



ANATOMY OF A COAL TO BIOMASS CONVERSION

Engineering a Fuel Handling System
for Unprocessed Biomass

SYNOPSIS

In 2011, ReEnergy Holdings LLC acquired the Black River Generation facility at Fort Drum, the home of the Army's 10th Mountain Division near Watertown, NY. The Albany-based company had plans to convert the decommissioned coal-burning power plant into a biomass-fed power-generation facility that would supply the military installation and surrounding communities with electricity. ReEnergy hired D&S Engineering, LLC, which turned to ProcessBarron to supply much of the new fuel handling equipment, which would transport wood scrap derived from local logging efforts — as well as construction and demolition material — to the plant's existing boilers. ProcessBarron contributed key components to the robust biomass fuel system that is capable of keeping the 60-megawatt generation facility firing while handling the stringent requirements dictated by the military installation's restrictions on fuel delivery.

As a complete coal-to-biomass conversion and ReEnergy's biggest plant, the Fort Drum project was complex and had many components.

Despite the scope, ReEnergy wanted to make sure the retrofitted site was up and running as quickly as possible in order to take advantage of a 10-year contract offered by New York State Energy Research and Development Authority (NYSERDA). All parties contracted to work on the project therefore faced considerable time constraints while also having to contend with military requirements (the site is on an Army installation) and upstate New York's winter weather. The final timeframe for the project was roughly eight months from August 2012 until April 2013 — a sprint under any circumstances.

The design of the fuel handling system presented a few challenges. In the first place, as with many coal to biomass conversions, there was a strong desire to reuse as much existing equipment as possible to reduce costs. This is often difficult, though, as biomass requires specialized equipment to move the fuel through the system. Often, this equipment is larger than coal equipment and there is more of it, which created a second major challenge in the case of the Fort Drum project — space constraints. The site available for the wood yard was relatively small and could not be expanded since it was hemmed in by military facilities that could not be altered.

This issue could have been managed fairly easily if fuel was to be delivered at regular intervals and in small lots, but the renovated Fort Drum site needed to be able to receive large amounts of fuel in a short window due to the military restrictions on delivery hours. While the facility receives roughly 600,000 tons of biomass fuel per year (an average of 1,650 tons per day), it sometimes arrives at rates as high as 300 tons per hour, 12 hours a day, or 3,600 tons per day.

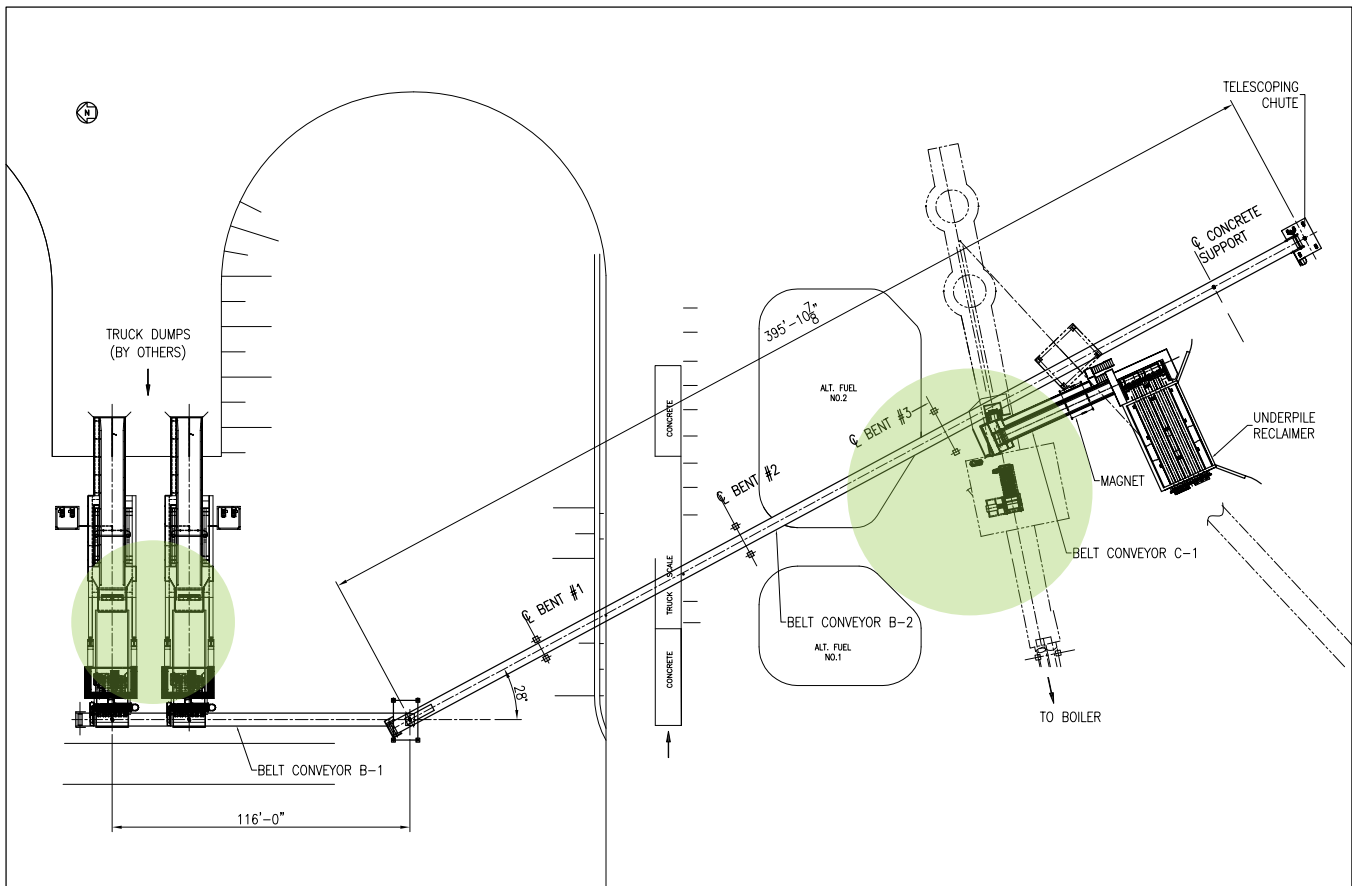
Lastly, the fuel handling system had to be designed to handle unprocessed material, including brush from surrounding logging operations and demolition material from construction sites. The system had to be able to receive, stack, and reclaim the material in the limited area provide before passing it through any screening or sizing equipment. Once reclaimed from the storage pile, the material was to be conveyed under an electro-magnet to remove ferrous metals and then fed into the processing system, which would then discharge the material directly onto the main boiler feed belt conveyor.

LAYOUTS AND RETROFITS

As they began to look for solutions that would address the requirements of the Fort Drum project, ProcessBarron engineers worked closely with D&S Engineering staff and representatives from ReEnergy.

The two challenges that required the most collaboration were the restrictions on space and the need to recover as much of the existing coal

equipment as possible. It wasn't just that the site for the proposed wood yard was small, but that it was surrounded by military installations that could not be changed to accommodate any new equipment at the plant. Another twist was that the existing coal stack-out system was to remain standing, which added another obstacle for the new biomass stack-out system to work around.



The layout of the Fort Drum site. Two areas were available for biomass equipment installation — the old coal system (right) and a delivery yard on the other side of a central access road (left).

Reclaiming the existing coal equipment proved challenging. In general, there are few coal components that can be used for biomass because of the drastically different ways the two materials are handled. Coal is usually somewhat consistent in size, free flowing, and, overall, predictable. Gravity is a useful and simple conveying method for handling coal. Biomass however, is extremely unpredictable, typically inconsistent in size, and does not flow well. Biomass must be manipulated almost constantly, gravity chutes must have ample open space and steep pitches, and mechanical components must be robust and designed for worst-case scenarios such as compacted or oversized material. Successful handling of biomass relies on a combination of brute force, experience, and an understanding of how material will react in various situations.

Each piece of equipment in the existing fuel handling system was evaluated for reuse or possible retrofit. It was determined that only a few of the existing belt conveyors could be integrated into the new system — a fairly common occurrence in any coal-to-biomass project that seeks to preserve portions of an old plant’s fuel handling system.

The truck dumpers where unprocessed biomass fuel is delivered to the Fort Drum facility. The beginning of the long conveyor that leads to the wood yard is on the right.

BIOMASS SYSTEMS SOLUTIONS

ProcessBarron designed equipment for four different sections of fuel handling equipment belonging to two distinct areas of the overall system — the wood yard and the boiler feed.

The fuel receiving system devised for the Fort Drum installation begins with two truck dumpers, which both discharge material onto a ProcessBarron collection belt conveyor. This belt conveyor then feeds another ProcessBarron belt conveyor, which carries the material over the existing coal stack-out system to the other side of the property, where it is stacked and managed. To minimize dust, the discharge of the stack-out belt is equipped with a telescoping chute to contain the material as it drops 70 feet to the ground.





The long conveyor that passes across the Fort Drum access road and delivers fuel to the wood yard on the other side.



The fuel pile being built by the 70-foot telescoping chute.

The fuel is then bulldozed into a reclaim area defined by a three-sided concrete bunker. The bunker is equipped with two ProcessBarron three-strand drag-chain reclaimers. Each reclaimer is capable of maintaining a fuel supply at the fuel consumption level of all three boilers, so under normal operation both reclaimers run at approximately half speed. This provides

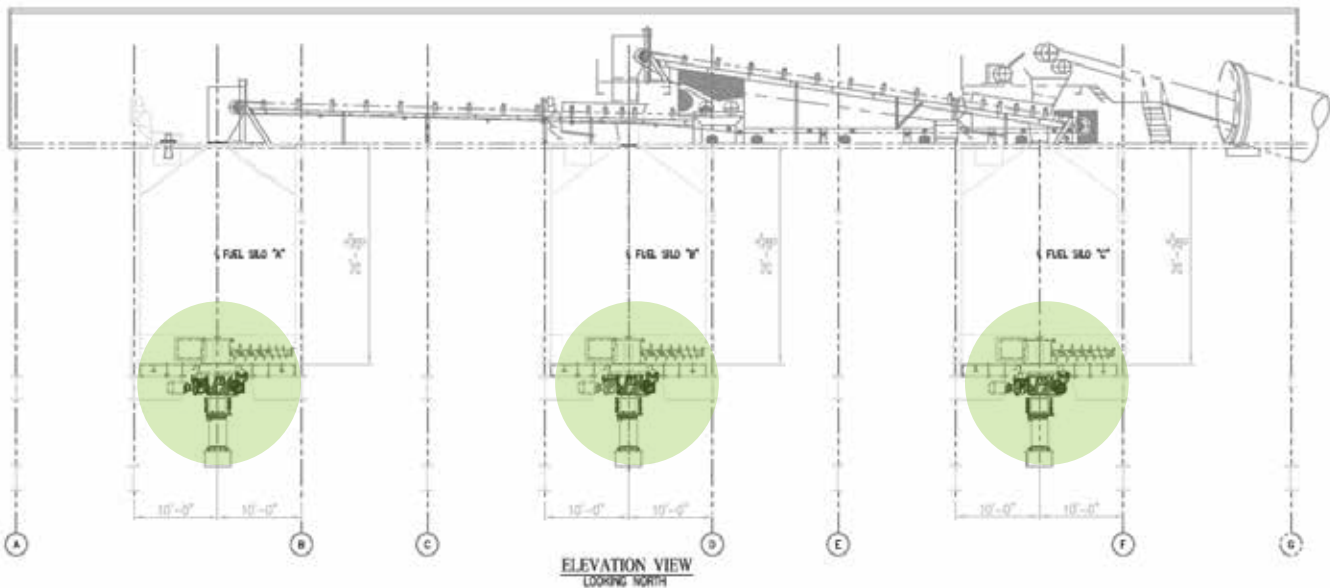
complete redundancy, ensuring uninterrupted fuel to the boilers. The reclaimers feed a ProcessBarron belt conveyor, which passes under a self-cleaning magnetic separator before discharging onto the screen and hog feed belt conveyor. The material is then processed and discharged onto the existing boiler feed belt.



The reclaim area with drag-chain reclaimers (center) and the transfer belt that leads to the legacy boiler feed system (top right).

At the end of its run, about 70 feet in the air, the boiler feed belt unloads onto the old coal system’s “tripper” belt, which then transfers fuel to a trio of old coal bunkers. Both the boiler feed belt and fixed tripper belt were modified for handling biomass as part of the conversion project. ProcessBarron retrofitted the old coal bunkers by replacing the original conical bottoms with new flat floors and outfitting them with Circular Screw Reclaimers (CSRs). Process-

Barron proposed this retrofit as an alternative to live-bottom screw bins because it provided the opportunity to re-use much of the existing coal bunkers, reducing the amount of new structural steel required and providing a compact and simplified system arrangement that still delivers the maximum amount of storage capacity. ProcessBarron transfer drag conveyors carry the metered fuel from the CSRs to the boiler feed chutes.



System arrangement of the circular screw reclaimer retrofits that allowed the existing coal bunkers to be retained as parts of the new biomass system.



BLACK RIVER REBORN

The fast-paced project completion schedule dictated that all the new equipment had to be installed in mid-January 2013 — one of the most difficult times of the year to be working outside in upstate New York due to the harsh winter weather. While the sub-zero conditions were uncomfortable for everyone on the project, it was particularly challenging for ProcessBarron’s field services crew, which had to work in the exposed wood yard.

During the installation, the ProcessBarron field crew had to contend with temperatures that dipped to -14° F, as well as near constant wind and wind chill. Predictably, it snowed quite a bit during the three weeks it took to complete the installation. At one point, roughly two feet of snow covered the ground. And when there wasn’t snow, there was mud.

Despite these environmental challenges, the ProcessBarron crew persevered and brought the converted fuel handling system online in March 2013. Designed to deliver an average of 84 tons per hour, the boiler feed system can handle up to 90 tons per hour, fueling the plant’s three boilers each rated for 30 tons per hour.



A ProcessBarron engineer warms his hands during the cold, outdoor equipment installation at the Fort Drum site in January 2013.

The re-christened ReEnergy Black River facility began commercial operation in May of 2013, roughly on schedule. Capable of generating 60 megawatts, the plant plans to supply Fort Drum with its needed 28 megawatts, while the remaining balance will be exported to the local utility provider to be sold into the energy market. For each megawatt generated by biomass fuel, ReEnergy sells the renewable energy credits to NYSERDA per New York’s Renewable Portfolio Standard, which requires that 30 percent of the state’s electricity be generated from renewable resources by 2015.

SELECTED BIBLIOGRAPHY

Johnson, Jessica, "ReEnergy's Black River Retrofitted for Biomass,"

Wood Bioenergy, December, 2013, 16-18,

http://issuu.com/hattonbrown/docs/wb_1213-digimag?e=1281587/5685365

"ReEnergy Black River," ReEnergy Holdings LLC,

http://www.reenergyholdings.com/our-facilities/energy-generation-facilities/_owned-and-operated-by-reenergy/reenergy-black-river

"ReEnergy Holdings Acquires Black River Generation Facility at Form Drum,"

The Mountaineer Online, March 22, 2012,

<http://www.drum.army.mil/mountaineer/Article.aspx?ID=6238>