Environment Agency

Best Available Techniques for Pulverised Combustion of Wood Pellets in Power Plant

V1.0 September 2013

We are the Environment Agency. We protect and improve the environment and make it a better place for people and wildlife.

We operate at the place where environmental change has its greatest impact on people's lives. We reduce the risks to people and properties from flooding; make sure there is enough water for people and wildlife; protect and improve air, land and water quality and apply the environmental standards within which industry can operate.

Acting to reduce climate change and helping people and wildlife adapt to its consequences are at the heart of all that we do.

We cannot do this alone. We work closely with a wide range of partners including government, business, local authorities, other agencies, civil society groups and the communities we serve.

Published by:

Environment Agency
Horizon house, Deanery Road,
Bristol BS1 5AH
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk

Further copies of this report are available from our publications catalogue:
http://publications.environment-agency.gov.uk
or our National Customer Contact Centre:
T: 03708 506506

Email: enquiries@environment-agency.gov.uk.

Contents

1. Introduction

The Government's drive to renewable generation and European legislation has resulted in many coal power stations converting to biomass fuel or considering this move for the future. Potential biomass sources include the USA and Canada with the biomass transported as wood pellet to reduce contained volumes and the unnecessary movement of water.

There are significant differences in the properties of coal and biomass and it's important that these are recognised at the outset of any conversion proposal since they affect storage, handling, combustion and ash management. Storage of biomass is a relatively well understood field but combustion of 100% wood pellet in >300MWth modified plant is new and experience limited.

This document provides guidance for large combustion power plant operators who have converted, or are considering converting their power stations to use wood pellets instead of coal. The guidance identifies infrastructure and operation that can be considered as Best Available Techniques (BAT) to prevent fire related accidents. It focuses on plant originally defined in the Large Combustion Plant Directive (LCPD) as 'existing' and that will be operating beyond 2016 under the Industrial Emissions Directive. Plant that opted-out under the Large Combustion Plant Directive are also considered; the difference relates to the plant lifetime and associated economic assessment of options.

This guidance only addresses fire prevention and suppression techniques for white wood[1] pellet combustion. We will provide guidance on BAT for the combustion aspects in the future.

[1] White wood pellets are those wood pellets that haven't undergone any form of torrefaction or similar processes.

2. BAT Issues

2.1 Biomass Specification, Storage and Handling

The pelletised biomass used in England is generally white wood which has a lower calorific value and lower density than coal and is hygroscopic. Unlike coal it needs to be stored carefully and kept protected from the weather. It's also dusty and must be handled correctly to control fugitive dust emissions and manage or eliminate fire, explosion and health risks. The generic risks associated with dust are well known but suppression of smouldering wood pellet and fighting wood pellet fires is a relatively new challenge. When existing coal facilities are retrofitted you will need to plan for as much automation as possible based on the principle of long term trouble free operation with minimum down times, zero dust emissions, and minimum operator intervention during start-up, shutdown and ongoing operation.

Handling wood pellets can result in significant dust emission if you don't include appropriate measures in the design. Biomass dust can have fire and explosive potential and is also harmful to health. Whilst the aim may be 100% elimination of dust and ignition sources the reality is often not the desired total removal and in these situations BAT takes into consideration the practicability associated with prevention.

The key BAT principles, then, are:

- Ensure your design and project management teams are fully competent in the biomass field and have a comprehensive understanding of the specific issues associated with biomass combustion plant.
- Determine a bespoke strategy for your Installation having consideration for fuel specification, source, travel history and storage time, operation, fire prevention and suppression. This strategy needs to recognise the potential changes to fuel specification over the lifetime of the proposed plant.
- Ensure dust emissions are prevented and where that is not possible, minimised, through design, construction and operation.
- Ensure ignition sources are eliminated and where that cannot be achieved, minimised and the risk controlled.
- Prevent biomass self ignition as far as possible by eliminating moisture and minimising storage and handling times.

2.2 Milling and Ash Handling

Milling

Primary air flow rates and temperatures through the mills are significantly different from coal due to the higher volatile material content and physical properties of biomass pellets.

Ash handling

The character, quantity and, potentially, carbon content of biomass ash is significantly different compared to coal ash.

3. BAT for Existing Plant

3.1 Fuel Specification

3.1.1 Pellet physical degradation and biodegradation will vary with source, distance travelled, handling, intermediate storage and transfer points. Because of this you should design your plant and/or have procedures that takes into account the:

- fuel specification
- effects of transport on the pellet integrity and dust levels prior to arrival at the power station
- the biodegradation and resultant heating effects
- measures that need to be taken on receipt of a full or part load that is out of specification

3.1.2 Risk assessments for your plant should ensure that the design provides the appropriate controls for the characteristics and behaviour of the range of pellets planned to be burnt in the boilers. You should review the risk assessments whenever there is a change of plant or change of pellet source.

3.1.3 You need to understand how and where metal and other contaminants could enter the wood pellet supply chain. To reduce the risk of spark and ignition along your plant's fuel route, you should design systems and procedures to remove any of these residual materials.

3.2 Fuel Storage (for containment larger than 10m^3 volume)

3.2.1 For silos, bunkers, hoppers and other containment less than 10m^3 volume, you should carry out an appropriate documented risk assessment and implement the necessary control measures, having regard for the issues identified below.

3.2.2 You should optimise the size of the main fuel stores, taking into account the operating requirements and the fire risk. The length of time the pellets are stored should be determined by an assessment of the pellet specification, history and also their condition, as determined by on-site monitoring.

3.3.3 All storage should be covered.

3.3.4 You should minimise the entry of personnel into the storage areas to reduce the fire risk potential of moisture ingress and introduction of potential ignition sources.

3.3.5 Storage should be water tight, incorporating features which will prevent internal condensation, such as roof insulation, thereby helping to prevent self-heating and consequent fire. Storage silos should avoid air ingress that is likely to introduce moisture to the fuel.

3.3.6 Gas extraction systems with multi-gas (including CO, CO_2) monitoring, should be installed to ensure removal of naturally occurring gases from storage of biomass, and the continuous assessment of the biomass biological activity. Dual range meters should be used to provide monitoring of normal operation and also of any smouldering and/or fire event. The trends can be used to support optimal use of the fire suppression systems.

3.3.7 You should install a temperature measurement system, to give a temperature matrix throughout the stored fuel. These will only detect within a relatively small radius and so it's important to have additional monitoring point(s) in the extracted gas stream. You should use continuous calculation and the trend of the rate of temperature rise to detect excursions and raise an alarm. Thermal imaging can be appropriate for surface monitoring.

3.3.8 The method used to deal with hot spots will depend on the temperature. Operations likely to introduce air to the hot spot should cease if the temperature, or the rate of temperature rise in the extracted gas stream, is high enough for the biomass to self ignite in the presence of air. The precise location of the hotspot in the store is unlikely to be known and inerting gas should be used to cool the store and hence the hot spot. You need to consider at the design stage, how distribution of the inerting gas can be optimised. Once the store is cool, and this may take considerable time, you should remove the material from the store.

3.3.9 Your fire suppression systems include a combination of use of inerting gases (nitrogen is preferred), foam, and water deluge. Inerting gas injection should be installed above and below the biomass for cooling and suppression; water deluge may be appropriate as a final measure in fire control.

3.3.10 Storage should have a means of emergency discharge to allow safe removal for cooling.

3.3.11 Coal bunkers converted to biomass use should be sealed and dust extraction installed.

3.3 Fuel Handling

3.3.1 The plant should be ATEX zoned, appropriate construction materials should be used to avoid ignition sources, and controls in place to ensure against build up of dust in and on equipment.

3.3.2 For those locations where dust emissions have the potential to be highest (junction houses and buildings are typical locations) you should clad or sheet internal surfaces to prevent the build up of dust. Any internal beams or structural horizontal ledges capable of collecting fine dust should be fitted with shedding plates or internally clad. Dust issues associated with lighting, cabling, pipework and other equipment should be similarly addressed at the design stage. Infrastructure design should facilitate easy monitoring and cleaning of the dust layer

3.3.3 Equipment should have protection to prevent dust ingress.

3.3.4 Conveyors should be suitably enclosed for dust control, dust extraction and weather protection.

3.3.5 Conveyor systems should be designed to avoid the potential for ignition of residual dust by conveyor parts that have the potential to heat-up.

3.3.6 Conveyor systems should be designed and operated to minimise dust generation at all loadings.

3.3.7 Design of the conveyors should facilitate their easy inspection and cleaning.

3.3.8 Fuel transfer points should be optimised to minimise turbulence and degradation of the pellet.

3.3.9 Dust extraction should take place at regular intervals throughout the conveyor system, particularly at transfer points.

3.3.10 You should install monitoring systems (gas, thermal) and fire suppression systems (such as water fogging) for detection and control of hot spots along the length of the conveyors with divert systems available for removal of hot spots. The storage and handling systems should be considered as a whole when designing fire prevention and suppression systems to avoid unintended consequences.

3.3.11 Spark detection and extinguishing systems should be employed.

3.3.12 No sweeping should occur within the fuel handling system and permanent vacuum cleaning points should be installed at appropriate locations. Your cleaning regimes should be pro-active, not reactive. Monitoring, auditing, data collection and review of all relevant parameters should be carried out to ensure this status is maintained.

3.3.13 Dust should be filtered from extraction systems. The point and method for re-introduction of dust from collection/extraction/cleaning systems should be risk assessed and the handling system optimised to minimise further potential dust problems as a result of the re-introduction.

3.3.14 CCTV should be used to monitor the fuel route and this and all other monitoring instrumentation viewed from the control room.

3.4 Milling

3.4.1 Primary air temperatures should be sufficiently low to prevent release of volatile materials that can lead to explosions and mill fires.

3.4.2 Primary air flow rates should be sufficient to ensure the clearing of the milled fuel from the top of the mill, and the air velocities within the pipework leading to the boiler adequate to prevent settling out of milled fuel.

3.5 Ash Systems

3.5.1 Your ash management systems should take account of the potentially higher carbon content of the biomass fly ash compare to coal, its flow properties and the likely higher temperature of the ash transfer from the electrostatic precipitators to the fly ash storage.

3.5.2 The risks associated with operation of a dry bottom ash system and continuing burn out of the ash should be addressed and heat recovery maximised.

3.5.3 The potential for anaerobic breakdown of bottom ash from a wet system should be assessed in terms of ash handling and water disposal.

3.6 Emergency Plan

3.6.1 You should develop, following discussion with the fire service, a comprehensive emergency plan that takes into account the fire fighting considerations identified above. An assessment of the quantities of inerting gas and how it can be obtained is clearly critical.

4 BAT Considerations for LCPD Opted-Out Plant

If you operate an LCPD opted-out plant and wish to deviate from any of techniques described above, you will need to carry out a BAT options appraisal, using the Environment Agency horizontal guidance H1 Annex k, to justify the preferred technique(s). You may be able to justify more procedural or manual interventions, however, your justification must clearly demonstrate how the risk has been reduced to the levels provided by the techniques described in section 3.

List of abbreviations

ATEX Refers to the Explosive Atmospheres Directive 99/92/EC that was put into effect through regulations 7 and 11 of the Dangerous Substances and Explosive Atmosphere Regulations 2002

BAT Best Available Technique as defined in Article 1 of the Industrial Emissions Directive 2010/75/EC

LCPD Large Combustion Plant Directive 2001/80/EC

LCPD opted-out plant Decision under Article 4 of the LCPD not to operate the plant for more than 20,000 operational hours between 1 January 2008 and 31 December 2015

Would you like to find out more about us, or about your environment?

Then call us on

03708 506 506 (Mon-Fri 8-6)

Calls to 03 numbers cost the same as calls to standard geographic numbers (i.e. numbers beginning with 01 or 02).

email

enquiries@environment-agency.gov.uk

or visit our website

www.environment-agency.gov.uk

incident hotline **0800 80 70 60** (24hrs)
floodline **0845 988 1188**

Environment first: Are you viewing this on screen? Please consider the environment and only print if absolutely necessary. If you are reading a paper copy, please don't forget to reuse and recycle if possible.

LIT 8880