

Murray Energy's High Capacity Longwall Development

Murray Energy Corporation had its humble beginnings in 1988 with the acquisition of The Ohio Valley Coal Company's Powhatan No. #6 Mine which was producing approximately 1,000,000 tons of coal from a single continuous miner operation. Today, under the direction of Robert E. Murray, the company has grown to become the largest privately owned coal company and the 2nd largest operator of longwall mining systems, producing approximately 30 million tons of high quality bituminous coal annually.

The American Coal Company's Preparation Plant Facility - Galatia, Illinois



The Ohio Valley Coal Company's Powhatan No. 6 Mine - Clean Coal Pile, Alledonia, Ohio



The growth and success of the company can be partially attributed to the continuous development and implementation of advanced, cost effective mining solutions. This development is driven by a core team of employees with many years of mining experience who are uniquely qualified to challenge the "status quo" of mining equipment solutions. This team supports the company's management philosophy to have better control of their own destiny. Through key acquisitions such as the establishment of a longwall mining equipment manufacturing company in Centralia, Illinois in 2009 (American Equipment & Machine, Inc.), Mr. Murray's organization not only mines coal, but now also develops, designs and manufactures critical mining equipment tailored to the specific requirements of each mine.

Photo: American Equipment & Machine, Inc. – Centralia, Illinois



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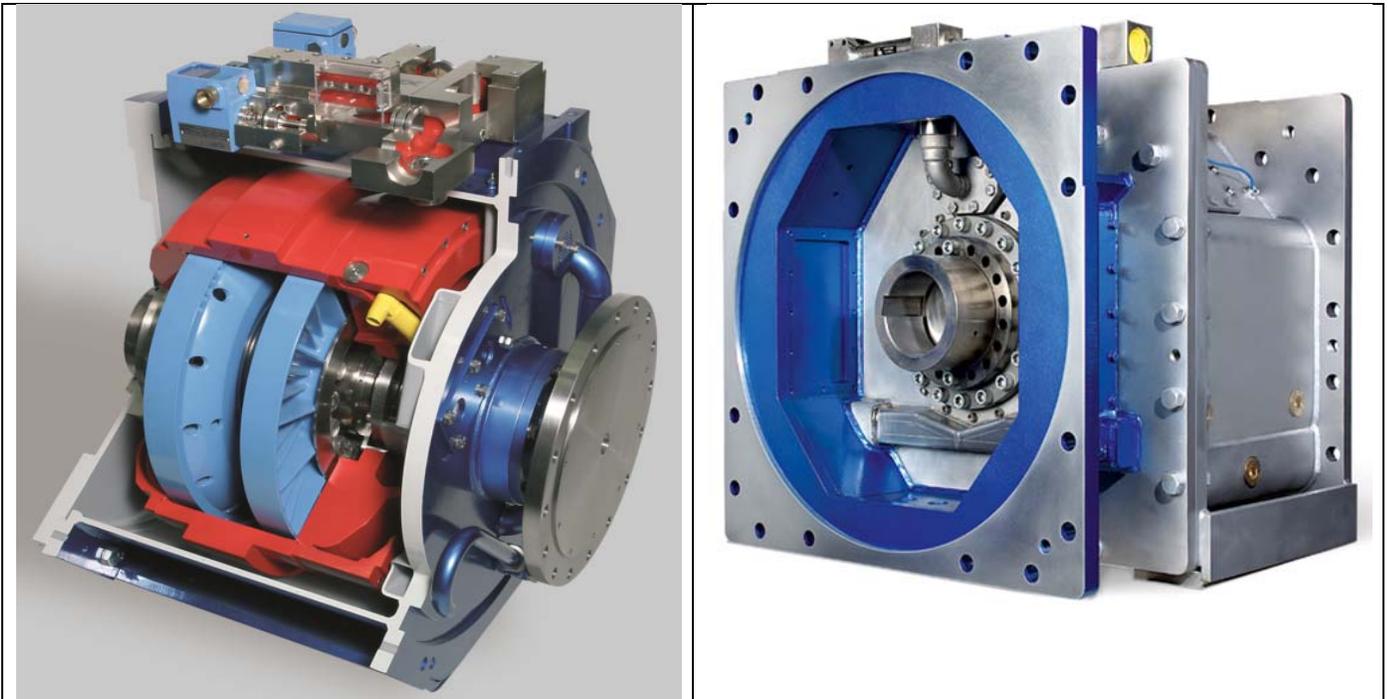
In addition to Murray Energy's in-house design and manufacturing capabilities, the company is supported by a team of experienced and knowledgeable distributor/suppliers and OEM's that provide additional key technical support and engineered products to complete the system scope of supply.

This unorthodox strategy was recently put to the test when Murray Energy committed to use this equipment development philosophy to design and manufacture several new high production longwall systems for their Century, Ohio Valley, and New Era mines. Longwall panels at these mines were being developed with face widths between 1150' – 1630', and panel lengths up to 12,000 ft. To meet the challenge of moving this much coal, Murray Energy's team established aggressive equipment expectations for the AFC drives. The drive technology needed to balance the requirement of providing high break-away torque for heavily loaded chain conditions, as well as protect the chain and drive components from anticipated shock loads resulting from sudden jamb conditions of the chain.

One of the key requirements put forth by Murray Energy's team was that the system must be simple to control while easy to operate and maintain by the mine's longwall and maintenance teams. This approach insured that Murray Energy did not have to rely on outside contract services to provide critical support when problems developed that would potentially result in unplanned downtime. Based on the preliminary engineering work, Murray Energy's team decided on using 3 x 1960 HP drives for all of their new high capacity AFC systems. This represented the highest power AFC's drives in operation currently in the USA.

Transferring all of this power to the chain in a controlled manner required an advanced, well proven technical solution. Murray Energy contacted the RM Wilson Company (Wheeling, WV) who specializes in supplying high quality mining products and rebuild service support for AFC drive systems. When given the opportunity to provide input, RM Wilson recommended Voith Turbo's high power range fill controlled fluid couplings. These actively controlled and actively cooled couplings were specifically developed for high powered AFC drives.

Voith 562 DTPKWL2 Water Fill Control Coupling:

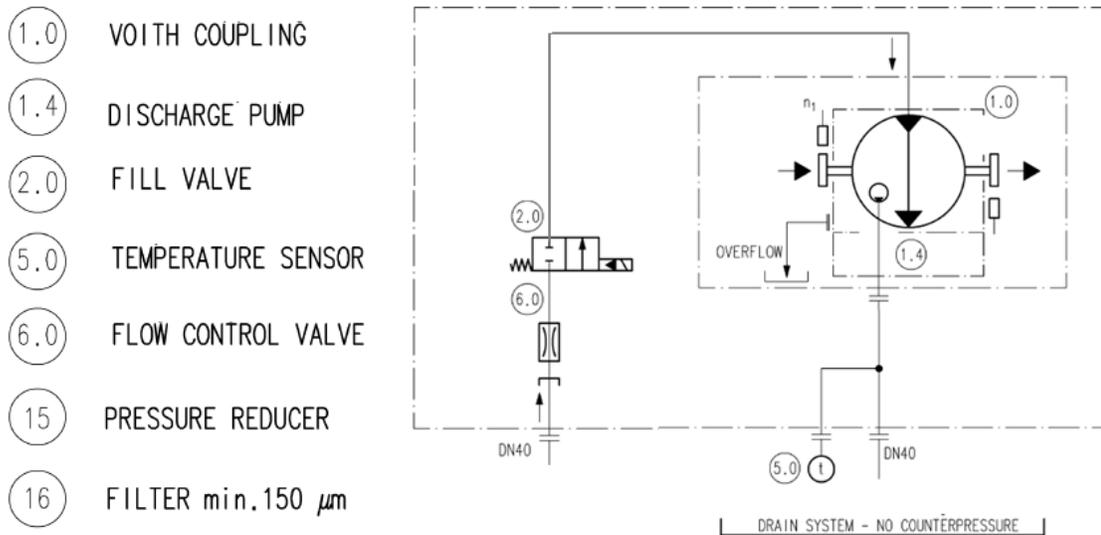


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RM Wilson Company had previously been supplying Murray Energy's mines with Voith's constant fill couplings for AFC drives up to 3 x 1000 HP, however the jump to 3 x 1900 HP exceeded the thermal range of constant fill fluid couplings. RM Wilson was aware that Voith's fill controlled fluid couplings were already a well proven solution, as this advanced technology drive component was already proven on other high production longwall mines worldwide.

Murray Energy's Longwall development team requested RM Wilson to organize a meeting with Voith to further discuss the control system requirements. Voith presented the newly developed ACC (Automated Cooling Circuit) control scheme which greatly simplified the hydraulic control components and resulted in the lowest possible water consumption for the drives. Based on the simplicity of the control scheme (shown below), Murray Energy's development team was satisfied that integrating the coupling control function into their longwall controller would be a straight forward process.

Voith ACC Water Control System Schematic:



Meeting the demands of these high powered AFC systems required detailed examination of the performance requirements of each major component of the drive. RM Wilson Company facilitated the coordination of various technical meetings with prospective drive component manufacturers and the Murray Energy Longwall Development team. The result was a properly engineered drive solution where the motor, fluid coupling, gearbox, torque limiting coupling, and chain were matched to the system performance specifications. The final drive solution provided Murray Energy with a system capable of providing the following performance and operational characteristics:

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Murray Energy Drive System Component Selection & Performance:

Component	Manufacturer / Model	Performance / System advantage
AFC Motor	Mohler / MT-2222 / 1900 HP	<ul style="list-style-type: none"> • across line, sequential start method (simple, easy on power system) • designed to support Voith coupling input runner set (compact design) • capable of producing 234% break down torque (for heavily loaded start conditions)
Fill Control Fluid Coupling	Voith / 562 DTPKWL2	<ul style="list-style-type: none"> • water fill control coupling for frequent heavily loaded starts (no thermal limit from fluid coupling) • wear free power transmission (no wear from slipping clutches) • naturally soft torque response (provides gentle starts and increases chain life significantly) • natural load sharing control (no PLC controls required, inherent load sharing performance) • hydrodynamic max torque for break-away condition up to 220% x FLMT (protects chain while delivering high break away torque)
Gear Reducer	Jahnel Kestermann / JPL-65 & KPL-65	<ul style="list-style-type: none"> • continuous rating = 1900 HP (7680 Nm) • Max. LSS torque rating = 650,000 Nm for 3 seconds • Ratio = 33:1
Torque Overload LSS Coupling	Voith Safeset / SRPG 555	<ul style="list-style-type: none"> • Safeset is designed to slip below chain proof load tension value (protects chain from sudden blocked chain conditions) • Highly accurate and repeatable torque release based on hydraulic clamping / friction slip principle

Photo of Rebuilt 1900 HP AFC drive assembly courtesy of RM Wilson Company:



The following table lists all of the major components which completed the Murray Energy Longwall AFC system scope of supply:

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Longwall Equipment Details / Supplier / OEM:

Equipment	Details	Supplier	OEM	Model
AFC Haulage System	See component details	AEMI	AEMI	AEMI 2010
AFC Panline	1000 mm width	AEMI	AEMI	1000 mm 1.75
AFC Motors	3 x 1900 HP x4160V	RM Wilson	Mohler	MT-2222
AFC Fluid Couplings	Water Fill Controlled with Automated Cooling Circuit (ACC)	RM Wilson	Voith Turbo	562 DTPKWL2
AFC Gearbox	In-line & Right Angle	RM Wilson	Jahnel Kesterman	JPL-65 & KPL- 65
AFC Chain Protection Torque Limiter	Hydraulic pressure set, non-fatigue type torque limiter	RM Wilson	Voith Turbo	SRPG-555
AFC Chain & Flight Bars	48 x 152	RM Wilson	Thiele	THD Galvanized
Shearer		Joy	Joy	7LS1A
Roof Support System	MEC 700 (Cent. + OVC) & AEMI 1053 (New Era)	MEC	MEC	
Stageloader	1300 mm, 475 FPM	MEC	MEC	

Photo of Longwall System by Murray Energy



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Installation & Commissioning:

Murray Energy is currently operating these new high capacity longwall systems at the Century Mine, Powhatan No. 6 Mine, and New Era Mine. Murray Energy also plans to install a similar system at their New Future mine in 2014. The longwall was initially commissioned at Century Mine which now has the longest history of operation on the new system. The remainder of this story will focus on the Century Mine installation and operational experience; however the installation and commissioning experience at the other mines has been very similar.

The first longwall setup with the new high capacity system was commissioned September 4, 2011 at Murray Energy's Century Mine on a relatively short longwall panel. This provided an opportunity to give the new system a thorough test and work out any technical issues. Considering the challenge that was accepted with this unusual approach to designing a large engineered system, the new longwall started producing coal in spite of some minor technical issues which arose during initial commissioning. Surprisingly, the mine was able to produce coal as they worked through these technical issues. This feat was partially attributed to the forgiving nature of the drive technology chosen for these systems which confirmed Murray Energy's requirement that the system be simple, yet robust and reliable.

The second longwall system installation began operation on September 25, 2011 at Murray Energy's Ohio Valley Coal mine. The third longwall system was commissioned at Murray Energy's New Era Mine in south central Illinois and began operation June 6, 2012.

Operational Experience to Date: Century Mine Longwall System

The Century Mine has successfully completed six longwall panel moves with this new equipment and they are now mining a longwall panel of 1482 (ft.) in width and 12,761 (ft.) in length. The system has been performing well and is now consistently producing 800,000+ tons/month. The Century Mine longwall has recently achieved a company production record of over 1,100,000 ton in a single month.

Murray Energy has every expectation that these longwall systems will prove to be among the highest producing longwall systems in the USA, with potential of exceeding 8,000,000 tons/year from a single longwall mining operation. This is an exceptional accomplishment considering that they are mining in the Pittsburgh No. 8 coal seam, and have the usual challenges associated with mining that seam of coal.

Murray Energy's longwall teams are pleased to report that the system availability is high and they have not experienced any chain failures in spite of the fact that the 48 mm chain can, under high load starting conditions, can experience tensions levels that approach the proof load limits of the chain. To date, the Murray Energy mines have noticed a considerable increase in chain life attributed to the very soft starting behavior of the Voith couplings (25-40 second start time). The controlled application of torque, along with the exceptional torsional dampening characteristics of the fill controlled fluid couplings mean Murray Energy can expect the maximum possible life out of all drive components and AFC chain.

Despite the already observed increase in equipment life, the Murray Energy mines are careful and diligent. The drive components get a thorough inspection and rebuild after each longwall panel. Based on years of reliable and timely support, Murray Energy again employed the services of the RM Wilson Company to perform the drive system rebuilds. The equipment rebuild services have been both timely and within anticipated cost levels.

The US Coal mining industry, in spite of the current energy market and regulatory challenges, has always found unique ways to advance technology to new heights. Murray Energy's experience with the development of this new high powered longwall system proves the industry can face these challenges and remain strong, supplying a vital part of this country's energy needs.

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Article Co-Authored by: James McClenathan; VP Technical Services, RM Wilson Co. Wheeling, WV & Roland Hoet; Director of Mining & Metals, Voith Turbo, Inc., York, PA