

Aberthaw power station prepares existing brick chimney flues for FGD operation by installing Pennguard® linings

Albert de Kreij, Hadek Protective Systems, The Netherlands
Gary Eastman, Bierrum Int. Ltd, United Kingdom

Introduction

Aberthaw power station is a 3 x 500 MW coal fired power station near Cardiff in Wales (figure 1). The owner, RWE npower is one of the leading electricity generators in England and Wales. When the European Union created more stringent regulations, requiring all coal fired stations to limit their SO₂ emissions by 2008, RWE npower had to investigate the feasibility and economics of fitting Flue Gas Desulphurization (FGD) at Aberthaw power station. Fitting FGD to the power station would also have consequences for the existing, 40 year old chimney.

After investigation of the risks of FGD operation for the existing chimney and its flues, the owner decided to modify the chimney by sealing all three brick flues with the Pennguard® Block Lining System. The first of three flues (Unit 8) was lined with Pennguard® in the summer of 2004. The applications in the second and third flues are planned for 2005 and 2007.

On behalf of the Aberthaw FGD project team, the Pennguard®



Figure 1 – Aberthaw power station

lining application in the Aberthaw Unit 8 flue was supervised by Bierrum International. Also, Bierrum acted as consultants during the tender phase and were responsible for the design, building and testing of the platform. The project was executed by Delta International. Hadek Protective Systems supplied the Pennguard® lining materials and the Quality Supervision for all Pennguard® lining activities.



Risks of FGD operation for the chimney

RWE npower is planning to install seawater FGD for all the three units. The three FGD systems will each incorporate a gas-to-gas heater, which will reheat the treated flue gas to at least 60 °C before it enters the chimney.

Even after the FGD retrofit, the units will be started up in FGD bypass mode and during this period, the gas stream in the flues will have a temperature of 135 °C. It is expected that the units will start-up frequently, possibly every day.

The Aberthaw chimney is a 153 m high concrete shell with three sectional, ceramic brick flues. Each brick flue consists of 17 barrels with an internal diameter of 6.9 metres. The barrels are placed on concrete support floors (figure 2).

Like the chimney itself, the flues have been in service for almost 40 years. After inspections of the chimney and its flues, it showed that the brick barrels and support floors are in good structural condition.

The frequent start ups and shut downs of the units at Aberthaw power station, will lead to frequent formation

of aggressive acidic condensate within the flues. If the flues were left unprotected, large amounts of condensate would permeate through the brick joints and attack the structural integrity of the chimney.

Furthermore, the sudden thermal swings associated with switching from FGD operation to FGD bypass operation (or vice versa) would create damaging stresses in the brickwork.

The owner decided that the existing chimney should continue to be used after the FGD retrofit, provided that the flues could be protected against the much more aggressive FGD operating conditions.

It was decided to prepare the flues for FGD operation by installing the Pennguard® Block Lining System over the internal brickwork surfaces.

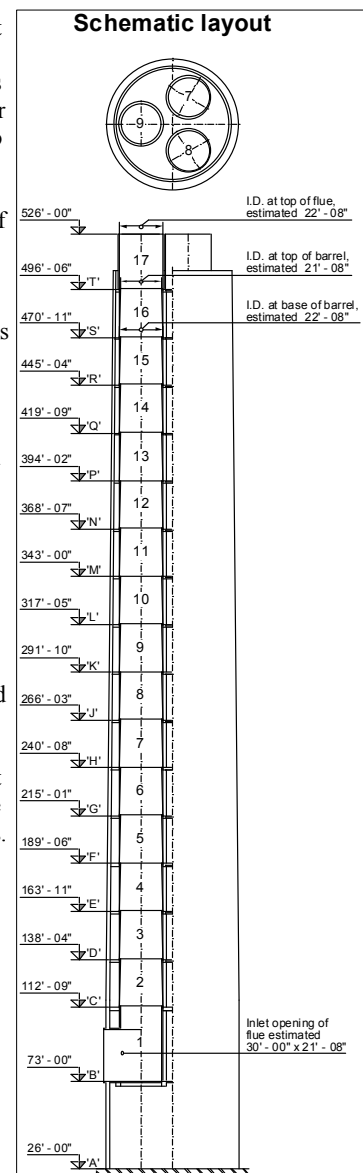


Figure 2 – Schematic Layout

The selection of Pennguard® linings

The Pennguard® Block Lining System consists of blocks of cellular borosilicate glass (Pennguard® Blocks), which are attached to the substrate using a 3 mm thick, chemical resistant adhesive and joint filler (Pennguard® Adhesive Membrane), see figure 3.

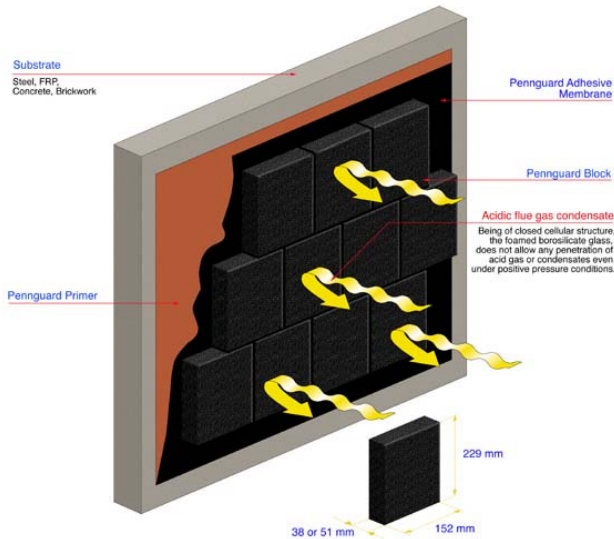


Figure 3 – Cross section of the Pennguard® Block Lining System

There are several important reasons why Pennguard® linings are suitable for brickwork surfaces.

First of all, the lining is completely acid resistant and, due to the thickness and closed cell structure of Pennguard® Block, it is impermeable to acid flue gas and condensates. The Pennguard® lining will form a durable barrier between the porous brick and the acidic flue gas.

Secondly, a Pennguard® lining is strongly insulating. As a result, the temperature loss

through the chimney structure will be minimized, which will help to reduce condensate formation, especially during unit start-ups.

The strong insulating effect of a Pennguard® lining will also protect the flues against thermal cycling and thermal shock (figure 4). In many FGD designs, the operation can change from FGD mode to FGD bypass mode within seconds, simply by the switch of a damper. The sudden exposure to a much more hotter gas stream (or, cooler gas stream, when switching back to FGD operation) creates great stresses in a brick flue, which will result in damaging crack formation

Figure 5 shows the temperatures experienced by a brick flue, when switching from FGD operation to FGD bypass operation and back, both for an unprotected flue (red/orange lines) and a Pennguard® lined brick flue (dark green/light green lines). The temperature of the Pennguard® lined brick flue is much lower and it varies only little with the operating mode.

Figure 6 shows that the quick changes in the flue gas temperature will result in significant stresses for the unprotected brick flue, whereas the Pennguard® lined flue experiences very little stress at any time.

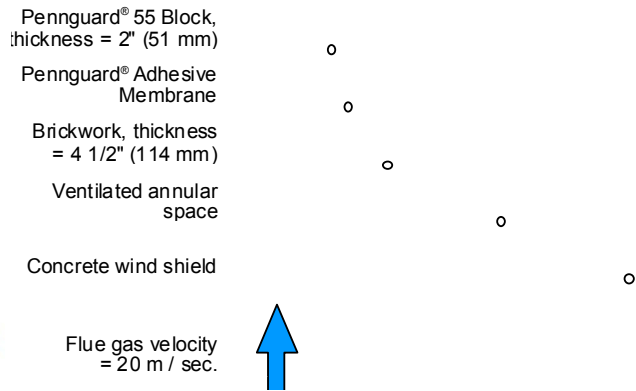


Figure 4 – Pennguard® will protect the brick flue from high temperatures and thermal shock

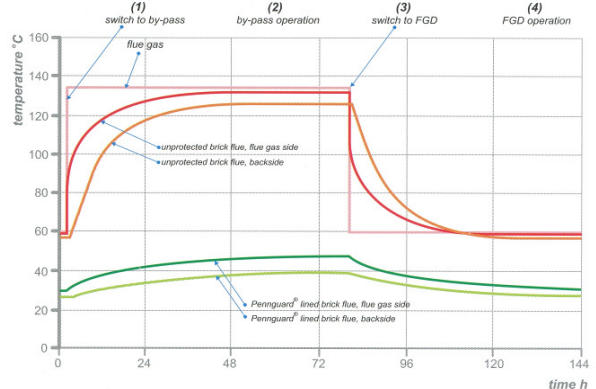


Figure 5 – Temperatures of flue gas and brickwork, when switching from FGD operation to FGD bypass operation, and back

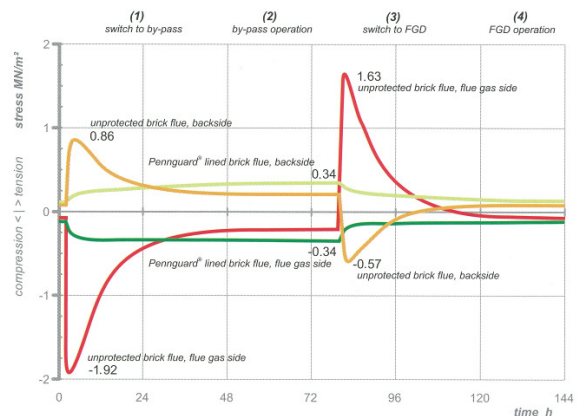


Figure 6 – Stresses in brickwork, when switching from FGD operation to FGD bypass operation, and back

Preparation of the Aberthaw Unit 8 chimney flue for FGD operation

The Pennguard® lining installation process in the Aberthaw Unit 8 chimney flue was carried out during the outage from May - July 2004.

The installation process can be summarized as follows:

1. Installation of the work platform: 2 days, 10 workers
2. Brickwork repairs: 2 days, 8 workers
3. Grit blasting of the brick surface: 4 days, 7 workers

4. Installation of new expansion joints: 6 days, 9 workers

5. Application of Penntrowel® Epoxy primer: 2 days, 10 workers

6. Pennguard® installation in flue: 20 days, 8 workers

7. Finishing works, including Tufchem® concrete on floor: 4 days

The work was performed on a schedule of 2 x 12 hours shifts per day, working mostly 7 days per week. The total number of working days required for all the main activities in the flue was: 40 days.

Below, there are several pictures of the installation process.

Installation of the platform

All work was done from a movable, aluminium work platform, which was suspended with steel wires from the head rig.



Figure 8



Figure 7

The floorboards were made of 10 mm thick plywood and the diameter of the platform was adjustable with movable boards on the outside. The personnel and materials were transported in a separate hoist (figures 7 and 8).

Brickwork repairs

The brick flues and their support floors are in good structural condition. Only a limited amount of repairs were carried out.

It is normal for brick flues, to show some offsets between individual bricks (figure 9). Pennguard® linings can accommodate an irregular brick surface, by using a thicker adhesive backjoint.

It is also common to find some narrow cracks in the brickwork (figure 10). Pennguard® linings can be applied directly over minor cracks (< 3 mm).



Figure 9



Figure 10

Installation of expansion joints

Specially designed, flexible expansion joints are installed over the transitions between the brick sections. They will ensure that the brick flue will become gastight in these areas, as well (figure 11).



Figure 11

Flue ready for Pennguard® lining

After grit blasting, installation of the expansion joints and application of the Penntrowel® Epoxy primer, the flue is ready to receive the Pennguard® lining (figure 12).



Figure 12

Pennguard® lining installation in flue

A Pennguard® lining can easily be installed by local bricklayers. In the Aberthaw flue, the Pennguard® lining was installed by two teams of 5 bricklayers, on a 2 x 10 hours per day work schedule (figures 13, 14, 15).



Figure 13



Figure 14 – Pennguard® lined flue



Figure 15 – Lining application at inlet section



Figure 16—At the bottom of the flue, a protective layer of Tufchem[®] cement is applied over the Pennguard[®] Blocks

Conclusions

The installation of the Pennguard[®] Block Lining System was achieved according to plan, without unexpected delays.

The first of three brick chimney flues is now effectively protected against FGD operating conditions.