Critical Review B

Ratcliffe-on-soar Power station

Pollutant Abatement and Treatment Strategies and their global implications

Ratcliffe-on-soar power station is a coal fired plant located between the cities Nottingham, Derby and Leicester on the River Trent (fig1). It can produce 2,000MW of electricity to supply around two million people (Eon-UK*1) and is classified as a "black start" station meaning it can work and start independently to the national grid network. (Personal Communication). Set on a 700 acre site (fig 2) it has had extensive landscaping work and over 57,000 shrubs and trees have been planted, its meadows are now some of the finest in Nottinghamshire. They are strictly controlled by the ISO14001 environmental standards and they are beginning trials with alternative fuels such as Biomass and "Petcoke" (Personal Communication). The "large combustion plant" directive is also adding pressure to reduce emissions, pollution and contaminants. The station is one of the most economical in the UK and has had a £250m Flue gas desulphurisation (FGD) plant installed to reduce its sulphur dioxide ($S0_2$) emissions (Eon-UK*2).

Fig 1

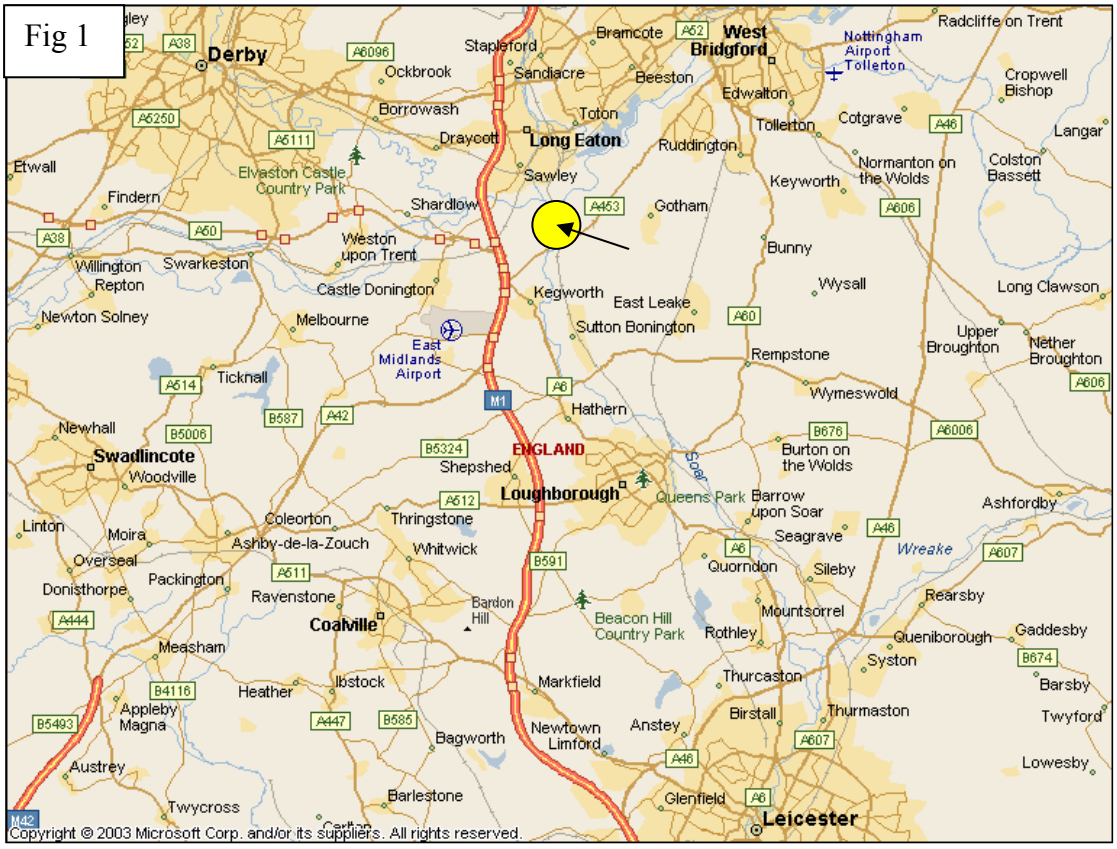

Fig 2

During the production of electricity at this site numerous pollutants could be released, Pulverised Fly Ash (PFA), Sulphur Dioxide, and Nitrogen Oxides from the combustion and boilers, visual pollution, and general airborne pollutants such as Hydrogen Chloride all need to be dealt with. The environmental standards on a site such as Ratcliffe put great pressure for them to reduce all pollutants and those which cannot be reduced have to be treated in a correct and environmentally friendly manner.
The FGD system installed at the plant helps to tackle many of the possible pollutants, its primary aim is to remove the $S0_2$ from the emissions but in the process Nitrogen Oxides and Hydrogen Chloride are also reduced by up to 95% (Eon-UK*2). This has obvious benefit for the environment since $S0_2$ is associated with problems such as acid rain and photochemical smog's (Microsoft, 2004). The process of removal is complex but by passing the contaminated gasses through limestone slurry, a chemical reaction occurs removing most of the dangerous constituents. This slurry is re-circulated throughout the system but eventually needs treating and disposal. 30,000 tonnes of this sludge is produced per annum and 900,000 tonnes/annum of waste water which all has to be tested and treated for contaminants and heavy metals (Eon-UK*2) before being released into the River Trent. In the experiments on the fly ash obtained from the site only one result was significantly higher than the EU maximum, this I believe to be an inaccurate result rather than a possible environmental problem. It is therefore safe to say that the controls in place on the site are succeeding in reducing heavy metal concentrations.

In the EU the maximum amounts of contaminations/ desired conditions for water discharge into a river are as below:

(Gill 1994)

Temperature	= 28°C
Suspended Solids	= 25ppm
PH	= 6-9
Chlorine	= 0.005ppm
Oils	= 5ppm
Toxic Metals	= 1ppm (depends on metal)

During the FGD process large amounts of Calcium Sulphate (gypsum) (fig3) are produced, when dried and checked this is transported to the British Gypsum factory just a few miles towards Nottingham where it will be used in the production of plasterboard. With quantities in excess of 480,000 tonnes/annum (Eon-UK*2) this can provide an income to pay for the FGD systems running and hopefully help in its advancement in the future. Although the FGD system is probably the most efficient way of removing the harmful gasses it must be remembered that only 90% of $S0_2$ is removed this means that per annum around 18,000 tonnes of $S0_2$ is being released into the atmosphere.

Fig 3

Globally acid rain and smog are a growing problem, it has been linked directly to lung problems and asthma. This aside it also can cause major damage from the "dissolving" of limestone and marble buildings to the extreme cases of acidification of rivers and ponds restricting or totally destroying biological life (Microsoft, 2004). These pollutants being airborne can travel huge distances and cause problems on continental or global scales, because of this it is everybody's responsibility to help in its reduction. The Large Combustion Plant Directive (an EEC directive) helps with this in Europe, by setting strict guidelines on certain pollutants such as Sulphur Dioxide, and Nitrogen Oxides.

With 812 tonnes of coal being burnt every hour, large amounts of PFA have to be removed from the site. 99% of this is taken out by the use of electrostatic precipitators, the other 1% is released into the atmosphere. The PFA when removed is left in settling lagoons then sold to the building trade where it can be used for engineering projects and building blocks, but any excess is disposed of in gravel pits and for agricultural use (Eon-UK*1). This is an economical use for the waste and provides a sustainable income for the factory, but if contamination occurs within the PFA it could easily be spread and possibly enter the food chain. This problem should be addressed at the source and all checks and safety precautions need to be done before the PFA reaches its settling pits on the site. To significantly reduce the pollution caused by the PFA though is complex and the easiest option is to increase the efficiency of the plant, which in turn should then require less coal to run it. At Ratcliffe efficiency is high (Personal Communication) thanks largely to the design of the boilers and turbines but also the new "On-line Combustion Monitoring" (OLCM) systems that they have installed (Rea, 2003). These systems allow constant monitoring and tiny adjustments to be made of all aspects of the combustion process to reduce failure rates and warn operators of the "health" of the machines. With the combustion of organic materials Carbon Dioxide (CO_2) is released, although no data can be found to show the amounts from Eon themselves the estimated cost to nationally to clean up CO_2 emissions is 2% of the gross domestic product (GDP) (Microsoft, 2004). For The UK this would cost in the region of £18.2 billion (www.cia.gov) per year. CO_2 concentrations world wide vary but are usually between 3 and 4 parts per 10,000, this though is increasing by around 0.4% per year (Microsoft, 2004). During coal production methane is produced, when burnt on the Ratcliffe CO_2, SO_2 and Nitrous Oxide's are also released in varying quantities. All these gasses are known as "green house" gasses and add to the insulating effect of global warming. One of the biggest greenhouse gasses though is water vapour, although not harmful at ground level when in the upper atmosphere it has an extensive insulating effect. At Ratcliffe alone 13m gallons (Personal Communication) of water evaporates per day adding to a global problem. Although a controversial topic global warming is currently believed to be the main cause of climate change and some of the extreme weather conditions and natural disasters seen over recent years.

Chlorine in the evaporated water, used during the treatment process of the Gypsum (Eon-UK*2) could cause even more dangerous problems. Ozone (O_3) gas forms a protective layer around the Earth to shield all life from the harmful Ultraviolet (UV) radiation emitted by the Sun. When in the atmosphere Chlorine acts as a catalyst destroying at alarming rates the molecules of Ozone gas, thinning or destroying our only real protection from the UV radiation. Health issues associated with this range from skin cancer to cataracts, environmental issues such as reduced plankton and crop growth could have world wide implications. Ozone though in turn is believed to enhance the greenhouse effect (Microsoft, 2004) so begins a difficult to escape circle.

Visual Pollution on the site is obvious and a problem especially when situated like Ratcliffe so near to centres of population, little can be done about the large cooling towers which occupy the site but with the planting of 57,000 plants, shrubs and trees some of the other workings are less obvious (Personal Communication). The work done by Eon has been successful but the visual intrusion of the towers can be seen for many miles. In environmental terms the sight of the towers has no physical damage but does affect the landscape as a whole, this I think will be a necessary problem for years to come. But Eon's responsibility over pollution is not strictly limited to the Ratcliffe site or any other site. As part of their "Extended Producer Responsibility" they should be considering numerous aspects from the transport of waste products to the mining and transport of the coal. Many would believe this is not their problem and should be addressed by the Coal, Gypsum or Transport Companies which is technically true but the power industry is the main consumer and producer of their goods. Although it cannot be expected the Eon pay for the other institutes environmental improvement they could help in planning mutually beneficial environmental policies. If a fully integrated system could be enforced the pollution could be tackled at each stage helping the next person along, reducing the difficulty and complex systems needed to cleaning up and aiding in the governments emissions policies.

On a site the size of Ratcliffe-on-Soar pollution is an obvious and unavoidable problem in one form or another. Eon who run the plant have invested many hundreds of millions in cleaning up the general production of electricity and the treatment of the pollutants it produces. By gradually increasing environmental standards the EU has forced the site to develop state of the art monitoring and treatment facilities such as the Flue Gas Desulphurisation (FGD) system and On-line Combustion Monitoring (OLCM) systems. The recycling of waste products for other prominent industries in the form of Pulverised Fly Ash (PFA) and Gypsum help to reduce pollution and provide a sustainable income. Landscaping work has helped with the visual problems and by carefully monitoring water constituents little river water pollution should occur. Utilitarianist's may say that the pollution is a necessary side effect of power production for so many people, this though is not necessarily true, numerous problems generally associated with global warming will need to be addressed. Only through the development of new treatment systems, alternative fuels and increasing efficiency will pollution level be lowered even more.

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Fig 2 = Site from Nottinghamshire Direction (author)
Fig 3 = Gypsum Store (author)