Client Requirements (Norfolk Southern Corporation)

Norfolk Southern Corporation’s (NS) Lamberts Point Terminal in Norfolk, Virginia, is one of the safest, fastest, and most efficient coal transloading facilities in the world. Since 1884, Norfolk Southern and its predecessor Norfolk & Western Railway have delivered millions of tons of high-quality Appalachian coal to ships at Lamberts Point. Of course, NS’s Lamberts Point facility has seen new piers and loading equipment constructed over the years, resulting in dramatic improvements in speed and capacity. Lamberts Point has even loaded coal into a number of famous vessels, such as those used in Admiral Byrd’s 1933 expedition to Antarctica.

Over 95 percent of the coal NS ships is low-sulfur, metallurgical coal used for steel making in blast furnaces around the world. To maintain the quality of this valuable coal, NS moves it quickly from the mines to Lamberts Point, keeping it in rail cars to minimize oxidation. Each incoming train contains up to 180 hopper cars carrying about 18,000 tons of coal. NS’s current transloading facility, known as Coal Pier No. 6, was placed into operation on December 26, 1962. The construction associated with the facility included 45 miles of classification tracks, weighing stations, thawing sheds, dumpers, blending stations, conveyor belt systems, and the pier and its respective shiploaders. Coal Pier No. 6 operates 24 hours per day, seven days per week, to accommodate all scheduled vessel demands.

The facility accommodates four rotary dumpers to transfer coal from the hopper cars to bins in the blending station; where the hopper cars are unloaded two at a time. An electronic control panel regulates the feeding mechanism and shuttle conveyors, permitting precise blending. Eight-foot-wide conveyor belts move the coal from the blending station to the self-propelled shiploaders, which travel up and down the length of 1,800-foot pier. The pier can accommodate two “super colliers” ships at a time. The shiploaders can work together to load a single ship or can work independently of each other to separately load ships as determined by demand. The shiploaders have a maximum combined loading capacity of 20,000 net tons per hour.
Coal Pier No. 6 has set record upon record in the years following its completion. During a single 24-hour period in November 1990, the pier dumped 1,772 hopper cars containing 171,315 tons of coal. That year saw a record 39.5 million tons of coal transloaded at Lamberts Point. The largest cargo in the history of Lamberts Point was loaded in 1998, when the M/V (motor vessel) Irongate received 157,645 net tons of coal. Pier 6 dumped its billionth ton of coal in 1999, becoming the only facility in the world to reach such a milestone.

Through the decades, Lamberts Point Terminal has been maintained to the highest standards of reliability and economy. Nevertheless, by late 2009 – at nearly 50 years of age – the dumper structures, hoppers, and support framing were repaired to the fullest extent possible, and had exhausted their usable serviceable life. Continued repair of the hoppers and their support framing was no longer a viable option, and it was obvious that these components were due for replacement. NS engaged Urban Engineers, Incorporated to perform an inspection of the facility and provide a structural assessment of the rotary dumper hopper and sill girder structures. The assessment report included options regarding repair or replacement of the facility and also included cost estimates, phasing and scheduling information.

Design Development (Urban Engineers, Incorporated)

In 2009 Norfolk Southern Corporation (NS) solicited Urban Engineers, Incorporated (Urban) to perform an inspection and prepare an assessment report summarizing the findings, conclusions and recommendations associated with the condition of the coal dumping facility. The assessment report concluded that the structure had generally exceeded its useful service life and continued to remain operational due to the implementation of repairs to address observed structural deficiencies. The observed repairs introduced supplemental column framing at eight locations to essentially "shore-up" the primary hopper girder framing and dumper sill girder framing by effectively reducing the clear span of the girders by approximately thirty percent. Other than the introduction of the supplemental support framing, the inspection observed little other work intended to increase the stiffness of the primary girder framing.

Urban's assessment report recommended complete replacement of the hopper primary girder framing and secondary support framing as well as the dumper sill girder framing and all hopper shell plates and deflector shield plating. The assessment report presented essentially two repair scenarios: total replacement of the hopper and sill girder framing including the removal of the two 250 ton dumpers, and as an alternative, replacement of the hopper and sill girder framing without the removal of the dumpers.

The first option, which included the removal of the dumpers, permitted the use of a modular construction methodology whereby shop fabrication of the hoppers, hopper support framing, and sill girder framing assemblies proposed fabrication, to the greatest extent possible, in the shop and shipped to the site as nearly complete assemblies. This approach minimized the need for field fabrication to the greatest extent possible.
The second option eliminates the need to remove the dumpers and minimizes nearly all peripheral work associated with re-piping and rewiring the associated control systems, monitoring systems and dust suppression systems related to dumper operation. However, this approach requires the execution of the work on the hoppers, hopper support framing and sill girder framing from below, requiring erection and extensive field assembly within a limited and very confined access area. This method also required temporary support of the 250 ton dumpers in order to remove and replace the supporting sill girder framing.

After review and consideration of both approaches and some minor variations associated with each approach, Norfolk Southern elected to remove the dumpers, which permitted access to the hopper framing and sill girder framing from above, and directed Urban to proceed with the design of the replacement framing based on this decision. Additionally, this approach permitted NS to inspect and repair the dumper barrel assemblies and generally refurbish the dumpers prior to erecting them back into their operational position. NS also directed Urban Engineers to develop a design based on a phased construction approach. With this approach, Phase 1 addressed the removal of the two North Line (A1-Line) dumpers and Phase 2 addressed the removal of the two South Line (A-Line) dumpers. Generally, NS determined that each phase of construction would coincide with consecutive facility outages initially scheduled for the spring and fall of 2011. In the end and due to scheduling issues associated with facility demands, the project proceeded forward to coincide with the summer/fall outage of 2012 and the spring outage of 2013. The development of construction documents based the design on an outage length of 90 days.

NS charged Urban to develop a design to address many serviceability and operational issues as follows:

The design needed to provide for a stiffer sill girder framing system to support the weight of the dumpers plus the weight of fully loaded coal cars with a nominal capacity of 100 tons. Over the years, NS had modified and reinforced the dumper barrel assemblies to accommodate increased coal-car capacity. However, the supporting framing remained generally unchanged receiving no significant alteration or reinforcement to compensate for the increased loads.

In addition, the design needed to address trunnion (roller support bearings) servicing and replacement issues associated with the dumper operation. NS observed that trunnion failures were occurring on a regular basis and replacement and subsequent repair was becoming labor intensive, costly and a problematic endeavor. In conjunction with the hopper and sill girder framing replacement, NS investigated trunnion replacement alternatives that utilized a more open design that prevented coal dust from accumulating between the trunnion wheels and the side-plate support assemblies and impacting and clogging the wheel bearings with coal dust.

The design also required that Urban address the issues associated with "fugitive" coal accumulation on flat surfaces and obstructed areas. NS charged Urban to develop a
design that closed off as many openings as possible where coal could escape and to eliminate, to the greatest extent possible, any flat surfaces or obscured areas where coal accumulated during operation.

Other aspects of the design required that Urban address issues associated with mounting assemblies used to attach the electric and pneumatic vibrators to the hopper shell plates. NS observed that the pneumatic vibrator mounts assemblies regularly failed and requested the development of a more robust design that provided better access for maintenance and replacement and yet still provided for a stiffer support assembly to prevent failures.

The design also required that Urban address issues related to the use of liner plate material that would adequately protect the hopper shell plates and provide a “slippery” surface to promote the flow of coal through the hopper throat and on to the conveyors below. The liner plate needed to be easily removable and replaceable and also incorporate fittings for air cannon nozzles to help move coal towards the throat of the hopper utilizing blasts of pressurized air.

The design also needed to incorporate features to improved serviceability issues associated with regular maintenance and functionality. NS required that Urban address safety related issues to the greatest extent possible by closing off open areas with removable grating sections, providing additional guardrails and grab rails at key locations, and incorporating lighting and fire detection systems.

Urban based its design on the original proprietary Wellman Engineering Company design drawings of the early 1960's (circa 1961). As the original design is a proprietary design, Urban retained the original intent of the early 1960 design to the greatest extent possible while adapting the design to account for increased coal-car loads; to account for increased stiffness requirements; address fatigue issues; address fugitive coal issues; address safety issues and included the necessary modifications to address constructability issues, shop versus field fabrication, project phasing and to account for a 90 day, 24/7 work schedule.

NS was able to provide Urban with the design calculations associated with the dumper rehabilitation work of circa 1998. Svedala Bulk Materials Handling (Svedala) developed the calculations to evaluate and determine the dynamic forces associated with the rotational operation of the dumpers. Supplemental calculations developed by Svedala validated the accuracy of the dynamic loads associated with the trunnion bearing upgrade from the original two wheel system to the present four wheel system.

Urban reviewed the calculations and concluded that the calculations satisfactorily addressed and accounted for the dynamic loads associated with the increased coal-car loads. The calculations also included the overall increase in dumper barrel weight due to the addition of reinforcing plates, stiffeners, an increase in the overall diameter of the dumper end rings and additional counter weights to compensate for the increased coal-car weight when empty.
With the dynamic forces adequately accounted for, Urban proceeded to develop supplemental calculations to account for the adjustments in supporting member stiffness, thicker hopper shell plates and thicker abrasion resistant liner plates. Using the available Wellman design drawings as a guide, Urban calculated the weight of the additional material, and with this information in hand, evaluated the existing framing for the increase in the dead load due to the additional material. The increase in hopper shell plate and liner plate thickness added approximately twenty seven percent to the overall weight of the structure, but though a significant increase, had little impact on the overall design of the hopper support framing. Taking advantage of the increase in strength associated with the use of ASTM A992 material in lieu of the original ASTM A36 material, Urban determined that the member sizes associated with the original design adequately accommodated the increased loads with regard to both (allowable) strength and deflection. However, as many of the original member sizes are no longer available as tabulated in the AISC 7th ed. Steel Manual, Urban revised the Wellman design to reflect the current member sizes as tabulated in the AISC 13th ed. AISC Steel Manual.

With the additional dead load of the hopper support framing and thicker shell and liner plates accounted for, Urban focused on the design requirements associated with the trunnion support bearings at the sill girder elevation. Urban reached out to Metso Minerals Industries, Incorporated (Metso) for data concerning the sill girder stiffness requirements. The Metso trunnion bearing design specified a rather stiff support system with the total live load deflection limited to a deflection of L/2500 or 1/8" on a span of approximately 24′, center-to-center of bearing. Urban evaluated the existing framing at the sill girder elevation concluding that the existing framing did not adequately provide the necessary stiffness with regard to the 1/8" span requirement and further determined that the strength of the material (ASTM A992 versus ATM A36) did not drive the design.

To accommodate for the necessary required stiffness, Urban compensated by selecting beams of increased weight (per linear foot) while holding size within the overall nominal beam depth. Generally, sill girder weight increased by approximately 18 percent. As an example the original W36x280 shown on the Wellman drawings increased in size and was replaced by a W36x330, a nominal increase of two to three beam sizes (by weight) depending on the sill girder position within the structure.

During the design, Urban performed calculations addressing the serviceability issues associated with the operation of the facility. NS prescribed a desired service life of 40 years for the facility after the execution of the replacement. Urban reached out to NS facility operational personnel to confirm the maximum throughput of the facility with all systems running at peak performance based on "best shift" data. NS confirmed that the optimum throughput at the facility is one coal car approximately every three and one half minutes. Using a operational criteria of three shifts a day, seven days a week, and accounting for at least one two week outage per year, Urban calculated the number of (dump) cycles at approximately five million five hundred thousand cycles over the course of the 40 year period specified.
With this in mind, Urban performed fatigue calculations to determine if fatigue related issues had any impact on the design. Calculations revealed that fatigue related issues were of no significant concern. The calculations determined that the member properties associated with the desired stiffness requirements prohibited the calculated stress from exceeding the threshold fatigue stress associated with various member types and geometrical configurations associated with standard W-sections, built-up I-sections, and built-up box-type girder sections.

To accommodate safety related issues, Urban developed a design that addressed as many safety related issues as possible within the constraints of the existing structural framing geometry and concrete vault construction. Generally, the new hopper framing and sill girder framing replaced the original framing on a one-for-one basis. Little latitude existed to adjust the location of the framing to accommodate, caged ladders, ships ladders or even guardrails and hand rails based on code stipulated requirements. In some cases, the only reasonable solution proposed rotating a ladder ninety degrees from its original position to provide better headroom at the top of the ladder and to permit the user to step out onto a platform or landing in a manner that promoted a more "secure" feeling. To accommodate accessibility concerns, Urban provided supplemental handholds and grab bars at convenient locations to aid the climber when transitioning from the ladder to the platform. Urban widened service access walkways and provided guardrails to close off open, hazardous areas. The Urban design also provided for a grating walkway system with removable panels to accommodate the raising and lowering of equipment from grade to the higher access walkway elevations at the work location to accommodate maintenance requirements.

To accommodate undocumented NS enhancements to the facility, Urban reached out to NS personnel to provide the necessary supplemental information in the form of field sketches, equipment manufacturer's data sheets and installation requirements and other available archive documentation. In some cases, the evolution of the design progressed right through the shop drawing review phase even as Fenton Rigging and Contracting, Incorporated (Fenton) mobilized and commenced with demolition. Close coordination between Urban, Fenton and the fabricator, the Littell Steel Company (Littell), permitted documentation of the enhancements and incorporation of the enhancements within the scope of the project documents. In some cases Littell solicited the services of a local detailer to make field measurements and prepare sketches for Littell's detailers to use in the development of the structural steel fabrication drawings.

In all, close coordination between Urban, Fenton and Littell permitted for a timely processing of the shop drawings. This permitted Littell to go to fabrication almost immediately upon receipt of the drawings with out the need for timely resubmissions and reviews.
NS contracted with Fenton Rigging & Contracting, Incorporated (Fenton) in March of 2012 to proceed with their project, *Replacement of Hoppers and Structural Steel Supporting Rotary Car Dumpers at Coal Pier No. 6*. Fenton served as the Prime Contractor for NS responsible for coordinating all activities associated with the demolition, construction, remedial design, implementation and operation of the project.

Prior to site mobilization, Fenton coordinated the fabrication of the supporting steel framing, hopper shell framing, trunnions bearings, sloped sheets (deflector shields) and other dumper components between Urban and the fabricator, Littell Steel, along with the sand blasting and painting of the dumpers barrel assemblies. Due to the complexity of retrofitting a new design within the current concrete vault environment and geometry, many alterations were required in order to meet the time demands of the project. Fenton made the decision to perform a high definition laser scan of the existing dumpers in order to capture the exact location of all components scheduled for removal. In addition, Fenton and Urban validated the initial assumptions associated with the actual weight of the dumpers and the assumed conditions of the areas under the dumpers and the dumper support framing. Areas not visible for over fifty years.

Fenton mobilized and arrived on site in May of 2012 to prepare for the first outage on the North Dumpers (A-1 Line Dumpers) that would take place in Mid-August in conjunction with the upcoming NS scheduled outage. In order to prepare for the outage, Fenton built a retaining wall on the North side and raised the elevation of the ground by 4 feet to create a level area to accommodate the crane pads for the two 450 ton cranes used to lift the dumpers.

Fenton developed and initiated a plan to insure that the cranes, at all times, would remain a safe distance from the underground conveyor tunnel and active kick-back track for the South Dumper (A Line Dumper). In addition, Fenton created a Lift Plan in order to pick and remove the 250 ton dumpers from their current operational location, which required the design and fabrication of special lifting devices to lift the dumpers, and place them safely on the ground at a location designated by NS.

On August 20th at 7:00 am, NS shut down North Line of the Rotary Dumper facility and turned it over to Fenton. On the 3rd day, Fenton lifted both dumpers from their operational positions and lowered them to the ground. Fenton then proceeded to remove the North Dumper kick-back tracks and retarders at grade immediately adjacent the crane pad area to make room for future work and shake out areas. Fenton then proceeded to dismantle all structural framing which included the dumper sill girders, hopper support girders and hopper shell and deflector shield framing and all other miscellaneous framing right down to bare concrete vault walls. This work also included the removal of all the line shaft drive motors, line shaft reducing gears, the line shafts themselves, all support bearings, and monorail crane systems that obstructed the removal of the dumper barrel assemblies. This work also included the removal of all...
concrete support pedestals installed as "original equipment" associated with the original circa 1960 construction.

With the steel framing removed, Fenton commenced work on the concrete piers that support the hoppers and hopper girder framing and dumper sill girder framing. The piers were demolished to the limits shown on Urban's structural drawings, utilizing controlled selective demolition to minimize damage to the existing reinforcing and then reconstructed the piers to support the new steel framing with new anchor rods and supplemental concrete pier reinforcement added as necessary. Fenton inspected all existing embedded plates and determined that most plates exhibited a severely deteriorated condition. Urban's design generically accounted for this anticipated condition; however, the proposed design required refinement. Fenton worked with Littell and Littell's on site detailer to develop a more suitable embedded plate replacement detail utilizing surface mounted plates and epoxy adhesive anchors.

Fenton's work also included a complete rebuild of the electrical wiring and mechanical piping systems within the limits shown on Urban's mechanical and electrical drawings. To accommodate this work, Fenton coordinated with NS personnel to determine logical termination points for both piping and wiring and systematically tagged the terminations appropriately for later reuse.

On October 3rd of 2012, Fenton hoisted the dumpers back into position on top of the new sill girder framing on the 45th day of the 90 day outage. Substantial completion was met by the end of October and the North Dumpers were turned back over to NS for start-up testing. Generally, the Phase1 work was completed approximately three weeks ahead of schedule.

There were many lessons learned from the Phase 1 work, including the observed need to completely shop assemble the hoppers and ship them by rail in order to expedite the installation process. Several other changes were made between Phase 1 completion and the start of Phase 2 to accommodate existing conditions and to allow for ease of construction.

Fenton prepared for South Line (A-Line), Phase 2 work of the project scheduled to coincide with NS's Spring outage planned for April of 2013. The task of replacing the South Dumpers was similar to the first phase with regard to the anticipate scope of work, but this side also had its own unique set of challenges.

The South Dumpers were considerably heavier than the North Dumpers and there were many more existing obstacles to contend with that interfered with the placement of the cranes on the South side. Fenton, with the help of NS, relocated underground utilities, relocated and rebuilt the lube oil and water suppression sprinkler buildings and demolished the abandoned Pier No. 5 concrete supports in close proximity to the South Dumper concrete vault wall. To accommodate the removal of the dumpers, Fenton removed the operators' cab and tower from the South vault wall which obstructed the ability of the cranes, working in tandem, to clear the vault and lower the dumper barrel.
assemblies to grade. Fenton refurbished the tower sections as necessary to accommodate new anchorages and reinstalled the tower and operators' cab after resetting the dumper barrel assemblies. The work of Phase 2 also required removal and reconstruction of the West concrete vault wall, within the limits shown on Urban's structural drawings.

On April 8th, 2013 NS shut down the South Line at 7:00 am and turned the line over to Fenton. On the 33rd day of the 90 day outage Fenton hoisted both dumpers back into position and prepared to turn the facility back over to NS for start-up testing. Generally the Phase 2 work was completed approximately 5 weeks ahead of schedule.
GENERAL PLAN NOTES
NEW HOPPER FRAMING

1. SET CONSTRUCTION PHASING PLAN AND COORDINATE INSTALLATION OF NEW HOPPER FRAMING WITH NO. 3 WITH REGARD TO PHASING AND ASSOCIATED ISSUES.

2. PHASE 1 - CONSTRUCTION OF A LINE, NORTH SIDE, SECTIONS 3 AND 4 - COORDINATE WITH NO. 3 WITH REGARD TO PHASING AND ASSOCIATED ISSUES.

3. PHASE 2 - CONSTRUCTION OF A LINE, SOUTH SIDE, SECTIONS 1 AND 2 - COORDINATE WITH NO. 3 WITH REGARD TO PHASING AND ASSOCIATED ISSUES.

4. SET DRAINAGE EN-1 AND EN-2 FOR GENERAL NOTES AND ILLUSTRATIONS.

KEY NOTES
NEW HOPPER FRAMING

- INSTALL: HOPPER FRAMING SCAFFOLD (X4) W/16X122 AND (X4) W/16X101 PER SIDE, REPLACE EXISTING ANCHOR RODS.
- INSTALL: HOPPER CONDITIONAL SCREEN (X2) W/16X122 AND (X2) W/16X101 PER SIDES, INSTALL NEW HANGER WALL LATERAL TRANSVERSE FRAMING (X4) W/16X101 PER SIDE.
- INSTALL: HOPPER SHELL PLATES CONSTRUCTED USING 1/8" PLATE MATERIAL REINFORCED WITH CHANNEL W.16X122 OR (X2) W/16X101 PER SIDES, INSTALL SHELL PLATES WITH STAINLESS STEEL BOLTS. SEE REFERENCE DRAWINGS FOR ADDITIONAL INFORMATION. ENSURE HOPPER SHELL PLATES ARE FASTENED CORRECTLY PER SIDE.
- INSTALL: HOPPER FRAMING (X2) LOCATIONS PER SIDE. SEE REFERENCE DRAWINGS FOR ADDITIONAL INFORMATION.
- INSTALL: NEW HOPPER TRANSVERSE FRAMING (X4) LOCATIONS PER SIDE. CONSTRUCT HOPPER SHELL PLATES FROM 1/8" PLATE MATERIAL USING 3/4" DIA X 3" HARD PLATE MATERIAL. INSTALL TRANSVERSE FRAMING (X4) W/16X101 PER SIDE. USE HANGER WALL LATERAL TRANSVERSE FRAMING (X4) W/16X101 PER SIDE. INSTALL BOLTS AS MANDATED PER SIDE. SEE REFERENCE DRAWINGS FOR ADDITIONAL INFORMATION.
- INSTALL: HOPPER SHELL PLATES CONSTRUCTED USING 1/8" PLATE MATERIAL REINFORCED WITH STAINLESS STEEL STUDS (X4) DIA X 3" HARD PLATE MATERIAL. INSTALL NEW HANGER WALL LATERAL TRANSVERSE FRAMING (X4) W/16X101 PER SIDE. INSTALL BOLTS AS MANDATED PER SIDE. SEE REFERENCE DRAWINGS FOR ADDITIONAL INFORMATION.
- INSTALL: HOPPER SHELL PLATES CONSTRUCTED USING 1/8" PLATE MATERIAL REINFORCED WITH STAINLESS STEEL STUDS (X4) DIA X 3" HARD PLATE MATERIAL. INSTALL NEW HANGER WALL LATERAL TRANSVERSE FRAMING (X4) W/16X101 PER SIDE. INSTALL BOLTS AS MANDATED PER SIDE. SEE REFERENCE DRAWINGS FOR ADDITIONAL INFORMATION.
- INSTALL: HOPPER SHELL PLATES CONSTRUCTED USING 1/8" PLATE MATERIAL REINFORCED WITH STAINLESS STEEL STUDS (X4) DIA X 3" HARD PLATE MATERIAL. INSTALL NEW HANGER WALL LATERAL TRANSVERSE FRAMING (X4) W/16X101 PER SIDE. INSTALL BOLTS AS MANDATED PER SIDE. SEE REFERENCE DRAWINGS FOR ADDITIONAL INFORMATION.
Norfolk Southern
Rotary Dumper Hopper
Coal Loading Facility
Replacement Project

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Norfolk Southern (NS)
Lamberts Point Coal Terminal

Loading records:
- 1,772 hopper cars (24h)
- 171,315 tons (24h)
- 39.5m tons (1998)
- Largest cargo loaded 157,645 tons
- Billionth Ton Surpassed (1999)

Project History:
- After 50yrs of operation
- Facility had Reached the end of its useful service life
- NS engaged UE to inspect the facility
- Prepare an assessment report
- And make recommendations

Inspection Highlights:
- Useful service life exceeded
- Observed repairs:
  - Installation of supplemental column framing
  - Essentially “shore-up” the primary girder support framing
  - Repairs reduced the span length by 30%
  - Repairs allowed facility to continue to operate
NS Lamberts Point Coal Terminal

Observed Repairs

Option 1 – Dumpers Removed:
- Modular fabrication/construction approach
- Shop fabricated assemblies
- Delivered to site via rail car and/or truck
- Erected into position as completed assemblies
- Requires minimal field assembly
- Reduces field labor
- But requires more shop labor
- Permits NS to inspect, service and repair the dumpers during the outage

Option 2 – Dumpers Not Removed:
- “Stick-built” fabrication/construction approach
- Shipped to site via truck in pieces
- Erected and assembled piece by piece
- Reduces shop labor
- But increases field labor
- Work performed beneath the dumpers
- Requires supplemental framing to support the dumpers
- Restricts NS’s ability to service and repair dumpers

Two Phase Approach (90 Day Outage)
- Phase 1 - North Line (A-1 Line)
- Phase 2 - South Line (A Line)
- One Line in Service at all times

Serviceability and operational issues:
- Trunnion sill girder support issues
- Trunnion servicing and maintenance issues
- “Fugitive” coal issues
- Electric and pneumatic vibrator mount issues
- Liner (wear) plate issues
- Safety issues
- Functionality issues
- Lighting issues
- Dust and fire suppression issues
NS Lamberts Point Coal Terminal

Trunnion Support Bearings

NS Lamberts Point Coal Terminal

NS reviewed both options and elected to remove the dumpers
- Permitting NS to inspect, service and repair the dumpers
- Permitting all work to be performed from above
- Permitting a modular fabrication approach
- Permitting the erection of completed assemblies

NS Lamberts Point Coal Terminal

South Elevation (Looking North)

NS Lamberts Point Coal Terminal

UE design based on Wellman Engineering Company design of the early 1960’s
- UE retained original design adapting the design for:
  - Increased coal car loads
  - Increased stiffness requirements
  - Increased deflection requirements (less deflection)
  - Fatigue related issues
  - Fugitive coal issues
  - Safety and constructability issues
  - Phased construction, 90 day, 24/7 work schedule

NS Lamberts Point Coal Terminal

UE design also based on dumper rehabilitation work of 1998
- Rehab work preformed by Svedala Bulk Materials Handling (Svedala)
  - Calculations evaluated the dynamic forces associated with dumper operations
  - Calculations validated the accuracy of the dynamic loads associated with trunnion upgrades
  - Calculations addressed increased coal car loads
  - Calculations accounted for increased end ring diameter and additional counterweights
**NS Lamberts Point Coal Terminal**

**Dumper End Rings**

**UE Design Modifications:**
- Addressed weight increases due to thicker shell and liner plates
- Provided significantly stiffer sill girder framing
- Adapted the design to take advantage of ASTM A992 material
- Adjusted the design to account for increases in beam depth
- Adapted the design for a 40 years service life (5,500,00 dump cycles)
- Addressed safety related issues
- Addressed operational issues

**Undocumented NS Enhancements:**
- UE reached out to NS personnel for equipment data sheets
- Field sketches
- Archive data
- UE coordinated Fenton Rigging and the fabricator, Littell Steel, Inc. to document the enhancements and incorporate the enhancements. Evolution of the enhanced design progressed right through shop drawing review.

**NS contracted Fenton Rigging and Contracting, Inc. (Fenton) in March of 2012**
- Fenton served as the Prime Contractor responsible for:
  - Coordinating all activities associated with Demolition, Construction, Remedial design, Implementation, Operational issues.
- Prior to the start of demolition Fenton coordinated:
  - Review of shop fabrication drawings
  - Structural steel fabrication with Littell Steel
  - Shipping and delivery of the structural assemblies to the site (via rail car)
  - Surveying of existing conditions
  - Validated initial design assumptions, such as dumper weight.

**Undocumented NS enhancements:**
- In some cases Littell Steel recruited the services of a local detailer to make field measurements and prepare sketches for Littell’s detailers to use.
- In all, close coordination permitted for a timely processing of the shop drawings.
NS Lamberts Point Coal Terminal

- Hoppers Loaded for Shipping

Fenton mobilized on August 20, 2012:
- NS shut down the North (A-1) Line at 7:00 am and turned it over to Fenton
- On the 3rd day of the outage, Fenton hoisted and lowered the dumpers to the ground

NS Lamberts Point Coal Terminal

- Dumper Removal

NS Lamberts Point Coal Terminal

- Dumper Removal

NS Lamberts Point Coal Terminal

- Demolition and Site Preparation
  - Fenton removed the North kick-back tracks to create work area and shake-out areas
  - Fenton dismantled and removing the line shafts, line shaft motors and reducing gears
NS Lamberts Point Coal Terminal

Demolition and Site Preparation

Demolition and Construction included:
- Demolition of the dumper sill girders and assemblies
- Demolition of the hopper girders, shell plates and deflector shields
- Disassembly of the hammer mills
- Demolition of the grizzlies
- Demolition of all electrical wiring and mechanical piping within the limits shown on project documents

NS Lamberts Point Coal Terminal

Demolition

NS Lamberts Point Coal Terminal

45th Day: Dumpers Hoisted Into Position

NS Lamberts Point Coal Terminal

Installation of Dumper No. 2
NS Lamberts Point Coal Terminal

Demolition and Construction
- Substantial completion was met by the end of October
- The North Dumpers were turned back over to NS for start-up testing

Generally the Phase 1 work was completed approximately three weeks ahead of schedule

Phase 1 - Lessons Learned
- Critical to completely assemble the hoppers and ship them by rail to the site
- Several other changes were made between Phase 1 and Phase 2
  - To accommodate existing conditions
  - To accommodate field welding and bolting
  - The elimination of aspects of the original Wellman design no longer used by NS
  - Increased weight of the South dumpers

Phase 2 Work Required
- To accommodate crane access
  - Required the rerouting of underground utilities
  - Demolition of the old Pier No. 5 concrete supports
  - Demolition of adjacent buildings
  - Removal of the dumper operators’ cab
  - Demolition and reconstruction of the West vault wall
  - Rehabilitation of the dumper operators’ cab
  - Reinstallation of the dumper operators’ cab

On April 8th, 2013 NS shut down the South (A) Line at 7:00 am and turned the line over to Fenton
- On the 33rd day of the 90 day outage, Fenton hoisted both dumpers back into position and prepared to turn the facility back over to NS for start-up testing.

Generally, Phase 2 work was completed approximately 5 weeks ahead of schedule
Special Thanks

Julia M. Mullin, PE, PMP, LEED Green Assoc.

and

Robert Thaw, Chuck Farris and Carol Hermsen at Littell Steel, Inc.

and

Mandie Ennis at AREMA

NS Lamberts Point Coal Terminal

Questions?

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