CASE STUDY

H-VARB PF Diffuser at Longannet Power

Background.

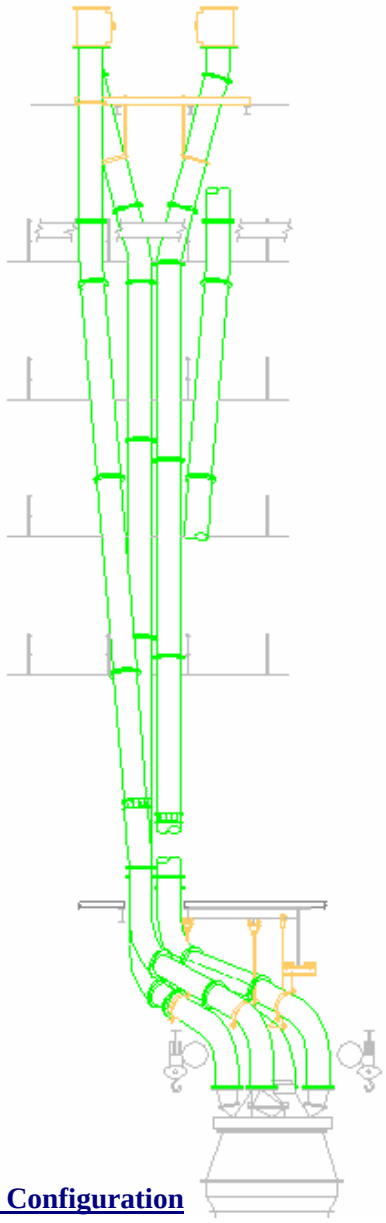
May 2004, Greenbank was invited by Southwestern Corporation to provide a solution to a potential PF distribution problem.

Southwestern were retrofitting 2 x high performance static classifiers on to 2 mills at Longannet Power Station, where previously 2 dynamic classifiers had been tried, tested and found to be unsuitable.

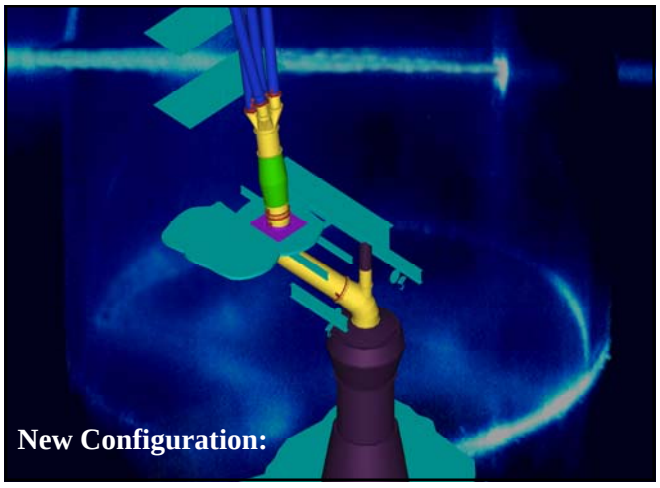
Prior to the dynamic classifiers being fitted there was a single pipe outlet, 1072NB(42”), which was routed through primary and secondary splitters to 534Nb (21”) pipework at the burners. When the dynamic classifiers were fitted, individual 534NB pipelines were routed from 4 outlets on the Classifier top directly to the burners alleviating the need for splitters.

To reinstate the HP Classifiers without having to replace all the primary and secondary pipework along with splitters, it was proposed by Greenbank that a single pipe be taken off the HP Classifier and a 4 way splitter be installed, which connected up to the 534NB pipelines, such they did not need removing and replacing. It was proposed that a VARB be fitted upstream of the 4-way splitter to improve distribution across the outlets.

Again GAIM Ltd. provided CFD analysis to compliment their design, which in this instance needed a more aggressive VARB as it was to be positioned directly after 2 PF bends. The aggressive VARB includes a venturi section and vortex finder to mix the air and fuel and to move the rope away from the pipe wall. This was tested at 1/3 scale on the test rig and the design was verified before going into production.



Original Configuration



New Configuration:

Outline Performance Data.

- Air to Fuel Ratio: 2.1 to 3.2:1 , Velocity: 22-30m/s, Coal Type: Black (Varies)
- Pipe Inlet Diameter: 1072NB (42”), Pipe Outlet Diameter: 534NB (21”)
- Pipe Linings: Zalcon & ADILux

VARB Arrangement:

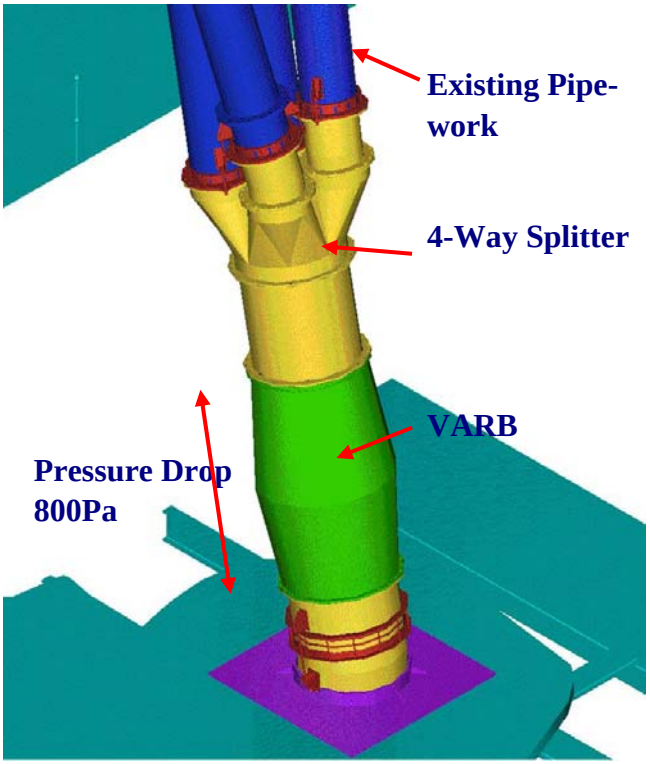
Installation and Operation:

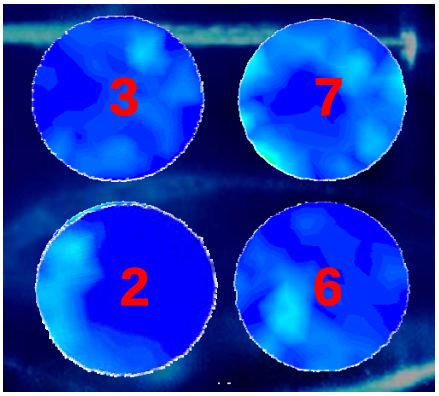
On this occasion we were unable to correlate the pre-modification CFD work with an operating configuration. The pre-VARB data was from the 4 legs of the dynamic classifier. This could not be utilised as it was to be removed.

Having no initial piping configuration or data to correlate to, our sister company, GAIM Ltd had to design the system from scratch using their CFD model and the test rig.

The pipework was surveyed and measured up. The VARB and 4-Way splitter was installed as shown to the right. This arrangement was typical for 2 mills. Hence, due to having had Southwestern Corporation's latest high performance classifier replace the dynamic classifiers previously installed, this new piping arrangement is unique to 2 mills.

Our analysis deemed this to be the most difficult application to date and such the VARB was designed to be





Results:

The results are outlined below showing the installation before and after the VARB was fitted. In this instance a VARB was fitted to one mill, such the distribution is over 4 outlets. The second VARB has yet to be fitted. The results for the first are shown stating:

% Distribution: Which is a percentage of the total mass flow and,

% Deviation: Which is the percentage deviation from the required

Results	Outlet:	2	3	6	7
% Distribution	4 Outlet Pipes	30.3%	28.3%	18.7%	25.0%
	VARB	**29.5%**	**27.0%**	**21.9%**	**22.3%**
% Deviation	4 Outlet Pipes	21.0%	13.0%	-34.0%	0.0%
	VARB	**18.1%**	**8.1%**	**-14.3%**	**-12.1%**

Bespoke Design:

Using the principles developed by our sister company GAIM Ltd., each application is studied on its own merits. The methods used are as follows. A CFD model is developed to replicate the existing pipe configuration (from mill to splitter), performance range and flow distribution. Once the CFD model replicates the existing distribution characteristics, the model is changed to incorporate the proposed VARB.

The design of the VARB is then tailored to obtain the best results over a range of air to fuel ratios and velocities. Once the design of the VARB is complete it can be physically tested on our 1/3 scale rig which is situated at the University of Nottingham.