Safe handling and storage of biomass in thermal power stations

energy institute

SAFE HANDLING AND STORAGE OF BIOMASS IN THERMAL POWER STATIONS

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FOREWORD

There has been a rapid expansion in the use of biomass fuel for large scale power generation over the last five years. This has resulted in a very large expansion in the number and size of facilities designed for handling and storage of biomass in the UK and elsewhere.

Storage units, now being built, are an order of magnitude bigger in scale than anything previously built in the UK for handling a product that creates a risk of dust explosions. As the plant scale increases, self-heating of the bulk stored material becomes inherently more difficult to control.

Self-heating is most likely to start in a ship, large silo or large heap formed during flat floor storage. The point at which an overheating event becomes a fire is not easy to define or identify, and experience in the UK and elsewhere shows that the time required to extinguish a deep seated fire can be very long. There should be an agreed system of measuring bulk temperatures, and criteria for rejection, or alternative handling established.

Similarly, dust explosions are a real risk. At the largest scale of operation and storage there is a consequent increase in uncertainty about the effectiveness of established technologies for controlling the risks.

Biomass is far from a consistent product, and the properties relevant to the fire and explosion hazards do vary from one type to another, one source to another, from batch to batch and even within a single parcel of fuel transported in ship load quantities. This creates difficulties for design, that can only be controlled by the plant operator if the design assumptions, and the implications these have for ongoing control of the fuel it will handle, are understood.

As with other developing technologies, research requirements can be foreseen. In relation to the risks from fires and explosions, little has been done outside Sweden in recent years.

Biomass purchasing specifications have been published, and further work is ongoing to develop more detailed requirements relevant to the power generation industries. Those who develop these standards should understand the purposes for which they will be used. EN 14961 has been written primarily as a descriptive quality standard, addressing issues that are mainly of commercial importance. As such it does not address the issue of bulk temperature at the time of delivery, but this is clearly relevant to specifying safe receipt and storage arrangements.

Until published standards cover all the issues relevant to controlling the risks of fires and explosions, all individual operators should agree supplementary specifications with their suppliers, that may need to be linked back to the original design assumptions for their plant.

Pellet users should work with their suppliers and understand what steps the suppliers are taking to deliver a feedstock that is reasonably consistent, both within a bulk delivery and between batches. The supplier also has a part to play in delivering fuel that does not contain excessive dust, tramp metal, grossly oversized material, or is overheating to a hazardous degree by the time it reaches the end user.

Safe handling and storage of biomass in thermal power stations provides detailed guidance, aligned with identified standards, covering the various aspects of storage of biomass. It includes guidance on all of the issues raised above. It also provides annexes containing a review of pertinent literature and standards and pertinent biomass-related incidents. Whilst some guidance is aimed specifically for power stations, much of the guidance may be more broadly applicable for storage of biomass more generally.

Suggested revisions are invited and should be submitted through the Technical Department, Energy Institute, 61 New Cavendish Street, London, W1G 7AR. e: technical@energyinst.org

1 INTRODUCTION

The use of biomass in quantity as a fuel for power generation is comparatively recent in the UK, and operating experience is limited to a small number of sites running for a relatively few number of years. However, within this short time frame there have been a number of incidents in Europe and the USA, including fires, explosions and fatalities from carbon monoxide and other gases generated from biological activity in biomass storage and handling.

This publication provides information and guidance for the safe on-site handling and storage of biomass material suitable for burning in thermal power stations. Its scope includes fuel reception (the point at which fuel enters the jurisdiction of the power station operator), and ends at the point of inlet to fuel preparation. It does not include milling itself, which should be the focus of its own individual hazard study or hazard review, and is currently outside the scope of this guidance document.

This guide is aimed at personnel responsible for designing and/or operating large-scale facilities for handling biomass for use in power generation plants. It is not intended to cover the much smaller facilities that are increasingly being installed at domestic, commercial or smaller industrial sites, where, typically, the fuel is delivered in quantities carried by a single road vehicle. However, the information provided on the hazards of biomass, and measures to prevent incidents occurring, are still relevant to these other applications.

The guide addresses the hazards of:

– Fire: from self-heating and external ignition sources.
– Explosion: from wood and organic dusts, and the build up of combustible gases from the products of partial combustion in silos.
– Health risks: arising from the presence of wood dust, the use of carbon dioxide or nitrogen for providing inert atmospheres, and the presence of confined spaces, where there is potentially a lack of oxygen or danger from the production of toxic gases, such as carbon monoxide, from biological activity of the biomass in storage.

The guide examines safety issues relating to biomass handling and storage. It also provides measures that can be taken to prevent a potential hazard becoming an incident. The extent of the measures taken depend on the size and scale of the facility, risk to personnel and the financial risk from major fire or explosion.

The information in this guide is drawn from diverse sources (including many of the publications listed in Annex B), discussions with major operators in the UK power industry, incident reports mainly from internet sources, and from involvement with major engineering design and construction companies developing detailed proposals for new projects in the UK.