# Comparison of techniques employed at Scunthorpe Integrated Steelworks with those in the BAT Conclusions for Iron and Steel Production published in the Official Journal of the European Union, 8th March 2012



Section 1.4 - BAT Conclusion has been removed as it superseded by documents provided on 11th August 2014

# GENERAL CONSIDERATIONS

The techniques listed and described in these BAT conclusions are neither prescriptive nor exhaustive. Other techniques may be used that ensure at least an equivalent level of environmental protection.

The environmental performance levels associated with BAT are expressed as ranges, rather than as single values. A range may reflect the differences within a given type of installation (e.g. differences in the grade/purity and quality of the final product, differences in design, construction, size and capacity of the installation) that result in variations in the environmental performances achieved when applying BAT

**EXPRESSION OF EMISSION LEVELS ASSOCIATED WITH THE BEST AVAILABLE TECHNIQUES (BAT-AELs)**

In these BAT conclusions, BAT-AELs for air emissions are expressed as either:

- mass of emitted substances per volume of waste gas under standard conditions (273.15 K, 101.3 kPa), after deduction of water vapour content, expressed in the units $g/Nm^3$, $mg/Nm^3$, $\mu g/Nm^3$ or $ng/Nm^3$
- mass of emitted substances per unit of mass of products generated or processed (consumption or emission factors), expressed in the units kg/t, g/t, mg/t or µg/t.

and BAT-AELs for emissions to water are expressed as:

- mass of emitted substances per volume of waste water, expressed in the units g/l, mg/l or µg/l.

# DEFINITIONS

For the purposes of these BAT conclusions:

- 'new plant' means: a plant introduced on the site of the installation following the publication of these BAT conclusions or a complete replacement of a plant on the existing foundations of the installation following the publication of these BAT conclusions
- 'existing plant' means: a plant which is not a new plant
- '$NO_X$' means: the sum of nitrogen oxide (NO) and nitrogen dioxide ($NO_2$) expressed as $NO_2$
- '$SO_X$' means: the sum of sulphur dioxide ($SO_2$) and sulphur trioxide ($SO_3$) expressed as $SO_2$
- 'HCl' means: all gaseous chlorides expressed as HCl
- 'HF' means: all gaseous fluorides expressed as HF

## 1.1 General BAT Conclusions

Unless otherwise stated, the BAT conclusions presented in this section are generally applicable.

**The process specific BAT included in the Sections 1.2 – 1.7 apply in addition to the general BAT mentioned in this Section.**

### 1.1.1 Environmental management systems

1. **BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the following features:**
   - I. commitment of top management, including senior management;
   - II. definition of an environmental policy that includes continuous improvement for the installation by top management;
   - III. planning and establishing the necessary procedures, objectives and targets, in conjunction with financial planning and investment;
   - IV. implementation of the procedures paying particular attention to:
     - i. structure and responsibility
     - ii. training, awareness and competence
     - iii. communication
     - iv. employee involvement
     - v. documentation
     - vi. efficient process control
     - vii. maintenance programme
     - viii. emergency preparedness and response
     - ix. safeguarding compliance with environmental legislation;
   - V. checking performance and taking corrective action, paying particular attention to:
     - i. monitoring and measurement (see also the Reference Document on the General Principles of Monitoring)
     - ii. corrective and preventive action
     - iii. maintenance of records
     - iv. independent (where practicable) internal and external auditing in order to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained;
   - VI. review of the EMS and its continuing suitability, adequacy and effectiveness by top management;
   - VII. following the development of cleaner technologies;
   - VIII. consideration for the environmental impacts from the eventual decommissioning of the installation at the stage of designing a new plant, and throughout its operating life;
   - IX. application of sectoral benchmarking on a regular basis.

   **Applicability**

   The scope (e.g. level of details) and nature of the EMS (e.g. standardised or non-standardised) will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have.

   *The entire Scunthorpe site is covered within the scope of an environmental management system, which has been certified by an accredited external body as conforming to ISO 14001.*

   ***BAT achieved***

### 1.1.2 Energy management

**2. BAT is to reduce thermal energy consumption by using a combination of the following techniques:**

I. improved and optimised systems to achieve smooth and stable processing, operating close to the process parameter set points by using

   i. process control optimisation including computer-based automatic control systems
   ii. modern, gravimetric solid fuel feed systems
   iii. preheating, to the greatest extent possible, considering the existing process configuration.

II. recovering excess heat from processes, especially from their cooling zones
III. an optimised steam and heat management
IV. applying process integrated reuse of sensible heat as much as possible.

In the context of energy management, see the Energy Efficiency BREF (ENE).

**Description of BAT I.i**

The following items are important for integrated steelworks in order to improve the overall energy efficiency:

- optimising energy consumption
- online monitoring for the most important energy flows and combustion processes at the site including the monitoring of all gas flares in order to prevent energy losses, enabling instant maintenance and achieving an undisrupted production process
- reporting and analysing tools to check the average energy consumption of each process
- defining specific energy consumption levels for relevant processes and comparing them on a long-term basis
- carrying out energy audits as defined in the Energy Efficiency BREF, e.g. to identify cost-effective energy savings opportunities.

**Description of BAT II – IV**

Process integrated techniques used to improve energy efficiency in steel manufacturing by improved heat recovery include:

- combined heat and power production with recovery of waste heat by heat exchangers and distribution either to other parts of the steelworks or to a district heating network
- the installation of steam boilers or adequate systems in large reheating furnaces (furnaces can cover a part of the steam demand)
- preheating of the combustion air in furnaces and other burning systems to save fuel, taking into consideration adverse effects, i.e. an increase of nitrogen oxides in the off-gas
- the insulation of steam pipes and hot water pipes
- recovery of heat from products, e.g. sinter
- where steel needs to be cooled, the use of both heat pumps and solar panels
- the use of flue-gas boilers in furnaces with high temperatures
- the oxygen evaporation and compressor cooling to exchange energy across standard heat exchangers
- the use of top recovery turbines to convert the kinetic energy of the gas produced in the blast furnace into electric power.

**Applicability of BAT II – IV**

Combined heat and power generation is applicable for all iron and steel plants close to urban areas with a suitable heat demand. The specific energy consumption depends on the scope of the process, the product quality and the type of installation (e.g. the amount of vacuum treatment at the basic oxygen furnace (BOF), annealing temperature, thickness of products, etc.).

*Tata Steel Scunthorpe has a dedicated Energy Optimisation Manager and team, supported by a central team of experts in Group Environment, to ensure that energy consumption is minimised across the site. Energy audits are a key tool in identifying improvement opportunities. There is a manned Energy Control Centre and dedicated Energy Operations Department responsible for collecting and distributing process-arising gases in the most efficient manner to ensure optimum energy consumption and optimum steam and heat management across the site. In addition, all major processes are controlled by means of computer-based systems to ensure safe operation and to achieve the most efficient overall steel production, taking into account the integrated nature of Scunthorpe steelworks, the dependence of each process on the preceding processes and market demand for steel products.*

*Energy consumption data are gathered automatically for the various processes around the site and compared with benchmark targets derived from best practice/best historical practice. Additionally, across Tata Steel Group, there is in place a state-of-the-art system, which is believed to be unique in the industry, that gathers required data to report energy consumption and $CO_2$ emissions for every major process site (globally). This system also compares the performance of each process on each site against a best practice performance and analyses the cause of deviations from best practice to identify improvement opportunities.*

*All the reheating furnaces on the site are fired with process-arising gases and include an unfired recuperation zone to preheat the stock using the furnace exhaust gases before the gases pass to recuperators for further heat recovery by preheating the combustion air.*

*Steam and hot water pipes are lagged to minimise energy losses.*

***BAT achieved***

**3. BAT is to reduce primary energy consumption by optimisation of energy flows and optimised utilisation of the extracted process gases such as coke oven gas, blast furnace gas and basic oxygen gas.**

**Description**

Process integrated techniques to improve energy efficiency in an integrated steelworks by optimising process gas utilisation include:

- the use of gas holders for all by-product gases or other adequate systems for short-term storage and pressure holding facilities
- increasing pressure in the gas grid if there are energy losses in the flares – in order to utilise more process gases with the resulting increase in the utilisation rate
- gas enrichment with process gases and different caloric values for different consumers
- heating fire furnaces with process gas
- use of a computer-controlled caloric value control system
- recording and using coke and flue-gas temperatures
- adequate dimensioning of the capacity of the energy recovery installations for the process gases, in particular with regard to the variability of process gases.

**Applicability**

The specific energy consumption depends on the scope of the process, the product quality and the type of installation (e.g. the amount of vacuum treatment at the BOF, annealing temperature, thickness of products, etc.).

*The site collects blast furnace gas (BFG), BOS gas and coke oven gas (COG) and has gas holders for each installed as part of the gas distribution and storage network on the site to* *maximise their utilisation. Process gas collection systems are sized to cope with the normal variations in fuel gas production and demand.*

*BFG, BOS gas and COG are automatically blended on the site in a mixing station to produce a gas (mixed enhanced gas - MEG) with a controlled calorific value and Wobbe index. The MEG is piped around the site and burned in various processes, particularly in the reheating furnaces of three rolling mills. Other processes use different gases, with different calorific values, for example coke oven underfiring utilises COG and the blast furnace stoves BFG. The surplus process-arising gases are burned in boilers at the Central Power Station and Turbo Blower House.*

*There is a minimal import of natural gas, which is required to fire a relatively small heat treatment furnace.*

*Coke oven flue gas temperatures are continuously monitored to control combustion to the required degree.*

***BAT achieved***

*Whilst in total, the measures described above are considered to realise BAT, it is recognised that further improvements will always be possible. A state-of-the-art predictive control system (ISOLDE) is being developed and applied on the site by Tata Steel R&D to further improve the use of process gases and steam by reacting in an optimum manner to temporal perturbations in fuel production and demand. This system is expected to be operational by 2014.*

4. **BAT is to use desulphurised and dedusted surplus coke oven gas and dedusted blast furnace gas and basic oxygen gas (mixed or separate) in boilers or in combined heat and power plants to generate steam, electricity and/or heat using surplus waste heat for internal or external heating networks, if there is a demand from a third party.**

**Applicability**

The cooperation and agreement of a third party may not be within the control of the operator, and therefore may not be within the scope of the permit.

*Process-arising gases not required for process heating are used in on-site boilers to generate steam and electricity for internal use. Blast furnace gas is dedusted before use as described in the response to BAT 64 and coke oven gas from both coke plants is dedusted within the respective by-products plants. All BOS gas produced at Scunthorpe is mixed with other gases to provide Mixed Enhanced Gas (MEG) for use at the on-site mills and is not used for steam and electricity generation.*

*Coke oven gas is not currently desulphurised, and the sulphur content of the COG is instead reduced by the use of low sulphur coking coals. Conceptually it is planned to install coke oven gas desulphurisation units to treat the gas arising from both of the coke plants at Scunthorpe, subject to the capital planning process within Tata Steel. More details on these schemes are included in the response to BAT 48.*

***BAT achieved***

5. **BAT is to minimise electrical energy consumption by using one or a combination of the following techniques:**

   I. power management systems
   II. grinding, pumping, ventilation and conveying equipment and other electricity-based equipment with high energy efficiency.

   **Applicability**

   Frequency controlled pumps cannot be used where the reliability of the pumps is of essential importance for the safety of the process.

   *A voltage optimisation programme was undertaken in 2008/09 to improve power management across the site.*

   *A number of key improvement areas have been initiated on rotating equipment. Firstly, audits of such equipment have been carried out as part of the drive-save project to identify systems where variable speed drives would make significant energy efficiency improvements. A number of these systems also had their motors replaced with high efficiency versions. Significant collaboration with motor suppliers to introduce new motor management practices to increase the uptake of higher efficiency motors is underway and soon to be rolled out.*

   *Energy reduction is an ongoing process and Tata Steel Scunthorpe has a dedicated Energy Optimisation Manager and team, supported by a central team of experts in Group Environment, to ensure that energy consumption is minimised across the site. Energy audits are a key tool in identifying further improvement opportunities.*

   ***BAT achieved***

### 1.1.3 Material management

6. **BAT is to optimise the management and control of internal material flows in order to prevent pollution, prevent deterioration, provide adequate input quality, allow reuse and recycling and to improve the process efficiency and optimisation of the metal yield.**

   **Description**

   Appropriate storage and handling of input materials and production residues can help to minimise the airborne dust emissions from stockyards and conveyor belts, including transfer points, and to avoid soil, groundwater and runoff water pollution (see also BAT 11).

   The application of an adequate management of integrated steelworks and residues, including wastes, from other installations and sectors allows for a maximised internal and/or external use as raw materials (see also BAT 8, 9 and 10).

   Material management includes the controlled disposal of small parts of the overall quantity of residues from an integrated steelworks which have no economic use.

   *Management of material flows is underpinned by a hierarchy. Where possible, potential wastes are avoided through prevention and minimisation at the source. When these options are not feasible, the emphasis is upon reuse or recycling of materials and by-products to avoid waste arisings.*

   *Internal material flows are carefully controlled to prevent deterioration, provide adequate input quality, allow reuse and recycling and to improve the process efficiency and optimisation of the metal yield as a matter of course. Material costs form a large part of the overall costs of* *steel production and so efficient materials management across the site is a high priority. The integrated nature of Scunthorpe steelworks, the dependence of each process on the preceding processes and market demand for steel products will all impact on management of internal material flows within each process area, with the aim being to minimise the total cost to the business.*

*Additional measures to minimise pollution arising from materials storage, handling and transport are detailed in the response to BAT 11.*

*Additional measures to maximise the internal and external use of steelworks residues are detailed in the responses to BAT 8 and BAT 9.*

*The small fraction of residues that have no economic use are disposed of either at an internal landfill site or externally. In all cases appropriate measures are taken to ensure that such disposals are properly controlled, for example through the use of waste transfer notes.*

***BAT achieved***

**7. In order to achieve low emission levels for relevant pollutants, BAT is to select appropriate scrap qualities and other raw materials. Regarding scrap, BAT is to undertake an appropriate inspection for visible contaminants which might contain heavy metals, in particular mercury, or might lead to the formation of polychlorinated dibenzodioxins/furans (PCDD/F) and polychlorinated biphenyls (PCB).**

**To improve the use of scrap, the following techniques can be used individually or in combination:**

- specification of acceptance criteria suited to the production profile in purchase orders of scrap
- having a good knowledge of scrap composition by closely monitoring the origin of the scrap; in exceptional cases, a melt test might help characterise the composition of the scrap
- having adequate reception facilities and check deliveries
- having procedures to exclude scrap that is not suitable for use in the installation
- storing the scrap according to different criteria (e.g. size, alloys, degree of cleanliness); storing of scrap with potential release of contaminants to the soil on impermeable surfaces with a drainage and collection system; using a roof which can reduce the need for such a system
- putting together the scrap load for the different melts taking into account the knowledge of composition in order to use the most suitable scrap for the steel grade to be produced (this is essential in some cases to avoid the presence of undesired elements and in other cases to take advantage of alloy elements which are present in the scrap and needed for the steel grade to be produced)
- prompt return of all internally-generated scrap to the scrapyard for recycling
- having an operation and management plan
- scrap sorting to minimise the risk of including hazardous or non-ferrous contaminants, particularly polychlorinated biphenyls (PCB) and oil or grease. This is normally done by the scrap supplier but the operator inspects all scrap loads in sealed containers for safety reasons. Therefore, at the same time, it is possible to check, as far as practicable, for contaminants. Evaluation of the small quantities of plastic (e.g. as plastic coated components) may be required
- radioactivity control according to the United Nations Economic Commission for Europe (UNECE) Expert Group framework of recommendations
- implementation of the mandatory removal of components which contain mercury from End-of-Life Vehicles and Waste Electrical and Electronic Equipment (WEEE) by the scrap processors can be improved by:

- fixing the absence of mercury in scrap purchase contracts
- refusal of scrap which contains visible electronic components and assemblies.

**Applicability**

The selection and sorting of scrap might not be entirely within the control of the operator.

- *Strict procurement criteria exist for internal and external purchase of scrap on cleanliness and chemistry.*
- *The scrap procurement criteria include removal of mercury-containing WEEE & End-of-Life Vehicles.*
- *Radioactivity monitors are located on the scrap receipt weighbridges, through which the external scrap lorries must pass before discharging scrap on site. There are also radioactivity monitors at the scrap bays. There are strict procedures around the detection of radioactive materials and subsequent response plan.*
- *Harsco Metals receives scrap for the BOS plant. Harsco has a scrap inspector and work instructions for monitoring composition and standard of scrap. When scrap does not meet the standard of the BOS criteria, scrap is quarantined and the supplier is investigated. Investigations are documented. Scrap is sometimes returned to the supplier due to quality standards.*
- *The scrap bay is canopy-covered with a concrete base and dividing bay walls.*
- *The scrap management at the BOS plant is managed by a contract featuring key performance indicators, regular contract review meetings etc.*
- *Contamination within the scrap, e.g. plastic, is minimised initially through scrap acceptance criteria (referred to earlier) but also through the scrap inspection procedures and through the scrap bays and loading to the BOS vessels. Where contamination is found, scrap is quarantined and potentially sent back to the supplier.*
- *Throughout the scrap handling process up to the point of charging into the BOS vessels there is segregation of scrap types into clearly defined compositions/qualities/types.*
- *The BOS plant utilizes a computer-based program called a "Charge Balance Model" to ensure correct scrap composition and grades according to the hot metal quality and end steel grade quality criteria (this particularly considers sulphur and alumina contents of the scrap types.*
- *All internally generated scrap is recycled where composition and volume allows.*

***BAT achieved***

### 1.1.4 Management of process residues such as by-products and waste

**8. BAT for solid residues is to use integrated techniques and operational techniques for waste minimisation by internal use or by application of specialised recycling processes (internally or externally).**

**Description**

Techniques for the recycling of iron-rich residues include specialised recycling techniques such as the OxyCup® shaft furnace, the DK process, smelting reduction processes or cold bonded pelletting/briquetting as well as techniques for production residues mentioned in Sections 9.2 – 9.7.

**Applicability**

As the mentioned processes may be carried out by a third party, the recycling itself may not be within the control of the operator of the iron and steel plant, and therefore may not be within the scope of the permit.

*Internally arising solid materials are extensively re-circulated within the plant with the result that only a small proportion of total material arising (typically <5%) requires to be disposed of. In particular, iron-bearing materials - or reverts - can readily be incorporated into the sinter feed and recovered at the sinter plant, where their 'value in use' can be realised. When using reverts at the sinter plant, due care must be taken to manage the chemistry of the resultant sinter feed so as not to impact on waste gas emissions. The BOS plant is also a receiving plant for certain reverts, usually after they have been processed on-site into waste oxide briquettes (WOBs) which can comprise scales, grits and waste gas cleaning sludges and filter dusts from the BOS plant and blast furnaces.*

*Blast furnace slag and BOS slag are by-products and are not discussed in this section.*

*Sludges and filter cakes from waste gas cleaning systems at the blast furnaces and BOS plant arise in large volumes and are processed and re-circulated internally wherever possible.*

*In the case of the blast furnaces, off gas is first dry de-dusted using expansion. The dry BF flue dust is rich in iron and is used directly as a raw material at the sinter plant. This material also contains chlorides, which are thought to have an impact on sinter plant emissions, so options for washing BF flue dust to remove chlorides are being investigated. The blast furnace gas is further treated in wet scrubbers, giving rise to BF sludge. This is processed first in a clarifier and then in hydrocyclones, with the coarse underflow recycled to the sinter plant. The fine overflow material goes to a filter press to remove the solids as a filter cake which is sold into the cement industry as iron oxide for trimming cement kiln chemistry.*

*BOS sludge is de-gritted and clarified. The coarse 'BOS grit' is used as a binder in the production of waste oxide briquettes (WOBs). Excess BOS grit is used as a raw material in the sinter plant.*

*Dry dust from the BOS plant secondary ventilation system is incorporated into WOBs and returned to the vessels.*

*Material recovered from defined areas such as ore stockyards are returned to the sinter plant. Residue materials from the BOS plant including slags, refractories and sweepings are processed in a metal recovery (MR) plant operated by a permitted third party (which is primarily used for BOS vessel slag). The non-metallic fraction is processed by crushing, screening, washing and grading to prepare it for use as an aggregate. In the case of the fine fraction of BOS slag-based material, this is used as a lime substitute at the sinter plant and BOS plant. The metallic fines fraction from BOS debris processing at the MR plant is also returned to the sinter plant.*

*Other revert streams include millscale (which is screened, with the undersize sent to the sinter plant and the oversize charged to blast furnace) and mill sludges (which are recovered using thermal desorption by a third party). Steel scrap from both internal arisings and external purchase is used at the BOS plant.*

***BAT achieved***

*In addition to the techniques described above, and in recognition that (i) revert generation can sometimes exceed the rate at which reverts can be consumed by the sinter plant and BOS plant, (ii) process chemistry constraints exist on elements such as zinc, copper, manganese, phosphorous and aluminium, and, (iii) research suggests a link between revert chemistry and sinter plant emissions, which has to be controlled, detailed planning is under way to construct and commission a rotary hearth furnace (RHF) at Port Talbot in order to process approximately 270,000 tonnes of iron-bearing reverts each year from around the company, including BOS and BF sludges arising at Scunthorpe.*

**9. BAT is to maximise external use or recycling for solid residues which cannot be used or recycled according to BAT 8, wherever this is possible and in line with waste regulations. BAT is to manage in a controlled manner residues which can neither be avoided nor recycled.**

*Due to the nature of the integrated steel works and the recyclability of Iron and Steel residues, the vast majority of solid residue materials arising at Scunthorpe are already "reverted", i.e. consumed back within the process internally, as described in response to BAT 8.*

*Iron oxide produced from both the blast furnaces and BOS plant is sold into the cement industry for trimming cement kiln chemistry. Processing of mill sludges by thermal desorption takes place to reduce the oil content and the clean material is returned back to the sinter plant process in the UK at the Scunthorpe site.*

*The small fraction of residues that have no economic use are disposed of either at an internal landfill site or externally. In all cases appropriate measures are taken to ensure that such disposals are properly controlled, for example through the use of waste transfer notes.*

***BAT achieved***

**10. BAT is to use the best operational and maintenance practices for the collection, handling, storage and transport of all solid residues and for the hooding of transfer points to avoid emissions to air and water.**

*Solid residues are treated in the same way as raw materials and the responses given in respect of BAT 11 apply equally to BAT 10.*

***BAT not achieved***

*The ongoing improvement programmes and capital investments discussed in the response to BAT 11, prioritised to tackle the sources with the greatest impact, will achieve BAT by 2016.*

### 1.1.5 Diffuse dust emissions from materials storage, handling and transport of raw materials and (intermediate) products

**11. BAT is to prevent or reduce diffuse dust emissions from materials storage, handling and transport by using one or a combination of the techniques mentioned below.**

**If abatement techniques are used, BAT is to optimise the capture efficiency and subsequent cleaning through appropriate techniques such as those mentioned below. Preference is given to the collection of the dust emissions nearest to the source.**

I. General techniques include:

- the setting up within the EMS of the steelworks of an associated diffuse dust action plan;
- consideration of temporary cessation of certain operations where they are identified as a source of $PM_{10}$ causing a high ambient reading; in order to do this, it will be necessary to have sufficient $PM_{10}$ monitors, with associated wind direction and strength monitoring, to be able to triangulate and identify key sources of fine dust.

*Tata Steel has an EMS for the Scunthorpe site that records the overarching steelworks' Air Quality Management Plan (AQMP), which is supported by formal objectives and goals (OGSM project management system). This plan includes scheduled improvement projects (in OGSM) and the use of the EMS for routine procedures for diffuse dust control for all works areas and key contractors (Tarmac, Harsco and Hargreaves). A Fugitive Emissions Reduction Programme (FERP) is a key part of the AQMP.*

*On-site and off-site $PM_{10}$ monitoring and weather data are utilised to predict and detect high ambient dust levels to allow for a coordinated plan to prevent diffuse dust lift off before it happens (based on forecasts) and to reduce it when it occurs. Additional dust abatement measures and cessation of activities where appropriate are recorded on shift logs in response to daily email warnings.*

II. Techniques for the prevention of dust releases during the handling and transport of bulk raw materials include:

- orientation of long stockpiles in the direction of the prevailing wind

*The predominant wind direction at Scunthorpe is from the south-west. Following the historical development of the Scunthorpe site, the stockpile orientations are south-south-west to north-north-east for ore preparation and west-south-west to east-north-east for coal handling. The stockpiles are considered to be BAT for orientation.*

- installing wind barriers or using natural terrain to provide shelter

*The ore preparation beds are contained within a 20 metre deep land recess ensuring the beds are below the natural terrain. The coal handling plant and ore preparation beds have had a series of vegetated wind bunds created to reduce wind lift-off. Storage of reverts materials uses natural bunding to the south-west to provide protection from the prevailing wind for the materials more prone to diffuse dust lift-off.*

- controlling the moisture content of the material delivered

*Material moisture content is monitored prior to arrival on site and is closely controlled to an optimum to aid transport, delivery, storage and use.*

- careful attention to procedures to avoid the unnecessary handling of materials and long unenclosed drops

*The coal and ore preparation stackers in the stockyards have a variable height system that varies as the stockpiles are built up to minimise the drop height. The ore blending plant stacker has a limited lowest height and procedures are now in place to only stack out low dusting materials when the drop is to the floor. Material movements are minimised and all materials have their allocated areas within plants and are only removed when they are to be processed. The reverts storage area has been extensively reorganised to achieve a reduction in material movements and distances travelled.*

- adequate containment on conveyors and in hoppers, etc.

*The majority of the conveyors on site are covered or have wind protection. Maintenance programmes are in place to repair or replace sheeting as required.*

- the use of dust-suppressing water sprays, with additives such as latex, where appropriate

*The ore preparation beds and coal stocks are treated with latex to suppress dust if they are not to be used immediately, though during winter months wetting is predominantly used* *rather than latex (due to latex solidifying at cold temperatures). Mobile water spray systems are used in the materials storage areas throughout the year to provide additional dust suppression.*

- rigorous maintenance standards for equipment

*Maintenance routines and procedures are set out through a computer-based SAP maintenance management module and assessed through an asset maintenance framework (CAMF). All routine maintenance plans are automatically generated and assigned for each department and carried out by suitably trained personnel. Additional checks and controls are carried out at the operations level continually to identify and resolve emergency issues.*

- high standards of housekeeping, in particular the cleaning and damping of roads

*House keeping procedures have been developed for all plant areas and are assessed through Planned General Inspections (PGIs). Issues can be raised on PGIs through the management teams. Standards for road and roadside cleanliness have been implemented on the main roads throughout the site and a continuous improvement process is ensuring that this is progressed onto minor roads. An on-line road cleaning GPS tracking system is in use in conjunction with security 'Spillage notifications' that highlight any adverse issues and report them to the road sweeper team supervisor.*

- the use of mobile and stationary vacuum cleaning equipment

*Road sweepers and fixed and mobile vacuum systems are in use on dust-generating areas for coal, sintering, blast furnaces, coking and steel plant. There are five road sweepers that operate every day alongside various mobile vacuum contractors and some fixed vacuum systems are also operated at the BOS plant. Road sweepers generally follow a fixed route but can be deployed into a problem area on request to clean road spillages, while vacuum tanker resource is also available (including high vacuum units) when required. Fixed pipework has been installed at some locations within the coke ovens to enable mobile vacuum units to park up and connect without the need to set up mobile pipes into highline buildings.*

- dust suppression or dust extraction and the use of a bag filter cleaning plant to abate sources of significant dust generation

*When delivery of materials is into a building or silo, the facility is dedusted using a bag filter where practicable (for example BOS lime and additions deliveries). There are a number of raw materials handling systems with a bag filter.*

- the application of emissions-reduced sweeping cars for carrying out the routine cleaning of hard surfaced roads.

*There are five road sweepers that operate every day with additional resource available (including a high vacuum unit). Road sweepers generally follow a fixed route but can be deployed into a problem area on request. Road sweepers and fixed and mobile vacuum systems are in use on dust-generating areas for coal, sintering, blast furnaces, coking and steel plant.*

III. Techniques for materials delivery, storage and reclamation activities include:

- total enclosure of unloading hoppers in a building equipped with filtered air extraction for dusty materials, or hoppers should be fitted with dust baffles and the unloading grids coupled to a dust extraction and cleaning system

*Materials storage takes place primarily in the open air due to the scale of operations and there are no hoppers or air extraction. Coal deliveries are by rail via an underground silo in an enclosed building with no diffuse emissions generated at this point. Ore off-loading is by rail and uses a contained wagon tippler and there are no diffuse emissions from this system. Lime deliveries to the ore preparation plant are into a high-level suspended concrete silo. The lime silo has wind protection around the delivery point, but due to the height of the structure and its geography, it is currently not economically feasible to fit air extraction. The BOS plant lime delivery bunkers use curtains on the unloading hopper and the system has silo and conveyor dedusting through a bag filter. The additions materials bunkers at the BOS plant are enclosed, with fume extraction and bag filters to provide dedusting.*

- limiting the drop heights if possible to a maximum of 0.5 m

*Drop heights are minimised where possible; in other cases sheeting has been installed around the drop area to minimise emissions. The stackers in the stockyards have a variable height system that varies as the stockpiles are built up to minimise the drop height. The ore blending plant stacker had a limited lowest height and procedures are now in place to only stack out low dusting materials when the drop is to the floor.*

- the use of water sprays (preferably using recycled water) for dust suppression

*The ore preparation beds and coal stocks are treated with latex to suppress dust if they are not to be used immediately, though during winter months wetting is predominantly used rather than latex (due to latex solidifying at cold temperatures). Mobile water spray systems are used in the materials storage areas throughout the year to provide additional dust suppression and these use recycled water as a primary water source.*

- where necessary, the fitting of storage bins with filter units to control dust

*These are not used at Scunthorpe.*

- the use of totally enclosed devices for reclamation from bins

*These are not used at Scunthorpe.*

- where necessary, the storage of scrap in covered, and hard surfaced areas to reduce the risk of ground contamination (using just in time delivery to minimise the size of the yard and hence emissions)

*Scrap storage is in the open and on a natural clay-lined area. Scrap storage has a small footprint that restricts the amount of stock.*

- minimisation of the disturbance of stockpiles

*The use of materials is carefully planned to reduce double-handling. Freshly built ore preparation beds and coal stocks are treated with latex or water to suppress dust if they are not to be used immediately. Mobile water spray systems are used in the materials storage areas for additional dust suppression and exposed faces of stockpiles are re-latexed if they are partially used.*

- restriction of the height and a controlling of the general shape of stockpiles

*The height and shape of stockpiles is primarily controlled by the equipment used and the allocated area and space restrictions for coal and ore preparation beds. This has maximum length and height controlled by how far and how high the stacker can travel. Stockpiles that are not controlled by fixed equipment are stacked in controlled areas to reduce dust lift-off* *with additional controls in place, for example bund walls to control location and maximum height, removing the top peak of stock piles and clearly recorded locations for storage.*

- the use of in-building or in-vessel storage, rather than external stockpiles, if the scale of storage is appropriate

*Where economically feasible, materials are stored in contained areas, buildings or silos. Materials storage is primarily in the open air due to the scale of operations.*

- the creation of windbreaks by natural terrain, banks of earth or the planting of long grass and evergreen trees in open areas to capture and absorb dust without suffering long-term harm

*The coal handling plant, steel storage area (Redbourn) and ore preparation beds have had a series of vegetated wind bunds (grass and trees) incorporated into the topography to reduce wind lift-off. Storage of reverts materials uses natural bunding to provide wind attenuation for the materials more prone to diffuse dust lift-off.*

- hydro-seeding of waste tips and slag heaps

*Slag storage is not a permit-related activity for Tata Steel and is operated by Tarmac. Waste tips are capped, covered and seeded following the agreed Landfill Site Closure plans.*

- implementation of a greening of the site by covering unused areas with top soil and planting grass, shrubs and other ground covering vegetation

*A site greening plan has been developed which includes all high risk areas for diffuse dust lift-off. This plan has essentially been completed at the coal handling plant, steel storage area (Redbourn) and ore preparation beds. Further areas have been identified for landscaping and greening activities for a future phase of the project. The site is currently working though roadside improvements and maintaining an up-to-date list of isolated 'unused areas' to further reduce diffuse dust lift-off.*

- the moistening of the surface using durable dust-binding substances

*Unused areas have been identified for landscaping and greening activities in the site greening plan. The site is currently working though roadside improvements and maintaining an up-to-date list of isolated 'unused areas' to stop activity on these areas. Where an area is unused and cannot be suitably soiled and seeded, a surface treatment is used to bind dusts.*

- the covering of the surface with tarpaulins or coating (e.g. latex) stockpiles

*Tarpaulins are not frequently used due to the size of the stockpiles. The ore beds and coals are latexed if they are not to be immediately used and mobile water spray systems are also used in the materials storage areas.*

- the application of storage with retaining walls to reduce the exposed surface

*Only minor materials storage areas are currently controlled by retaining walls and this is not regarded as the best option for many raw materials at Scunthorpe. This is partly historical and also due to changes in storage locations and the variable storage capacity required. Intermediate materials have retaining walls in some process areas, for example at the blast furnaces and BOS plant.*

- when necessary, a measure could be to include impermeable surfaces with concrete and drainage.

*A programme of hard surfacing storage locations is ongoing as part of the plant improvement plans and the AQMP.*

IV. Where fuel and raw materials are delivered by sea and dust releases could be significant, some techniques include:

- use by operators of self-discharge vessels or enclosed continuous unloaders. Otherwise, dust generated by grab-type ship unloaders should be minimised through a combination of ensuring adequate moisture content of the material as delivered, by minimising drop heights and by using water sprays or fine water fogs at the mouth of the ship unloader hopper

*Import of bulk raw materials is via the sea port at Immingham by grab unloading into hoppers and then through enclosed conveyors for intermediate open storage. This is then reclaimed and loaded into rail wagons in an enclosed facility for transport to Scunthorpe. Coal and iron ore deliveries at the port are invariably wet and do not need additional suppression at the unloading stage. Suppression of dust from stockpiles is by fixed and mobile water sprays and uses water from on site storage reservoirs.*

- avoiding seawater in spraying ores or fluxes as this results in a fouling of sinter plant electrostatic precipitators with sodium chloride. Additional chlorine input in the raw materials may also lead to rising emissions (e.g. of polychlorinated dibenzodioxins/furans (PCDD/F)) and hamper filter dust recirculation

*Sea water is not used for dust suppression.*

- storage of powdered carbon, lime and calcium carbide in sealed silos and conveying them pneumatically or storing and transferring them in sealed bags.

*There is no powdered carbon, lime or calcium carbide delivered by sea.*

V. Train or truck unloading techniques include:

- if necessary due to dust emission formation, use of dedicated unloading equipment with a generally enclosed design.

*Coal deliveries are by rail via an underground silo in an enclosed building with no diffuse emissions generated at this point. Ore off-loading is by rail and uses a contained wagon tippler and there are no diffuse emissions from this system. Lime deliveries to the ore preparation plant are into a high level suspended silo. The lime silo has wind protection but due to the height of the structure and its geography, it is currently not economically feasible to fit air extraction or further enclosures. The BOS plant lime delivery bunker has a raised building and uses curtains on the unloading hopper. The system has silo and conveyor dedusting through a bag filter. The additional material bunkers at BOS plant are enclosed with fume extraction and bag filters.*

VI. For highly drift-sensitive materials which may lead to significant dust release, some techniques include:

- use of transfer points, vibrating screens, crushers, hoppers and the like, which may be totally enclosed and extracted to a bag filter plant

*Various transfer points, vibrating screens, crushers and hoppers are in use across the site and these vary in the methods for dust control. Bag filter extraction is only used in process areas where a requirement was identified prior to construction. The sinter grading system uses extraction to the dedust ESP. Enclosing the process and, where necessary, wetting is the primary control measure for most transfer systems at Scunthorpe.*

- use of central or local vacuum cleaning systems rather than washing down for the removal of spillage, since the effects are restricted to one medium and the recycling of spilt material is simplified.

*Plant areas have cleaning teams that prioritise removal by either returning to the process or by vacuum. Washing down spillage is avoided due to issues created with recycling materials.*

VII. Techniques for the handling and processing of slag include:

- keeping stockpiles of slag granulate damp for slag handling and processing since dried blast furnace slag and steel slag can give rise to dust

*Granulated blast furnace slag is stored for a short period on the Tata Steel site and remains damp prior to being transported to a permitted third party (on site). Blast furnace and BOS slags are sprayed with water during cooling and on loading to reduce dust release. Slag processing and storage are operated by a third party and regulated under a separate permit.*

- use of enclosed slag-crushing equipment fitted with efficient extraction and bag filters to reduce dust emissions.

*Slag storage and processing are operated by a third party and regulated under a separate permit.*

VIII. Techniques for handling scrap include:

- providing scrap storage under cover and/or on concrete floors to minimise dust lift-off caused by vehicle movements

*Scrap storage is in the open and on a natural clay lined area. Scrap storage has a small footprint that restricts the amount of stock.*

IX. Techniques to consider during material transport include:

- the minimisation of points of access from public highways

*The site has a new security system to restrict access to site. Materials are stored in 'dirty' areas with minimised entry and exit points onto 'clean' areas to reduce carry over onto hard surfaced roads and the public highway.*

- the employment of wheel-cleaning equipment to prevent the carryover of mud and dust onto public roads

*Materials are stored in 'dirty' areas with wheel wash facilities at the exit points to reduce carry over onto 'clean' areas of hard surfaced roads and the public highway.*

- the application of hard surfaces to the transport roads (concrete or asphalt) to minimise the generation of dust clouds during materials transport and the cleaning of roads

*Materials are stored in unmade 'dirty' areas with minimised entry and exit points with wheel-wash facilities to reduce carry-over onto hard surfaced 'clean' areas. Haul routes have various surfaces with the primary type being a slag surface which is wetted and managed to reduce dust lift-off. Higher risk areas have been identified and have been hard surfaced, for example the northern end of the slag haul road, opposite the Tarmac facility.*

- the restriction of vehicles to designated routes by fences, ditches or banks of recycled slag

*Designated routes and stocking areas have segregated areas using bunding to contain and minimise road size and use. As an example, the slag haul road has been narrowed to a single vehicle width (with passing places) in recent years to restrict the area being driven over and ensure that bowsering and regrading of the road surface can be undertaken more effectively in order to minimise dust emissions.*

- the damping of dusty routes by water sprays, e.g. at slag-handling operations

*Haul routes have various surfaces with the primary type being a slag surface which is wetted by road bowser and managed to reduce dust lift-off.*

- ensuring that transport vehicles are not overfull, so as to prevent any spillage

*Procedures are in place and training is given to ensure vehicles are not overfilled. Standards for road cleanliness have been implemented on the main roads within the site. An on-line road cleaning GPS tracking system is in use in conjunction with security team 'Spillage notifications' that highlight any adverse issues to the road sweeper supervisor.*

- ensuring that transport vehicles are sheeted to cover the material carried

*Procedures are in place and training is given to ensure that vehicles are not overfilled and are sheeted where this is practicable (where heat is not an issue and vehicles have the ability to use sheeting). An on-line road cleaning GPS tracking system is in use in conjunction with security team 'Spillage notifications' that highlight any adverse issues to the road sweeper supervisor.*

- the minimisation of numbers of transfers

*Materials movements are carefully planned to minimise the number of road transfers necessary and conveyor transport is used instead where feasible. One way of reducing the numbers of vehicle movements is to use larger vehicles, however this may have adverse effects through increased damage to road surfaces and the fact that larger vehicles may be difficult to sheet or adequately wet. As a result in some areas vehicle sizes have decreased which increases the number of vehicle movements, but reduces emissions overall.*

- use of closed or enclosed conveyors

*The majority of the conveyors on site are covered or have wind protection. Maintenance programmes are in place to repair or replace sheeting as required.*

- use of tubular conveyors, where possible, to minimise material losses by changes of direction across sites usually provided by the discharge of materials from one belt onto another

*Tubular conveyors are not used at Scunthorpe.*

- good practice techniques for molten metal transfer and ladle handling

*Molten metal is transferred from the blast furnaces to BOS plant by rail in lidded torpedoes. Torpedo tipping at the BOS plant is carried out under an extraction hood with a bag filter, and ladle handling and transfers are contained within the BOS plant.*

- dedusting of conveyor transfer points.

*There is dedusting of conveyors at the sinter plant at Scunthorpe.*

*In total, the measures described above are considered to substantially realise BAT for the prevention or reduction of diffuse dust emissions from materials storage, handling and transport at Scunthorpe. It is, however, recognised that further improvements will always be possible. Areas where the risk of dust generation remains relatively high are being assessed as part of the overall Air Quality Management Plan and identified within the high-level OGSM strategy. Additional measures to further prevent and reduce diffuse dust emissions are being prioritised based on reduction of impact on a year by year basis.*

***BAT not achieved***

*The ongoing improvement programmes and capital investments, prioritised to tackle the sources with the greatest impact in consultation with the Environment Agency as appropriate, will achieve BAT by 2016.*

### 1.1.6 Water and waste water management

**12. BAT for waste water management is to prevent, collect and separate waste water types, maximising internal recycling and using an adequate treatment for each final flow. This includes techniques utilising, e.g. oil interceptors, filtration or sedimentation. In this context, the following techniques can be used where the prerequisites mentioned are present:**

- avoiding the use of potable water for production lines
- increasing the number and/or capacity of water circulating systems when building new plants or modernising/revamping existing plants
- centralising the distribution of incoming fresh water
- using the water in cascades until single parameters reach their legal or technical limits
- using the water in other plants if only single parameters of the water are affected and further usage is possible
- keeping treated and untreated waste water separated; by this measure it is possible to dispose of waste water in different ways at a reasonable cost
- using rainwater whenever possible.

**Applicability**

The water management in an integrated steelworks will primarily be constrained by the availability and quality of fresh water and local legal requirements. In existing plants the existing configuration of the water circuits may limit applicability.

*Long-standing constraints on water abstraction at Scunthorpe mean that the site is already highly efficient in terms of water use, utilising closed-loop systems in preference to once-through systems wherever possible, and maximising the reuse of process waters where practicable, taking into account water quality and the distance between different processes. Examples of recycling/reuse of process waters are detailed in the responses to BAT 27, BAT 53, BAT 54, BAT 66 and BAT 80. Water used within the production processes is generally abstracted from rivers or mine drainage and the use of potable water is avoided.*

*At the sinter plant there are no process effluents that require treatment (see response to BAT 28). At the coke ovens there is a dedicated waste water treatment plant which treats both process effluents and drainage water from the coke ovens and by-products plant, which may be contaminated with high levels of organic pollutants, before discharge to the River Trent (see the responses to BAT 55 and BAT 56 for further details). The main process effluents from the blast furnaces and BOS plant are initially treated close to the process (see responses to BAT 67 and BAT 81), but are then mixed with other process effluents and site drainage water and undergo further settling in the Seraphim lagoon before final discharge to Brumby Beck. Some minor effluent streams from the BOS plant are discharged to Bottesford*

*Beck after treatment; some drainage systems from the site also discharge to Bottesford Beck after basic treatment.*

*Drainage water from the coal handling plant (rainwater) is used in the coke quenching system.*

*In total, the measures described above are considered to realise BAT, but it is recognised that further improvements may be possible. Studies are currently in progress within Tata Steel to investigate the use of methodologies based on process integration to identify further opportunities for water reuse in other processes, and to investigate more extensive use of rainwater harvesting.*

***BAT achieved***

### 1.1.7 Monitoring

**13. BAT is to measure or assess all relevant parameters necessary to steer the processes from control rooms by means of modern computer-based systems in order to adjust continuously and to optimise the processes online, to ensure stable and smooth processing, thus increasing energy efficiency and maximising the yield and improving maintenance practices.**

*All major processes are controlled by means of computer-based systems to ensure safe operation and to achieve the most efficient overall steel production, taking into account the integrated nature of Scunthorpe steelworks, the dependence of each process on the preceding processes and market demand for steel products.*

***BAT achieved***

**14. BAT is to measure the stack emissions of pollutants from the main emission sources from all processes included in the Sections 1.2 – 1.7 whenever BAT-AELs are given and in process gas-fired power plants in iron and steel works.**

**BAT is to use continuous measurements at least for:**

- primary emissions of dust, nitrogen oxides ($NO_X$) and sulphur dioxide ($SO_2$) from sinter strands
- nitrogen oxides ($NO_X$) and sulphur dioxide ($SO_2$) emissions from induration strands of pelletisation plants
- dust emissions from blast furnace cast houses
- secondary emissions of dust from basic oxygen furnaces
- emissions of nitrogen oxides ($NO_X$) from power plants
- dust emissions from large electric arc furnaces.

**For other emissions, BAT is to consider using continuous emission monitoring depending on the mass flow and emission characteristics.**

*Continuous measurements are undertaken of the following stack emissions:*

| *Description* | *BAT* | *Dust* | *$NO_x$* | *$SO_2$* | *Comments* |
|---|---|---|---|---|---|
| *Sinter plant primary emissions (A1)* | *20, 22 & 23* | ✓ | ✓ | ✓ | ***BAT achieved*** |
| *Sinter plant secondary emissions (A2)* | *26* | ✓ | | | ***Beyond BAT*** |
| *Induration strands of pelletisation plants* | *33 & 34* | *NA** | *NA** | *NA** | *No pelletisation plant at Scunthorpe* |
| *Blast furnace cast houses (A46/A47)* | *61* | ✓ | | | ***BAT achieved*** |
| *BOS plant secondary emissions (A57, A59, A61, A78 and A81)* | *78* | ✓ | | | ***BAT achieved*** |
| *BOS plant secondary emissions (A58)* | *78* | | | | ***BAT not achieved*** |
| *Power plants* | | ✓ | ✓ | ✓ | ***Beyond BAT*** |
| *Electric arc furnaces* | | *NA** | *NA** | *NA** | *No electric arc furnace at Scunthorpe* |

* *NA – these BAT requirements are not applicable at Scunthorpe as the relevant processes are not operated on the site.*

*Unshaded cells with bold borders represent situations where the use of continuous measurements is BAT; shaded cells represent emissions where the use of continuous measurements is not BAT, but in some cases the emission characteristics are such that additional continuous measurements have been implemented.*

*There is no continuous emissions monitoring on the BOS plant West secondary vent system (A58), but this emission point is now only used when the East secondary vent (A57) is unavailable. The West secondary vent system includes a wet scrubber to remove dust and the cleaned waste gas is therefore saturated with moisture and may contain droplets, making conventional forms of continuous dust monitoring impracticable. Due to the infrequent operation of the system and the practical difficulties of continuous monitoring, it is not proposed to install any continuous emissions monitoring at this location. With the exception of the West secondary vent system,*

***BAT achieved***

15. **For relevant emission sources not mentioned in BAT 14, BAT is to measure the emissions of pollutants from all processes included in the Sections 1.2 – 1.7 and from process gas-fired power plants within iron and steel works as well as all relevant process gas components/pollutants periodically and discontinuously. This includes the discontinuous monitoring of process gases, stack emissions, polychlorinated dibenzodioxins/furans (PCDD/F) and monitoring the discharge of waste water, but excludes diffuse emissions (see BAT 16).**

**Description (relevant for BAT 14 and 15)**
The monitoring of process gases provides information about the composition of process gases and about indirect emissions from the combustion of process gases, such as emissions of dust, heavy metals and $SO_x$.

Stack emissions can be measured by regular, periodic discontinuous measurements at relevant channelled emission sources over a sufficiently long period, to obtain representative emission values.

For monitoring the discharge of waste water a great variety of standardised procedures exist for sampling and analyzing water and waste water, including:

- a random sample which refers to a single sample taken from a waste water flow
- a composite sample, which refers to a sample taken continuously over a given period, or a sample consisting of several samples taken either continuously or discontinuously over a given period and blended
- a qualified random sample shall refer to a composite sample of at least five random samples taken over a maximum period of two hours at intervals of no less than two minutes, and blended.

Monitoring should be done according to the relevant EN or ISO standards. If EN or ISO standards are not available, national or other international standards should be used that ensure the provision of data of an equivalent scientific quality.

***Process gases***

*The composition of blast furnace gas, coke oven gas and BOS gas is measured using continuous monitoring devices. Dust is not routinely measured as the gases are toxic, under positive pressure and any sampling therefore represents a significant risk to personnel.*

***Process emissions***

*In addition to the continuous monitoring described under BAT 14, the following measurements are undertaken periodically for other stack emissions where BAT-AELs are given:*

| *Description* | *BAT* | *Species* | *Frequency* |
|---|---|---|---|
| *Sinter plant primary emissions (A1)* | *21* | *Mercury* | *6 months – **BAT achieved*** |
| | *25* | *Dioxins* | *6 months – **BAT achieved*** |
| *Pelletisation plants* | *33, 34* | *Dust, HF, HCl* | *No pelletisation plant* |
| *Coal grinding* | *42* | *Dust* | *No relevant emission point* |
| *Pulverised coal storage* | *43* | *Dust* | *No relevant emission point* |
| *Land-based extraction of gases from coke oven charging* | *44* | *Dust* | *Not used at Scunthorpe* |
| *Coke oven underfiring (A301, A320 and A303)* | *49* | *$SO_2$, dust, $NO_x$* | *3 months ($NO_x$)*<br>*12 months (dust at Appleby)*<br>*No dust monitoring at Dawes Lane*<br>*No $SO_2$ monitoring*<br>***BAT not achieved*** |
| *Land-based extraction of gases from coke oven pushing* | *50* | *Dust* | *Not used at Scunthorpe* |
| *Coke grading and handling* | *52* | *Dust* | *No relevant emission point* |
| *Coal injection storage bunkers (A14)* | *59* | *Dust* | *No monitoring – **BAT not achieved*** |
| *Blast furnace stoves (A15 to A20)* | *65* | *$SO_2$, dust, $NO_x$* | *3 months ($SO_2$ & $NO_x$)*<br>*12 months (dust)*<br>***BAT achieved*** |
| *BOS plant primary emissions – full combustion* | *76* | *Dust* | *Suppressed combustion used* |
| *Slag crushing and screening* | *79* | *Dust* | *Not operated by Tata Steel* |
| *Electric arc furnaces* | *88, 89 & 90* | *Dust, mercury, dioxins* | *No electric arc furnace* |

***Waste water***

*Spot samples are taken from all the permitted discharge points as specified in the current permit, but it has been identified that the prescribed sampling does not cover all the pollutants for which BAT-AELs are given. Tata Steel met with the Environment Agency on 1st August 2013 to discuss future monitoring requirements, which will be implemented once formalised.*

***BAT not achieved***

*Dust levels in process gases will not be routinely monitored due to safety concerns, but where possible will be inferred from the dust concentrations in the waste gas from combustion of the gases, as detailed, for example, in the response to BAT 64.*

*It is planned to install additional sampling ports or equipment so that all stack emissions where BAT-AELs are given will be monitored by 2016. In the case of the coal injection storage bunkers at the blast furnaces (A14), quantitative sampling is impracticable, but "policing CEMS" will be fitted to provide reassurance that the bag filters are operating satisfactorily, as detailed in the response to BAT 59.*

*Tata Steel will change the procedures for sampling and analysis of waste water discharges in the light of a meeting with the Environment Agency on 1st August 2013 to ensure compliance with this BAT condition.*

*The improvements listed above will ensure that BAT is achieved by 2016.*

**16. BAT is to determine the order of magnitude of diffuse emissions from relevant sources by the methods mentioned below. Whenever possible, direct measurement methods are preferred over indirect methods or evaluations based on calculations with emission factors.**

- Direct measurement methods where the emissions are measured at the source itself. In this case, concentrations and mass streams can be measured or determined.
- Indirect measurement methods where the emission determination takes place at a certain distance from the source; a direct measurement of concentrations and mass stream is not possible.
- Calculation with emission factors.

**Description**

***Direct or quasi-direct measurement***

Examples for direct measurements are measurements in wind tunnels, with hoods or other methods like quasi-emissions measurements on the roof of an industrial installation. For the latter case, the wind velocity and the area of the roofline vent are measured and a flow rate is calculated. The cross-section of the measurement plane of the roofline vent is subdivided into sectors of identical surface area (grid measurement).

***Indirect measurements***

Examples of indirect measurements include the use of tracer gases, reverse dispersion modelling (RDM) methods and the mass balance method applying light detection and ranging (LIDAR).

***Calculation of emissions with emission factors***

Guidelines using emission factors for the estimation of diffuse dust emissions from storage and handling of bulk materials and for the suspension of dust from roadways due to traffic movements are:

- VDI 3790 Part 3
- US EPA AP 42

*The estimation of diffuse dust emissions from the Scunthorpe site is an ongoing area of work being undertaken by Tata Steel under the site's Air Quality Management Plan. Further advice is provided by a multi-partner Technical Working Group, led by the Environment Agency.*

*Direct emission measurements have been undertaken of fugitive releases from roof vents on the BOS plant, BF casthouse and the Plate Mill. Such emissions can be very variable, but the measurement exercises were undertaken over a period of several days in each case to try to obtain representative results and are sufficient for an order of magnitude determination. Emissions from conveyors have been estimated in a similar manner, and even though only a few junction houses have been monitored, this may be sufficient for an order of magnitude determination.*

*Dust emissions from battery operations at Dawes Lane coke ovens have been directly measured for a small number of ovens by channelling the fugitive releases into temporary ducts to allow conventional dust monitoring.*

*Direct emission measurements have also been undertaken of releases from the sinter cooler.*

*Emissions from roads have been estimated indirectly using dust monitors attached to the rear of vehicles. Results were very variable, depending on vehicle type, speed, whether the road was metalled or not and how wet the road was, but the results were broadly in agreement with estimates made using emission factors from US EPA AP 42.*

*Emissions from the ore stockyards have been estimated indirectly using reverse dispersion modelling techniques. Ambient dust levels were monitored for at least six weeks to ensure a wide range of conditions were encountered to try to obtain representative estimates. A similar exercise to estimate emissions from the coal handling plant did not produce reliable estimates as insufficient monitoring data were obtained.*

*Dust emissions from battery operations at Appleby have been estimated using emission factors derived from the work undertaken at Dawes Lane.*

*Emissions factors derived for the Plate Mill could be applied to other mill buildings.*

*Diffuse dust emissions from some sources that might be expected to be relevant have not yet been determined, for example fugitive releases from the sinter plant and mill buildings (other than the Plate Mill) and diffuse emissions from slag handling and the steel stocking area at Redbourne. Emission factors from work undertaken at other Tata Steel plants or from US EPA AP 42 could be used to assess these sources.*

***BAT not achieved***

*Studies are already planned to improve the diffuse emissions inventory. Dispersion modelling, based on the updated inventory, will be used to test whether the impacts of the emissions included match the dust concentrations measured in the environment, and a judgement will then be made whether additional sources also need to be quantified, or whether the remaining unquantified emissions have a sufficiently small impact that they can be neglected. BAT will be achieved by 2016.*

### 1.1.8 Decommissioning

**17. BAT is to prevent pollution upon decommissioning by using necessary techniques as listed below.**

Design considerations for end-of-life plant decommissioning:

I. giving consideration to the environmental impact from the eventual decommissioning of the installation at the stage of designing a new plant, as forethought makes decommissioning easier, cleaner and cheaper
II. decommissioning poses environmental risks for the contamination of land (and groundwater) and generates large quantities of solid waste; preventive techniques are process-specific but general considerations may include:
    i. avoiding underground structures
    ii. incorporating features that facilitate dismantling
    iii. choosing surface finishes that are easily decontaminated
    iv. using an equipment configuration that minimises trapped chemicals and facilitates drain-down or cleaning
    v. designing flexible, self-contained units that enable phased closure
    vi. using biodegradable and recyclable materials where possible.

*The design and construction of the majority of plant and equipment employed in the production of iron and steel in the UK was undertaken before the implementation of modern environmental and health & safety legislation. The Construction (Design and Management) Regulations 1994 (CDM Regulations) now require decommissioning aspects to be taken into consideration at the design stage of a project (BAT technique I above). For new Tata Steel plant and equipment, these BAT requirements will be taken into consideration at the design and build stage wherever applicable and/or possible.*

*Tata Steel site closures are planned as and when required. It is not the Company's policy to formulate site closure plans prior to the actual announcement of closure. In the majority of instances, the specific environmental implications of iron and steelmaking activities cannot categorically be established until comprehensive site investigations have been undertaken and contamination, or the lack of contamination, determined. Rather than develop a "closure plan" that would in all likelihood be subject to major change at the actual time of closure, Tata Steel has reached the conclusion that it would be both more effective and practical to develop a "site closure environmental toolkit" to be used by all employees involved in closure activities. The environmental implications of closure activities have been assessed and guidance to prevent or minimise their impact prepared and published. The "site closure environmental toolkit" comprises both the site health & safety and environmental issues addressed within the overall remit of the CDM Regulations, and the specific environmental issues addressed by Company environmental, health & safety specifications and guidance notes.*

***BAT achieved***

### 1.1.9 Noise

**18. BAT is to reduce noise emissions from relevant sources in the iron and steel manufacturing processes by using one or more of the following techniques depending on and according to local conditions:**

- implementation of a noise-reduction strategy
- enclosure of the noisy operations/units
- vibration insulation of operations/units
- internal and external lining made of impact-absorbent material
- soundproofing buildings to shelter any noisy operations involving material transformation equipment
- building noise protection walls, e.g. the construction of buildings or natural barriers, such as growing trees and bushes between the protected area and the noisy activity
- outlet silencers on exhaust stacks
- lagging ducts and final blowers which are situated in soundproof buildings
- closing doors and windows of covered areas.

*Noise is one of the aspects included in the site-wide EMS. A Noise Management Plan (NMP) has been developed which details potential sources of noise and control measures to be taken and prioritises the sources in terms of their contribution to the overall noise impact of the site.*

*Noise from process operations is largely controlled by enclosure within buildings and the implementation of procedures to ensure that doors are opened only when necessary so that the noise is contained as much as possible. Some of the buildings incorporate sound-proofing materials to attenuate the noise further. Fans situated outside the main buildings generally also have acoustic cladding to minimise noise.*

*Where potentially noisy operations are undertaken outside buildings, use is made of existing buildings and/or purpose-built barriers to provide some attenuation of noise – for instance for the slag breaking operations to the south of the BOS plant. Vegetated bunds built across the site, principally to reduce diffuse dust emissions (see BAT 11) will also attenuate noise from areas such as stockyards.*

*Outlet silencers are installed on the sinter plant main fans, casthouse extraction fans and BOS secondary extraction fans amongst others. Silencers are also installed on the air intakes for the sinter cooler fans.*

*Tata Steel has operated a “Buy Quiet” policy since 1980 (Corporate standard BES 5 – “Limiting noise from plant and equipment”) to ensure that noise levels are taken into consideration whenever buying new equipment.*

*Complaints of noise from the local community are recorded and investigated to try to identify the source of the noise. The majority of complaints in the period 2002 to 2007 related to noise from the main off gas fans at the BOS plant. Additional noise abatement measures were then implemented and the frequency of complaints has fallen as a result.*

***BAT achieved***

## 1.2 BAT Conclusions For Sinter Plants

Unless otherwise stated, the BAT conclusions presented in this section can be applied to all sinter plants.

***Air emissions***

**19. BAT for blending/mixing is to prevent or reduce diffuse dust emissions by agglomerating fine materials by adjusting the moisture content (see also BAT 11).**

*A controlled amount of water is added at the mixing drum to achieve the required moisture content of the raw sinter blend, and as such, there will not be an adverse effect on downstream dust emissions.*

***BAT achieved***

**20. BAT for primary emissions from sinter plants is to reduce dust emissions from the sinter strand waste gas by means of a bag filter.**

**BAT for primary emissions for existing plants is to reduce dust emissions from the sinter strand waste gas by using advanced electrostatic precipitators when bag filters are not applicable.**

The **BAT-associated emission level** for dust is <1 – 15 mg/Nm$^3$ for the bag filter and <20 – 40 mg/Nm$^3$ for the advanced electrostatic precipitator (which should be designed and operated to achieve these values), both determined as a daily mean value.

***Bag Filter***

**Description**

Bag filters used in sinter plants are usually applied downstream of an existing electrostatic precipitator or cyclone but can also be operated as a standalone device.

**Applicability**

For existing plants requirements such as space for a downstream installation to the electrostatic precipitator can be relevant. Special regard should be given to the age and the performance of the existing electrostatic precipitator.

***Advanced electrostatic precipitator***

**Description**

Advanced electrostatic precipitators are characterised by one or a combination of the following features:

- good process control
- additional electrical fields
- adapted strength of the electric field
- adapted moisture content
- conditioning with additives
- higher or variably pulsed voltages
- rapid reaction voltage
- high energy pulse superimposition
- moving electrodes
- enlarging the electrode plate distance or other features which improves the abatement efficiency.

*The current electrostatic precipitators (ESPs) fitted to Scunthorpe Sinter Plant are suitable for the de-dusting of primary emissions from the sinter plant because they are characterised by advanced features that include good process control, adapted strength of the electric field, adapted moisture content, higher and variably pulsed voltages, rapid reaction voltage and high energy pulse superimposition. In addition, conditioning with additives will be achieved before 2016 by the installation of a lignite injection system.*

*Bag filters are not applicable in this context because the plant is already fitted with advanced electrostatic precipitators and there are severe space restrictions upon further downstream installations. Furthermore, installation of bag filters would be disproportionately costly compared to the environmental benefit. Based on the costs of installing bag filters at Tata Steel's IJmuiden plant, where the waste gas flow is lower than that at Scunthorpe, it is estimated that the capital cost of such a scheme would be over £60M at Scunthorpe sinter plant. The existing precipitators would still be used as an initial dedusting stage before the bag filters, though some planned improvement works would not be required, resulting in a small saving in the costs of upgrading the ESPs – the net capital cost would be around £60M. No data on operating costs is available from IJmuiden as the system there is not yet fully operational. The BREF (Tables 3.21 and 3.22) gives some indicative operating costs - €1.6-1.8 per tonne sinter at voestalpine, Donawitz and €3.32 per tonne at DK Recycling, Duisberg. The detailed derivation of these costs is not included in the BREF, but they may include some depreciation costs, so as a conservative estimate an operating cost of £1/tonne sinter (in addition to the existing abatement costs of the advanced electrostatic precipitators) has been assumed:*

- *Total capital cost = £60M*
- *Annualised cost of capital = £6.3M (for a 25 year life and a cost of capital of 9.4%)*
- *Annual graded sinter production = 3.4M tonnes (2012 data)*
- *Annual operating costs = £3.4M (conservative estimate assuming £1/tonne sinter)*
- *Annual maintenance costs = £2.4M (assumed 4% of capital cost)*
- *Total equivalent annual cost = £12.1M*

*Assuming that the mean dust concentration after upgrading the current advanced ESPs would be 30 mg/Nm³ (in order to ensure that the daily mean is consistently below 40 mg/Nm³), and that the mean dust concentration after bag filters would be 10 mg/Nm³ (allowing for periods when the bag filter is unavailable), the reduction in annual dust emissions attributable to installation of a bag filter would be 196 tonnes (assuming a waste gas flow of 388 Nm³/s and 80% operational factor in 2012). The equivalent abatement cost of installing bag filters would therefore be 12,110,000/196 = £61,850 per tonne dust abated.*

*In addition to the financial costs, generation of the additional electrical energy required to run the fans will result in emissions of $CO_2$, $NO_x$, $SO_2$ and dust at power stations connected to the national grid; these emissions have not been quantified here.*

*Current emission concentrations from the existing advanced ESPs (2011 data, based on spot measurements) were in the range 32.5 mg/Nm$^3$ to 174 mg/Nm$^3$, with an average of 87 mg/Nm$^3$, for Strand 1, and 24.4 mg/Nm$^3$ to 79.2 mg/Nm$^3$, with an average of 33.8 mg/Nm$^3$, for Strand 2, and therefore the BAT-AEL is exceeded on some occasions.*

***BAT not achieved***

*Measures to achieve BAT:*

- *Tata Steel has established a Sinter Plant IED project in the UK to achieve the BAT-AEL by 2016 based on the control of chlorides in the raw sinter blend, the injection of adsorbent (activated lignite) into the waste gas stream, and refining the operation of the advanced ESPs.*

- *Extensive studies in 2010 - 2011 by Tata Steel showed that the management of chloride content and reverts in the raw sinter blend gave a typical reduction of 39% in particulate emissions, implying that the introduction of appropriate measures would have a significant impact on sinter plant particulate emissions.*

- *Studies at other sinter plants, for example at ArcelorMittal Eisenhűttenstadt, have shown that the control of chlorides in the blend can reduce emissions by 50%, resulting in emissions below the BAT-AEL for advanced ESPs.*

- *Studies will be undertaken to benchmark the current performance of the advanced ESPs and seek improvements where needed. Emphasis will be made at Scunthorpe to align the performance of ESP 1 to the better performance of ESP 2.*

*BAT will be achieved by 2016.*

**21. BAT for primary emissions from sinter strands is to prevent or reduce mercury emissions by selecting raw materials with a low mercury content (see BAT 7) or to treat waste gases in combination with activated carbon or activated lignite coke injection.**

The **BAT-associated emissions level** for mercury is <0.03 – 0.05 mg/Nm$^3$, as the average over the sampling period (discontinuous measurement, spot samples for at least half an hour).

*The emission concentrations at Scunthorpe Sinter Plant were in the range 0.0057 to 0.017 mg/Nm$^3$ in 2011, which is below the BAT-associated emission level for mercury.*

***BAT achieved***

**22. BAT for primary emissions from sinter strands is to reduce sulphur oxide ($SO_X$) emissions by using one or a combination of the following techniques:**

I. lowering the sulphur input by using coke breeze with a low sulphur content
II. lowering the sulphur input by minimisation of coke breeze consumption
III. lowering the sulphur input by using iron ore with a low sulphur content
IV. injection of adequate adsorption agents into the waste gas duct of the sinter strand before dedusting by bag filter **(see BAT 20)**
V. wet desulphurisation or regenerative activated carbon (RAC) process (with particular consideration for the prerequisites for application).

The **BAT-associated emission level** for sulphur oxides ($SO_X$) using BAT I – IV is <350 – 500 mg/Nm$^3$, expressed as sulphur dioxide ($SO_2$) and determined as a daily mean value, the lower value being associated with BAT IV.
The **BAT-associated emission level** for sulphur oxides ($SO_X$) using BAT V is <100 mg/Nm$^3$, expressed as sulphur dioxide ($SO_2$) and determined as a daily mean value.

**Description of the *RAC process* mentioned under BAT V**

Dry desulphurisation techniques are based on an adsorption of $SO_2$ by activated carbon. When the $SO_2$-laden activated carbon is regenerated, the process is called regenerated activated carbon (RAC). In this case, a high quality, expensive activated carbon type may be used and sulphuric acid ($H_2SO_4$) is yielded as a by-product. The bed is regenerated either with water or thermally. In some cases, for 'fine-tuning' downstream of an existing desulphurisation unit, lignite-based activated carbon is used. In this case, the $SO_2$-laden activated carbon is usually incinerated under controlled conditions.

The RAC system can be developed as a single-stage or a two-stage process.

In the single-stage process, the waste gases are led through a bed of activated carbon and pollutants are adsorbed by the activated carbon. Additionally, $NO_X$ removal occurs when ammonia ($NH_3$) is injected into the gas stream before the catalyst bed.

In the two-stage process, the waste gases are led through two beds of activated carbon. Ammonia can be injected before the bed to reduce $NO_X$ emissions.

**Applicability of techniques mentioned under BAT V**

***Wet desulphurisation:*** The requirements of space may be of significance and may restrict the applicability. High investment and operational costs and significant cross-media effects such as slurry generation and disposal and additional waste water treatment measures, have to be taken into account. This technique is not used in Europe at the time of writing, but might be an option where environmental quality standards are unlikely to be met through the application of other techniques.

***RAC:*** Dust abatement should be installed prior to the RAC process to reduce the inlet dust concentration. Generally the layout of the plant and space requirements are important factors when considering this technique, but especially for a site with more than one sinter strand.

High investment and operational costs, in particular when high quality, expensive, activated carbon types may be used and a sulphuric acid plant is needed, have to be taken into account. This technique is not used in Europe at the time of writing, but might be an option in new plants targeting $SO_X$, $NO_X$, dust and PCDD/F simultaneously and in circumstances where environmental quality standards are unlikely to be met through the application of other techniques.

*The sulphur content of coal charged into the coke ovens is carefully monitored and controlled to ensure a low sulphur content in the coke breeze. The sinter plant fuel rate, including coke breeze consumption, is carefully controlled to limit sulphur loading into the plant and the associated $SO_2$ emissions. Measured concentrations of $SO_2$ over the period 2009 to 2011 have been in the range of 265 mg/Nm$^3$ to 474 mg/Nm$^3$, with an average of 336 mg/Nm$^3$, thereby meeting the BAT-AEL.*

***BAT achieved***

**23. BAT for primary emissions from sinter strands is to reduce total nitrogen oxides ($NO_X$) emissions by using one or a combination of the following techniques:**

**I. process integrated measures which can include:**
- **i. waste gas recirculation**
- **ii. other primary measures, such as the use of anthracite or the use of low- $NO_X$ burners for ignition**

**II. end-of-pipe techniques which can include**
- **i. the regenerative activated carbon (RAC) process**
- **ii. selective catalytic reduction (SCR).**

The **BAT-associated emission level** for nitrogen oxides ($NO_X$) using process integrated measures is <500 mg/Nm$^3$, expressed as nitrogen dioxide ($NO_2$) and determined as a daily mean value.

The **BAT-associated emission level** for nitrogen oxides ($NO_X$) using RAC is <250 mg/Nm$^3$ and using SCR it is <120 mg/Nm$^3$, expressed as nitrogen dioxide ($NO_2$), related to an oxygen content of 15 % and determined as daily mean values.

**Description of *waste gas recirculation* under BAT I.i**

In the partial recycling of waste gas, some portions of the sinter waste gas are recirculated to the sintering process. Partial recycling of waste gas from the whole strand was primarily developed to reduce waste gas flow and thus the mass emissions of major pollutants. Additionally it can lead to a decrease in energy consumption. The application of waste gas recirculation requires special efforts to ensure that the sinter quality and productivity are not affected negatively. Special attention needs to be paid to carbon monoxide (CO) in the recirculated waste gas in order to prevent carbon monoxide poisoning of employees. Various processes have been developed such as:

- partial recycling of waste gas from the whole strand
- recycling of waste gas from the end sinter strand combined with heat exchange
  - recycling of waste gas from part of the end sinter strand and use of waste gas from the sinter cooler
  - recycling of parts of waste gas to other parts of the sinter strand.

**Applicability of BAT I.i**

The applicability of this technique is site specific. Accompanying measures to ensure that sinter quality (cold mechanical strength) and strand productivity are not negatively affected must be considered. Depending on local conditions, these can be relatively minor and easy to implement or, on the contrary, they can be of a more fundamental nature and may be costly and difficult to introduce. In any case, the operating conditions of the strand should be reviewed when this technique is introduced.

In existing plants, it may not be possible to install a partial recycling of waste gas due to space restrictions.

Important considerations in determining the applicability of this technique include:

- initial configuration of the strand (e.g. dual or single wind-box ducts, space available for new equipment and, when required, lengthening of the strand)
- initial design of the existing equipment (e.g. fans, gas cleaning and sinter screening and cooling devices)
- initial operating conditions (e.g. raw materials, layer height, suction pressure, percentage of quick lime in the mix, specific flow rate, percentage of in-plant reverts returned in the feed)
- existing performance in terms of productivity and solid fuel consumption
- basicity index of the sinter and composition of the burden at the blast furnace (e.g. percentage of sinter versus pellet in the burden, iron content of these components).

**Applicability of *other primary measures* under BAT I.ii**

The use of anthracite depends on the availability of anthracites with a lower nitrogen content compared to coke breeze.

**Description and applicability of the *RAC process* under BAT II.i see BAT 22.**

**Applicability of the *SCR* process under BAT II.ii**

SCR can be applied within a high dust system, a low dust system and as a clean gas system. Until now, only clean gas systems (after dedusting and desulphurisation) have been applied at sinter plants. It is essential that the gas is low in dust (<40 mg dust/Nm³) and heavy metals, because they can make the surface of the catalyst ineffective. Additionally, desulphurisation prior to the catalyst might be required. Another prerequisite is a minimum off-gas temperature of about 300 °C. This requires an energy input.

The high investment and operational costs, the need for catalyst revitalisation, $NH_3$ consumption and slip, the accumulation of explosive ammonium nitrate ($NH_4NO_3$), the formation of corrosive $SO_3$ and the additional energy required for reheating which can reduce the possibilities for recovery of sensible heat from the sinter process, all may constrain the applicability. This technique might be an option where environmental quality standards are unlikely to be met through the application of other techniques.

*Measured concentrations of $NO_x$ (2011) have been in the range 253 mg/Nm$^3$ to 367 mg/Nm$^3$ with an average of 303 mg/Nm$^3$, thereby meeting the BAT-AEL.*

***BAT achieved***

**24. BAT for primary emissions from sinter strands is to prevent and/or reduce emissions of polychlorinated dibenzodioxins/furans (PCDD/F) and polychlorinated biphenyls (PCB) by using one or a combination of the following techniques:**

I. avoidance of raw materials which contain polychlorinated dibenzodioxins/furans (PCDD/F) and polychlorinated biphenyls (PCB) or their precursors as much as possible **(see BAT 7)**
II. suppression of polychlorinated dibenzodioxins/furans (PCDD/F) formation by addition of nitrogen compounds
III. waste gas recirculation (**see BAT 23** for description and applicability).

*Studies have shown that raw materials contain very little PCDD/Fs or PCBs so these inputs are limited to naturally occurring amounts and therefore significant inputs are avoided. Urea addition is used at Scunthorpe sinter plant to suppress the formation of PCDD/Fs. Waste gas recirculation is not utilised at Scunthorpe or other UK sinter plants.*

***BAT achieved***

**25. BAT for primary emissions from sinter strands is to reduce emissions of polychlorinated dibenzodioxins/furans (PCDD/F) and polychlorinated biphenyls (PCB) by the injection of adequate adsorption agents into the waste gas duct of the sinter strand before dedusting with a bag filter or advanced electrostatic precipitators when bag filters are not applicable (see BAT 20).**

The **BAT- associated emission level** for polychlorinated dibenzodioxins/furans (PCDD/F) is <0.05 – 0.2 ng I-TEQ/Nm$^3$ for the bag filter and <0.2 – 0.4 ng-I-TEQ/Nm$^3$ for the advanced electrostatic precipitator, both determined for a 6 **–** 8 hour random sample under steady-state conditions.

*Scunthorpe sinter plant is fitted with advanced electrostatic precipitators (ESPs). The average dioxin concentration in 2011 was 1.04 ng I-TEQ/Nm$^3$.*

***BAT not achieved***

*Measures to achieve BAT:*

- *Tata Steel has established a Sinter Plant IED project in the UK to achieve the BAT-AEL by 2016 based on the use of urea addition, injection of adsorbent (activated lignite) into the waste gas stream, and the control of chlorides in the raw sinter blend.*

- *Extensive studies in 2010 - 2011 by Tata Steel showed that the management of chloride content and reverts in the raw sinter blend gave a typical reduction of 50% in PCDD/F emissions, implying that the introduction of appropriate measures would have a significant impact on sinter plant PCDD/F emissions.*

- *A CAPEX plan is being submitted to install a lignite injection system.*

*BAT will be achieved by 2016.*

**26. BAT for secondary emissions from sinter strand discharge, sinter crushing, cooling, screening and conveyor transfer points is to prevent dust emissions and/or to achieve an efficient extraction and subsequently to reduce dust emissions by using a combination of the following techniques:**

I. hooding and/or enclosure
II. an electrostatic precipitator or a bag filter.

The **BAT-associated emission level** for dust is <10 mg/Nm$^3$ for the bag filter and <30 mg/Nm$^3$ for the electrostatic precipitator, both determined as a daily mean value.

*Electrostatic precipitators are currently utilised in the Scunthorpe de-dust system. Measured concentrations (2011) were in the range 15 mg/Nm$^3$ to 113 mg/Nm$^3$ with an average of 33.4 mg/Nm$^3$.*

***BAT not achieved***

*Studies are being undertaken as part of the sinter plant IED project to benchmark the ESP in order to seek performance improvements through measures such as refurbishment of engineering and electrical systems.*

*BAT will be achieved by 2016.*

***Water and waste water***

**27. BAT is to minimise water consumption in sinter plants by recycling cooling water as much as possible unless once-through cooling systems are used.**

*A semi-closed loop recirculation system is used for cooling the ignition hood.*

***BAT achieved***

**28. BAT is to treat the effluent water from sinter plants where rinsing water is used or where a wet waste gas treatment system is applied, with the exception of cooling water prior to discharge by using a combination of the following techniques:**

I. heavy metal precipitation
II. neutralisation
III. sand filtration.

The **BAT-associated emission levels,** based on a qualified random sample or a 24-hour composite sample, are**:**

- suspended solids <30 mg/l
- chemical oxygen demand (COD[1]) <100 mg/l
- heavy metals <0.1 mg/l
  (sum of arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), and zinc (Zn)).

([1]) In some cases, TOC is measured instead of COD (in order to avoid $HgCl_2$ used in the analysis for COD). The correlation between COD and TOC should be elaborated for each sinter plant case by case. The COD/TOC ratio may vary approximately between two and four.

*No water is used for rinsing in the Scunthorpe sinter plant and gas cleaning is achieved using dry electrostatic precipitators, rather than a wet system, such as Airfine. The only waste waters from the sinter plant arise from blowdown from cooling systems. Since neither rinsing nor wet gas treatment processes are used at Scunthorpe sinter plant this BAT is not applicable.*

***BAT not applicable***

***Production residues***

**29. BAT is to prevent waste generation within sinter plants by using one or a combination of the following techniques (see BAT 8):**

I. selective on-site recycling of residues back to the sinter process by excluding heavy metals, alkali or chloride-enriched fine dust fractions (e.g. the dust from the last electrostatic precipitator field)
II. external recycling whenever on-site recycling is hampered.

BAT is to manage in a controlled manner sinter plant process residues which can neither be avoided nor recycled.

*Current practice is to recycle the sinter plant ESP dusts from the first two fields back into the sintering process. Dust from the last ESP field is rich in heavy metals, alkali and chloride and is not recycled to the sinter plant; it is instead formed into waste oxide briquettes (WOBs) and recycled through the BOS plant.*

***BAT achieved***

**30. BAT is to recycle residues that may contain oil, such as dust, sludge and mill scale which contain iron and carbon from the sinter strand and other processes in the integrated steelworks, as much as possible back to the sinter strand, taking into account the respective oil content.**

*Recycling of these materials is maximised as described in the response to BAT 8, subject to the restrictions described in BAT 31.*

***BAT achieved***

**31. BAT is to lower the hydrocarbon content of the sinter feed by appropriate selection and pretreatment of the recycled process residues.**

**In all cases, the oil content of the recycled process residues should be <0.5 % and the content of the sinter feed <0.1 %.**

**Description**

The input of hydrocarbons can be minimised, especially by the reduction of the oil input. Oil enters the sinter feed mainly by addition of mill scale. The oil content of mill scales can vary significantly, depending on their origin.

Techniques to minimise oil input via dusts and mill scale include the following:

- limiting input of oil by segregating and then selecting only those dusts and mill scale with a low oil content
- the use of 'good housekeeping' techniques in the rolling mills can result in a substantial reduction in the contaminant oil content of mill scale
- de-oiling of mill scale by:
  - heating the mill scale to approximately 800 °C, the oil hydrocarbons are volatilised and clean mill scale is yielded; the volatilised hydrocarbons can be combusted.
  - extracting oil from the mill scale using a solvent.

*There are strict controls over materials to be introduced to the sintering process with specific emphasis on oil content which is limited to less than 0.5% in any input materials. From an understanding of the relative contribution of millscale to total sinter feed, it is thereby ensured that the level in the total feed is less than 0.1%.*

***BAT achieved***

## *Energy*

**32. BAT is to reduce thermal energy consumption within sinter plants by using one or a combination of the following techniques:**

I. recovering sensible heat from the sinter cooler waste gas

*The temperature of the sinter cooler waste gas varies significantly along the cooler, with the air from the entry end of the cooler, where sinter temperatures are highest, offering the greatest potential for heat recovery. A proportion of the gas from this part of the cooler is used to preheat the combustion air in the ignition hoods; some of the heat from the sinter cooler is recovered in this way.*

*Recovering further sensible heat in the form of steam to generate additional electricity has been assessed but is not currently economically feasible. For example at Port Talbot, it was estimated that the cost of necessary modifications to the sinter cooler to minimise air leakage would be around £8M and the heat recovery installation itself would cost around £11M (based on experience from Tata Steel in IJmuiden). In addition, a boiler (£2M) and superheater (£2M) would be required to generate steam suitable for electricity generation, thus the total capital cost would be around £23M. Taking into account the cost of blast furnace gas used for superheating and the potential benefit of the steam generated, such as scheme could theoretically show a net profit, but this depends on sufficient electrical generating capacity being available to fully utilise the additional steam produced. Improved energy efficiency across the site and changes in plant configuration (e.g. closure of some mills) over recent years mean that the amount of process gas available for electricity generation has increased and the spare generation capacity to utilise the additional steam from recovering sensible heat from the sinter cooler waste gas is thus insufficient to allow full utilisation. In these circumstances, such a scheme is not economically feasible.*

II. recovering sensible heat, if feasible, from the sintering grate waste gas

*The sintering grate waste gas contains acid gases such as $SO_2$, $SO_3$, NO, $NO_2$, HCl and HF and it is necessary to maintain waste gas temperatures above the dew point to avoid downstream corrosion. This makes heat recovery from these gases infeasible, as is recognised under "Applicability" below. Furthermore, reducing the waste gas temperature would result in a less buoyant plume and less effective dispersion of pollutants from the sinter plant main stack.*

III. maximising the recirculation of waste gases to use sensible heat **(see BAT 23** for description and applicability).

*Recirculation of a proportion of the waste gases back to the sintering process would lower the oxygen content of the gases drawn through the sinter bed which can adversely affect productivity. Waste gas recirculation is not utilised at Scunthorpe or other UK sinter plants.*

**Description**

Two kinds of potentially reusable waste energies are discharged from the sinter plants:

- the sensible heat from the waste gases from the sintering machines
- the sensible heat of the cooling air from the sinter cooler.

Partial waste gas recirculation is a special case of heat recovery from waste gases from sintering machines and is dealt with in BAT 23. The sensible heat is transferred directly back to the sinter bed by the hot recirculated gases. At the time of writing (2010), this is the only practical method of recovering heat from the waste gases.

The sensible heat in the hot air from the sinter cooler can be recovered by one or more of the following ways:

- steam generation in a waste heat boiler for use in the iron and steel works
- hot water generation for district heating
- preheating combustion air in the ignition hood of the sinter plant
- preheating the sinter raw mix
- use of the sinter cooler gases in a waste gas recirculation system.

**Applicability**

At some plants, the existing configuration may make costs of heat recovery from the sinter waste gases or sinter cooler waste gas very high.

The recovery of heat from the waste gases by means of a heat exchanger would lead to unacceptable condensation and corrosion problems.

*The techniques described above have been investigated but the existing configuration makes the costs of heat recovery from the sinter waste gases or sinter cooler waste gas very high. In addition, it is necessary to maintain waste gas temperatures above the dew point to avoid unacceptable corrosion problems, and lowering the waste gas temperature would also lead to less effective dispersion of the sinter plant plume.*

***BAT I achieved as much as economically feasible***

***BAT II not feasible***

***BAT III not applicable***

***Overall – BAT achieved***

## 1.3 BAT Conclusions For Pelletisation Plants

Unless otherwise stated, the BAT conclusions presented in this section can be applied to all pelletisation plants.

***Air emissions***

**33. BAT is to reduce the dust emissions in the waste gases from**

- **the raw materials pre-treatment, drying, grinding, wetting, mixing and the balling;**
- **from the induration strand; and**
- **from the pellet handling and screening**

**by using one or a combination of the following techniques:**

I. an electrostatic precipitator
II. a bag filter
III. a wet scrubber

*This BAT conclusion is not applicable at Scunthorpe Works as no pelletisation plant is operated at this site.*

**34. BAT is to reduce the sulphur oxides ($SO_X$), hydrogen chloride (HCl) and hydrogen fluoride (HF) emissions from the induration strand waste gas by using one of the following techniques:**

I. a wet scrubber
II. semi-dry absorption with a subsequent dedusting system

*This BAT conclusion is not applicable at Scunthorpe Works as no pelletisation plant is operated at this site.*

**35. BAT is to reduce $NO_X$ emissions from the drying and grinding section and induration strand waste gases by applying process-integrated techniques.**

*This BAT conclusion is not applicable at Scunthorpe Works as no pelletisation plant is operated at this site.*

**36. BAT for existing plants is to reduce $NO_X$ emissions from the drying and grinding section and induration strand waste gases by applying one of the following techniques:**

I. selective catalytic reduction (SCR) as an end-of-pipe technique
II. any other technique with a $NO_X$ reduction efficiency of at least 80 %.

*This BAT conclusion is not applicable at Scunthorpe Works as no pelletisation plant is operated at this site.*

**37. BAT for new plants is to reduce $NO_X$ emissions from the drying and grinding section and induration strand waste gases by applying selective catalytic reduction (SCR) as an end-of-pipe technique.**

*This BAT conclusion is not applicable at Scunthorpe Works as no pelletisation plant is operated at this site.*

### *Water and waste water*

**38. BAT for pelletisation plants is to minimise the water consumption and discharge of scrubbing, wet rinsing and cooling water and reuse it as much as possible.**

*This BAT conclusion is not applicable at Scunthorpe Works as no pelletisation plant is operated at this site.*

**39. BAT for pelletisation plants is to treat the effluent water prior to discharge by using a combination of the following techniques:**

I. neutralisation
II. flocculation
III. sedimentation
IV. sand filtration
V. heavy metal precipitation.

*This BAT conclusion is not applicable at Scunthorpe Works as no pelletisation plant is operated at this site.*

### *Production residues*

**40. BAT is to prevent waste generation from pelletisation plants by effective on-site recycling or the reuse of residues (i.e. undersized green and heat-treated pellets)**

**BAT is to manage in a controlled manner pellet plant process residues, i.e. sludge from waste water treatment, which can neither be avoided nor recycled**.

*This BAT conclusion is not applicable at Scunthorpe Works as no pelletisation plant is operated at this site.*

### *Energy*

**41. BAT is to reduce/minimise thermal energy consumption in pelletisation plants by using one or a combination of the following techniques:**

I. process integrated reuse of sensible heat as far as possible from the different sections of the induration strand
II. using surplus waste heat for internal or external heating networks if there is demand from a third party.

*This BAT conclusion is not applicable at Scunthorpe Works as no pelletisation plant is operated at this site.*

## 1.5 BAT Conclusions for Blast Furnaces

Unless otherwise stated, the BAT conclusions presented in this section can be applied to all blast furnaces.

*The following discussion of BAT for blast furnaces relates only to Queen Bess, Queen Anne and Queen Victoria blast furnaces. Queen Mary is currently not used and would have to be significantly upgraded before it could be returned to operation.*

***Air emissions***

**59. BAT for displaced air during loading from the storage bunkers of the coal injection unit is to capture dust emissions and perform subsequent dry dedusting.**

The **BAT-associated emission level** for dust is <20 mg/Nm$^3$, determined as the average over the sampling period (discontinuous measurement, spot samples for at least half an hour).

*There are two coal storage silos for each blast furnace, each with 200t capacity. The top of each silo is equipped with a bag filter.*

*Nitrogen is used to blow coal into the silos (air can be used as a back-up) and the filters screen the displaced nitrogen. The bags are changed regularly, this task being a scheduled activity within the local maintenance planning system. The filters are equipped with pulse-jet cleaning to de-dust the bags and maintain high levels of performance. This prevents the bags from becoming blocked with dust and then over-pressurising the filter. Collected dust is returned to the silo.*

*Although the techniques referred to above are used, it is not practicable to measure emissions from the filters; compliance with the BAT-AEL cannot be quantitatively demonstrated, but there is never a visible discharge from them during silo filling.*

***BAT not achieved***

*Suitable continuous monitors ("policing CEMS") will be installed by 2016 to alert the operators to any adverse emissions from these filters so that faults can be rectified. This will provide better protection of the environment than relying on infrequent discontinuous measurement and BAT will be achieved by 2016.*

**60. BAT for burden preparation (mixing, blending) and conveying is to minimise dust emissions and, where relevant, extraction with subsequent dedusting by means of an electrostatic precipitator or bag filter.**

*The site-wide approach to minimising diffuse dust emissions is detailed in the response to BAT 11, but more details for the blast furnace area are included below.*

*Emissions from burden preparation and conveying have been assessed as part of the Fugitive Emissions Reduction Programme referred to in the response to BAT 11. In general, these sources are not judged to be a high priority for control in comparison to sources elsewhere on the site, though an exception is the operation of the coke screens and subsequent stocking of coke breeze. Dust suppression using water (with or without chemical dosing) is to be investigated to improve control of these operations.*

*Stocked materials and associated screening and conveying activities are subject to inspection and water spraying to reduce dust generation. The main pickup point for the stock* *sinter screening area is protected from wind and has water mist sprays to minimise dust. At the highline storage area, materials fed into bunkers and charging systems are dry and dust is minimised by the controlled application of water sprays. There is a combination of continuous and pre-set automatic sprays initiated when bunker gates are opened to fill transfer cars.*

*Breeze stocking areas are protected from wind.*

*The extensive use of enclosed conveyors and transfer stations reduces the potential for wind to create dust problems. The conveyors are enclosed, with the exception of the mineral collection belts, which are protected from wind due to the position of buildings and walls. Water mist dust suppression sprays are strategically placed on the conveyor systems to reduce dust generation.*

*Scrapers are fitted within the head chute of all conveyors and are regularly checked for effectiveness. An outside contractor collects scrap belting for reclamation.*

*The coke car loading areas under the storage bunkers are equipped with automatic water dust suppression sprays that operate each time a bunker discharges.*

*The existing regime of cladding and other wind protection, in addition to suppression systems, means that dust is in most instances adequately controlled and extraction of emissions and subsequent dedusting is not required.*

***BAT not achieved***

*To achieve BAT, further assessment of the use of water and/or foam suppression systems will be undertaken, particularly in relation to the coke screens and breeze stocking. Schemes will be implemented where appropriate to minimise dust emissions.*

**61. BAT for casting house (tap holes, runners, torpedo ladles charging points, skimmers) is to prevent or reduce diffuse dust emissions by using the following techniques:**

I. covering the runners
II. optimising the capture efficiency for diffuse dust emissions and fumes with subsequent off-gas cleaning by means of an electrostatic precipitator or bag filter
III. fume suppression using nitrogen while tapping, where applicable and where no collecting and dedusting system for tapping emissions is installed.

When using BAT II, the **BAT-associated emission level** for dust is <1 – 15 mg/Nm$^3$, determined as a daily mean value.

*I. Slag and iron runners are covered in all cast houses, with the main iron runners only partially covered.*

*II. Cast houses on all operating furnaces have extraction systems with gas cleaning by means of bag filters. Scunthorpe blast furnaces share a common extraction system and two bag filter plants are used to clean the gases. There is currently no extraction from under covered slag and iron runners, although Queen Anne will be equipped with runner cover extraction at the next reline. There is extraction from all torpedo ladle-charging points.*

*The bag filters are capable of achieving the BAT-AEL. The BAT-AEL is expressed as a daily mean value and only one short-term measurement result over a 9-year history of compliance measurements exceeded the figure associated with a daily average. It can reasonably be concluded that adjusting to a longer-term average, the BAT-AEL would have been achieved consistently.*

| Year | A46 ('old' bag filter) mg/Nm³ | A47 ('new' bag filter) mg/Nm³ |
|---|---|---|
| *2005* | *3.09* | *0.75* |
| *2006* | *n/a* | *n/a* |
| *2007* | *1.63* | *0.95* |
| *2008* | *4.89* | *5.94* |
| *2009* | *3.67* | *n/a* |
| *2010* | *4.67* | *5.75* |
| *2011* | *12.5* | *16.0* |
| *2012* | *9.58* | *11.6* |
| *2013* | *9.10* | *n/a* |
| *Average* | ***6.14*** | ***6.83*** |

*III. Nitrogen suppression is not deemed applicable as tapping emissions are extracted directly from above the tap hole and collection efficiency is generally good. There is an ongoing re-appraisal of taphole clays to ensure that environmental and technical performance is optimised.*

***BAT achieved***

**62. BAT is to use tar-free runner linings.**

*Tar-free runner linings are used wherever it is cost effective to do so, however pitch linings are sometimes purchased. Where this is the case, Tata Steel ensures their use does not compromise the durability of the liner or impact on process operations.*

***BAT not achieved***

*Purchasing of pitch linings is considered in the wider context of Tata Steel's sustainable use of resources, and a progressive move towards tar-free linings is expected to be complete before 2016, therefore meeting BAT.*

**63. BAT is to minimise the release of blast furnace gas during charging by using one or a combination of the following techniques:**

I. bell-less top with primary and secondary equalising
II. gas or ventilation recovery system
III. use of blast furnace gas to pressurise the top bunkers.

**Applicability of BAT II**

Applicable for new plants. Applicable for existing plants only where the furnace has a bell-less charging system. It is not applicable to plants where gases other than blast furnace gas (e.g. nitrogen) are used to pressurise the furnace top bunkers.

*A bell-less top is used at Queen Bess, Queen Anne and Queen Victoria. Each also uses semi-clean blast furnace gas (BFG) to pressurise the top bunkers. As such, BAT is already being met.*

*This notwithstanding, a new system is to be installed at Queen Anne for nitrogen equalisation and this will replace the use of semi clean BFG pressure equalisation for this furnace. There will still be a requirement to provide semi clean BFG as a back up and for routine maintenance.*

*Taking the following assumptions* *15 cycles per hour*
*16,200 Nm³/hr for 10 seconds*
*616 Nm³/hr for 150 seconds*

*Total gas per cycle = 16,200 x 10/3600 + 616 x 150/3600*
*= 45 Nm³ + 26Nm³*
*= 71 Nm³ per cycle*

*Thus implementing nitrogen equalisation will remove = 1065 Nm³/hour of semi clean gas released.*

*Semi clean gas contains approximately 2 g/m³ particulates and nitrogen equalisation would result in an improvement from this process of approximately 18.7 t/year.*

***BAT achieved***

**64. BAT is to reduce dust emissions from the blast furnace gas by using one or a combination of the following techniques:**

I. using dry prededusting devices such as:
   i. deflectors
   ii. dust catchers
   iii. cyclones
   iv. electrostatic precipitators.
II. subsequent dust abatement such as:
   i. hurdle-type scrubbers
   ii. venturi scrubbers
   iii. annular gap scrubbers
   iv. wet electrostatic precipitators
   v. disintegrators.

For cleaned blast furnace (BF) gas, the residual dust concentration associated with **BAT** is <10 mg/Nm$^3$, determined as the average over the sampling period (discontinuous measurement, spot samples for at least half an hour).

*All furnaces are equipped with dust catchers to dry dedust the blast furnace gas prior to further dust removal. The recovered flue-dust is returned for use in the sinter plant.*

*Subsequent dust abatement of blast furnace gas is undertaken using a wet scrubbing system. Solids are removed from the gas cleaning waters in clarifiers and the resultant material is recovered, with the supernatant material being re-circulated (see BAT 8 response for more information).*

*The measurement of dust concentrations in cleaned BF gas is difficult to achieve owing to safety concerns when attempting to measure in a positively pressurised gas stream containing approximately 22% carbon monoxide. Although it is not recommended to perform them on a regular basis, experienced personnel using personal protective equipment such as breathing apparatus have attempted measurements in the past for commissioning purposes. Following the reline of Queen Anne, measurements will be taken of particulates in the cleaned gas for commissioning purposes and these should provide some confidence that the BAT-AEL is achieved.*

*An estimate of current particulate levels in BF gas can be made by looking at particulate levels in combustion processes fired on BF gas. The blast furnace stoves are fired on BF* *gas during normal operation and have over the last 9 years averaged approximately 3 mg/Nm³ of particulate in the waste gas, related to 3% oxygen.*

*Assuming BF gas comprises roughly 50% $N_2$, 23% $CO_2$, 22% CO and 5% $H_2$, then combustion with enough excess air to give 3% oxygen in the waste gases requires 0.891 m³ air per m³ of BF gas and gives 1.706 m³ dry waste gas. Therefore if the dust concentration in the waste gas is 3 mg/Nm³ at 3% $O_2$, dry, and it's assumed that all that dust was originally contained in the BF gas, the dust concentration in the BF gas would have been 3 x 1.706 = 5.1 mg/Nm³. If some of the dust in the waste gas is soot from incomplete combustion, then the amount in the BF gas would need to be lower, so 5.1 mg/Nm³ represents an upper bound to the level in the cleaned BF gas.*

*Even allowing for uncertainty in measuring dust in the waste gas, variation in BF gas composition and so on, this is sufficiently far below the BAT level of 10 mg/Nm³ to show that the current blast furnace gas cleaning system is achieving the BAT-AEL.*

*Other than the commissioning trials following a blast furnace reline, it is proposed to use dust emissions from blast furnace stoves as a surrogate for measuring dust concentrations in the blast furnace gas itself.*

***BAT achieved***

**65. BAT for hot blast stoves is to reduce emissions by using desulphurised and dedusted surplus coke oven gas, dedusted blast furnace gas, dedusted basic oxygen furnace gas and natural gas, individually or in combination.**

The **BAT-associated emission levels**, determined as daily mean values related to an oxygen content of 3 %, are:

- sulphur oxides ($SO_x$) expressed as sulphur dioxide ($SO_2$) <200 mg/Nm$^3$
- dust<10 mg/Nm$^3$
- nitrogen oxides ($NO_x$), expressed as nitrogen dioxide ($NO_2$) <100 mg/Nm$^3$.

*The stoves are fired exclusively on dedusted blast furnace gas and the results presented below pertain to measurements on the stoves since 2005. The BAT-AEL is expressed as a daily mean value but since all the short-term measurement results over a 9-year history of compliance measurements were below the figure associated with a daily average, it can reasonably be concluded that adjusting to a longer-term average, the BAT-AEL would have been achieved consistently.*

| *Year* | *$NO_X$* | *$SO_2$* | *PM* |
|---|---|---|---|
| | *mg/Nm³* | *mg/Nm³* | *mg/Nm³* |
| *2005* | *6* | *48* | *4.3* |
| *2006* | *4* | *53* | *n/a* |
| *2007* | *6* | *36* | *1.8* |
| *2008* | *7* | *96* | *8.4* |
| *2009* | *4* | *79* | *0.84* |
| *2010* | *5* | *106* | *0.24* |
| *2011* | *5* | *84* | *2.35* |
| *2012* | *9* | *87* | *n/a* |
| *2013** | *8* | *74* | *0.66* |
| *Average* | ***6*** | ***74*** | ***2.66*** |

**up to Q2*

***BAT achieved***

### *Water and waste water*

**66. BAT for water consumption and discharge from blast furnace gas treatment is to minimise and to reuse scrubbing water as much as possible, e.g. for slag granulation, if necessary after treatment with a gravel-bed filter.**

*Scrubbing water is processed in clarifiers (for Queen Anne and Queen Victoria, which are on a common scrubber water system, there are 3 clarifiers). Supernatant water from these is re-circulated into the scrubbing system and is additionally used in slag granulation, where there is an evaporative loss from the system and a controlled fresh-water make up to maintain water chemistry within the system.*

***BAT achieved***

**67. BAT for treating waste water from blast furnace gas treatment is to use flocculation (coagulation) and sedimentation and the reduction of easily released cyanide, if necessary.**

The **BAT-associated emission levels,** based on a qualified random sample or a 24-hour composite sample, are:

- suspended solids <30 mg/l
- iron <5 mg/l
- lead <0.5 mg/l
- zinc <2 mg/l
- cyanide ($CN^-$), easily released ([1]) <0.4 mg/l.

([1]) This level is based on the use of the DIN 38405 D 13-2 or any other national or international standard that ensures the provision of data of an equivalent scientific quality.

*Blast furnace gas cleaning water is discharged to clarifiers where the solids settle out. The clarified water is pumped to a cooling tower for recycling via the reservoir and the sludge from the clarifiers is treated in a bank of hydrocyclones. The hydrocyclone overflow is pumped to the BF/BOS slurry lagoons where further settlement is allowed. The hydrocyclone underflow is recycled via the sinter plant. This process is capable of achieving the BAT-AELs for suspended solids, iron, zinc and lead. Cyanide has not been measured in the hydrocyclone overflow, though measurements at the final discharge point (W1) demonstrate that the BAT-AEL is achieved at that point.*

***BAT achieved***

### *Production residues*

**68. BAT is to prevent waste generation from blast furnaces by using one or a combination of the following techniques:**

I. appropriate collection and storage to facilitate a specific treatment
II on-site recycling of coarse dust from the blast furnace (BF) gas treatment and dust from the cast house dedusting, with due regard for the effect of emissions from the plant where it is recycled
III. hydrocyclonage of sludge with subsequent on-site recycling of the coarse fraction (applicable whenever wet dedusting is applied and where the zinc content distribution in the different grain sizes allows a reasonable separation)

IV. slag treatment, preferably by means of granulation (where market conditions allow for it), for the external use of slag (e.g. in the cement industry or for road construction).

**BAT is to manage in a controlled manner blast furnace process residues which can neither be avoided nor recycled.**

*I. The main residual materials arising are the two separate fractions from the sludge hydrocyclone. The underflow is returned as a raw material to the sinter plant for incorporation into sinter beds. It is moist and doesn't present a risk in terms of diffuse emissions to air. The fine overflow material goes to a filter press with removal of the solids as a filter cake that is then sold into the cement industry as iron oxide for trimming cement kiln chemistry. Another residual material is cast house extraction unit filter dust. This too is stored safely and returned as a raw material to the sinter plant.*

*II. All dust from the dustcatcher is recovered and transported for use in the sinter plant.*

*III. Hydrocyclones are used for processing of all blast furnace sludge at Scunthorpe.*

*IV. Slag granulation is the preferred route for slag treatment at Scunthorpe. In practice, it is not possible to achieve 100% granulation as a result of unavoidable granulator outages (scheduled and unscheduled maintenance), and on occasions when slag is diverted for safety reasons, including high slag temperature. All slag that is not granulated is air-cooled. Granulated slag is supplied to an on-site third party for grinding into a cement and air-cooled slag is subject to metal recovery and other processing for use as an aggregate.*

*On occasion, material must be temporarily stockpiled because of imbalances between the rates of generation and consumption. The inherent moisture content of such stockpiles is such that diffuse dust emissions are well controlled. Stockpiling to facilitate later recovery is deemed BAT and constitutes a better environmental outcome than disposal.*

***BAT achieved***

**69. BAT for minimising slag treatment emissions is to condense fume if odour reduction is required.**

*Odour reduction is not required and fully condensing granulation is not deemed to be relevant.*

***BAT not applicable***

***Resource management***

**70. BAT for resource management of blast furnaces is to reduce coke consumption by directly injected reducing agents, such as pulverised coal, oil, heavy oil, tar, oil residues, coke oven gas (COG), natural gas and wastes such as metallic residues, used oils and emulsions, oily residues, fats and waste plastics individually or in combination.**

**Applicability**

***Coal injection:*** The method is applicable to all blast furnaces equipped with pulverised coal injection and oxygen enrichment.

***Gas injection:*** Tuyère injection of coke oven gas (COG) is highly dependent upon the availability of the gas that may be effectively used elsewhere in the integrated steelworks.

***Plastic injection:*** It should be noted that this technique is highly dependent on the local circumstances and market conditions. Plastics can contain Cl and heavy metals like Hg, Cd, Pb and Zn. Depending on the composition of the wastes used (e.g. shredder light fraction), the amount of Hg, Cr, Cu, Ni and Mo in the BF gas may increase.

***Direct injection of used oils, fats and emulsions as reducing agents and of solid iron residues:*** The continuous operation of this system is reliant on the logistical concept of delivery and the storage of residues. Also, the conveying technology applied is of particular importance for a successful operation.

*All blast furnaces at Scunthorpe are equipped with granular coal injection and oxygen enrichment.*

***BAT achieved***

***Energy***

**71. BAT is to maintain a smooth, continuous operation of the blast furnace at a steady state to minimise releases and to reduce the likelihood of burden slips.**

*Furnace operation is monitored constantly using electronic instrumentation. A display is provided on a VDU in the manned control room. Burden descent is closely monitored to prevent slippage. If required, action is taken by reducing the blast volume when it is seen that a furnace has stopped descending. This action can affect burden movement and prevent an impending slip. Occasionally, however, the burden can slip without warning. Any and all burden slips are subject to investigation and corrective action planning.*

***BAT achieved***

**72. BAT is to use the extracted blast furnace gas as a fuel.**

*Blast furnace gas is used wherever possible, primarily in the blast furnace stoves, the Turbo Blower House and the Central Power Station. Flaring is monitored constantly and efforts are taken to minimise this; the future application of a state-of-the-art predictive control system (ISOLDE) will further minimise losses through flaring (see BAT 3).*

***BAT achieved***

**73. BAT is to recover the energy of top blast furnace gas pressure where sufficient top gas pressure and low alkali concentrations are present.**

**Applicability**

Top gas pressure recovery can be applied at new plants and in some circumstances at existing plants, albeit with more difficulties and additional costs. Fundamental to the application of this technique is an adequate top gas pressure in excess of 1.5 bar gauge.

At new plants, the top gas turbine and the blast furnace (BF) gas cleaning facility can be adapted to each other in order to achieve a high efficiency of both scrubbing and energy recovery.

*The working top gas pressure for Scunthorpe blast furnaces is insufficient (the three operational furnaces all have a working top gas pressure of 0.8 bar), therefore top gas energy recovery is not applicable.*

*BAT achieved*

**74. BAT is to preheat the hot blast stove fuel gases or combustion air using the waste gas of the hot blast stove and to optimise the hot blast stove combustion process.**

**Description**

For optimisation of the energy efficiency of the hot stove, one or a combination of the following techniques can be applied:

- the use of a computer-aided hot stove operation
- preheating of the fuel or combustion air in conjunction with insulation of the cold blast line and waste gas flue
- use of more suitable burners to improve combustion
- rapid oxygen measurement and subsequent adaptation of combustion conditions.

**Applicability**

The applicability of fuel preheating depends on the efficiency of the stoves as this determines the waste gas temperature (e.g. at waste gas temperatures below 250 °C, heat recovery may not be a technically or economically viable option).

The implementation of computer-aided control could require the construction of a fourth stove in the case of blast furnaces with three stoves (if possible) in order to maximise benefits.

*Each furnace has four hot blast stoves operated in a computer-controlled, staggered parallel, automatic system. This enables maximum hot blast temperature to be achieved continuously without the need to bleed cold blast into the flow, maximising efficiency.*

*Preheating of the fuel or combustion air is not feasible as the waste gas temperature after passing through the stove chequerwork is typically below 250°C (though it varies through the heating cycle), making further heat recovery uneconomic.*

*Stoves are equipped with individual waste gas analysers to ensure that maximum combustion efficiency is maintained.*

*BAT achieved*

## 1.6 BAT Conclusions For Basic Oxygen Steelmaking And Casting

Unless otherwise stated, the BAT conclusions presented in this section can be applied to all basic oxygen steelmaking and casting.

***Air emissions***

**75. BAT for basic oxygen furnace (BOF) gas recovery by suppressed combustion is to extract the BOF gas during blowing as much as possible and to clean it by using the following techniques in combination:**

I use of a suppressed combustion process

II. prededusting to remove coarse dust by means of dry separation techniques (e.g. deflector, cyclone) or wet separators

III. dust abatement by means of:
   i. dry dedusting (e.g. electrostatic precipitator) for new and existing plants
   ii. wet dedusting (e.g. wet electrostatic precipitator or scrubber) for existing plants.

The residual dust concentrations associated with **BAT**, after buffering the BOF gas, are:

- 10 – 30 mg/Nm$^3$ for BAT III.i
- <50 mg/Nm$^3$ for BAT III.ii.

*I. The BOS off-gas (OG) system is designed to collect and clean the gas arising, and this involves scrubbing a substantially uncombusted gas. To minimise gas volume and temperature, and allow export via gas recovery of a sufficiently rich fuel gas, combustion of carbon monoxide within the hood is suppressed by reducing the ingress of air by lowering the skirt to reduce the air gap between the vessel top and the hood.*

*Ingress of air is further reduced by controlling the hood pressure by hydraulically adjusting the throat of the Pease Anthony (PA) venturi, or in the case of hydraulic failure by a nitrogen accumulator, so that the pressure within the hood above the converter is maintained similar to atmospheric pressure. The gas then drawn off by the induced draught (ID) fan matches that produced in the converter.*

*II. As the gas leaves the hood section, it is cooled by evaporation of water sprays, before passing through two parallel saturation quencher venturis for initial cleaning. Venturi inlet throat sprays ensure the gas stream is saturated with water vapour.*

*III. Excess water is removed as an effluent in the guides of the quencher venturi separating elbow, and the gas is pre-conditioned by the upper PA venturi sprays before passing through the variable PA venturi. The PA venturi completes the gas cleaning stage and gas either enters the gas recovery system or is flared to atmosphere.*

*The residual particulate concentration of cleaned BOS gas is not measured primarily for safety reasons. After buffering the gas, which contains in excess of 50% carbon monoxide, is under positive pressure, making measurement impracticable. The BOS gas is never combusted in isolation, but rather as a component of mixed enhanced gas (MEG). Particulate concentrations in combustion systems firing MEG are not measured and no comparison with the BAT-associated standard can be made even though the BAT techniques are applied.*

***BAT achieved***

**76. BAT for basic oxygen furnace (BOF) gas recovery during oxygen blowing in the case of full combustion is to reduce dust emissions by using one of the following techniques:**

I. dry dedusting (e.g. ESP or bag filter) for new and existing plants
II. wet dedusting (e.g. wet ESP or scrubber) for existing plants.

The **BAT-associated emission levels** for dust, determined as the average over the sampling period (discontinuous measurement, spot samples for at least half an hour), are:

- 10 – 30 mg/Nm$^3$ for BAT I
- <50 mg/Nm$^3$ for BAT II.

***BAT not applicable*** *as suppressed combustion is used – see response to BAT 75*

**77. BAT is to minimise dust emissions from the oxygen lance hole by using one or a combination of the following techniques:**

I. covering the lance hole during oxygen blowing

*The lance hole is covered during oxygen blowing.*

II. inert gas or steam injection into the lance hole to dissipate the dust

*A nitrogen purge system is used to ensure the seal.*

III. use of other alternative sealing designs combined with lance cleaning devices.

*The techniques described for BAT I and BAT II are adequate to minimise dust emissions from the oxygen lance hole.*

***BAT I achieved***

***BAT II achieved***

***BAT III not used***

***Overall – BAT achieved***

**78. BAT for secondary dedusting, including the emissions from the following processes:**

- reladling of hot metal from the torpedo ladle (or hot metal mixer) to the charging ladle
- hot metal pretreatment (i.e. the preheating of vessels, desulphurisation, dephosphorisation, deslagging, hot metal transfer processes and weighing)
- BOF-related processes like the preheating of vessels, slopping during oxygen blowing, hot metal and scrap charging, tapping of liquid steel and slag from BOF and
- secondary metallurgy and continuous casting,

**is to minimise dust emissions by means of process integrated techniques, such as general techniques to prevent or control diffuse or fugitive emissions, and by using appropriate enclosures and hoods with efficient extraction and a subsequent off-gas cleaning by means of a bag filter or an ESP.**

The overall average dust collection efficiency associated with **BAT** is >90 %

The **BAT-associated emission level** for dust, as a daily mean value, for all dedusted off-gases is <1 – 15 mg/Nm$^3$ in the case of bag filters and <20 mg/Nm$^3$ in the case of electrostatic precipitators.

If the emissions from hot metal pretreatment and the secondary metallurgy are treated separately, the **BAT-associated emission level** for dust, as a daily mean value, is <1 – 10 mg/Nm$^3$ for bag filters and <20 mg/Nm$^3$ for electrostatic precipitators.

**Description**

General techniques to prevent diffuse and fugitive emissions from the relevant BOF process secondary sources include:

- independent capture and use of dedusting devices for each subprocess in the BOF shop
- correct management of the desulphurisation installation to prevent air emissions
- total enclosure of the desulphurisation installation
- maintaining the lid on when the hot metal ladle is not in use and the cleaning of hot metal ladles and removal of skulls on a regular basis or alternatively apply a roof extraction system
- maintaining the hot metal ladle in front of the converter for approximately two minutes after putting the hot metal into the converter if a roof extraction system is not applied
- computer control and optimisation of the steelmaking process, e.g. so that slopping (i.e. when the slag foams to such an extent that it flows out of the vessel) is prevented or reduced
- reduction of slopping during tapping by limiting elements that cause slopping and the use of anti-slopping agents
- closure of doors from the room around the converter during oxygen blowing
- continuous camera observation of the roof for visible emission
- the use of a roof extraction system.

**Applicability**

In existing plants, the design of the plant may restrict the possibilities for proper evacuation.

*Process-integrated measures are used extensively to minimise dust emissions into the BOS shop, including a focus on "right first time", which reduces the number of ladle decants necessary. Other measures include documented procedures for vessel charging, the prevention of slopping during blowing and thermal imaging of ladles.*

*A secondary ventilation system is used to capture fume escaping from the hood in the area around the converters during charging and blowing, and to capture any fumes generated during tapping and stirring. The secondary ventilation system also serves to clear the tower block building of any fume not collected at source within the building.*

*Low-level extraction consists of hoods enclosing each of the three converters to collect fume generated during charging and tapping. These include enclosure doors to allow the hoods to assist with fume collection during blowing. Two fans, east and west serve the low-level extraction.*

*The East secondary ventilation fan, which is fitted for variable speed operation, feeds into the ducting at roof level, where collected fumes combine with those from the roof ventilation system. The electrostatic precipitator comprises two main zones with four fields per zone. If one zone were to fail then precipitation would continue on the other zone. The cleaned gas is then discharged via eight fans into the atmosphere (A57/1 to A57/8).*

*The West secondary ventilation comprises a fixed speed fan drawing emissions through a wet scrubber and discharging through a stack (A58). The fume and dust are scrubbed in a rectangular venturi and the wetted particulates are separated via a centrifugal elbow separator and impingement mist eliminator. The cleaned fume then passes through the extraction fan and is discharged via a stack with two impingement demisters. It should be noted that this emission point is now only used when the East secondary vent is unavailable.*

*Roof level extraction consists of twenty-two ventilation ports that are situated along the south side of the tower block building above the "smoke hole." Fumes from both high level and east fan low level extraction combine and are drawn through the electrostatic precipitator using eight fans.*

*The other components of the secondary ventilation system are as follows:*

- *Hot metal pour and hot metal desulphurisation are served by an extraction system that vents via a fabric filter (A61).*
- *An extraction system is provided for ladle to ladle decant, fitted with a fabric filter (A78).*
- *Two discrete extraction systems are in place for ladle arc furnaces (LAF). LAF#3 has its own system (A81) whereas LAFs #1 and #2 share a system (A59). These are all equipped with fabric filters.*

*The table below summarises the performance level achieved in each system:*

| *Stack Ref* | *Process Served* | *Abatement Technique* | *BAT-AEL (mg/Nm³, daily mean)* | *Current ELV (mg/Nm³, spot sample)* | *Measured emission (mg/Nm³, average of spot samples, 2010-2012)* | *Average monitoring result (mg/Nm³, continuous monitoring, 2013 to date)* | *BAT achieved?* |
|---|---|---|---|---|---|---|---|
| *A57* | *East secondary vent* | *Electrostatic precipitator* | *20* | *20* | *7.52* | *6.06* | *YES* |
| *A58* | *West secondary vent* | *Venturi wet scrubber* | *-* | *20* | *25.4* | *No CEM* | *No relevant BAT-AEL* |
| *A61* | *Hot metal pour/ desulphurisation* | *Bag filter* | *15* | *20* | *2.08* | *1.9* | *YES* |
| *A78* | *Steel/slag ladle decant* | *Bag filter* | *10* | *5* | *2.88* | *0.01* | *YES* |
| *A59* | *Lade Arc Furnaces 1&2* | *Bag filter* | *10* | *25* | *6.83* | *3.71* | *YES* |
| *A81* | *Lade Arc Furnace 3* | *Bag filter* | *10* | *25* | *4.11* | *0.1* | *YES* |

*The overall average dust collection efficiency at the BOS plant has been assessed by comparing estimated dust emissions with the total amount of dust captured by the extraction systems. In 2011, 43,356 tonnes of dust were captured in the primary wet scrubbers and 9,974 tonnes in the secondary abatement systems – a total of 53,330 tonnes. A measurement exercise in 2005 concluded that roof emissions averaged 140 g/tonne liquid steel, so taking the 2011 liquid steel production (3.4 M tonnes) gives an estimated fugitive release of 476 tonnes, and a further 174 tonnes was released from the permitted emission points – a total release of 650 tonnes. The overall dust collection efficiency is thus:*

$$1 - {}^{650}/_{(53,330 + 650)} = 98.8\%$$ *, which exceeds the BAT-associated standard of 90%.*

***BAT achieved***

**79. BAT for on-site slag processing is to reduce dust emissions by using one or a combination of the following techniques:**

I. efficient extraction of the slag crusher and screening devices with subsequent off-gas cleaning, if relevant

II transport of untreated slag by shovel loaders

III. extraction or wetting of conveyor transfer points for broken material
IV. wetting of slag storage heaps
V. use of water fogs when broken slag is loaded.

The **BAT-associated emission level** for dust in the case of using BAT I is <10 – 20 mg/$Nm^3$, determined as the average over the sampling period (discontinuous measurement, spot samples for at least half an hour).

*Slag ladles are filled from the steelmaking vessel after tapping. The slag ladle is lifted and tipped by overhead crane into purpose built and prepared slag pits. A procedure is established to tip the slag safely and to quench it to achieve a cooling regime that ensures it meets product specifications. After quenching, it is loaded using shovel loaders and hauled along works roads to Yarborough Metal Recovery Plant. Additional abatement is provided by spraying the haul routes with water in dry weather. Fog cannons have been installed, but commissioning has not been completed pending investigation of noise impacts associated with their use.*

*Further slag processing is carried out by third parties on neighbouring ring fenced sites operated under different permits owned by the contractors. Thus this part of the BAT assessment is not applicable to Tata Steel Scunthorpe.*

***BAT achieved***

***Water and waste water***

**80. BAT is to prevent or reduce water use and waste water emissions from primary dedusting of basic oxygen furnace (BOF) gas by using one of the following techniques as set out in BAT 75 and BAT 76:**

**- dry dedusting of basic oxygen furnace (BOF) gas;**
**- minimising scrubbing water and reusing it as much as possible (e.g. for slag granulation) in case wet dedusting is applied.**

*BOS scrubbing water is treated in clarifiers, with the collected sludge being processed in a filter press and the overflow water being re-circulated as scrubbing water.*

***BAT achieved***

**81. BAT is to minimise the waste water discharge from continuous casting by using the following techniques in combination:**

I. the removal of solids by flocculation, sedimentation and/or filtration
II. the removal of oil in skimming tanks or any other effective device
III. the recirculation of cooling water and water from vacuum generation as much as possible.

The **BAT-associated emission levels,** based on a qualified random sample or a 24-hour composite sample, for waste water from continuous casting machines are:

- suspended solids <20 mg/l
- iron <5 mg/l
- zinc <2 mg/l
- nickel <0.5 mg/l
- total chromium <0.5 mg/l
- total hydrocarbons <5 mg/l

*Wastewater from casting and vacuum generation is processed using clarifiers. Overflow water is further polished in a sand filtration unit. Finally, any residual oil is removed before the water is re-circulated. The system only needs to be blown down when turbidity, conductivity and/or chlorine levels exceed defined set-points. These parameters are subject to regular monitoring.*

*Wastewater from the casting area is discharged through two points, W4 and W6. Although suspended solids levels in excess of 20 mg/l have been recorded on some occasions, these occur following heavy rain and are associated with surface water run-off, rather than as a result of inadequate treatment of process waste waters. Not all of the parameters for which BAT-AELs are given are routinely monitored and so it not possible to guarantee that the current techniques achieve BAT without further data.*

*Tata Steel met with the Environment Agency on 1st August 2013 to discuss future monitoring requirements, including the possibility of separate dry weather and wet weather consents to account for the impact of site run-off on suspended solids levels in W4 and W6.*

***BAT not achieved***

*Tata Steel will change the procedures for sampling and analysis of waste water discharges in the light of a meeting with the Environment Agency on 1st August 2013 and an exercise will be undertaken to understand more fully the performance level of the casting area effluent treatment processes to confirm conformance with the BAT-AELs by 2016.*

### *Production residues*

**82. BAT is to prevent waste generation by using one or a combination of the following techniques (see BAT 8):**

I. appropriate collection and storage to facilitate a specific treatment
II. on-site recycling of dust from basic oxygen furnace (BOF) gas treatment, dust from secondary dedusting and mill scale from continuous casting back to the steelmaking processes with due regard for the effect of emissions from the plant where they are recycled
III. on-site recycling of BOF slag and BOF slag fines in various applications
IV. slag treatment where market conditions allow for the external use of slag (e.g. as an aggregate in materials or for construction)
V. use of filter dusts and sludge for external recovery of iron and non-ferrous metals such as zinc in the non-ferrous metals industry
VI. use of a settling tank for sludge with the subsequent recycling of the coarse fraction in the sinter/blast furnace or cement industry when grain size distribution allows for a reasonable separation.

**Applicability of BAT V**

Dust hot briquetting and recycling with recovery of high zinc concentrated pellets for external reuse is applicable when a dry electrostatic precipitation is used to clean the BOF gas. Recovery of zinc by briquetting is not applicable in wet dedusting systems because of unstable sedimentation in the settling tanks caused by the formation of hydrogen (from a reaction of metallic zinc and water). Due to these safety reasons, the zinc content in the sludge should be limited to 8 – 10 %.

**BAT is to manage in a controlled manner basic oxygen furnace process residues which can neither be avoided nor recycled**.

*See also response to BAT 8.*

*BOS filter cake (residue from waste gas treatment) is made into waste oxide briquettes (WOBs) which are re-charged as a raw material into the BOS process. All caster scale is returned directly to the sinter plant, as is black sand – the coarse component resulting from scrubber water treatment.*

*Any excess BOS filter cake is recovered off-site by a third party (for example, by the cement sector).*

*Slag production is minimised through effective process control (optimised flux additions) and unavoidably produced slag is processed by de-metalling, grading and weathering to form an aggregate product that is marketed externally by a third party (Lafarge Tarmac). A slag debris stream is generated within the plant and this too is processed by de-metalling. Fine fractions from this processing are used within the BOS process as a flux (lime) substitute. Metal fines from de-metalling are processed in the sinter plant.*

***BAT achieved***

### *Energy*

**83. BAT is to collect, clean and buffer BOF gas for subsequent use as a fuel.**

**Applicability**

In some cases, it may not be economically feasible or, with regard to appropriate energy management, not feasible to recover the BOF gas by suppressed combustion. In these cases, the BOF gas may be combusted with the generation of steam. The kind of combustion (full or suppressed combustion) depends on local energy management.

*See also response to BAT 3.*

*BOS gas is collected and cleaned for use as a fuel elsewhere within the installation.*

***BAT achieved***

**84. BAT is to reduce energy consumption by using ladle-lid systems.**

**Applicability**

The lids can be very heavy as they are made out of refractory bricks and therefore the capacity of the cranes and the design of the whole building may constrain the applicability in existing plants. There are different technical designs for implementing the system into the particular conditions of a steel plant.

*Ladle lid systems are employed on all the casters at Scunthorpe. These help maintain the desired thermal profile in the ladle and reduce back-end temperature drops.*

***BAT achieved***

**85. BAT is to optimise the process and reduce energy consumption by using a direct tapping process after blowing.**

**Description**

Direct tapping normally requires expensive facilities like sub-lance or DROP IN sensor-systems to tap without waiting for a chemical analysis of the samples taken (direct tapping). Alternatively, a new technique has been developed to achieve direct tapping without such facilities. This technique requires a lot of experience and developmental work. In practice, the carbon is directly blown down to 0.04 % and simultaneously the bath temperature decreases to a reasonably low target. Before tapping, both the temperature and oxygen activity are measured for further actions.

**Applicability**

A suitable hot metal analyser and slag stopping facilities are required and the availability of a ladle furnace facilitates implementation of the technique.

*A rapid analysis system has been developed which gives a sample that requires no further processing before analysis. Slag darts are used for slag stopping, and there are three ladle furnaces in the Scunthorpe BOS plant.*

*Normal procedure is that a sub-lance sample is taken during each blow to determine the progress of the blow compared to the final specification and a second sample is taken at the end of the blow. A statistical technique called case-based reasoning has been used to develop a "quick tap" model to predict, based on the in-blow sample analysis, subsequent processing history of the current blow and previous refining history on the vessel in question, whether the furnace can be tapped without waiting for the full analysis of the end-blow sample, in which case tapping occurs 1 to 1½ minutes after the end of the blow (equivalent to direct tapping as described above). In some cases, the quick tap model does not give sufficient certainty to allow direct tapping, and in these instances tapping is delayed until the end-blow sample results have been received.*

*Direct tapping is undertaken whenever feasible as determined by the quick tap model.*

***BAT achieved***

**86. BAT is to reduce energy consumption by using continuous near net shape strip casting, if the quality and the product mix of the produced steel grades justify it.**

**Description**

Near net shape strip casting means the continuous casting of steel to strips with thicknesses of less than 15 mm. The casting process is combined with the direct hot rolling, cooling and coiling of the strips without an intermediate reheating furnace used for conventional casting techniques, e.g. continuous casting of slabs or thin slabs. Therefore, strip casting represents a technique for producing flat steel strips of different widths and thicknesses of less than 2 mm.

**Applicability**

The applicability depends on the produced steel grades (e.g. heavy plates cannot be produced with this process) and on the product portfolio (product mix) of the individual steel plant. In existing plants, the applicability may be constrained by the layout and the available space as e.g. retrofitting with a strip caster requires approximately 100 m in length.

*This is not applicable, as Scunthorpe does not make strip products. Nevertheless, Caster #5 was commissioned to circumvent the need for the bloom and billet mill (BBM), which has now been decommissioned. As a result, the Rod Mill feedstock is directly cast material. Scunthorpe's downstream operations are now fed with directly cast material that is tailored to the desired final product (e.g. plate, rod, rail, medium sections, special profiles etc.)*

***BAT not applicable***

## 1.7 BAT Conclusions For Electric Arc Furnace Steelmaking And Casting

Unless otherwise stated, the BAT conclusions presented in this section can be applied to all electric arc furnace steelmaking and casting.

***Air emissions***

**87. BAT for the electric arc furnace (EAF) process is to prevent mercury emissions by avoiding, as much as possible, raw materials and auxiliaries which contain mercury (see BAT 6 and 7).**

*This BAT conclusion is not applicable at Scunthorpe Works as no electric arc furnace is operated at this site.*

**88. BAT for the electric arc furnace (EAF) primary and secondary dedusting (including scrap preheating, charging, melting, tapping, ladle furnace and secondary metallurgy) is to achieve an efficient extraction of all emission sources by using one of the techniques listed below and to use subsequent dedusting by means of a bag filter:**

I. a combination of direct off-gas extraction (4th or 2nd hole) and hood systems
II. direct gas extraction and doghouse systems
III. direct gas extraction and total building evacuation (low-capacity electric arc furnaces (EAF) may not require direct gas extraction to achieve the same extraction efficiency).

*This BAT conclusion is not applicable at Scunthorpe Works as no electric arc furnace is operated at this site.*

**89. BAT for the electric arc furnace (EAF) primary and secondary dedusting (including scrap preheating, charging, melting, tapping, ladle furnace and secondary metallurgy) is to prevent and reduce polychlorinated dibenzodioxins/furans (PCDD/F) and polychlorinated biphenyls (PCB) emissions by avoiding, as much as possible, raw materials which contain PCDD/F and PCB or their precursors (see BAT 6 and 7) and using one or a combination of the following techniques, in conjunction with an appropriate dust removal system:**

I. appropriate post-combustion
II. appropriate rapid quenching
III. injection of adequate adsorption agents into the duct before dedusting.

*This BAT conclusion is not applicable at Scunthorpe Works as no electric arc furnace is operated at this site.*

**90. BAT for on-site slag processing is to reduce dust emissions by using one or a combination of the following techniques:**

I. efficient extraction of the slag crusher and screening devices with subsequent off-gas cleaning, if relevant
II transport of untreated slag by shovel loaders
III. extraction or wetting of conveyor transfer points for broken material
IV. wetting of slag storage heaps
V. use of water fogs when broken slag is loaded.

*This BAT conclusion is not applicable at Scunthorpe Works as it relates to on-site processing of slags from electric arc furnaces and associated process, but no electric arc furnace is* *operated at this site. The corresponding BAT for on-site processing of slags from Basic Oxygen Steelmaking is described in BAT 79.*

### *Water and waste water*

**91. BAT is to minimise the water consumption from the electric arc furnace (EAF) process by the use of closed loop water cooling systems for the cooling of furnace devices as much as possible unless once-through cooling systems are used.**

*This BAT conclusion is not applicable at Scunthorpe Works as no electric arc furnace is operated at this site.*

**92. BAT is to minimise the waste water discharge from continuous casting by using the following techniques in combination:**

I. the removal of solids by flocculation, sedimentation and/or filtration
II. the removal of oil in skimming tanks or in any other effective device
III. the recirculation of cooling water and water from vacuum generation as much as possible.

*This BAT conclusion is not applicable at Scunthorpe Works as it relates to continuous casting of steel produced from an electric arc furnace, but no electric arc furnace is operated at this site. The corresponding BAT for continuous casting of steel produced by Basic Oxygen Steelmaking is described in BAT 81.*

### *Production residues*

**93. BAT is to prevent waste generation by using one or a combination of the following techniques:**

I. appropriate collection and storage to facilitate a specific treatment
II. recovery and on-site recycling of refractory materials from the different processes and use internally, i.e. for the substitution of dolomite, magnesite and lime
III. use of filter dusts for the external recovery of non-ferrous metals such as zinc in the non-ferrous metals industry, if necessary, after the enrichment of filter dusts by recirculation to the electric arc furnace (EAF)
IV. separation of scale from continuous casting in the water treatment process and recovery with subsequent recycling, e.g. in the sinter/blast furnace or cement industry
V. external use of refractory materials and slag from the electric arc furnace (EAF) process as a secondary raw material where market conditions allow for it.

**BAT is to manage in a controlled manner EAF process residues which can neither be avoided nor recycled**.

*This BAT conclusion is not applicable at Scunthorpe Works as it relates to waste generation from electric arc furnaces and associated processes, but no electric arc furnace is operated at this site. The corresponding BAT for waste prevention in Basic Oxygen Steelmaking is described in BAT 82.*

### *Energy*

**94. BAT is to reduce energy consumption by using continuous near net shape strip casting, if the quality and the product mix of the produced steel grades justify it.**

*This BAT conclusion is not applicable at Scunthorpe Works as it relates to continuous casting of steel produced from an electric arc furnace, but no electric arc furnace is operated at this site. The corresponding BAT for continuous casting of steel produced by Basic Oxygen Steelmaking is described in BAT 86.*

### *Noise*

**95. BAT is to reduce noise emissions from electric arc furnace (EAF) installations and processes generating high sound energies by using a combination of the following constructional and operational techniques depending on and according to local conditions (in addition to using the techniques listed in BAT 18):**

I. construct the electric arc furnace (EAF) building in such a way as to absorb noise from mechanical shocks resulting from the operation of the furnace
II. construct and install cranes destined to transport the charging baskets to prevent mechanical shocks
III. special use of acoustical insulation of the inside walls and roofs to prevent the airborne noise of the electric arc furnace (EAF) building
IV. separation of the furnace and the outside wall to reduce the structure-borne noise from the electric arc furnace (EAF) building
V. housing of processes generating high sound energies (i.e. electric arc furnace (EAF) and decarburisation units) within the main building.

*This BAT conclusion is not applicable at Scunthorpe Works as no electric arc furnace is operated at this site.*