

EDF Energy Cottam modifies 200 m high, multi-flue chimney for Wet Stack Operation



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Gary Eastman is the Managing Director of Bierrum International based in Dunstable in England.

He joined Bierrum in 1964. He has worked his way to become firstly a Contracts manager, Contracts director, and now Technical Director of the company.



Albert de Kreij

Albert de Kreij joined Hadek Protective Systems in 1989. He has been closely involved in a number of projects with the use of Borosilicate Glass Block Linings especially in wet stack operation conditions.



Figure 1: Cottam power station

protect the inner concrete surface of each flue directly with the Pennguard® Block Lining System.

Bierrum International was the contractor for the Cottam FGD chimney project. Hadek Protective Systems supplied the Pennguard® lining materials and the Quality Supervision for all Pennguard® lining activities.

Challenges of using the existing chimney for FGD Wet Stack Service

Introduction

Cottam power station is a 4 x 500 MW coal-firing power station in England (Figure 1). In 2003, the owner EDF Energy Cottam decided to install wet limestone FGD plants to all four units.

In preparation of the FGD retrofit, the 40-year old 200 m high chimney with four concrete flues, each lined with ceramic brick, was inspected and appeared to be in excellent technical condition. It was concluded, that the chimney could continue to be used after the FGD retrofit, provided that the flues could be prepared for FGD operating conditions.

The owner developed a plan, to place the four FGD systems close to the existing chimney, with a relatively simple ductwork design, while modifying the chimney flues for wet stack operation (no reheat). An environmentally safe operation of the wet stack was made a priority from the start of the design process and the owner selected Alden Research Laboratory from Massachusetts, to assist in the design of the outlet ductwork and chimney flue linings.

Based on the study of the consultant, the owner decided to remove the brick linings from the four concrete chimney flues and to



The existing 200 m high chimney was built in 1965 with 4 concrete flues, each with a diameter of 8 to 7 m and each internally lined with ceramic brick. The ceramic brick is divided in sections of about 10 m high and built up from the corbel supports in the concrete flues (Figure 2).

Challenge 1 - Droplets / condensate from FGD system will gather in base of chimney

A wet stack's main undesirable side effect could be the deposition of acidic droplets on the power station and the surrounding area. In order to prevent this, EDF Energy Cottam commissioned Alden Research Laboratory to design an integrated approach to liquid droplet collection. Alden started off by building a 1/16 scale model of the ductwork to predict the exact behaviour of the condensate droplets in the gas stream, as they make their way to the chimney.

Based on the test results, condensate collections rings, drains and other design details were optimized.

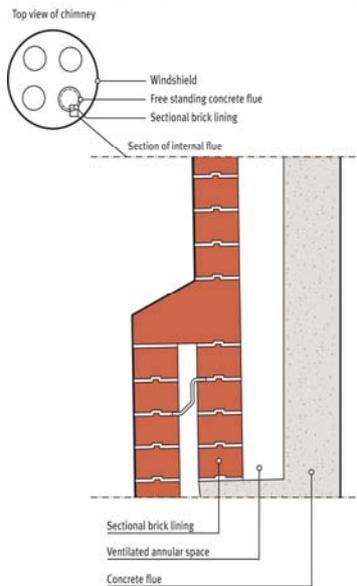


Figure 2: Existing chimney (top) and chimney flue design - before lining (bottom)



Figure 3: 1/16 scale model of ductwork used by Alden Research Laboratory

Challenge 2 – Units start up every day, with FGD in operation (no FGD bypass)

During start-ups when the chimney and its flues are still cool, there will be an initial period of high condensate formation. This high condensation rate will continue, until the internal surface of the flues has warmed up to its final operating temperature. In order to minimize the condensate formation during start-ups, a 54 mm thick, insulating Pennguard® lining was selected for its fast thermal response.

Also, the textured surface of the Pennguard® Block has an advantage for wet stack operation. The slight surface rough-



Figure 4 A: Pennguard® lining on concrete,

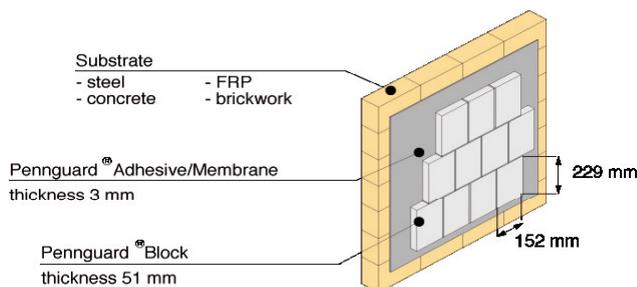


Figure 4 B: Cross section of the Pennguard® lining

ness creates a capability for the lining system, to ‘hold on’ to condensate films and it ensures that the liquid film cannot flow together in thick streams.

Challenge 3 - Gas flow velocities in chimney would be up to 25 m/s

To reduce the gas flow velocities to an acceptable level for wet stack operation, the brick linings were removed from the concrete shells and the Pennguard® Block Lining System was installed on the inside surface of the concrete flues.

With the increased diameter, gas velocities dropped below 20 m/s over the whole height of each flue.

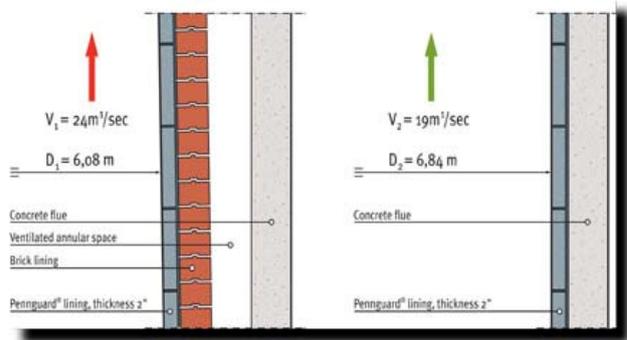


Figure 5: Comparison of gas flow velocities, with brick left in place (not built) and brick removed (as built)

As an additional safety feature for wet stack operation, all existing supports for the old brick lining were used as the location for liquid collection gutters, where condensate is caught and led to drainpipes on the outside of the flue.

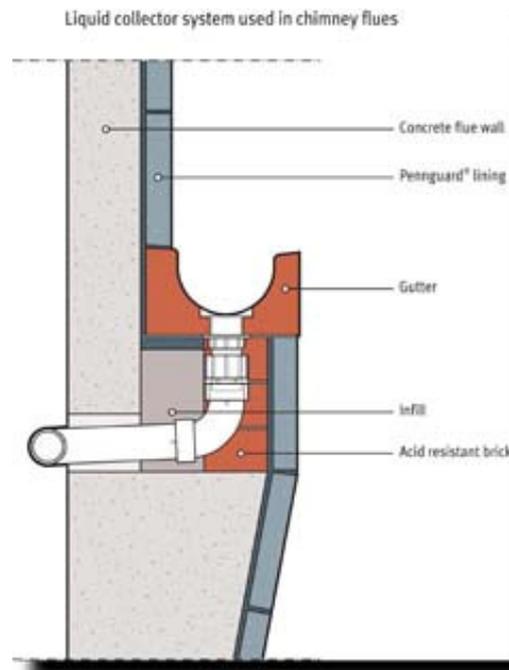


Figure 6: Liquid collector system used in chimney flues

Preparing the chimney for Wet Stack Service – An Overview

The installation process can be summarized as follows:

1. Removal of the brick lining;
2. Placement of an external lining to the surface of the brick pots on the roof with a Vinyl Ester glass covering;
3. Replacement of all metal parts on the roof with GRP including handrails, hatches, lights and vents;
4. Preparation of the concrete flues by grit blasting, partial resurfacing and installation of the Penntrowel® Epoxy Primer;
5. Installation of the drain gutters on the existing corbels (20 in each flue);
6. Installation of the Pennguard® Block Lining System onto the concrete surface by trained bricklayers under supervision of Hadek Inspectors.
7. Painting of the top 42 m of windshield.

An overview in pictures:



Figure 7: Removal of brick on the railway



Figure 9: Coating the brick pot at roof level



Figure 10: Application of the Penntrowel® Epoxy Primer



Figure 8: Trial erection of the GRP at the factory



Figure 11: Formation of the gutters



Figure 12: Installation of the Pennguard® lining



Figure 15: Installation of the Pennguard® lining in one flue took 30 days



Figure 13: Hadek inspectors supervise the lining works



Figure 14: Machines for mixing the Pennguard® Adhesive Membrane



Figure 16: Work complete and chimney back on line