Arch Coal has a new mining complex in southern West Virginia. In the past three years near the small town of Sharples, the Mingo Logan Coal Co., a wholly owned subsidiary of Arch Coal Inc., has invested more than US$ 300 million to create an underground mine, a preparation plant, and a rail loadout - the Mountaineer II mine and the Cardinal prep plant. The first contracts
were awarded in July 2004, and in July last year, the first train was loaded.

The Cardinal preparation plant has worked accident free since start-up over 16 months ago. The Mountaineer II mine has only one lost time accident in two years of operation, with that accident occurring approximately 18 months ago, while the mine was operating in construction mode. This performance has led to Mountain Laurel’s receiving several safety awards since start-up, namely the Mountaineer Guardian Award, MSHA’s Pacesetter Award and The Holmes Safety Association’s Safety Award. In an effort to ensure every employee returns home every day, accident free, an innovative behaviour-based safety process has been implemented at Mountain Laurel this year. This process is based on peer-to-peer observations, with the data managed by
an hourly steering team, to identify and eliminate at-risk behaviours.

Earlier this year, the Mountain Laurel complex earned the Greenlands Award from the West Virginia Department of Environmental Protection for its achievements in environmental care. In addition, Mountain Laurel’s community outreach includes helping 90 homes in the neighbouring towns of Sharples and Mifflin gain public water access, as well as funding the construction of a new stretch of highway, a railroad overpass and a bridge in Clothier, West Virginia, that now provides residents with a safe and reliable connection to the existing state highway.

The mine
Mining activity is progressing according to plan. The coal seam is between 6 and 7 ft high and approximately 350 ft below the surface of the valley, making it one of the last easily accessible large seams in the state. Production at the mine during the first three quarters of this year has focused on gaining access to the first longwall panel utilising three continuous miner units. Production is expected to increase during the fourth quarter of this year, as the Mountaineer II longwall operation ramps up to full production. Beginning next year, production is estimated to range between 4 and 5 million tpa, (see Figure 1). Arch Coal accounts for 11% of US coal production, and the Mountain Laurel complex will soon be one of its top producers among Appalachian operations.

The prep plant
The Cardinal prep plant is itself a testament to Arch’s planning skills and its extensive experience in coal cleaning. A modular approach to the plant - three modules, each of 700 tph raw coal capacity - gives the company flexibility both in maintenance and in responding to short-term variations in demand (see Figure 2). The plant can produce coal for steam, coking, and PCI customers, with ash ranges running from 10 - 16%, 6.5 - 8%, and 6.5 - 9%, respectively. Flexibility is also served by the eight stacking tube stockpiles, four each for raw coal and for clean coal. Trains are loaded at a rate of 5000 tph and the loading process usually draws from two stockpiles simultaneously.

Coal cleaning in each module begins with a double deck banana screen cutting at 10 mm on the top deck and 1 mm on the bottom deck. Heavy media vessels are used for the +10 mm size fraction. The heavy media vessel/heavy media cyclone combination, rather than strictly heavy media cyclones, permits lower moisture levels by 0.5 to 1%, a factor critical to serving the steam coal market. Compound spirals and column flotation are used to clean the fines and superfines, respectively (see Figure 2).

Quality control
Another decision made early in the mine planning was how coal quality would be achieved. Arch has built a reputation as a reliable supplier, striving for consistent quality not only train-to-train, but also within the train. The company has been able to achieve consistent quality in part through its philosophy of creating stockpiles and/or silos of coal of different quality, and using online analysers in the rail and barge loadouts to blend those coals to meet the contract specifications for sulphur, ash and Btu/lb. The decision to put an analyser in the loadout was therefore a virtual given. The decision of whether to use an analyser to control prep plant quality was not so obvious, but in the end, Arch decided that the advantages of controlling prep plant product quality outweighed the investment.
The placement of four stacking tube stockpiles between the prep plant and the loadout satisfied the need to create differing coal qualities and then blend those coals to meet the specifications of the train being loaded. With contracts to fill ranging from 6 to 16% ash, this meant that the plant had to create widely differing qualities in those four piles.

With a loadout rate of 5000 tph and trains ranging from 10,000 t to 15,000 t, the time to load each train is two to three hours. The mine typically designates two of the four stockpiles as sources for each train.

As the train is loaded, the analyser in the loadout tower tracks the cumulative quality of the train, which enables the loadout operator to adjust the reclaim proportions of the two stockpiles to keep the train on track with the specifications.
specification. The analyser chosen by Arch is the Gamma-Metrics CQM™ (Coal Quality Manager) from Thermo Fisher Scientific. Since Arch had six other loadouts in Appalachia with this model analyser, it was quite familiar with its record for reliability and accuracy. The analyser is located two decks below the top of the loadout tower, where it receives the rejects from the secondary sampler in a three-stage James A. Redding sampling system (see Figure 3).

The analyser performance requirements for monitoring the prep plant product were not as exacting. The greatest accuracy is required at the loadout, but since the prep plant product is directed to one of four stockpiles where it mixes with tens of thousands of tonnes of coal already in the pile, the accuracy requirements are not as tight. Arch chose the Gamma-Metrics ECA™ (Elemental CrossBelt Analyser), also from Thermo Fisher Scientific, for that purpose. Unlike the CQM analyser, which analyses a sample stream, the ECA analyser analyses the full flow of coal on the conveyor (see Figure 4). The product itself mounts around the existing conveyor. The plant also has a two-stage James A. Redding sampling system operating on the product belt leaving the plant.

The ECA analyser monitors the product ash being sent to the clean coal stacking tube stockpiles. The control room operator can respond to variations away from the target ash by diverting more or less coal to the met rewash plant. This is done by way of six gates, one top deck and one bottom deck from each of the three heavy media vessel product screens.

The existence of the two sampling systems on the same coal stream as the analysers not only facilitated quick and precise on-site calibration of the analysers, it also gave the plant ongoing confirmation of the precision of the analysers. This rigorous means of quality control enabled Arch to decide that it would not need an on-site coal laboratory. Figures 5 and 6 give an indication of the degree of correlation between the analysers and the laboratory. As expected, the estimated accuracy of the CQM analyser is slightly better than that of the ECA analyser, although the ECA accuracy is optimised by the fact that the tph on the product belt shows little variation.