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## Sticking with Coal



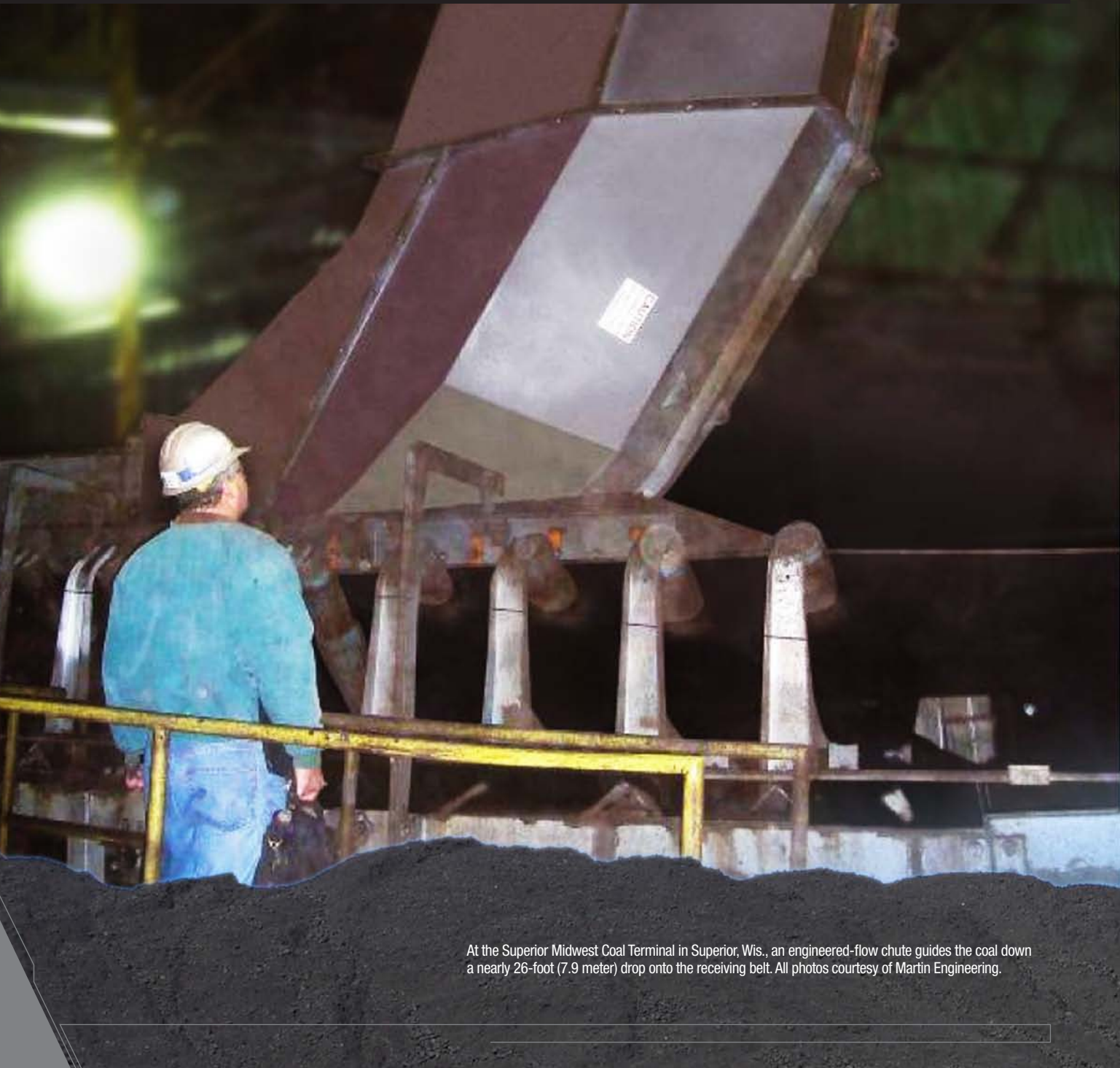
**EPA Boiler Rules**

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# New Tricks for the Old Dog: Coal Conveying for the 21<sup>st</sup> Century

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At the Superior Midwest Coal Terminal in Superior, Wis., an engineered-flow chute guides the coal down a nearly 26-foot (7.9 meter) drop onto the receiving belt. All photos courtesy of Martin Engineering.

*Editor's Note: This article is based on a paper given at COAL-GEN 2011 in Columbus, Ohio.*

**T**he efficient handling of coal on belt conveyors is essential to coal-fired power plants. The conveying of coal is prone to problems including the escape of spillage and airborne dust. These are typical problems, common problems, problems of long-standing, problems that continue to make the handling of coal a dirty, inefficient, unpleasant, high maintenance, low reward job—a “dog” of a job.

A key to improving coal conveying is the implementation of advanced systems to improve performance and prevent fugitive material. These new technologies present the opportunity to teach the “old dog” that is coal handling some “new tricks.” When I say “tricks,” I do not mean “magic trick,” --that is something not repeatable by the average individual. I am using another definition of “trick,” as pulled out of on my computer’s thesaurus—as in “knack, technique, or habit.”

The new technologies that this article will examine include engineered chutes that channel the material stream to reduce the entrainment of air into the material flow, and so minimize the release of dust. The article will also feature a modern architecture with improved belt support and sealing systems that reduce maintenance requirements and allow maintenance work to be performed from safely outside enclosures and away from moving parts.

### **Engineered-Flow Transfer Chutes**

The loading and discharge of the conveyor belts is the area where many, if not most, of the environmental problems in coal conveying occur. Fortunately, a new technology provides chutes that can accomplish conveyor loading and discharge without blockages, and while minimizing the dust generated. This innovation is engineered-flow chutes. With a design based on testing and computer-based flow studies of the specific material to be handled, these transfer chute systems provide better material control, continuous flow at higher capacities, and dramatic reductions in material spillage and the release of airborne dust.

Engineered-flow chutes typically include a “hood” discharge chute and a “spoon” receiving chute. Inside each conveyor transfer point, the “hood” controls the flow of material from the discharging conveyor, maintaining a coherent material stream, and minimizing induced air. At the bottom, a smooth-line transfer loading chute or “spoon” directs the stream of material onto the receiving belt at the proper speed and angle, without impact, to minimize material degradation, belt abrasion, and the expulsion of airborne dust.

Using this “hood and spoon” design, these chutes lay the cargo onto the receiving belt at the proper speed and direction of travel. This reduces impact and abrasive wear on the receiving belt and minimizes the positive pressure that creates and drives off airborne dust. The use of these engineered-flow chutes stabilizes the material flow rate, reduces cleanup and maintenance expenses, and controls the risk of explosion and fire in coal handling.

To develop the chute for a given transfer point, the design for the chute relies on the information generated by material testing. Testing of samples of the actual material to be conveyed provides important data. Information drawn from this testing includes material composition and physical properties, moisture content, lump size range, and fines size. After the various conveyor and material parameters are spelled out, the material discharge trajectory can be determined. This detailed information is used in developing a computer-generated 3D model of flow through the chute.

### **The Benefits Of Engineered- Flow Chutes**

- Engineered-flow chutes offer a number of benefits, including:
- Passive dust control to reduce dust escape while minimizing baghouse collection.
  - Increased flow rate to eliminate chutes as a production bottleneck.
  - Reduced material buildups and blockages to reduce chute plugging.
  - Reduced loading impact to extend belt life by reducing damage and abrasion.
  - Reduced degradation of material to minimize dust generation.
  - Controlled load placement to prevent mistracking, spillage, and belt-edge damage.
  - Reduced wear on liners to extend service life and cut replacement cost and time.

### **A New Conveyor Architecture**

A second “new trick” for coal conveying—one that can be combined with the first trick of engineered chutes—is a modern conveyor architecture. Part of this new architecture label stems from the system’s “back to the drawing board” approach, where many “long-standing conventions” of conveyor design are reexamined. Users of the new system are not afraid to ask why components are designed the way they have been. Safety and maintenance-friendly





Components of the new conveyor architecture are incorporated in the loading zone of the shiploader conveyor at the coal terminal at Port of Seward, Alaska.

features are the dominant characteristics of this design standard. Some of the design innovations included in this new conveyor architecture include:

#### ***Slide-In/Out Components***

To simplify maintenance in the new conveyor architecture, belt support systems such as impact cradles, support cradles, and idlers incorporate track-mounted sub-assemblies that slide out on one side of the conveyor for maintenance. This service system will minimize conveyor downtime and enhance employee safety, as workers will no longer need to crawl into the structure to remove and replace components.

#### ***External Wear Liner***

For years, wear liners have been installed on the inside of the transfer point's skirtboard, to help preserve the steel structure and protect the skirtboard sealing system. But this internal liner proved too difficult to install and inspect, and even harder to replace. Now, the modern conveyor architecture has developed an external wear liner; that is, a liner that is mounted on the outside of the skirtboard. External liner allows for safer installation and maintenance. The external wear liners effectively protect the skirtboards and the sealing system, yet are easily inspected and maintained or replaced without requiring confined space procedures.

#### ***Modular Chute Walls and Covered Skirtboard***

Preventing the escape of fugitive material is another important aspect of modern conveyor architecture. Pre-engineered modular chute wall, which simplifies the design and construction of transfer point

skirtboards and stilling zones, will help to manage airflow and control dust. Skirtboard covers with a "peaked roof" form a settling zone to prevent escape of airborne dust from the conveyor loading zone, while improving safety by keeping workers away from moving cargo and rolling components.

### **Applications of Advanced Conveyor Technologies**

These advanced conveyor technologies have already achieved improvements in operations and maintenance in coal-handling operations in terminals and power plants.

#### **Port of Seward Coal Terminal**

To allow the expansion of its cross-Pacific coal exports, Aurora Energy Services (AES) needed to increase the flow of coal through the shiploader at its coal terminal in the Port of Seward, Alaska. But transfer chutes on the shiploader choked at rates above 750 mtp, which limited loading speed and slowed turnaround. And worse, the escape of coal dust during loading led to concerns from a nearby cruise ship dock and marina, as well as environmental interest groups. AES officials looked for ways to upgrade the terminal's material handling system, and selected the modern conveyor architecture as developed by Martin Engineering. The new architecture's external wear liner and self-adjusting, double-life skirtboard sealing system provided effective containment to prevent dust and spillage escaping from the sides of the conveyor belt.

The components of the system com-

ponents improve the shiploader's serviceability, because they are engineered to be accessible from outside the structure. This allows terminal personnel to inspect the components while the system is in operation. Then, if maintenance is required, this work can be done quickly, cleanly, and safely, from outside the conveyor and chute.

"When terminal management realized they could increase through-put, improve safety, and reduce environmental impact all at once with this new conveyor architecture, they were all for it," said Terminal General Foreman Vic Stoltz.

With the new architecture conveyor components in place, the Port of Seward has increased the loading rate to 850 mtp, an increase of more than 15 percent. Shiploading time has been reduced by an



The engineered-flow chutes in this Wyoming coal-fired power plant improve the loading of its air-supported conveyor system.

average of 21 hours, resulting in a significant reduction in demurrage charges. With the improved control of the material stream, there is less dust. Now, operation officials report, cleanup is minimal and the shiploader has been cleaned in less than four hours.

"We've reduced the cleanup time on the shiploader and dock by over 40 man-hours per ship," Stoltz said.

#### **Wyoming Power Plant**

A power generation facility in Wyoming has also taken advantage of the new conveyor architecture. The plant's fuel is friable PRB coal that creates significant amounts of coal dust, and the

problems this dust can create. Company management emphasizes cleanliness inside all of their facilities, and they are conscious of maintaining environmentally-friendly coal-handling systems. To improve their coal handling systems and maintain their environmentally conscious operation, management elected to replace a number of transfer chutes and belt conveyors that were not working to their design specifications.

The coal handling system upgrades at this plant were completed in three stages. First, a new engineered-flow load chute was installed on an existing air-supported conveyor. Then an air-supported conveyor was commissioned for the bunker room along with new load chutes for one of the pant leg chutes below the primary crusher. Finally, a second load chute beneath the primary crusher was upgraded with the installation of an engineered-flow chute.

This power generation facility has benefited from the installation of these leading edge conveyor technologies with the following results:

- Reduced risk of fire and explosions from the handling of PRB Coal.
- Reduced risk of employee health issues due to exposure to dust.
- Improved cleanliness in the coal handling system with minimal maintenance requirements.
- Increased safety associated with the reduction in maintenance efforts.
- Center loading of the air-supported conveyor, reducing mistracking, spillage, and other problems.

### Kansas Power Plant

In northern Kansas, a power plant fired with PRB coal has begun a program to improve its material handling system. The plant was experiencing excessive airborne dust and spillage at transfer points. Worn out skirtboard in the loading zones increased the problems and the plant was willing to try a new solution. The plant determined to use components of the new conveyor architecture, starting with the loading

points coming out of the belt feeders.

Included in the reconstruction were new head chutes at the belt feeder discharge, new “spoons” at the loading zone where the cargo is placed on the receiving belt, and new impact cradles and belt support cradles to stabilize the belt’s line of travel through the transfer point. In addition, the project called for installation of modular chutewall and skirtboard to provide a stilling zone where dust will settle out of the air, external wear liners to provide effective protection for the skirtboard seal and are easy to install, inspect, and replace, and a self-adjusting sealing system that provides a double service life simply by inverting the elastomer strip.

Following project completion, plant officials have agreed to the reconstruction of additional transfer points.

### Indiana Power Plant

One of Indiana’s largest power generators has announced a significant upgrade to its conveyor feed system, virtually eliminating fugitive material and the problems that it causes. By updating the facility’s longest conveyor, company officials anticipate that reduced waste will contribute to greater productivity, plant safety, and environmental responsibility.

For years, the plant struggled to achieve consistent and reliable operation of the conveyor system feeding its largest coal-fired generator. The surge of material as railcars unloaded combined with the high head pressure from the hoppers, caused extensive spillage in the plant that wasted material and created housekeeping and safety concerns. Worn-out chutes compounded the issue.

The plant decided to install a retrofit wear liner on the four feeders below the rail car dump, as well as on the two feeders from the reclaim system. The installation of this external wear liner saves labor by eliminating the need for confined space entry, without requiring extensive tear-out of the existing chutes.

Attached on unique mounting blocks outside the chute, the wear liner is readily adjustable through a specially-designed bolt-on alignment system. Rather than scheduling a full plant outage, the installation was completed during



The enlarged settling zone on this transfer point at the Kansas power plant allows dust to settle out of the air.

singleshift downtime. The technicians prefabricated additional support structure to be installed below the idlers, designed so it could be moved into place through very confined spaces. When all sections were in place or repaired, they cut out the existing skirtboard and reinstalled it two inches inboard on both sides, to provide additional room for effective sealing.

Finally, the technicians installed the external wear liner and a skirtboard sealing system that can be flipped over to double the service life. The design of the wear liner allows it to be mounted outside of the transfer point skirtboard, keeping the coal away from the sealing system to extend the seal’s life.

All work was performed outside the chutes, eliminating the need for a long system outage to install the upgrades. The upgrades have eliminated the dust and coal piles adjacent to the coal handling components, improving safety and reducing material waste. **pe**

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