BARNHART

LIFTING LETTER

www.barnhartcrane.com

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CIBRIS SYSTEM

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INNOVATIVE SYSTEMS REDUCE WIND MAINTENANCE COSTS

Barnhart's craneless blade removal and installation system (CBRIS) is revolutionizing the way the wind industry performs maintenance projects. To be clear, it's not a system that is crane free, but instead reduces the size or number of cranes needed for a project.

Customarily two and sometimes three cranes are needed on a blade replacement project, which is an expensive proposition. By eliminating even one crane in the process, the cost of mobilizing that crane along with its crew are also eliminated.

The CBRIS system uses a cable winch system to lower the blade. The lifting cable is routed through the turbine's nacelle and secured to the root end of the blade with Barnhart's proprietary lifting beam system. Taglines are wrapped around the root end and tip end of the suspended blade to control it in a "rabbit ear" and 6 o'clock position. The tagline system stabilizes and allows for complete control of the suspended blade.

The cables are operated by two multi-tagline devices on the ground and a hydraulically powered winch for lifting. This device has allowed Barnhart to reduce the manpower required to perform the tagline operation.

Depending on the turbine type and components that need replacement, our system also includes other custom rigging equipment. In the case of a bearing replacement, Barnhart's bearing installation and removal device, otherwise known as the BIRD, comes into play. The BIRD is a remotely operated work platform with adjustable lift points and two designated spaces for bearings.

The BIRD is rigged to a crane and lifted to the hub. A worker inside the hub secures the BIRD to the old pitch bearing and disconnects the old bearing from the hub. The BIRD is then rotated 180 degrees to position the new bearing for installation. By using this method, only one lift is needed to remove and replace a bearing.

The single crane Blade Bar is designed to stabilize and balance a blade that is being removed and can be rotated on three different rotation points. (See article on the Blade Bar in our Equipment Profile of this issue.)

> **"THESE INNOVATIONS PROVIDE VALUE TO OUR CUSTOMERS BY REDUCING THEIR COST OF REPLACING MAJOR COMPONENTS."**
> **—JOHN CLARK, VICE PRESIDENT OF BARNHART RENEWABLES**

1 Barnhart was hired to install a 15,679 lb. chiller through the top of an 11-story building. One challenge was that the team had to use a public street to get the proper setup for the crane. That required blocking off several blocks in downtown Little Rock to reduce traffic.

2 Barnhart used a 275-ton crane to lift the chiller to the top of the building where there was a roof hatch. But preplanning had determined that the chiller was larger than the opening on the roof.

3 Barnhart's engineering team helped create a rigging system using a swing away jib that allowed the team to invert the piece so it could go vertically through the hatch. Then they used two 10 ton chain falls to level the piece out and set it into place with air skates and a motorized pallet jack. This innovative approach provided the customer a unique and cost-effective solution.

1 Barnhart received six components for a nuclear power plant, including upper casings, lower casings and rotors from ship's gear in Wilmington, NC. Due to the state's DOT rules, Barnhart was only able to transport two components at a time in a convoy. The two upper casings were first, and were offloaded to two 13-axle trailers for transport. The other components were staged on site at the port.

2 A few weeks later, the second set of casings were hauled in a convoy on the same 150-mile journey using two 3-line drop deck 4-line trailers. The team had to coordinate with multiple Barnhart branches and utility companies along the route.

3 Finally, the rotors were transported using a GS-800. A project challenge included delivery and staging of the components on the power plant property. In total, Barnhart did four hauls over four weeks with all components being delivered on time.

1 Barnhart was contracted to assist in removing and replacing two heat exchangers. The 14,750 lb. exchangers had to be maneuvered in a tight space with multiple piping obstructions very close to the travel path. The engineering challenge was to design a system that allowed for maximum flexibility, yet could be constructed using no overhead rigging.

2 Every 1/16" mattered when it came to doing field measurements, so the customer also performed a laser scan of the space. After creating a very accurate model, the Barnhart team designed a system using pull up jacks and saddle rollers to remove the old exchangers.

3 The pull-up jacks underneath the slide beams allowed Barnhart to change the height as required to get under pipes and over foundations and to tilt if needed.

EVERY 1/16" MATTERED WHEN IT CAME TO DOING FIELD MEASUREMENTS.

4 Barnhart had to roll the exchangers at multiple locations along the travel path to avoid the valves running into the piping and the saddles running into the foundations and anchor bolts. Custom-designed Hillman saddle rollers allowed the crew to rotate the vessel. After the old exchangers were removed, the new ones were brought in using the same method.

1 A customer in Connecticut needed to have a sync condenser installed in a building. Before work began, Barnhart had to set up gear inside the building in a tight space. The sync condenser base was offloaded with a 200 ton Demag crane to a light slide track outside of the overhead door.

2 The cooler was set on top of the condenser base and then the whole unit was slid on the track into the building, using Barnhart's custom designs and fabricated light slide track.

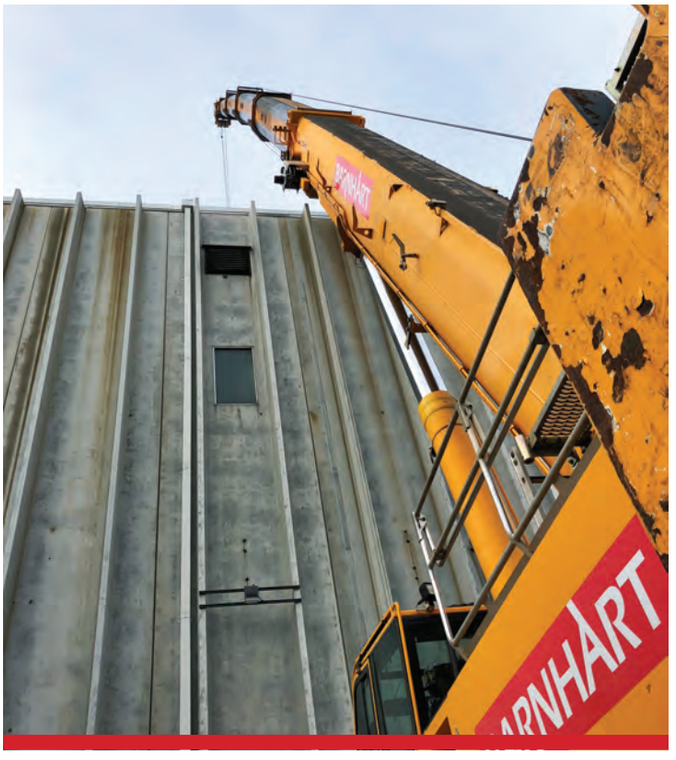
3 The entire unit was lifted with pull up gantries and set onto the customer's skid plate. The Barnhart team then had to remove their equipment after the piece was set. Despite weather and delays in delivery of the pieces, the job was completed safely and efficiently. It was a great example of successful coordination between the customer and Barnhart's Middletown branch and use of their local equipment assets.

IT WAS A GREAT EXAMPLE OF SUCCESSFUL COORDINATION BETWEEN THE CUSTOMER AND BARNHART'S MIDDLETOWN BRANCH.

1 The scope of work at this project at a manufacturing facility was to remove the trolley and bridge crane for repairs. There was no room in the building to bring in a crane so Barnhart used a 400-ton Terex crane to reach through a small hatch in the roof, meaning all lifts were made in the blind to the facility floor.

2 The crane lifted the 12,000 lb. trolley first off the bridge crane, which was rolled out of the way. The trolley was lowered onto a set of header beams that were set up on 300-ton gantries. Then the second bridge crane lifted the trolley and carried it to the staging area.

3 The Barnhart team welded four lifting plates onto bridge girders, lifted the 58,000 lb. bridge crane off of the runway, lowered it onto gantries, re-lifted with the east bridge crane and transported it to a Goldhofer to transport outside to the staging area for repairs.



4 After repairs were complete, the team reversed the procedure and put the bridge and trolley back into service.

BARNHART USED A 400-TON TEREX CRANE TO REACH THROUGH A SMALL HATCH IN THE ROOF.

1 Hauling oversized cargo is nothing new for Barnhart, so a project to receive and transport a degassing and recovery column from the Port of Houston to a plant site in La Porte, Texas was right in our wheelhouse. The recovery column was nearly 200 feet long and weighed 529,104 lbs.

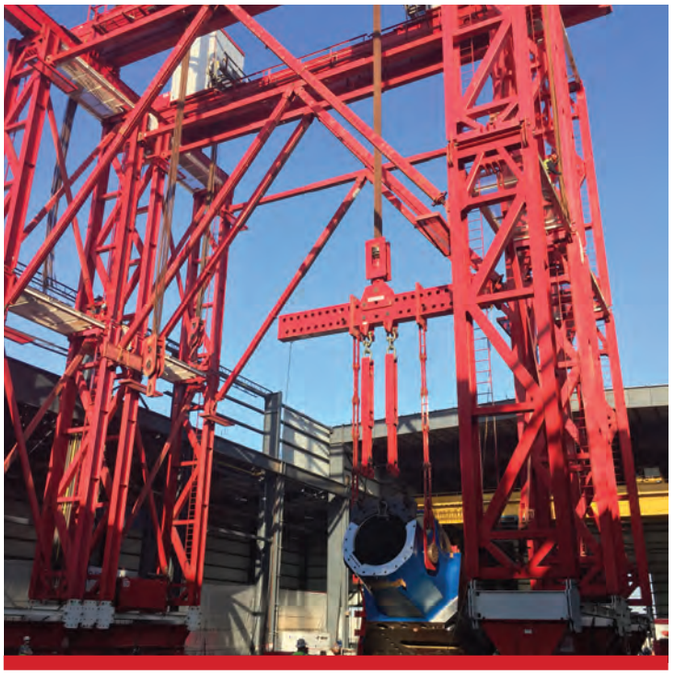
2 The recovery column was offloaded to two 8 axle line EasTrac transporters with bolster configurations.

3 While the permitted route was just 35 miles, it included safely navigating the 200 ft. recovery column through the crowded city of Houston.

4 Two days later, the degassing column was transported by a 12 Line EasTrac transporter. Both columns were delivered safely and on time.

1 Barnhart was hired to receive and transport over 40 components ranging up to 732,000 lb. from the Port of Long Beach to a steel forging plant. Barnhart worked with the port to receive the components from ship's hook using SPMT and stage them there on beams and stands. The staging operation also allowed for sequential delivery as needed for the on site assembly schedule.

2 Over the course of a year, the components were transported by dual lane trailer and suspension girders. The project required over six different trailer configurations which was accomplished by the modular flexibility of the dual lane trailer. The hydraulic trailer also allowed the equipment to be self loaded by Barnhart at the port. The cargo also included several large asymmetrical pieces, which were positioned as needed in Barnhart's suspension girders.



3 All components were transported to the site on the dual lane trailer. Once at the site, the components were transloaded to SPMT and brought into the new facility where they could be assembled. The team utilized its Modular Lift Tower with strand jacks to make the lifts. On several of the asymmetrical pieces, the CG was not centered between the lifting lugs so Barnhart utilized their extensive inventory of lifting devices to make rigging adjustments as needed on site.

4 Some larger pieces needed to be bolted together and assembled to a 0.1 mm tolerance using an assembly table made of Barnhart powered rollers and hydraulic jacks. The largest lift, the foundation crosshead, was assembled of seven components adding up to a final lift weight of 4,500,000 lbs. In the end, the team made over 50 engineered critical lifts with very low ground bearing requirements and helped assemble one of the world's largest presses. Despite the scale of the job, it was completed successfully with no injuries or property damage.

1 Barnhart hauled two of three cold boxes to a chemical facility in New York. The boxes varied in length and weight, ranging from 40' long to 180' long and 34,000 lb. to 503,000 lb. About a month later, Barnhart mobilized cranes to the site to set the three cold boxes. There was no storage area available onsite, so every piece of the crane had to be delivered just in time, a logistics feat considering the crane delivery consisted of over 70 truckloads

2 The boxes had to be staged in precise locations or the crane lifts wouldn't work. Too close to the foundations and the team would have faced clearance issues with surrounding objects. Too far and the crane wouldn't have had the capacity to make the lifts. Barnhart utilized a LR1600 with superlift as the head crane with the LR1400 acting as the tail crane to upend and set the boxes.

3 The job site was extremely tight and congested, which made lift planning and logistics essential. The crane also had to be optimized to minimize superlift changes in order to lift both the 503,000 lb. box and the 34,000 lb. box with the same crane.

4 Barnhart used "mud boats" under the crane to act as load spreaders to extend the effective length of the crawlers. Through this method, the team was able to get the ground bearing pressures under the 660-ton crawler crane to 2,500 psf, a low pressure for a crane of this size.

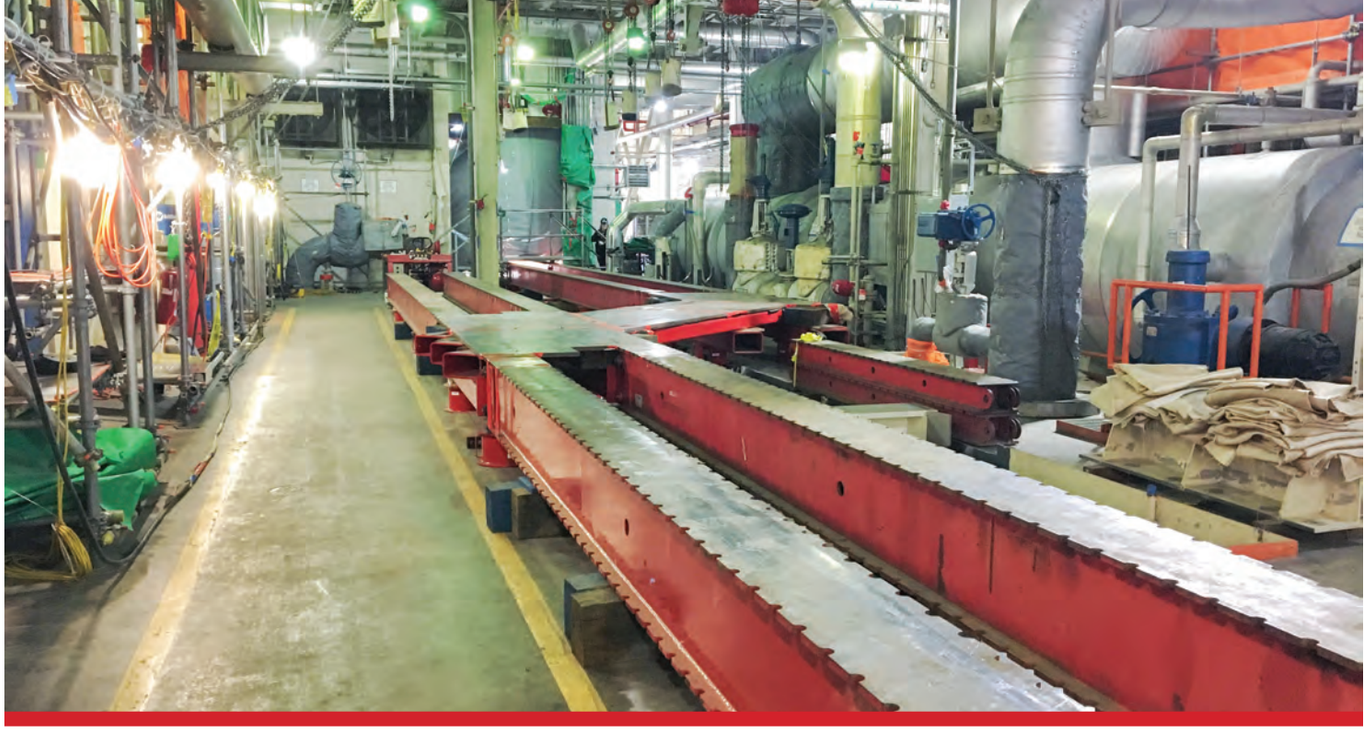
1 Barnhart was called to a wind farm in Iowa to remove a broken blade from a turbine. The rotor was locked out in a 12 o'clock position, with the broken piece of the 145' blade dangling midway down. The two other good blades also had to be removed and stored on the ground until a replacement blade could be found. Due to the nature of the work, wind speeds had to be below 15 mph along with a favorable forecast to allow each task to be completed. There were also safety issues to consider, like falling debris.

2 It took three rounds of engineering whiteboards plus numerous calls with the customer to devise a plan of action. One consideration was the hub height, which was 265' to the center of the hub. Barnhart performed an initial examination using two of the cranes with man baskets for preliminary rigging and inspection. Photos were then sent to the engineering team in Memphis for review and final adjustments to the plan.

3 The eventual removal method utilized two 550-ton and one 600-ton crane and personnel from several Barnhart branches. Barnhart used two cranes to stabilize the broken blade with multiple slings. The crew was able to sandwich the blade together and contain the pieces to make it rigid enough to cut and lower without pieces falling. The third crane held a man basket with a crew responsible for cutting the broken piece loose around the break.

4 Both broken pieces were then lowered to the ground for further inspection by the customer. Two cranes removed the remaining two good blades.

BARNHART USED TWO CRANES TO STABILIZE THE BROKEN BLADE WITH MULTIPLE SLINGS.



1 Barnhart was hired to remove and replace two feedwater heaters at a nuclear plant in Michigan. The team engineered a travel path solution using powered saddle rollers and over under beams that allowed for multiple turns on the removal and installation paths.

2 Barnhart used customized jack stands and pull-up jacks and beams for a more efficient jacking system.

3 Barnhart also used its new catenary saddles, a lower profile option to conventional saddles.

4 The feedwater heaters were loaded onto a Goldhofer PSTE for both removal and installation. A major challenge was the limited wall opening size that made for tight clearances. Barnhart and the customer worked together on a plan and executed the scope of the project well.

1 A Louisiana oil and gas production unit contracted with Barnhart to install a new snubbing unit with new piping and blowout preventers (BOPs). The team assembled a 90-ton crane, which was used to fly piping and smaller valves. A 500-ton crane was also used to fly the heavier BOP's and a man basket for the entirety of the job.

2 The project experienced delays early on because of improper sizing on the BOPs and trouble with the hole for the piping. This job was scheduled for two weeks and actually went almost two months with the crew working seven days a week for 12-14 hour shifts. The man basket was in constant use, flying the customer's snubbing crew.

3 Another situation arose during the third week delayed the process further, but Barnhart rose to the challenge. After numerous delays, all piping and BOP's were set, making for a successful snubbing project and a satisfied customer.

1 Barnhart was involved in projects at two wind farms in Canada in Nova Scotia and Prince Edward Island over the course of a month. At Price Edward Island, the crew was tasked with changing out blades utilizing a craneless blade system and our single crane system that allowed the work to be performed with one crane instead of two.

2 The team's secret weapon was Barnhart's single crane Blade Bar, an adjustable lattice boom bar with a custom counterweight system to adjust the center of gravity at height. A sling at the end of the bar was looped over the blade and another sling with a blade protector was attached at the root end.

3 Once the blade was removed from the hub, it was lowered to the ground in the stall position allowing for higher wind operating limits.

4 Under the two crane method, wind restrictions were limited to a cut off speed of around 15 mph. But the system enabled the team to perform at higher wind cut off speeds of 22 mph, increasing productivity on the project.

SEE OUR BLADE BAR EQUIPMENT PROFILE ON PAGE 17.

1 During a turnaround at a refinery, Barnhart was tasked with removing and replacing a T-805 tower. Barnhart loaded the new T-805, which was located in the laydown yard, utilizing the LTM 1400, a 500-ton hydraulic crane. The tower was then loaded to a Goldhofer trailer with 10 lines PST.

2 The 500-ton crane was then relocated to the existing T-805 tower, where it was used in conjunction with a tailing crane to lift and tail the old T-805 tower.

3 Once the old tower was in the horizontal position it was then loaded on to a Goldhofer trailer and transported to the laydown area. The new T-805 was then transported to its final location, lifted and tailed to the vertical position and set in place.

4 One of the challenges of the project was to provide client specific training needed to perform work inside the refinery and to provide all necessary documentation before each critical lift. Barnhart also operated 265-ton crane service for three months to remove and reinstall E-803 exchangers and miscellaneous equipment during the turnaround.

BLADE BAR

BARNHART'S BLADE BAR IS REVOLUTIONIZING MAINTENANCE PROJECTS IN THE WIND INDUSTRY.

The key innovation is that the Blade Bar replaces the industry standard two crane method for blade removal, requiring only one crane. One less crane means reduced mobilization, labor, trucks and equipment costs, resulting in a great reduction in cost for customers.

The Blade Bar is a metal frame, adjustable in five-foot increments from 5' long to 115' long, making it fully adjustable to the blade's specs. The length of the bar is adjusted on the ground and a sling is attached at one end. The Blade Bar is then lifted by a single hydraulic or crawler crane to the height of the damaged blade, eliminating a critical lift with a standard single crane operation.

At the end of the bar is a custom counterweight system, which easily adjusts to meet the blade's center of gravity. A hydraulically powered unit can rotate the bar and blade on three different rotation points in either direction.

The sling at the end of the bar is threaded over the damaged blade and another sling is eventually attached at the root end, which stabilizes and balances the blade. Once the blade is safely secured, it is disconnected from the turbine's hub and the Blade Bar and blade are lowered to the ground.

Scan with your phone's camera to watch our informational Blade Bar video.

Among the Blade Bar's further advantages is that one crane operator is in control of all operations versus two to coordinate. Smaller crane pad requirements also mean less environmental risk. The process is safer through reduced crew and crane operations. The Blade Bar system is also able to handle higher wind speed operating limits.

SOUTH SIOUX CITY, NE

BARNHART'S SOUTH SIOUX CITY, NEBRASKA BRANCH IS A FULL-SERVICE FACILITY AND ONE OF THREE BARNHART LOCATIONS IN THE STATE. IT SERVES CLIENTS IN SOUTH SIOUX CITY, NORFOLK, YANKTON, DENISON AND SPENCER.

The branch features an arsenal of cranes ranging from 35-ton hydraulic truck cranes to a 600-ton hydraulic all terrain crane, plus 440-ton and 330-ton class crawler cranes for wind projects. However, as part of the Barnhart team, the branch can tap into an extensive nationwide equipment inventory.

In addition to crane and rigging services, the branch offers transportation solutions, machinery moving, heavy haul, outage, turnaround and shut down support, and remove and replace capabilities.

"WE SPECIALIZE IN DAY TRADE WORK AND WIND MAINTENANCE PROJECTS," SAYS BRANCH MANAGER JOSH GRAY, "BUT ALSO HAVE THE EQUIPMENT AND PERSONNEL TO HANDLE PROJECTS IN A VARIETY OF INDUSTRIES, INCLUDING POWER GENERATION, PETROLEUM REFINING AND CHEMICAL PROCESS."

The Sioux City team uses a cantilever beam and counterweight with a 500-ton crane to install a 22,000 lb. tank at a plant.

The team successfully completes the installation of the tank.

Barnhart uses their new LR1300SX to perform a gearbox replacement on an 80-meter tower in North Central Iowa.

BARNHART

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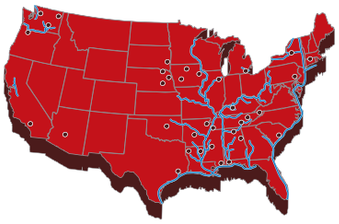
NATIONWIDE OFFICE LOCATIONS & FACILITIES



- DECATUR, AL | FULL SERVICE
- GADSDEN, AL | FULL SERVICE
- MOBILE, AL | FULL SERVICE
- BLYTHEVILLE, AR | FULL SERVICE
- LITTLE ROCK, AR | FULL SERVICE
- PHOENIX, AZ | RIGGING & TRANSPORT
- LONG BEACH, CA | RIGGING & TRANSPORT
- MIDDLETOWN, CT | FULL SERVICE
- AMES, IA | FULL SERVICE
- CEDAR RAPIDS, IA | FULL SERVICE
- DES MOINES, IA | FULL SERVICE
- MASON CITY, IA | FULL SERVICE
- CHICAGO, IL | RIGGING & TRANSPORT,
- EAST MOLINE, IL (CATTANI) | FULL SERVICE
- LADD, IL (CATTANI) | FULL SERVICE
- FOWLER, IN | FULL SERVICE
- CALVERT CITY, KY | FULL SERVICE
- OWENSBORO, KY | RIGGING & TRANSPORT
- BATON ROUGE, LA | FULL SERVICE
- SHREVEPORT, LA | FULL SERVICE
- WEST MONROE, LA | FULL SERVICE
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- CANTON, OH | FULL SERVICE
- PORTLAND, OR | FULL SERVICE
- PHILADELPHIA, PA | RIGGING & TRANSPORT
- CHARLESTON, SC | RIGGING & TRANSPORT
- SIOUX FALLS, SD | FULL SERVICE
- CHATTANOOGA, TN | FULL SERVICE
- KINGSPORT, TN | FULL SERVICE
- KNOXVILLE, TN | FULL SERVICE
- MEMPHIS, TN | FULL SERVICE, SERVICE CENTER, HEAVY LIFT TERMINAL
- HOUSTON, TX | RIGGING & TRANSPORT
- HAMPTON, VA | FULL SERVICE
- KENT, WA | FULL SERVICE
- MT. VERNON, WA | FULL SERVICE
- RICHLAND, WA | RIGGING & TRANSPORT
- SPOKANE VALLEY, WA | FULL SERVICE

BARNHART EQUIPMENT

ALTERNATIVE HEAVY LIFT
- MODULAR LIFTING TOWER
- PULL-UP GANTRY
- HYDRAULIC SLIDE SYSTEM
- JACKS & RAMS
- 4-POINT GANTRY SYSTEM
- STRAND JACKS
- MODULAR HOISTS

TRANSPORTATION SYSTEMS
- DUAL LANE TRANSPORTERS
- GOLDHOFER PSTE
- HYDRAULIC DOLLY SYSTEMS
- BARGING
- RAMPS AND TEMPORARY BRIDGES

MARINE HEAVY LIFT
- DERRICK CRANE – MISSISSIPPI RIVER
- BARGE CRANE – GULF COAST
- BARGE CRANE – GREAT LAKES
- HEAVY LIFT TERMINAL – GREAT LAKES
- HEAVY LIFT CRANE – HOUSTON

TELESCOPIC BOOM CRANES
- FROM 7 TONS TO 650 TONS

LATTICE BOOM CRANES
- CRAWLERS FROM 100 TO 1800 TONS
- TRUCK CRANES FROM 115 TO 800 TONS
- RINGER CRANES FROM 360 TO 1,800 TONS

OPERATED CRANE SERVICE
- OVER 450 CRANES
- LATTICE BOOM TO 1,760 TONS
- TELESCOPIC BOOM TO 600 TONS
- FULL TURNAROUND SERVICES
- NATIONWIDE NETWORK OF CRANE BRANCHES