Biomass storage, dust explosion issues

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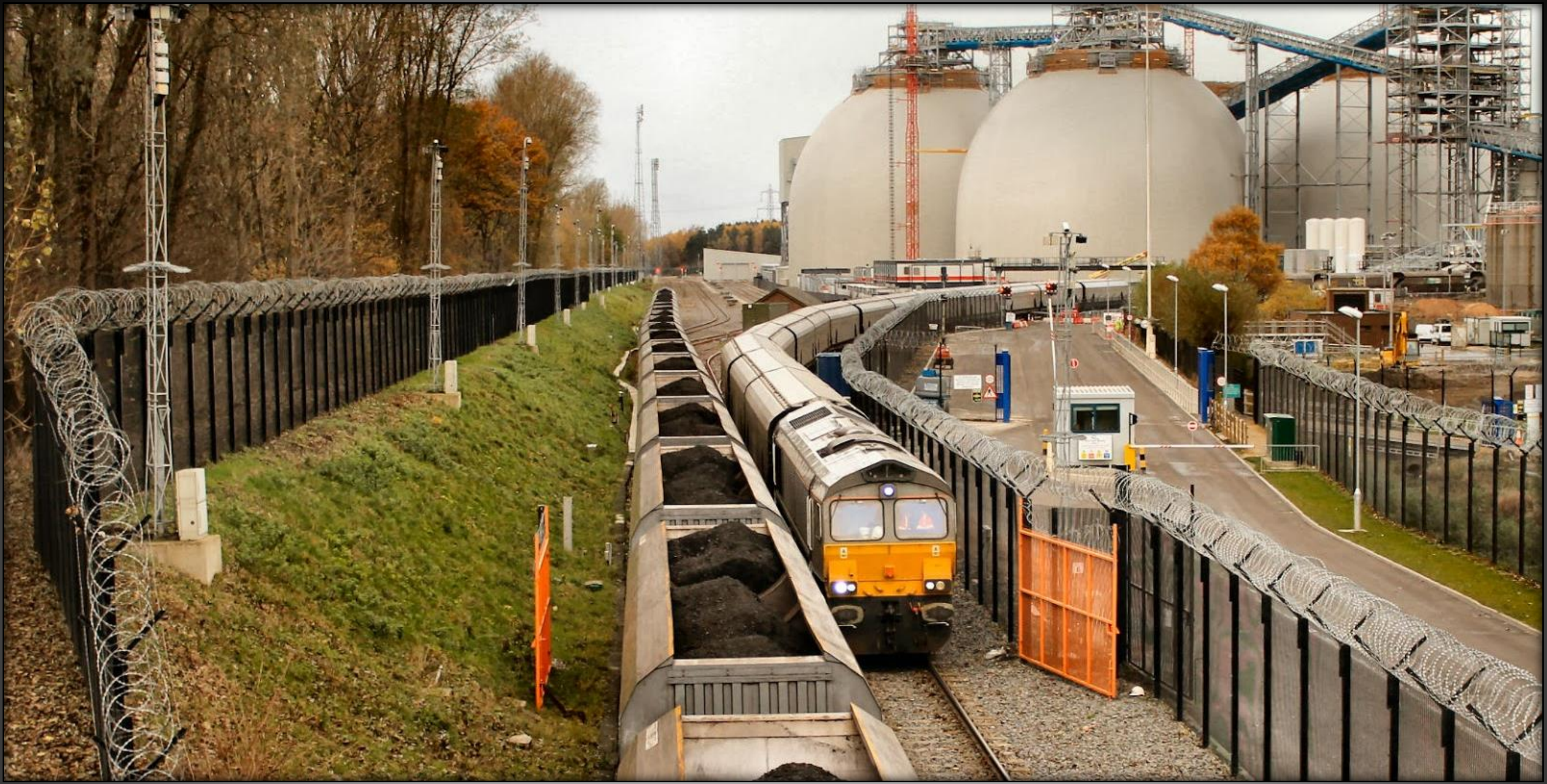

Biomass is big

Blaye , 44 silos @1000m3 each, Imperial Sugar 3 silos @3740m3
Markinch, 3 silos @5750m3,   Drax 4 domes @ 100,000m3

Dust content

- Biomass fuels are very variable, recovered wood, forest waste, pelletised, torrefied
- Dust is fibrous, sieving does not measure it
- Unevenly distributed within a shipload
- Not specified in the purchasing contract
- Is it realistic to base design on filling the entire silo with a dust cloud of explosive concentration?

Design of explosion vents

- Based on experimental work at 250m3 and smaller
- Equations are computer fit to experimental data, no underlying physical model
- Claimed validity to 10,000m3
- Based on handling dust, not granular with some dust
- Large vent areas create problems with condensation

CFD Modelling

- Key inputs are turbulence, dust cloud concentration, volume of explosible cloud
- All these are difficult to measure
- Presumably calibrated against the same experimental data as EN 14491
- Difficulty taking account of coarse component
- At the largest scale taking conservative values for all inputs is impractical

Inert gas in biomass stores

- No clear objective:
- Suppressing surface fires?
- Preventing dust explosion?
- Preventing onset of biological heating?
- Cooling bulk before onset of smouldering?
- Extinguishing smouldering pockets?
- Permeability changes during storage
- Design data based on Swedish work in a silo of diameter 1m

Research needs

- Fire spread along inclined conveyors
- Control of fires in flat floor storage
- Use of foam or water mist for fire suppression
- Clarifying design objectives for use of nitrogen inerting

Do we have enough information to design a safe store?

- In terms of life safety, these are largely unoccupied facilities, biggest risk comes from inert gas and during attempts to control fires
- Design for explosion, we cannot know if the designs are conservative, or are missing some problem of scale we have not anticipated
- Incident history suggests that we should build more and smaller units for property protection and business interruption reasons

Sources of information

- Fires in silos, book by H Persson
- Energy Industry guide, published later in 2014
- Specification for biomass in EN 14961