fired plants - fuel feedstock should be sampled and analysed at a frequency and manner appropriate to the type of plant concerned	Gas oil undergoes regular testing for quality and contamination. Where fuel is found to be outside acceptable limits, fuel polishing is undertaken to ensure high quality fuel feedstock, which enables efficient combustion.
Emission Limit Values under MCPD	New plant from 20th December 2018 or existing plant from 2024 will have to comply with emission limit values (ELVs) under the MCPD, unless the plant operates less than 500 hours year.	Individual generators operate less than 500 hours per year, therefore, does not have to comply with ELVs.
Grid reliability	Optimising grid reliability within the site to minimise emergency operating hours is required.	Each building in the campus Crawley Unit 1 and Crawley Unit 2 are independently powered by 2 HV electrical incomers. Each site can be supported by either HV supply in isolation. There is good grid reliability at the sites. It is unlikely that a grid outage would affect both units simultaneously.

Table 1: BAT Assessment

About EcoAct

Together with our clients, we act to put climate and nature centre stage to drive sustainable corporate transformation within planetary boundaries.

EcoAct is an international sustainability consultancy and project developer with 18+ years of industry experience and 360+ climate experts globally. Founded in France in 2005, the company now spans three continents with offices in Paris, London, Barcelona, New York, Montreal, Munich, Milan and Kenya.

EcoAct's core purpose is to lead the way in developing sustainable business solutions that deliver true value for both climate and client. Data is the cornerstone of our consulting practice, supported by our dedicated Climate Data Analytics and Research & Innovation teams.

At EcoAct we are driven by a shared purpose to make a difference. To help businesses implement positive change in response to climate and environmental sustainability challenges, whilst also driving commercial performance.

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