Technical and purchasing specifications for Coker Bottom and Top Unheading and Reheading Valve Systems for Delayed Coke Units

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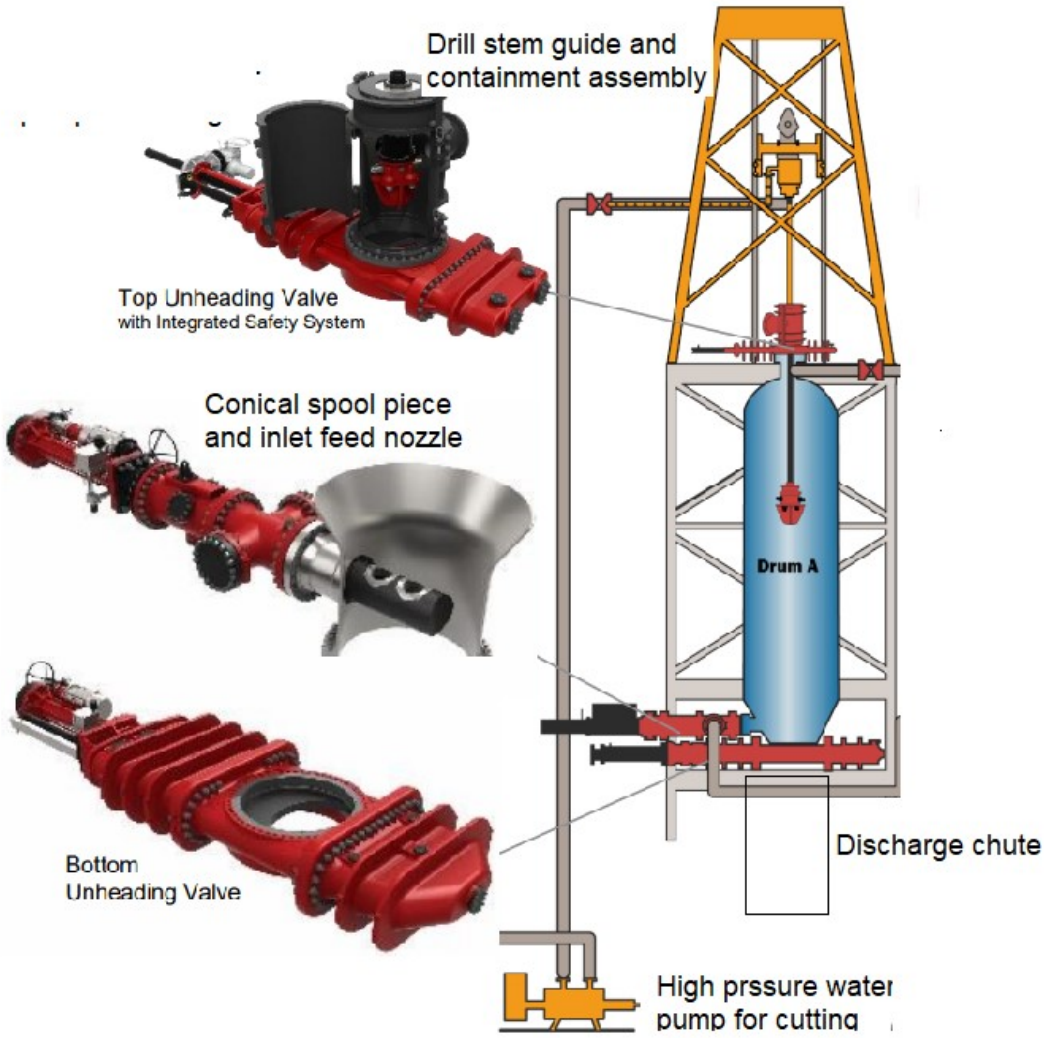
1. Purpose

This specification sets forth the minimum requirements for the design, fabrication, inspection, testing and supply of the remotely operated fully automated unheading and reheading valves, here named SYSTEM, to be installed at the top and the bottom of each Coke Drum from a Delayed Coking Unit, according to the information on Table 1.

The SYSTEM shall be complete with quick opening and closing top and bottom unheading valves, the respective electrohydraulic actuators and controls, HPU - Hydraulic Power Unit and HCU - Hydraulic Control Unit, PLC control panel and the facilities to interconnect with the DCS system of the Plant.
The HPU shall attend all the Coke Drums of the same Delayed Coking Unit and HCU shall be proper of each Coke Drum.



From Delta Valve catalog

Table 1: Basic Informations

Remotely operated fully automated unheading and reheading systems		
Plant location		
Delayed Coking Unit	Tag No -	
Number of Coke Drums		
Cycle production	18 to 24 hours	
Total coke production	m³ per day	metric tons per day
Coke production per each Coke Drum	m³ per day	metric tons per day
Coke Drums	Tag No	

	Tag No Tag No Tag No	
Top Unheading valves	Valve Tag No Valve Tag No Valve Tag No Valve Tag No	
Bottom Unheading valves	Valve Tag No Valve Tag No Valve Tag No Valve Tag No	

Note:
All weights shall be given on a “dry” basis and are based on a dry bulk density of 875 kg/m³.

2. SYSTEM description

Petroleum Coke shall be produced in vertical drums at a total rate according to Table 1 and after cutting by means of high-pressure hydraulic jets the coke is discharged into a concrete pit adjacent to the Coke Drums.
Each SYSTEM shall be permanently connected, sealed and automatically actuated for unheading and reheading operations, consisting of the following sub-systems/components:
• Top Unheading
System Device comprising of a 36” nominal diameter automated slide gate valve assembly, hydraulic actuated for each drum;
• Bottom Unheading
System Device comprising of a 60” nominal diameter automated slide gate valve assembly, hydraulic actuated for each drum;
• Skid-mounted Hydraulic Power Unit
To power up the unheading valves, common to all Coke Drums.
• Local Hydraulic Control Unit for each Coke Drum;
• Local control panel for the Top Unheading System for each Coke Drum;
• Local control panel for the Bottom Unheading System for each Coke Drum;
• All local and remote control devices and instruments;
• Insulation blankets for the valves;
• Drill stem guide/containment assembly to be installed and remain permanently connected to each top unheading valve;
• Discharge chute to be installed and remain permanently connected to each bottom unheading valve;
• Transition cone spool piece with inlet nozzles for each Coke Drum
Note:
Transition cone spool piece is the component of the Coke Drum conical end, where the inlet feed piping is assembled and the Bottom unheading valve is connected.

The control and shutdown logic shall be inherent in the Plant Distributed Control System (DCS) and safety interlocking instrumented system (SIS).

Coke Drum top and bottom unheading and reheading operations are executed from their respective control panels located on the cutting and unheading deck, a safe distance from the Coke Drum to be opened.

Possible suppliers
a. Delta Valve
http://www.deltavalve.com/bottom-unheading-valves/
http://www.deltavalve.com/wp-content/uploads/2016/07/DV_TUD_Brochure_2015v2-secured.pdf
b. IMI Critical engineering
https://www.imi-critical.com/products/delayed-coking-bottom-unheading/
c. Z&J-Zimmermann and Jansen
https://group-premium.com/EN/files/Coker-e-2010_01.pdf

3. SYSTEM normal operation sequence

Brief description of how to operate the SYSTEM.
Firstly, the Coke Drum and hydraulic pump selections are made from the HPU and prior to coke cutting, the Coke Drum unheading operation is performed.

Upon selection of the Coke Drum and hydraulic pump, the operator ensures that all permissives are satisfied and control system requirements of the Coke Drum are safe before initiating the unheading operation.
Then the operator initiates top unheading procedure from a local control panel for the Top Unheading System.
The top unheading valve is first opened.
Once the top unheading valve is completely open and its open position is acknowledged via a proximity switch, the operator then secures the top unheading valve in its open position by a lockout pin.
DCS then acts to close the line block valve.

The operator then initiates bottom unheading procedure from a local control panel for the Bottom Unheading System.
After all permissives are satisfied and control system requirements of the Coke Drum are deemed to be safe, operator then opens the bottom unheading valve.
Once the bottom unheading valve is completely open and its open position is acknowledged via a proximity switch, the operator then secures the bottom unheading valve in its open position by a lockout pin.
DCS then acts to close the line block valve.

Once the top and bottom unheading operation is complete, the operator initiates coke cutting operation.

After all coke in the Coke Drum is cut and discharged, reheading of the top and bottom unheading systems shall be completed in the reverse order.

4. Scope of the supply

4.1. Vendor/Manufacturer shall supply the SYSTEM in accordance with:

- **a.** Design, construction and supply of a complete set of remotely operated fully automated unheading reheading SYSTEM functional and safe, consisting of top and bottom unheading valve systems, for each Coke Drum complain with the Figure 1 showing the Coke Drum and respective SYSTEM.
  The SYSTEM and the Coke Drum inlet feed spool piece shall be designed to operate in severe conditions inherent in a coking process.
- **b.** Temperature variations experienced during the coking and quenching operations shall be considered in the material selection, design and fabrication techniques.
- **c.** The equipment and components shall be designed to operate while exposed to coke dust.
- **d.** All the procedures and any special tools necessary for the installation, operation and maintenance shall be provided.
- **e.** Vendor/Manufacturer shall give references of the use of his SYSTEM in delayed coking services in the petroleum/petrochemical industry.
- **f.** This reference shall include Company name, e-mail, Plant location, startup operation date, plant operational conditions (fluid, operating pressure and temperature, operational time cycle, number of cycles per year) and valve characteristics (nominal diameter, leakage class, steam purging consume, pressure rating and material specification).

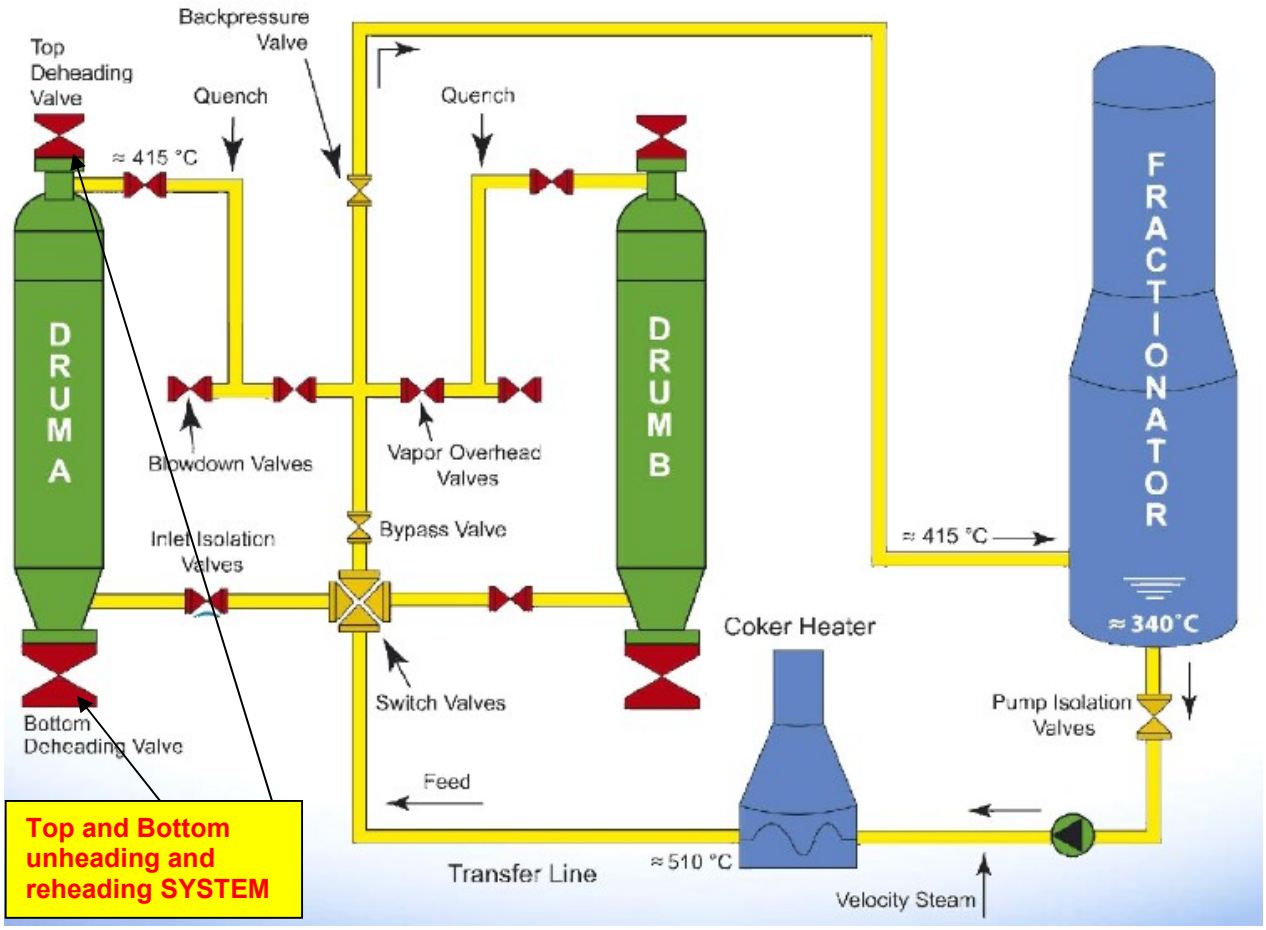


Figure 1: Flowsheet showing a typical Coke Drum and Top and Bottom Unheading Systems

4.2. Each unheading/reheading SYSTEM set supplied by Vendor/Manufacturer shall include, but not be limited to:

4.2.1. A Bottom Unheading System complete with an unheading valve assembly, hydraulic actuators, HPCU electrohydraulic power and control unit, lockout pin, shroud, inlet feed spool piece, discharge chute, bracing, fasteners, gaskets, bolting and other accessories, as necessary for a complete assembly.

4.2.2. A Top Unheading System complete with an unheading valve assembly, hydraulic actuators, UPCU electrohydraulic power and control unit, lockout pin, drill-stem guide/containment assembly, bracing, fasteners, gaskets, bolting and other accessories, as necessary for a complete assembly.

4.2.3. A fixed discharge chute for the Bottom Unheading System.

4.2.4. A complete trolley/cartridge system with brackets and spring supports for supporting, installation and removal of the Bottom Unheading System.

4.2.5. A transition conical spool piece connection of the Coke Drum to the Bottom unheading valve shall be provided.

4.2.6. A skid-mounted hydraulic power unit (HPU), with full redundancy, designed to operate all Coke Drums top and bottom valves.

4.2.7. The HPU shall be complete with high pressure reservoirs, two 100% redundant hydraulic pumps with their drive trains, filters, hoses, tubings, control and operating valves, fittings, control instrumentation, electrical devices, gauges, alarms, supports, interconnecting wiring on the skid, and other accessories for complete and workable operating systems.

4.2.8. The hydraulic actuators shall have ability to throttle coke plus water and steam mixtures.

4.2.9. The HPU shall be able to communicate with the Central Control room and interlock system.

4.2.10. A hydraulic control panel (HCP) for the HPU, common to all Coke Drums. The HCP shall be complete with panel-mounted hydraulic, electric and control devices, instruments, gauges, interlocks, alarms and other accessories for a complete and workable operating system.

4.2.11. Two double-acting linear electrohydraulic cylinder actuators (titular and for emergency); position indicator; locking/lockout system, for each valve.

4.2.12. All instrumentation and interlocks to assure safety operations, including, interconnecting piping, tubings, hoses, supports and fittings between the HPU and top and bottom unheading systems.
4.2.13. Electrical and control panels, as required.
4.2.14. Electrical and instrumentation power supply and respective interconnections with the control panels and the control rooms.
4.2.15. A pneumatic back-up system for the HPU, complete with a gear pump, an air motor, an air filter/regulator/lubricator, and suction, pressure and return hoses mounted on a portable dolly.
4.2.16. A cooling water skid to cool and recirculate clean water to prevent stem and/or seat damage.
4.2.17. Local control panel for Top Unheading System complete with all panel-mounted instrumentation, electrical devices, interconnecting wiring, gauges, alarms, indicating lights, pushbuttons, and all associated electrical devices.
4.2.18. Local control panel for Bottom Unheading System, complete with all panel-mounted instrumentation, electrical devices, interconnecting wiring, gauges, alarms, indicating lights, pushbuttons, and all associated electrical devices.
4.2.19. Local pushbutton stations, junction boxes, and all field-mounted electrical devices. All necessary field-mounted instrumentation and controls to execute the top and bottom unheading and reheading operations without mechanical damage.
4.2.20. All fasteners, gaskets, bolting, and hardware required for a complete assembly of the SYSTEM.
4.2.21. Thermal Insulation blankets and their installation hardware for Top Unheading System.
4.2.22. Thermal Insulation blankets and their installation hardware for Bottom Unheading System.
4.2.23. Spare parts for commissioning, start-up and two years of operation, for each valve and each HPCU.
4.2.24. Transition cone spool piece supply in accordance with:

a. Vendor/Manufacturer shall supply a conical transition spool piece to be welded to the conical bottom of the Coke Drum and flanged with 60 in nominal diameter to be connected to the Bottom unheading valve.
   The inlet feed nozzles shall be part of conical transition spool piece.
   Vendor/Manufacturer shall supply one set of bolts, nuts, washers and gasket required for each flanged connection supplied.
b. In case of existing Coke Drums, Vendor/Manufacturer shall supply the conical transition spool with both ends flanged, one end accordingly the bottom nozzle of the drum and the other end with 60 in nominal diameter to be connected to the Bottom unheading valve.
c. See the Figure 2 for better clarifications on the scope of supply.

4.2.25. Structure for valve support and maintenance device system, shall be independent of the Coke drum, that is, not supported on.
4.2.26. Design engineering, raw material supply and procurement of materials and components.
4.2.27. Supply the welding consumables and materials for the assembly.
4.2.28. Specification of welding procedures.
4.2.29. Qualification of welding procedures, welders and welding operators.
4.2.30. Welding and weld inspection.
4.2.31. Specification for NDE procedures.
4.2.32. Qualification for NDE procedures, inspectors and operators.
4.2.33. Weld production tests.
4.2.34. Heat treatments and materials needed.
4.2.35. Hydraulic pressure test.
4.2.36. Leak testing.
4.2.37. Equipment preservation in order to allow it to be stored for one year prior to installation.
4.2.38. Painting.
4.2.39. Fireproofing of the structure support of the Bottom unheading valve.
4.2.40. Delivery and transportation to the refinery.
4.2.41. Complete assembly and functional testing of the SYSTEM at shop.
4.2.42. On-site supervision for installation, commissioning, functional testing and start-up.
4.2.43. System operation and maintenance manual (in Portuguese language).
4.2.44. Training for maintenance and operation staff at Refinery.

4.2.45. Technical assistance to Client to suppress any doubt, during the installation, commissioning, and assisted start-up.

4.2.46. Technical assistance and maintenance services for Client during the first year in operation.

4.2.47. Supply of any existing steam manifold and pipe arrangement with all the necessary recommended documents.

4.2.48. Performance and functional requirements are listed as follows

a. Possibility of both remote and local operation.
b. Quick and safe operation.
c. Optional operation in case of power failure.
d. Design in order to avoid accumulation of coke fines.
e. Design to minimize maintenance.
f. Design of any gaskets necessary to the SYSTEM.
g. Purging for sealing and cleanness.
h. No need of operator on the decoking deck during normal operation.
i. Assembly procedure that guarantees that no stress is transmitted by the SYSTEM to the Coke Drum at any time during operation and/or maintenance.
j. No leakage of product at any time during operation.

4.2.49. Fireproofing protection

a. The actuator and accessories (filters, tubings, cables, solenoids, etc.) shall have passive fire protection, by means of painting with ablative (intumescent) paint, which meets the requirement of tolerability to the incidence of hydrocarbon flame, according to API Std 2218 and UL 1709 standards (Chapter 3 - Figure 3.1), preserving the nominal characteristics of the installations
b. All material applied in passive protection shall have a fire resistance certificate for at least 2 hours in the case of structural items, according to UL Standard 1709 tests, and 30 minutes in the case of electrical and control cables, according to UL Standard tests 2196, using the rapid temperature rise curve (typical for hydrocarbon fire: 1100ºC) contained in Standard UL1709.
c. Power supply and control cables, from the junction box to the actuator, shall meet one of the flame resistance technical solutions, namely:
    - Specification with “fireproof” according to IEC 60331 (Part 11 and Part 21), DN 1.5 x 1.5 mm, mica thermal insulation, twisted pair, with global shield and drain wire, or
    - Be sent in a tray of cable beds with passive fire protection type ablative paint (intumescent) paint or ceramic blanket, suitable to withstand direct incidence of hydrocarbon flames for a minimum period of 2 hours at 1100ºC, according to API Std 2218 and UL 1709 Standards (Chapter 3 - Figure 3.1). For the protection of electrical supply and actuator control cables, passive protection is mandatory throughout its length, regardless of the route taken in its path in the process area.

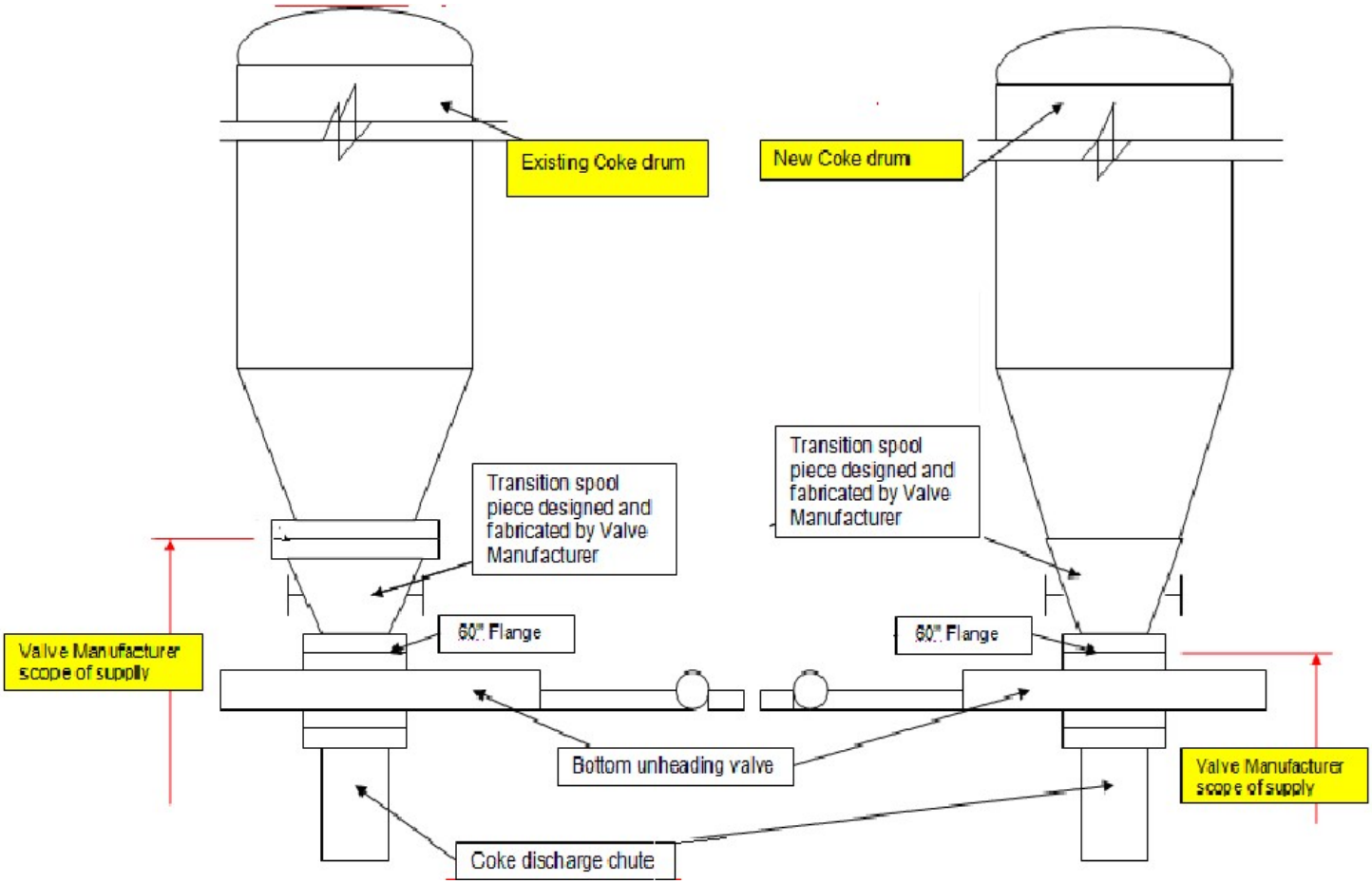


Figure 2: Supply scope of Bottom Unheading System for new and existing Coke Drums

5. Valve engineering and fabrication

The following activities shall be carried out.

5.1. Design and engineering coordination.
5.2. Preparation of calculations, final equipment and layout assembly and detailing drawings, structural drawings, electrical and control system drawings, PFDs, P&IDs, cause and effect diagrams, equipment and instrument data sheets, bills of materials, control logic, programming, other data required by Client, and operating instruction and maintenance manuals.
5.3. Design criteria for the Coke Drum top and bottom flanges mating to their respective top and bottom unheading system flanges.
5.4. Piping and valve loadings on the top and on the bottom of the Coke Drum.
5.5. Relating on the conical spool piece design, Valve/Manufacturer shall coordinate with Coke Drum manufacturer the conditions for designing and fabricating, as like material, design conditions, dimensions, including NDTs, welding and PWHT-Post Welding Heat Treatment.
5.6. ASME Code Data Reports and U-1 forms.
5.7. ASME Section VIII, Division 1 Code calculation reports.
5.8. Element Finite Stress Analysis – FEA – considering design conditions and the thermal and mechanical fatigue due to temperature transients and pressure operational cycling.
5.9. ASME Material Certificates for all pressure containing parts and parts welded to pressure parts, labeled by component.
5.10. Fabrication, inspection and testing.
5.11. Valves critical internal dimensions and tolerances.
5.12. NDE records.
5.13. Testing Reports including PMI.
5.14. Weld maps, including the locations of all material inspection points (PMI, NDE, hardness, etc.).
5.15. All coordination with the Client, hydraulic actuating manufacturer and sub-suppliers.
5.16. All approved and certified documents.
5.17. Part number list.
5.18. Record of the repairs.
5.19. Location and welding procedures of weld repair in pressure containing parts.
5.20. Information sheets for paints, thermal insulation blankets , greases, rust preventatives and fluids.

5.21. Certificates of all material applied in passive fire protection.
5.22. Certificates of compliance of all the equipment and any component thereof as applicable with local codes and regulations, i.e., electrical standards, safety regulations, etc.
5.23. INMETRO certificates for all electrical and electronic components.
5.24. Valves Manufacture, Inspection and Tests Data Book.
5.25. Operation and maintenance manuals in Portuguese language.

6. Field services

The following services at site are previewed during the installation and start-up
6.1. Supervisory during field assembly.
6.2. Tests and calibration of the control system.
6.3. Tests and adjustments at the valve support and maintenance device system.
6.4. Assistance during commissioning, start-up and assisted operation.

7. Works Not Included

7.1. Coke Drums and their supports.
7.2. Coke Drum metallic structures.
7.3. Interconnecting field piping/tubing between Valves, DCS equipments and HPU, but Valves Vendor/Manufacturer shall recommend size and type of piping/tubing and their mating fittings.
7.4. All interconnecting external field wiring.
7.5. Distributed control system (DCS), safety interlock system (SIS), interfacing wiring between DCS, SIS and Valves field devices.
7.6. Plant communication system.
7.7. Grounding of Valves, grounding hardware, and plant ground loop.
7.8. Area lighting.
7.9. Fire detection and protection systems, as required, but Valves Vendor/Manufacturer shall recommend the field devices.
7.10. Field receiving, storage, handling, assembly, installation, erection, start-up, commissioning, and testing of Valves and supplied equipments.
7.11. Local stations for operator and sheds for housing the Valves Vendor/Manufacturer people.
7.12. Remote operation and visualization by close circuit TV (CCTV-Closed-Circuit Television).

8. Valve construction characteristics

All valves shall open, close and seal in a safe way.

8.1. **Top Unheading System**

8.1.1. The Vendor/Manufacturer shall supply a 914.4-mm (36-inch) nominal diameter, automated top unheading assembly complete with valve, hydraulic cylinders, fasteners, gaskets, a drill stem guide/containment assembly, and all other needed accessories for each Coke Drum.

8.1.2. The top unheading assembly device shall be with a 36-inch slide gate type valve for on/off service of Coker Drum, with flat and flanged body, full bore and mounted horizontally.

8.1.3. The Vendor/Manufacturer shall supply redundant hydraulic actuators, one mounted on the valve body and one available as an emergency (temporary) actuator, each one capable of opening and closing slide gate of the top unheading system. The Vendor/Manufacturer shall supply tubing arrangement that shall allow easy connection of the emergency (temporary) actuator to the hydraulic system.

8.1.4. The drill stem guide/containment assembly shall be designed to accommodate up to 254-mm (10-inch) drum movement from its centerline in all directions (360° in a horizontal plane) for a maximum deflection of 508-mm (20-inch) along any diagonal in the horizontal plane.

8.1.5. The drill stem guide/containment assembly shall be designed to accommodate the largest drill assembly selected by the Client. The Client will advise Vendor/Manufacturer of the drill stem assembly size upon finalization of its selection. As a basis for bid, the Vendor/Manufacturer shall assume a 178-mm (nominal 7-inch) diameter drill stem.

8.1.6. The drill stem guide/containment housing shall be of open top design. It shall be designed to direct any blow-out through the top of the enclosure.

8.1.7. The drill stem guide/containment housing shall be designed to protect an operator on the cutting deck from an escape out of Coke Drum live drill stem.

8.1.8. The disc/obturator shall be assembled in a frame which moves from closed to open condition and vice versa running freely between two guides placed in the machined body studs, in metal-to-metal contact with the carrier frame

The valve shall be designed to withstand the internal pressure, self-weight, thermal gradients and other forces and moments generated by the piping system.
The valve shall be able to function satisfactorily under all loads and operating conditions, and the loads that happens during the moving from closed to open condition and vice versa.

8.1.9. The valve body shall be supplied and equipped with the following flanged connections, as a minimum:

- Body vent nozzles;
- Body purge nozzles;
- Body seat purge nozzles;
- Body drainage nozzles;
- Inspection openings on each side;
- Flushing actuator stem cooling water connections.

8.1.10. Bonnets shall be flanged on both sides of the body and allow for access to the valve internals.
The routine maintenance services shall be done from the top of the valve without dismantling of bonnets.

8.1.11. Valve internal components, seats and disc, shall be maintainable and exchangeable from the top without dismantling the valve bonnets.

8.1.12. The slide disc/obturator shall be attached to the valve stem by means of a screwed-in hammer head.

8.1.13. Main internal parts and components of the valve:

a. Disc or slide or obturator

Disc shape properly to minimize thermal distortion and shall assure tight shut-off for both sides of the valve.

b. Guides

The disc carrier shall be guided while moving from open to closed operating position and vice versa.

c. Body and disc seats

The body and disc seats surfaces completely protected from the flow and overlaid with a wear resistant welding deposit.
The seats on the body and disc shall be exchangeable in the valve position.

d. Knife edge hard faced

The sharp edge of the inlet body connection shall act as a knife to cut off the coke particles which got stuck on the disc and as a scrapper to clean the upper face of the disc.

e. Stuffing box

Purge steam connection at stuffing box housing.

f. Live load sealing

Live loaded sealing design with Belleville springs on stuffing box and flange bolts.

g. Dual or double actuator system with full redundancy

h. Auto locking device to prevent human error.

8.2. **Bottom Unheading System**

8.2.1. ~~The~~ Vendor/Manufacturer shall supply a 1,524-mm (60-inch) nominal diameter, automated bottom unheading assembly complete with valve, hydraulic actuators, a chute assembly, a bottom valve support system, fasteners, gaskets, and other needed accessories for each Coke Drum.

8.2.2. The bottom unheading ~~assembly~~ device shall be with a 60-inch slide gate type for on/off service of Coker Drum, with flat and flanged body, full bore and mounted horizontally.

~~8.2.3. The~~ Vendor/Manufacturer shall supply redundant hydraulic actuators (cylinders), one mounted on the valve body and one available as an emergency (temporary) actuator. Each actuator (cylinder) shall be capable of opening and closing slide gate of the bottom unheading system under full head of coke column. The Vendor/Manufacturer shall supply tubing arrangement that shall allow easy connection of the emergency (temporary) actuator to the hydraulic system~~.~~

8.2.4. Handled material, solids and fluid shall be transferred through the valve body without entering in the body. In closed valve position the seat surfaces shall be completely protected.
The closure part of the obturator or disc shall provide positive tight shut-off position.
Vendor/Manufacturer shall consider the risk of jamming at the high operating temperatures or at thermal shocks and also the possible obstruction of the body due to large pieces of coke.

At closed situation the sealing force of the disc facing the Coke Drum shall assure the tight condition.

8.2.5. The disc shall be assembled in a frame which moves from closed to open condition and vice versa running freely between two guides placed in the machined body studs, in metal-to-metal contact with the carrier frame

The valve shall be designed to withstand the internal pressure, self weight and coke and fluid weights, thermal gradients and other forces and moments generated by the piping system. The valve shall be able to function satisfactorily under all loads and operating conditions, including hydrostatic loading, and the loads that happens during the moving from closed to open condition and vice versa.

8.2.6. The lower flange of the valve shall be suitable to fit up the coke discharge chute.

8.2.7. The valve body shall be supplied and equipped with the following flanged connections, as a minimum:

- Body vent nozzles;
- Body purge nozzles;
- Body seat purge nozzles;
- Body drainage nozzles;
- Ramming nozzle opposite of actuator side;
- Inspection openings on each side;
- Flushing actuator stem cooling water connections.

8.2.8. Bonnets shall be flanged on both sides of the body and allow for access to the valve internals.

The routine maintenance services shall be done from the top of the valve without dismantling of bonnets.

8.2.9. Valve components which are exposed to the coking conditions, seats and disc, shall be maintainable and exchangeable from the top without dismantling the valve bonnets.

8.2.10. The seat assembly shall incorporate a scraper with knife edge for removing of coke deposit sticking on the upper disc surface.

8.2.11. External body support system shall be supplied for easy assembly of the complete valve and on-line maintenance, with a trolley facility to move the valve to a maintenance position.

8.2.12. The disc/obturator shall be attached to the valve stem by means of a screwed-in hammer head.

8.2.13. Main internal parts and components of the valve:

a. Disc or slide or obturator

Disc shape properly to minimize thermal distortion.

b. Guides

The disc carrier shall be guided while moving from open to closed operating position and vice versa.

c. Body and disc seats

The body and disc seats surfaces completely protected from the flow and overlaid with an wear resistant welding deposit.

The seats on the body and disc shall be exchangeable in the valve position.

d. Valve disc and guides

Guiding system prevents entry of solids into the body cavity and disc shall assure tight shut-off for both sides of the valve.

e. Body sealing

The seats shall seal the body to prevent coke particles to enter between body seat and disc seat.

f. Knife edge hard faced

The sharp edge of the inlet body connection shall act as a knife to cut off the coke particles which got stuck on the disc and as a scrapper to clean the upper face of the disc.

g. Stuffing box

Purge steam connection at stuffing box housing.

h. Live load sealing

Live loaded sealing design with Belleville springs on stuffing box and flange bolts.

i. Purge steam and body drain connections

Steam shall be inserted through to purge the body seats, that is, the space between seat and disc. The body drains arranged to allow effective purging and drainage.

j. Dual or double actuator system with full redundancy

k. Auto locking device to prevent human error.

9. Steam supply

Sufficient supply of steam flow shall be used for heating up the valve body and for keeping the purging and cleaning of the body and disc seats and for pressurizing the valve body higher than the Coke Drum operating pressure.
Valves shall be purged with steam in order to keep them properly heated and keep the bonnets positively pressurized to prevent coke fines and dust to entry inside the valve.
Vendor/Manufacturer shall inform the predicted steam consumption (lbs/hr or kg/hr), considering:

- Closed valve

—The steam injection is related to the following situations:

a- Valve body pressurization, warming and purging during the operational cycle;
b- Steam flowing through the valve seat into the process.

- Opened valve

Steam injection only to clean the body and seats.

Supply a monitoring of the steam consumption into DCS to verify the conditions of the internal sealing.

10. Codes, standards and recommended practices

Equipment design and fabrication shall be in accordance with the applicable section of the following codes, standards and recommended practices, the attached specifications, and attached data sheets.

10.1. **General Design**

- American Institute of Steel Construction (AISC)
- American Society of Civil Engineers (ASCE)
- American Petroleum Institute (API)
- American Society of Mechanical Engineers (ASME)
- American Society of Nondestructive Testing (ASNT)
- American Society of Testing and Materials (ASTM)
- American National Standards Institute (ANSI)
- Federal Occupational Safety and Health, (OSHA)
- American Welding Society (AWS)

10.2. **Electrical Motors and Equipment**

- NEMA, National Electric Manufacturers Association
- NEC, National Electric Code.
- IEEE, Institute of Electrical and Electronics Engineers
- ISA, Instrument Society of America
- IEC, Industrial Control and Systems
- UL, Underwriters Laboratories

10.3. **Steel Structures**

- AISC, American Institute of Steel Construction, Manual of Steel Construction.
- OSHA, Occupational Safety and Health Administration
- SSPC, Steel Structures Painting Council
- AWS D1.1, Structural Welding Code

10.4. **Welding**

- API RECOMMENDED PRACTICE 582

Welding Guidelines for the Chemical, Oil, and Gas Industries

10.5. **Others**

- Manufacturer's Standardization Society (MSS) Specification SP-55, Quality Standards for Steel Castings for Valves, Flanges, Fitting and Other Piping Components

11. Basic design requirements

11.1. Design conditions

Valve operating conditions to be considered at the design			
Operating condition	**Fluid**	**Inlet pressure kgf/cm²**	**Medium Inlet temperature**

			ºC
Heating condition Valve opened	Coke plus gases from other Coke Drum	Ambient	250
Coking condition Valve closed at hot conditions	Coke	Top valve 7.0 kgf/cm^2 Bottom valve 10.8 (Including static head)	515
Quenching condition Valve closed at cold condition	Coke plus operating steam and water	Top valve 7.0 kgf/cm^2 Bottom valve 10.8 (Including static head)	200
Opening condition Valve opened	Coke plus water	Bottom valve 3.0 (only static head)	200
Purging steam conditions Valve opened.	Clean superheated steam	10.8	300

Notes**:**

a- Steam flow rate shall be provided for attending the following conditions simultaneously, at the valve closed position:

- For heating up the valve body;
- For pressurizing the valve body;
- For purging and cleaning of the seats.

Immediately prior to open the bottom valve the purging steam shall be released to a level of 1.0 kgf/cm² max.

b- The steam operating pressure shall be 1.0 kgf/cm² above the actual Coke Drum bottom pressure.

c- At the valve opened condition does not require steam purging.

d- Basic information data: to be informed later

Site conditions	
Meteorological data	
Utilities	
Electrical Power	

11.2. This specification, referenced codes, standards and the recommended engineering practices establish the minimum acceptable requirements that shall be met or exceeded. The Vendor/Manufacturer may use his proprietary design guidelines and manufacturing practices provided they meet or exceed the aforesaid requirements, as determined by the Client.

11.3. All equipment and their controls shall be selected for an extremely severe coker service on an 18 to 24-hour per day, 365 days per year basis. They shall be new and best suited for the intended application and site conditions.

11.4. Mechanical parts and structures shall be designed with due regard to impact, possible overloads, cyclic stresses, reversing loads, physical properties of materials and geometrical shape of components, to reduce stress concentration. The design life of mechanical components shall be divided into the following classifications:

a. When deterioration cannot be observed and failure may be unexpected or dangerous, or both, e.g., failure in shafts, drums, etc., and their selection calculations require input on their design life, then the design life shall be 30 years.
b. When deterioration can be observed and failure can be prevented by repair or replacement at a reasonable cost, e.g., drive belts, drive chains, bushings, etc., the design life shall comply with industry standards as determined by the application of recognized factors of safety, allowable working stresses, lubrication, etc.

11.5. The pressure components of the top and bottom unheading systems shall be designed, fabricated, inspected and tested in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Divisions 1, for design, and 2, for stress and fatigue analysis.

11.6. Inspection, examination and testing of the pressure components of the top and bottom unheading systems shall be supplemented by specific requirements of ASME B16.34, API 598 and other applicable portions of the codes, standards and recommended practices listed in item 10 of this specification.

11.7. All piping associated with the pressure components of the top and bottom unheading

systems shall be designed, fabricated, inspected and tested in accordance with ASME B31.1 Process Piping Code and other applicable portions of the codes, standards and recommended practices listed in item 10. of this specification.

11.8. The top and bottom unheading valve assemblies shall be subject to the same design conditions as the Coke Drums, stated in the Coke Drum data sheet. Special consideration shall be given in the design of pressure components of the top and bottom unheading systems and their associated piping for fatigue due to reversing cycles under high temperatures and pressures. The Vendor/Manufacturer shall submit stress analysis and fatigue calculations per ASME Code Section VIII, Division 2. The pressure components shall be stamped to ASME Code Section VIII Division 1.

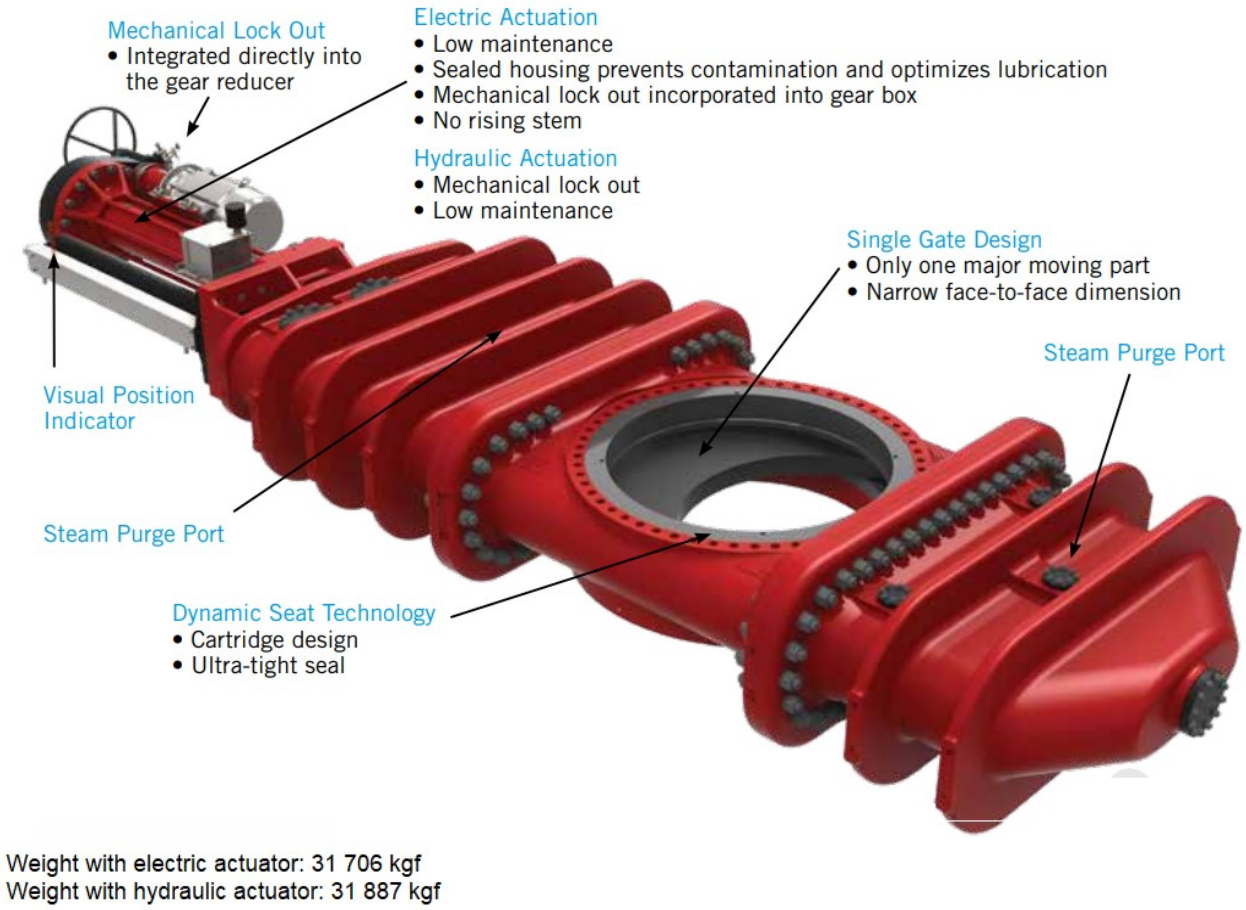
11.9. No asbestos, asbestos containing products, lead-based paints, mercury and other hazardous materials shall be used in the assemblies.

11.10. Environmental considerations, personnel and equipment safety, noise, interchangeability of components, and overall system availability, reliability and maintainability are of supreme importance. Vendor/Manufacturer shall pay special attention to these aspects in the system design.

12. Mechanical design

12.1. Valves

Top and bottom unheading valve shall be designed, manufactured, inspected and pressure tested in compliance with ASME Code Sec. VIII Division 1 and ASME Code Sec. II Parts A and D, latest edition, the specified service design conditions and other requirements as agreed in the Inspection and Test Plan. The leak test shall be in accordance with API Std 598.
ASME Code Section VIII Division 1 U designator stamping is not required.



Typical unheading valve (from Delta Valve catalog)
http://www.deltavalve.com/wp-content/uploads/2022/09/DV_BUD_Brochure_2019.pdf

Top Unheading Valve design conditions	
Valve Tag No.	
Valve type	Single or double disc through conduit gate valve
Valve design	Hot shell
Quantity	

Operating conditions	
Operating fluid	Coke residuum
Fluid characteristics	Feed composition: Contaminants: Sulfur: Nitrogen: TAN (Total Nitrogenic Acidity):
Fluid state	Liquid plus solid particles
Type of solids	Coke pieces of several shapes and weights
Coke physical properties	Bulk density (kgf/m³): 875 Hardness: Adherence to the valve body:
Direction of flow	Vertical
Valve position	Horizontal
Valve stem position	Horizontal
Port area	Full bore
Valve position during operation	Closed
Valve position during shut-off	Opened
Valve tightness test	Zero leakage according to API-Std 598 High Pressure Closed Test
Design conditions	
Valve body design pressure/temperature	7.0 kgf/cm² / 515ºC
Disc and Stem differential pressure design	7.0 kgf/cm²
Minimum Metal design temperature	0ºC Charpy V notch impact tested Average energy 54 J Minimum energy 47 J
Max delta pressure on the disc at closed position	7.0 kgf/cm²
Actuator sizing design pressure	3.0 kgf/cm² to open and atmospheric to close
Required valve opening/closing force	Vendor/Manufacturer shall inform the calculated required force, using a safety factor of 150% as a minimum, to specify the main hydraulic actuator. The back-up hydraulic actuator shall be 100% redundancy
Actuator stroke speed (time to open)	2.0 minutes max.
Actuator stroke speed (time to close)	2.0 minutes max.
Operating cycle time	Every 18 to 24 hrs

Bottom Unheading Valve design conditions	
Valve Tag No.	
Valve type	Single or double disc through conduit gate valve
Valve design	Hot shell
Quantity	
Operating conditions	
Operating fluid	Coke residuum / water Feed composition: Contaminants: Sulfur: Nitrogen: TAN (Total Nitrogenic Acidity):
Fluid state	Liquid plus solid particles

Type of solids	Coke pieces of several shapes and weights
Direction of flow	Vertical
Valve position	Horizontal
Valve stem position	Horizontal
Port area	Full bore
Valve position during operation	Closed
Valve position during shut-off	Opened
Valve tightness test	Zero leakage according to API-Std 598 High Pressure Closed Test
Design conditions	
Valve body design pressure/temperature	10.8 kgf/cm² (including static head) / 515ºC Considering a Coke Drum with 28,000-mm high
Disc and Stem differential pressure design	10.8 kgf/cm² (including static head) Additionally, the gate assembly shall also be capable of withstanding, and opening and closing under a 1,524-mm (60”) diameter x 28,000-mm (92’-0” nominal) high coke column without any permanent deformation, distortion or bending of the gate assembly and its sliding plate.
Minimum Metal design temperature	0ºC Charpy V notch impact tested Average energy 54 J Minimum energy 47 J
Max delta pressure on the disc at closed position	10.8 kgf/cm² ~~(including static head)~~
Actuator sizing design pressure	3.0 kgf/cm² to open and atmospheric to close
Required valve opening/closing force	Vendor/Manufacturer shall inform the calculated required force, using a safety factor of 150% as a minimum, to specify the main hydraulic actuator. Consider the risk of jamming at the high operating temperatures or at thermal shocks and also the possible obstruction of the body due to large pieces of coke. The back-up hydraulic actuator shall be 100% redundancy
Actuator stroke speed (time to open)	2.0 minutes max.
Actuator stroke speed (time to close)	2.0 minutes max.
Operating cycle time	Every 18 t0 24 hrs

Top and Bottom Unheading Valves mechanical design conditions	
Valve design and construction code	ASME Code Sec VIII Div 1 latest Edition and Addenda
Seismic design	No
Wing loading design	Not required
Corrosion allowance	Valve body and flanges: 3.0 mm Internals: 1.5 mm each side
ASME stamp	Not required
External loads	Top valve Weight of drill-stem-guide/containment assembly and piping loads Bottom valve Weight of discharge chute, piping loads and reaction forces of spring hanger support
Stress and Fatigue analysis	Finite element analysis shall be performed to calculate the thermal distortion in order not have any biding of the valve disc or stem,

	according to ASME Sec VIII Div 2 using the allowable stresses from ASME Sec VIII Div 1, according to operating cycle during 30 years life time.
Ambient temperature range	Winter 10ºC to summer 80ºC
Minimum design metal temperature	0ºC Charpy V notch impact tested Average energy 54 J Minimum energy 47 J
Valves weight kgf	By Vendor/Manufacturer
Top and Bottom Unheading Valves construction materials according to ASME Sec II latest Edition and Addenda	
Pressure retaining parts: body, flanges and bonnets Casting Forgings Plates	 SA217 Gr C5 SA182 Gr. F5 SA387 Gr.11 Cl 1 overlaid with Inconel 625 (ERNiCrMo-3)
Flanges	SA182 Gr. F5 overlaid with Inconel 625 (ERNiCrMo-3).
Disc	SA182 Gr. F5 with both sides hard facing tugstenium carbide
Seats	SA182 Gr. F5 with both sides hard facing tugstenium carbide
Stem	SA182 Gr. F5 with hard facing tugstenium carbide
Guides	SA182 Gr. F5 with hard facing tugstenium carbide
Stem bushing	Nitronic 60
Internal and external bolts and nuts	SA193 Gr.B16 / SA194 Gr.4 SA 193 Gr.B5 / SA194 Gr.3
Washers	Cr-Mo low alloy
Stuffing box packing rings	J.C style 1625
Body and bonnet flange gaskets	Grooved metal gasket with covering layer type Kamprofile gasket 304 SS + flexible graphite cover, according to standard ASME B16.20 Metallic Gaskets for Pipe Flanges.

Notes**:**

a- External bolts shall be provided with Belleville springs to assure constant tight load during the high temperature operation.

b- All bolting shall be lubricated with molybdenum disulfide or equivalent, before assembly.

c- All bolting shall be enough extra length to apply a hydraulic bolt tensioner tool for tensioning. Hydraulic torque wrenches are not acceptable.

d- Vendor/Manufacturer shall supply one set of all required bolts, nuts, washers and gasket.

e- Material qualification

All plate, forgings and casting material J Factors (%Mn+%Si) x (%Sn+%P) x 10^4 shall not exceed 150.

All Cr-Mo plate, forging, casting and pipe materials shall be provided with qualification for a minimum of 3 (three) PWHT- Post Weld Heat Treatments cycles, one for fabrication, one for any repair and another for Client future maintenance works.

f- All mechanical properties, yielding stress, rupture stress, elongation and Charpy V notch impact tested at 0ºC shall be in accordance with ASME code.

g- Carbon steel parts are not permitted.

h- All the materials shall be fully documented by appropriate test certification.

i- Gasket area shall be coated with a deposit of minimum 12% Chrome measured 7.94-mm (5/16”) below the finished surface.

Top valve inlet and outlet flanges

Design and construction standard	ASME B16.47 Type A
Nominal diameter	36 in minimum
Pressure rating	300 class
Finishing face	Tongue & groove type facing with 32 RMS finishing at seats
Body and bonnet flange gaskets	Grooved metal gasket with covering layer type Kamprofile gasket 304 SS + flexible graphite cover, according to standard ASME B16.20 Metallic Gaskets for Pipe Flanges.
Top valve bonnets flanges	
Design and construction standard	ASME Sec VIII Div 1 Appendix 2
Nominal dimensions	By Vendor/Manufacturer
Pressure rating	According to the valve design conditions
Finishing face	Raised face type facing with 125 to 250 RMS finishing
Body and bonnet flange gaskets	Grooved metal gasket with covering layer type Kamprofile gasket 304 SS + flexible graphite cover, according to standard ASME B16.20 Metallic Gaskets for Pipe Flanges.

Bottom valve inlet and outlet flanges	
Design and construction standard	ASME B16.47 Type A
Nominal diameter	60 in minimum
Pressure rating	300 class
Finishing face	Tongue & groove type facing with 32 RMS finishing at seats
Body and bonnet flange gaskets	Grooved metal gasket with covering layer type Kamprofile gasket 304 SS + flexible graphite cover, according to standard ASME B16.20 Metallic Gaskets for Pipe Flanges.
Bottom valve bonnets flanges	
Design and construction standard	ASME Sec VIII Div 1 Appendix 2
Nominal dimensions	By Vendor/Manufacturer
Pressure rating	According to the valve design conditions
Finishing face	Raised face type facing with 125 to 250 RMS finishing
Body and bonnet flange gaskets	Grooved metal gasket with covering layer type Kamprofile gasket 304 SS + flexible graphite cover, according to standard ASME B16.20 Metallic Gaskets for Pipe Flanges.

Valves Auxiliary flanged connections	
Body vent nozzles; Body purge nozzles; Body seat purge nozzles; Body drainage nozzles; Ramming nozzle opposite of actuator side; Inspection openings on each side; Flushing water connections.	
Design and construction standard	ASME B16.5 welding neck type
Nominal diameter	4 in
Pressure rating	300 class
Flange finishing face	Raised face type facing with 125 to 250 RMS finishing
Flange gasket	Spiral-wound gasket metal windings 304 SS and flexible graphite HT (High Temperature) reinforced with Inconel yarns filler material, according to standard ASME B16.20.

12.2. **Conical transition spool piece**

Vendor/Manufacturer shall supply a flanged transition cone spool piece to connect the bottom valve to each Coke Drum bottom flange and long enough to contain the product inlet feed nozzles with 100 mm min distance between welds.

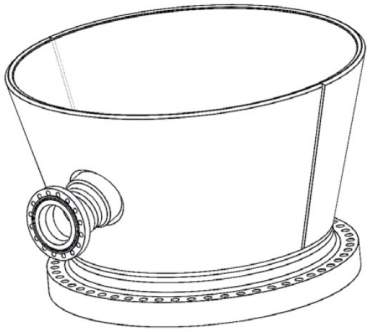
One end of the conical spool piece shall be welded to the conical bottom of the Coke Drum and the other end shall be flanged with 60 in nominal diameter to be connected to the Bottom unheading valve.

In case of existing Coke Drums, Vendor/Manufacturer shall supply the conical transition spool with both ends flanged, one end accordingly the bottom nozzle of the Coke Drum and the other end with 60 in nominal diameter to be connected to the Bottom unheading valve.

Flanged ends shall be tong & groove type facing and to use a grooved metal gasket with covering layer type Kamprofile gasket 304 SS + flexible graphite cover, according to standard ASME B16.20 Metallic Gaskets for Pipe Flanges.

The inlet feed nozzles shall be part of conical transition spool piece.

Vendor/Manufacturer shall supply one set of bolts, nuts, washers and gasket required for each flanged connection supplied.



Conical transition spool piece (from Delta Valve catalog)

http://www.deltavalve.com/wp-content/uploads/2015/12/Spool-Spec-Sheets_2015_sm.pdf

Inlet feed nozzles	
Design and construction standard	ASME B16.5 welding neck type
Nominal diameter	12 in (to be confirmed)
Pressure rating	300 class
Flange finishing face	Raised face type facing with 125 to 250 RMS finishing
Flange gasket	Spiral-wound gasket metal windings 304 SS and flexible graphite HT (High Temperature) reinforced with Inconel yarns filler material, according to standard ASME B16.20.

The design and construction of the transition piece shall be in accordance with ASME Code Sec VIII Div 1 latest Edition and Addenda, full radiographed and post welding heat treated.

The transition piece shall be equipped with two 12 in 300# RF (to be latter confirmed), located at 180 from each other and tangentially to the wall, in order to not allow the impingement on the opposite nozzle.

These nozzles shall be self-reinforced according to ASME Sec VIII Div 1 Fig UW-16.1 details f-1, f-2, f-3, f-4, to permit radiographable welds.

All internal wall of the transition piece and nozzles shall be 410 SS cladding or weld overlaid with Inconel 625 (ERNiCrMo-3).

Vendor/Manufacturer shall supply one set of all required bolts, nuts, washers and gasket.

Conical transition spool piece specification	
Coke Drum Tag No.	
Quantity	
Operating conditions	
Operating fluid	Coke residuum
Fluid characteristics	Feed composition:

	Contaminants: Sulfur: Nitrogen: TAN (Total Nitrogenic Acidity):
Fluid state	Liquid plus solid particles
Type of solids	Coke pieces of several shapes and weights
Coke physical properties	Bulk density (kgf/m³): 875 Hardness: Adherence to the wall:
Design conditions	
Design pressure kgf/cm²	10.8 (including static head)
Design temperature ºC	515
Minimum metal design temperature	0ºC Charpy V notch impact tested Average energy 54 J Minimum energy 47 J
Mechanical design	
Design and construction code	ASME Code Sec VIII Div 1 latest edition and Addenda
Fatigue analysis	Finite element analysis shall be performed to calculate the thermal distortion in order not have any biding of the valve disc or stem, according to ASME Sec VIII Div 2 using the allowable stresses from ASME Sec VIII Div 1, according to operating cycle during 30 years life time.
Seismic design	No
Wind loading	Not required
ASME stamp	Not required
Fatigue analysis	According to ASME Sec VIII Div 2 using the allowable stresses from ASME Sec VIII Div 1, according to operating cycle during 20 years life time.
External loads	Weight of Bottom valve and discharge chute, piping loads and reaction forces of spring hanger support
Inlet flange	Nominal diameter: Construction standard: Pressure rating: Facing and finishing;
Outlet flange	Nominal diameter: Construction standard: Pressure rating: Facing and finishing;
Feed inlet flanges	Nominal diameter: Construction standard: Pressure rating: Facing and finishing;
Total weight kgf	By Vendor/Manufacturer

Conical transition spool piece construction materials according to ASME Sec II latest Edition and Addenda	
Pressure retaining parts: body and end flanges • Forgings • Plates	 SA182 Gr. F5 overlaid with Inconel 625 (ERNiCrMo-3) SA387 Gr F5 cladded with stainless steel 410 S or overlaid

	with Inconel 625 (ERNiCrMo-3)
End flanges	SA182 Gr. F5 overlaid with Inconel 625 (ERNiCrMo-3)
Feed inlet nozzles	SA182 Gr F5 overlaid with Inconel 625 (ERNiCrMo-3)
Internal and external bolts and nuts	SA193 Gr.B16/ SA194 Gr. 4 SA 193 Gr.B5 / SA194 Gr.3
Washers	Cr- Mo low alloy
Flange gaskets	Grooved metal gasket with covering layer type Kamprofile gasket 304 SS + flexible graphite cover, according to standard ASME B16.20 Metallic Gaskets for Pipe Flanges.

Notes**:**

a. External bolts shall be provided with Belleville springs to assure constant tight load during the high temperature operation.

b- All bolting shall be lubricated with molybdenum disulfide or equivalent, before assembly.

c- All bolting shall be enough extra length to apply a hydraulic bolt tensioner tool for tensioning. Hydraulic torque wrenches are not acceptable.

d- Vendor/Manufacturer shall supply one set of all required bolts, nuts, washers and gasket.

e- Material qualification

All plate, forgings and casting material J Factors (%Mn+%Si) x (%Sn+%P) x 10^4 shall not exceed 150.

All Cr-Mo plate, forging, casting and pipe materials shall be provided with qualification for a minimum of 3 (three) PWHT- Post Weld Heat Treatments cycles, one for fabrication, one for any repair and another for Client future maintenance works.

f- All mechanical properties, yielding stress, rupture stress, elongation and Charpy V notch impact tested at 0ºC shall be in accordance with ASME code.

g- Carbon steel parts are not permitted.

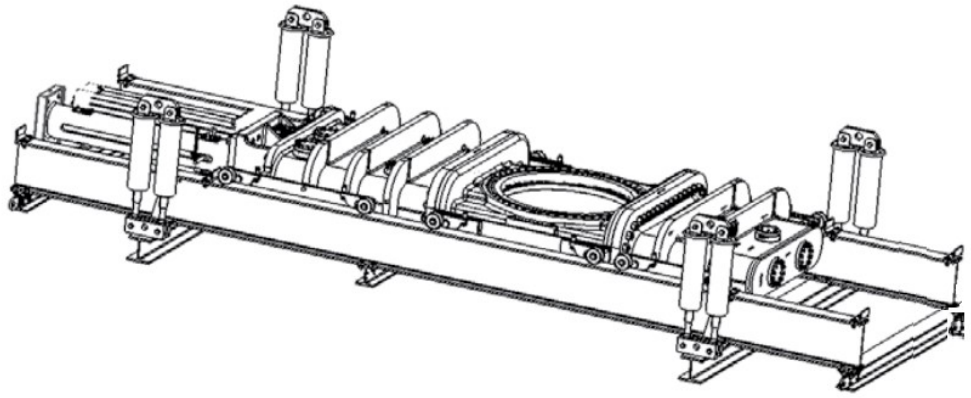
h- All the materials shall be fully documented by appropriate test certification.

i- Gasket area shall be coated with a deposit of minimum 12% Chrome measured 7.94-mm (5/16") below the finished surface.

13. Bottom valve support and maintenance device

13.1. **Arrangement**

The Bottom valve support and maintenance device consist mainly of a structure with a envelope of beams, (4) four trolleys for allowing easy valve movement, and at minimum (5) five spring hangers (four for the valve itself and one for the actuator, as well as the required rods and clevis fasteners. The purpose is to support the Bottom unheading valve, in order to minimize the loading on the Coke Drum bottom flange and include provisions to lower the valve when disconnected from the Coke Drum and to move the valve to an accessible position to easy the maintenance works, without leave the support beam envelope.



Bottom unheading valve support and maintenance system

Delta Valve catalog http://www.deltavalve.com/wp-content/uploads/2015/12/Glide-Spec-Sheets_2015_sm.pdf

13.2. **Structural design and fabrication**

13.2.1. Valve support and maintenance device design shall consider minimum loading impact on Coke

Drum bottom flange with the following loads:

- Valve self weight;

- Coking process loading: coke equivalent density 875 kgf/m³ totally full drum condition;
- Transition spool piece weight;
- Coke discharge chute.

13.2.2. The resultant local loading on the Coke Drum structure shall be informed to the Manufacturer
Coke Drum analysis.

13.2.3. Structural design, detailing drawings and fabrication shall be in accordance with ASCE 7-98-
Minimum Design Loads for Buildings and Other Structures,
Supply a 3D drawing for the supporting structure.

13.2.4. The equipment shall be structurally designed to operate in a maximum wind per Project Specification. The wind shall be combined with the dead load plus the live load.

13.2.5. Welding between structural parts:

a. Welding of the various structural components of the supports shall be per AWS D1.1 Structural Welding Code— Steel (does not apply to attachments to pressure parts).
b. Fabricator's welding specifications and procedures with weld map drawings shall be submitted for review.

14. Fabrication, inspection and testing

14.1. Fabrication and Tolerances

14.1.1. Tolerances for dimensions, orientations, and other design details shall be reviewed and approved by Client prior to the start of fabrication. Out-of-Roundness of the body flange neck shall not exceed 0.5%. Body flange neck to bottom cone plate mismatch at any point shall not exceed 1/16 of the plate thickness.

14.1.2. Forgings 50.8-mm (2") thick and greater shall be ultrasonically examined in accordance with
ASME SA388. Indications requiring recording per ASME SA388 shall be considered unacceptable. A 100% scan shall be used.

14.1.3. Vendor/Manufacturer shall prepare the Inspection and Test Plan, with all activities of fabrication
and inspection, including qualification procedures, to be verified and approved by Client, before beginning of manufacturing.

14.2. Pre-heating and Welding

14.2.1. All welding procedures shall be qualified according to the ASME Boiler and Pressure Vessel
Code, Section IX.
All procedures the Vendor/Manufacturer intends to use shall be qualified prior to the start of actual fabrication and procedure specifications, addressing all variables shall be submitted to the Client for review.
The welding procedures shall be qualified for a minimum of three PWHT cycles: for fabrication, any repair and one extra for Client uses.

14.2.2. Production welding shall strictly adhere to the qualified welding procedure parameters.

14.2.3. All pressure containing weld metal "X-Bar" factor (10P+5Sb+4Sn+As)/100 shall not exceed 15.

14.2.4. Welding parameters for production welding shall be within the following ranges relating to procedure qualification record unless otherwise specified.
a. Amps -15% to + 15%
b. Volts -10% to +10%
c. Travel Speed (Run out lengths) + 5% to -15%.

14.2.5. Downhill welding is prohibited.

14.2.6. Butt joints shall be welded from both sides, where possible, giving due consideration to welding
sequence and welding parameters for the control of distortion.

14.2.7. Straightening or bending methods, with or without the application of heat shall be agreed previously with Client in writing.

14.2.8. Weld Root Penetration
a. Unless otherwise agreed to in writing, all root beads shall be full penetration.

b. Root passes shall be fully fused on both edges and the depth of penetration shall be from flush to maximum plus 1.5mm.
c. Unfilled, unfused or concave welds are unacceptable.

14.2.9. All grinding shall be done with the correct type of disc for the material.
Grinding wheels and disks shall be dedicated to each material group so that disks used on Carbon and Carbon Alloy steels shall ONLY be used on those materials and not on Stainless or High Alloy steels.

14.2.10. Overlay shall be cut back by mechanical means or arc gouging and overlaid in all locations,
where plates are intended to be welded and dye penetrant tested.

14.2.11. Carbon arc gouge may be used as a de-seaming tool. All dross produced by the carbon arc
cutting or gouging shall be removed and the surfaces ground back 2mm prior to subsequent welding. Edges of 1 percent Cr. Mo. and higher alloy materials shall be magnetic particle or dye penetrant examined and any cracks removed.

14.2.12. Welding arc strike is any inadvertent contact outside the intended welding area between the
electrode, wire, etc., and the item being welded that results in arcing and creation of a surface defect. The resulting surface defects are considered serious detrimental defects and as such are unacceptable.
a. The Client requires that all welding arc strikes be non-destructively inspected.
b. Any cracks are to be ground out or removed by an approved means, the cavity filled with weld metal, the area re-inspected, and then finished to a contour the same as the original surface or by grinding only if grinding reduces the wall thickness by less than 1/16”.
c. All other weld arc strikes are to be repaired. They may be repaired by prepping, filling with weld metal and then blend grinding back to the original surface contour, or, if the metal loss can be proven not to be detrimental to the design, the weld arc strike may be blend ground to remove all sharp edges or ridges until smooth contoured surface results.
d. All repairs shall be MPT or LPT examined.

14.2.13. Preheating of all welded joints shall be in a minimum of 200°F for P-4 materials and 100°F for
P-1 materials.

14.2.14. Preheat shall be maintained until completion of the weldment. If the preheat is lost or lowered
for any reason, magnetic particle examination of the incomplete portion of the weld and interface with any completed portion is required. This examination shall be documented and submitted as part of the Final Data Package.

14.2.15. Fit up and Finishing Welds

a. All internal surfaces are to be ground flush for increased fatigue resistance.
b. Pressure containing welds are to be ground flush on the inside surface, to allow the finished overlay weld to remain flush and the same thickness as the overlay.

14.3. **Post Welding Heat Treatment - PWHT**

14.3.1. The valves and transition spool piece shall have the PWHT-Post Welding Heat Treatment, as
required by the Division 1 of ASME Code Section VIII or as required by the steel maker, whichever is the most restrictive.
Three PWHT cycles (one for fabrication, one for any repair and one extra for Client) shall be qualified to assure the mechanical properties of the materials to be heat treated.

14.3.2. The total number of hours spent in all PWHT shall be reported.

14.3.3. For 1¼Cr-½Mo the recommended range of PWHT temperature shall be in the range 680~720°C, the target temperature being 690°C and PWHT conditions, heating and cooling rates, and hold time shall be according ASME code.

14.3.4. The manufacturer shall obtain Client written approval of PWHT procedures prior to setting up
the qualified welding procedure.

14.3.5. Full details of the post weld heat treatment shall be submitted for Client’s review including
overall arrangement details of all heater controls, thermocouple layout and attachment and calibration certificates.

14.3.6. This heat treatment procedure shall state:

a- Temperature range;
b- Holding time;
c- Heating and cooling rates;
d- Number and location of thermocouples;
e- Calibration of thermocouple;
f- Furnace type;
g- Extent of heat treatment/sequences.

14.3.7. The Vendor/Manufacture shall prepare a report with the results after the PWHT and guarantee the final hardness and mechanical properties.

14.3.8. The seating surfaces of the flanges shall be machined after PWHT.

14.3.9. The internal overlaid surfaces of the valves and transition spool piece shall be machined and checked with a portable alloy analyzer and shall meet the minimum ERNiCrMo-3 chemistry.
Finished overlaid surfaces shall be 100% inspected using LPT. Surfaces shall be free of all linear indications and shall be free of porosity, slag, pinholes or gas pockets exceeding 1.6-mm (1/16”).
The overlay shall be 1/8” minimum thick after machining.
ERNiCrMo-3 filler metal shall be used for overlay restoration at plate welds, weld overlay for flanges and nozzles, and cone plate weld overlay.
The resultant weld shall be austenitic in structure and deposit shall have a minimum 12% Chrome measured 1.6-mm (1/16”) below the finished surface.

14.3.10. Weld overlay in the nozzle and other weld overlay areas not specifically requiring machining may be left in the as-welded condition. All weld overlays shall be 100% inspected using LPT.

14.3.11. Any procedure to correct for distortion after post weld heat treatment shall be approved by the Client.

15. Testing and inspection requirements for valves and transition spool piece

15.1. **Testings**

15.1.1. All tests shall be in accordance with applicable construction code.

15.1.2. The following tests shall be done to qualify the raw material and the Welding Qualification Process on test coupons having received a Simulated Stress Relief according to following table:

- Tension Tests
- Hardness Tests
- Impact Tests

Condition	Impact Test at the required minimum temperature	Tension Test at room and design temperature	Hardness
SSR - Simulated Stress Relief	After maximum SSR	After minimum and maximum SSR	After minimum SSR

Notes:

a- Maximum SSR: Refer to the simulated post welding heat treatment PWHT of the specimens including all fabrication PWHT plus 1 (one) for Client purposes.

b- Minimum SSR: Refer to the simulated post welding heat treatment PWHT of the specimens considering only the PWHT necessary to the fabrication

The Vendor/Manufacturer shall provide a report showing that raw material and the Welding Qualification Process is qualified considering all tests required below.

a. Tension tests

Tensile testing shall be carried out in accordance with ASTM A370.
Yield and tensile strength properties shall be evaluated at room and design temperature.

Test specimens shall meet the values required by ASME Section II Part D, at room and design temperatures, according to minimum values listed in Tables Y-1 and U.
At design temperature tensile strength values shall not be less than “0.9 x tabulated values”.

b. Impact tests

Impact testing shall be carried out in accordance with ASTM A370.
Tests shall be conducted at 0°C with the average value of 40 ft·lb (55J) without individual value below 35 ft·lb (47J).

c. Hardness tests

Hardness testing shall be carried out in accordance with ASTM A370.

- Spot hardness measurements shall be performed and recorded after heat treatment.

Hardness tests shall be performed by Telebrinell hardness tester method, after post weld heat treatment, on all pressure containing parts and weldments.
Such test can be done using a calibrated portable hardness tester, except EQUOTIP type.
The calibration must be done at same base material that is being tested.
Indentations formed by the hardness tests shall be removed by flush grinding.

- Hardness test frequency shall be as follows:

- Circumferential weld seams, test locations shall be 45° apart.
- Nozzle weldments shall be hardness checked at two locations at 180° apart.
- Longitudinal weld seams, 2 tests per seam minimum, 10 feet apart, maximum.
- For weld metal, three (3) hardness readings shall be taken at each location: one at the center of the weld and one on each weld heat-affected zone. The heat-affected zone is defined as the zone of the base metal affected by the heat of input of welding, running adjacent and parallel to each side of the weld seam.
- At any location, there will be three (3) hardness readings recorded. All three of these readings shall be less than 225 HB.
- Failure of any single reading to meet these permissible hardnesses will result in rejection of the entire weld or part. Parts or welds that are rejected shall be removed, rewelded and shall be retested as specified to establish that the hardness does not exceed the specified limit.

15.1.3. Hydrostatic test pressure

Vendor/Manufacturer shall execute a shop hydrotest of each completely assembled Unheading Valves and transition spool piece prior to shipment.
Vendor/Manufacturer shall hydrotest the equipments in the presence and satisfaction of Client’s Inspector.
Coating shall not be applied to the welds prior to hydrostatic testing.
Before hydrostatic test, the valve and transition spool piece shall be cleaned internally and externally of any kind of dirt, debris, welding slag, weld spatter, coating, grease and foreign material.
The required metal temperature throughout the hydrotest shall be established by the Vendor/Manufacturer to comply with Code and to ensure the safety of the equipment, but shall not be less than +30ºF above the impact test temperature as established from Clause UCS-66 of the ASME VIII Division 1 Code or test water shall be 20°C, the warmer.
Service bolting and gaskets used for the hydrostatic test shall be of the type required for the design conditions.
Vendor/Manufacturer shall conduct a hydrostatic pressure test in accordance with the requirements of ASME Code VIII Division 1 paragraph UG-99(c) after the completion of fabrication and all NDE-Non Destructive Examinations.
The test pressure shall be 1.5 times the MAWP-Maximum Allowable Working Pressure for new and cold condition calculated for the limiting component.
During the hydrostatic test, at least one manometer shall be recording type.
Vendor/Manufacturer shall provide access to all pressure-containing welds and test blinds.
The test shall be held until all pressure-containing welds and flanged nozzles can be visually inspected after the hold time. The minimum hold time shall be 2 hours.
The water to be used in hydrostatic test shall have chloride content limited to less than 30 ppm.
When stainless steels are used, the testing medium should be dematerialized water passivated as follows:
• 300 Series:
− Equipment operating at a temperature less than 175°F: A solution made up of low chloride water containing 1% soda ash by weight.

− Equipment operating at a temperature above 175°F: A solution made up of low chloride water containing 1% soda ash and 0.5% sodium nitrate by weight.
• 400 Series: A solution made up of low chloride water containing 1% soda ash by weight.
On completion of the hydrostatic testing all equipment shall be thoroughly drained and dried.
The method of drying shall be submitted to the Client's prior review.

15.1.4. Leak test

Vendor/Manufacturer shall carry out a shop leak test of each completely assembled Unheading Valves and transition spool piece prior to shipment.
Leak test shall be executed in the presence and satisfaction of Client's Inspector.
Leak test shall be performed following a written procedure, with previous Client approval, complying with the applicable technical requirements of ASME Section V, Article 10 for the leak test method.
Leak testing personnel shall be qualified and certified as required by ASME Section V, Article 1, T-120(e)(2).

15.1.5. Functional test

a. Vendor/Manufacturer shall execute the shop functional test of all pneumatic, hydraulic and electric devices to verify proper operation. The Vendor/Manufacturer to provide a test procedure for review by Client.
b. The hydraulic power unit and top and bottom unheading valves shall be fully assembled and all components wired and tested without load in the Vendor/Manufacturer's shop.
c. The Client will witness a shop functional test of all electrical equipment and controls.
d. After testing, if approved, it shall be marked and dismantled only to the extent required for shipment.
e. The final functional acceptance test will be carried out at Plant site during commissioning and start-up, based on a mutually agreed test procedure developed by the Vendor/Manufacturer.
f. Noise levels shall be calculated at a location 1 (one) meter downstream from the valve external surface, and max noise level to 85 dBA.

15.2. **Inspection general requirements**

15.2.1. All NDE-Non-Destructive Examinations shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section V.

15.2.2. All NDE procedures shall be qualified and certified by:

a- A Level III inspector qualified and certified by an independent international agency operating in conformity with the standard ISO 9712-Non-destructive testing-Qualification and certification of NDT personnel; or,

b- A Level III inspector qualified and certified by the SNQC-END-Sistema Nacional de Qualificação e Certificação de Pessoal em Ensaios Não Destrutivos of ABENDI- Associação Brasileira de Ensaios Não Destrutivos e Inspeção.

15.2.3. All personnel from manufacturer's NDE inspectors shall be:

a- Qualified by an independent international agency operating in conformity with the standard ISO 9712; or,

b- Qualified by the SNQC-END of ABENDI, in conformity with the NA-001-Qualificação e Certificação de Pessoas em Ensaios Não Destrutivos and DC-001 Requisitos de treinamento standards; or,

c- Qualified by ASNT-American Society for Nondestructive Testing, for Level II personnel, only inspectors qualified through the ACCP-ASNT Central Certification Program and ASNT CP-189 ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel.

Notes:

Level I qualified personnels are only qualified to perform specific calibration activities, examinations or evaluation that has written instructions to perform. The responsibility level of these NDT personnels is very low.

Level II personnels are qualified to interpret and evaluate the results of a testing and they can setup and calibrate testing equipment. Level II technicians have more responsibilities and they are supposed to come up with the written instructions and on the job training of Level I technicians.

Level III technicians are eligible to interpret the NDT codes and design the testing methods and techniques to be used in an inspection. Level III personnel also have the responsibility to train the Level I and level II personnels.

15.2.4. All weld repairs shall be fully documented and the documents shall be supplied to Client.

15.2.5. The following inspection points are mandatory and shall be incorporated into the Vendor/Manufacturer's Inspection and Test Plan, among other manufacturing inspection activities:

a- Review of material test certificates and calibration tests certificates of control instrumentation.
b- Verification to material conformity to approved drawings, visual and dimensional check.
c- Dye penetrant check on all seam welds of the hydraulic oil tank.
d- Pressure piping fabrication and testing.
e- Running test/simulation tests and verification of the security.
f- Inspection of hydraulic oil tank and piping for cleanliness.

15.2.6. Any item of equipment or the whole system, as applicable, subject to inspection by local authorities, shall be subjected to such inspection at the care of the Vendor/Manufacturer.

15.2.7. Upon completion of inspection, the Vendor/Manufacturer must supply the following data prior to issuance of the release notice:

a- Material test certificates
b- Hydraulic Pressure Chart
c- Hydrostatic test certificates
d- Oil tank dye-penetrant test certificate
e- Calibration test certificate of control instrumentation
f- Works test report unit presented showing simulating running test of securities
g- ASME Code Manufacturer's Data Book.

Table 7.5
NDE Techniques, Method, Characterization, Acceptance Criteria

NDT Technique	Method	Paragraph Reference for Characterization and Acceptance Criteria
Visual examination (VT)	...	7.5.2
Radiographic examination (RT)	Section V, Article 2	7.5.3
Ultrasonic examination(UT)	Section V, Article 4	7.5.4
Ultrasonic examination (when used in lieu of RT) [Note (1)]	Section V, Article 4 and 7.5.5	7.5.5
Magnetic particle examination (MT)	Section V, Article 7	7.5.6
Liquid penetrant examination (PT)	Section V, Article 6	7.5.7
Eddy current examination (ET)	7.5.8	7.5.8

NOTE:
(1) For SAW welds in $2\frac{1}{4}$Cr-1Mo-$\frac{1}{4}$V vessels, ultrasonic examination in accordance with 7.5.4.1(e) is required.

From ASME Code Section VIII Division 2

15.3. **Visual Inspection - VT**

15.3.1. All welds shall be visually inspected for flaws and shall be assessed for suitability against the acceptance criteria of the application code.

15.3.2. VT shall be performed in accordance with ASME Code Section V Article 9 and ASME Code Section VIII, Division 2 part 7.5.2 and paragraph 7.5.2.2 for acceptance criteria.

15.3.3. Intermediate weld passes may be visually inspected at the option of Client representative. If the weld has an unworkmanlike appearance, the inspector may require additional inspection to be performed.

15.3.4. Visual inspection must be carried out under adequate lighting conditions.

15.3.5. Surface texture symbols specified for flange faces and other surfaces are in accordance with those designated in ASME Y14.36- Surface Texture Symbols.

15.3.6. Surface texture shall be produced and measured in accordance with ASME B46.1- Surface Texture (Roughness, Waviness, Lay).

15.3.7. Tolerances for dimensions, nozzle and manhole locations and orientations, and other design details shall be reviewed and approved by Client prior to the start of fabrication.

15.4. **Radiographic Examination - RT**

15.4.1. All pressure retaining butt welds shall be fully radiographed according to ASME Code Sec VIII
Div 1.

15.4.2. RT shall be performed in accordance with ASME Code Section V Article 2 and ASME Code
Section VIII, Division 2 part 7.5.3 and paragraph 7.5.3.2 for acceptance criteria.

15.4.3. All weld nozzle to shell or head shall be fully RT examined and UT Phased Array on all finished fillet welds for nozzles and manholes.

15.4.4. The use of film types I or II shall be agreed with the Client, according to ASTM E 242- Standard Reference Radiographs for Appearances of Radiographic Images as Certain Parameters are Changed

15.4.5. Acceptance standard for radiography shall be based on the ability to see the essential hole or
wire required to the penetrameter, as indicated by the Article 2 of ASME Code Section V, as well to attempt the density requirements.

15.4.6. Radiographic examination of welds shall be performed in accordance with a written procedure, which shall be submitted to Client for review prior to commencement of fabrication. The procedure shall include as a minimum:

(1) Test Standard e.g., ASME Code Section V
(2) Technique
(3) Film type
(4) Radiation source
(5) Intensifying screens
(6) I.Q.I. type and position
(7) Acceptance criteria
(8) Coverage

15.4.7. Composite viewing is not permitted.

15.4.8. Category A, B, C and D welds shall be 100% radiographically examined before and after final post weld heat treatment. The acceptance criteria shall be in accordance with ASME Code VIII Division 1 with the exception that the weld porosity-rounded indications acceptance criteria shall be as defined for ¼" to 3/8" thick plate instead of that defined for ¾" to 2" plate. Any crack and incomplete fusion or penetration is unacceptable.

15.4.9. All major weld repairs (defined as greater than 3/8 inch or 10% of the thickness in depth, whichever is less) shall be radiographed or examined by a Client agreed ultrasonic volumetric method.

15.5. **Ultrasonic Examination - UT**

15.5.1. All pressure retaining base metal welds shall be fully examined by using both angle-beam
method and straight-beam method.
All surfaces to be UT examined shall be previously machined.

15.5.2. UT shall be performed in accordance with ASME Code Section V Article 4 and ASME Code
Section VIII, Division 2 part 7.5.4 and paragraph 7.5.4.2 for acceptance criteria.

15.5.3. UT shall be carried out before and after PWHT as well as after hydrostatic testing.

15.5.4. Final acceptance shall be based upon the UT after hydrostatic testing.

15.5.5. During fabrication, scanning shall be made from inside and outside.

15.5.6. The test and inspection plan shall include a 100% UT examination of all major load bearing
attachments (support cleats, hinges, etc.).

15.5.7. Clad or Overlay Welds

a. After cladding or weld overlay, the plate shall be 100% tested according to ASME Code Section V, Article 4 Paragraph T-465.2, Technique two Scanning
b. UT examination on cladded or weld overlaid weldments shall be carried out on 100% area before PWHT and after PWHT, using as acceptance criteria ASME SA578 S7 Standard Specification for Straight-Beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications

15.5.8. Ultrasonic examination of welds shall be performed in accordance with a written procedure,

which shall be submitted to Client for review prior to commencement of fabrication. The test methods shall comply as a minimum with standard referenced in the design code. The procedure shall include as a minimum:

(1) Test Standard e.g., ASME Code Section V
(2) Sensitivity levels
(3) Surface condition
(4) Scanning limits
(5) Scanning sensitivity
(6) Evaluation levels
(7) Reporting levels
(8) Test restrictions

15.5.9. Equipment shall be Pulse Echo; capable of high resolution 'A Scan' display, with a minimum amplifier bandwidth of 1 - 5 MHz. Screen uprate must be sufficient to allow continuous smooth scanning.

15.5.10. Other techniques such as Ultrasonic testing B Scan or TOFD- Time Of Flight Diffraction, for example, may be considered provided that their sensitivity and resolution can be demonstrated to the satisfaction of Client inspector.

15.5.11. The equipment shall be subject to calibration control and shall conform to the linearity requirements of ASME V as a minimum. Calibration Blocks shall be certificated and maintained in good condition. Routine probe and calibration checks shall be carried out in order to demonstrate consistency of results.

15.5.12. Ultrasonic evaluation of all nozzle attachment welds is required.

15.5.13. As an alternate to radiography after PWHT Category A, B, C and D weld joints may be 100% ultrasonically examined after final post weld heat treatment by a Client approved volumetric UT examination method.

15.6. **Magnetic Particle Inspection - MT**

15.6.1. MT examination is required on 100% of external and internal surfaces of forming plates, including bevels sides (borders) according to ASTM E709 Standard Guide for Magnetic Particle Testing, by manufacturer.

15.6.2. Plate edges and cut edges of nozzle openings prior to welding shall be inspected for lamination and/or injurious segregation detection in accordance with ASTM E 709 Standard Guide for Magnetic Particle Testing

15.6.3. No repair by welding will be permitted without full metallurgical investigation and Client representative acceptance.

15.6.4. All pressure retaining welds shall be examined before and after the PWHT and after hydrostatic testing (both sides wherever possible).

15.6.5. The inner faces of completed welds for pressure retaining joints shall be examined prior to overlay welding.

15.6.6. Non pressure attachment welds, shall be examined before and after PWHT. Attention shall be drawn to the temporary attachment areas which shall be located and MT tested as well.

15.6.7. After each magnetic particle test, the entire surface examined shall receive immediately a post cleaning treatment to remove any test residues.

15.6.8. Magnetizing and inspection medium systems:

a) AC yoke with wet fluorescent powder for inner surface (base weld metal);
b) AC yoke and wet contrast powder on all the external surfaces.

15.6.9. MT shall be performed in accordance with ASME Code Section V Article 7 and ASME Code Section VIII, Division 2 part 7.5.6 and paragraph 7.5.6.2 for acceptance criteria.

15.6.10. Magnetic Particle Inspection of welds shall be performed in accordance with a written procedure, which shall be submitted to Client for review prior to commencement of fabrication. The test methods shall comply as a minimum with the standard referenced in the design code. The procedure shall include as a minimum:

(1) Test Standard e.g., ASME Code Section V

(2) Magnetizing method
(3) Surface condition
(4) Technique
(5) Lighting conditions

15.6.11. Magnetic particle testing shall be carried out after final heat treatment on all non-austenitic nozzle attachments and seam welds. Magnetic particle examinations shall be made in accordance with the ASME Code. All prod burns shall be removed by grinding.

15.6.12. All plate weld bevels and stripped back areas shall receive a magnetic particle examination prior to welding or overlaying. Grinding or chipping shall remove all indications of linear flaws, and the area shall be re-examined to assure satisfactory removal of the flaw. Repairs shall be made with a welding procedure qualified in accordance with Project Specification.

15.6.13. After completion of post weld heat treatment, all Category A, B, C, and D welds shall be magnetic particle examined and also after hydrostatic testing.

15.6.14. All welded root areas shall receive a magnetic particle examination after back gouging or back chipping.

15.6.15. All external attachment welds shall receive a magnetic particle examination after completion of welding and after post weld heat treatment.

15.6.16. All surfaces where temporary attachments have been removed shall receive a magnetic particle examination after grinding. Temporary attachments shall not be removed by hammering or gouging.

15.6.17. All repairs shall be magnetic particle examined after completion of the repair.

15.7. **Liquid Penetrant Examination - PT**

15.7.1. The entire surface of the clad or weld overlay shall be checked after the deposition and after the PWHT.

15.7.2. PT shall be performed in accordance with ASME Code Section V Article 6 and ASME Code Section VIII, Division 2 part 7.5.7 and paragraph 7.5.7.2 for acceptance criteria and the surface shall be free of cracks.

15.7.3. When local repair by welding is required after defect removal, the completed repair weld shall be reinspected by dye penetrate examination.

15.7.4. After each penetrate test, the entire surface examined shall receive immediately a post cleaning treatment to remove penetrate test residues.

15.7.5. Liquid Penetrant Examination of welds shall be performed in accordance with a written procedure, which shall be submitted to Client for review prior to commencement of fabrication.

15.7.6. For multiple-layer weld overlay or back cladding the first layer of weld overlay shall be examined by liquid penetrant methods.

15.7.7. All back cladded surfaces, weld overlaid surfaces and flange-seating surfaces shall be examined by liquid penetrant methods after post weld heat treatment.

15.7.8. Liquid penetrant examinations may replace magnetic particle examinations where it is not practical to use MT because of surface geometry, with Client acceptance in writing.

15.7.9. Dye penetrant tests shall be carried out at all weld overlay locations at seams and nozzles.

15.7.10. Maximum content of chlorides 10 ppm in the solution.

15.8. **Cladded welds and weld overlay inspection**

Back cladded welds and overlay welding shall be checked for chemical composition at a depth of 1/16” from the overlay surface. The frequency of the weld samples shall be as follows:

a) Weld Seams 2 samples each seam
b) Nozzle Attachments 1 sample each nozzle
c) Nozzle Bores 1 sample 6” from each end
d) Face of Flanges 1 sample each flange

15.9. **Chemical analysis “in situ” or PMI – Positive Metal Identification**

15.9.1. Positive Material Identification is required for all pressure parts, cladding and clad restoration weldments in accordance with Project Specification.

15.9.2. During fabrication and on completed or assembled parts of the valve, a spot qualitative chemical analysis shall be performed.

15.9.3. It is recommended for PMI check the equipment NITON model Infiniton XLi 818 Portable Alloy Analyzer (source Americium).

15.9.4. Such positive alloy material identification shall be made by qualified operators.

15.9.5. All tests and their results shall be documented and certified on the report. A sketch shall be attached to the report. Indicating the number and location of readings and the report shall be traceable to the material’s CMTR-Certified Material Test Report.

15.9.6. If a non-conformity is observed, samples for chemical analysis shall be taken and the results of this analysis shall govern.

16. Painting and Coatings

16.1. The unheading valves systems and transition spool piece shall be coated in accordance with the Vendor/Manufacturer’s standard.

16.2. Purchased items, such as, motors, gear reducers and off-the-shelf ancillary components, such as, electrical devices, controllers, filters etc., may be painted per manufacturer’s standards practices suitable for the specified ambient and operating conditions and are pre-agreed by Client in writing.

16.3. All passive fire protection coatings shall be applied in accordance with item 4.2.49 Fireproofing protection of this specification.

17. Cleaning

17.1. After hydrostatic pressure test, the valve and transition spool piece shall be completely drained, dried and perfectly cleaned and free from all foreign material, including oil and grease deposits.

17.2. After hydrostatic testing, the valves and transition spool piece shall be pressurized at 0.5 kgf/cm²g nitrogen pressure, with silica gel installed.

17.3. Silica gel bag must be hanged without contact with the valve and transition spool piece walls.

17.4. Solid metal gaskets, bolting and all flange faces shall be coated with grease for shipment.

17.5. The valve and transition spool piece shall be sealed with neoprene gaskets and steel bolted flanges, with 15 mm of minimum thickness.

17.6. Each valve and transition spool piece to be fitted with one ball valves and a waterproof pressure gauge to be checked in transit.

17.7. The manometer shall have to be periodically verified at site.

18. Equipment Tagging

18.1. All valves and transition spool piece parts, including actuator and High Pressure Control Unit and the valve support system as well as the spare parts shall be prepared with seaworthy export packing.

18.2. An austenitic stainless steel nameplate shall be mounted on the front of each valve and transition spool piece in a readily accessible location and seal welded to a steel bracket, with adequate projection to keep the nameplate from being covered with insulation. The nameplate shall contain the following information:

a. Manufacturer’s name and model/serial number
b. Manufacturing year
c. Purchase order number
d. Client name
e. Design and construction code
f. Design conditions
g. Hydrostatic test pressure (corroded and hot)
h. Client’s equipment tag number
i. Other pertinent informations.

18.3. Name tags for purchased equipments, such as motors, instruments, gear reducers, couplings, etc., shall be stainless construction and shall include the Client’s equipment tag number as a minimum.

19. Packaging, Preparation for Shipment and Handling

19.1. Equipment shall be assembled and wired in Vendor/Manufacturer's shop, match-marked and dismantled to the extent required for shipment. Machined surfaces shall be suitably protected against corrosion. Small pieces shall be boxed for shipment. Boxes shall be numbered and clearly marked for positive identification in the field in accordance with Vendor/Manufacturer's shipping procedure.

19.2. All equipment bases shall be firmly fixed to their structural framing. All equipment shall be of sufficient strength and rigidity for normal handling. This includes rail or truck or ship and job site handling. If required, the Vendor/Manufacturer shall install at the factory adequate permanent braces, struts, or lifting lugs to permit handling at the job site with conventional slings or hooks without damage to the equipment. All equipment shall be properly prepared before crating or packaging including the covering of all openings to protect them from abuse encountered during shipping, trucking, ocean freight, jobsite handling and storage. Small, easily broken parts shall be removed, packed in sealed separate containers, and tagged to avoid damage and loss during shipment and storage. Reassembly instructions shall be included.

19.3. The tipping-up of a piece of equipment for a lift is one example where additional bracing may be required.

19.4. All machine surfaces shall be protected from rust, corrosion, and damage. Upon arrival in the field, the unit will be stored in an open field for a period up to six months. All interior surfaces of the reservoirs, tanks, coolers, filters, gear boxes, pumps, etc., which are normally in contact with lubricating or seal oils shall be carefully coated with suitable rust preventive that can be easily flushed out by a solvent when placed into operation.

19.5. Vendor/Manufacturer's equipments shall be protected in accordance with the manufacturer's standard practice. Vendor/Manufacturer shall provide lifting and handling instructions.

19.6. All equipment/material subjected to Positive Material Identification shall have a copy of the PMI certificate included in the packaging for verification at receipt on site.

19.7. All loose equipment shall be packed in shipping crates or cartons suitable for shipment.

20. Shipping

20.1. The equipment shall be shipped as completely assembled as possible and practical to conform to shipping practices and regulations for this type of equipment. The Vendor/Manufacturer shall provide a description of his normal shipping practices to Client for review.

20.2. The Vendor/Manufacturer shall be responsible for all works necessary to prepare, handle, load/unload and transport materials.

20.3. Whenever possible, wiring and conduit shall be left in place during shipment.

21. Training

Instruction and hands-on training of plant personnel in the operation and maintenance of the Unheading Valves systems are required at Plant site.

22. Fabrication documents

The following documents shall be provided by Vendor/Manufacturer and be submitted to Client for comments and approval:

- Complete data sheet of the SYSTEM, including material specifications.
- General arrangement of the installation.
- Valves Process, Mechanical and Structural calculation report.
- Valves FEA: Stress and fatigue analysis.
- Valves fabrication and detailing drawings.
- Inspection and Test Plan.
- Welding Map.
- Complete P&I diagrams and instrument specifications.
- Electrohydraulic actuators and controls, HPU - Hydraulic Power Unit and HCU - Hydraulic Control Unit, PLC control panel specification and construction drawings.
- Interlock system sketch.
- Installation, operation, maintenance and repairs instruction manuals, in Portuguese language.
- Material specifications and special material requirements.
- Material certificates.
- Bill of materials.

- Spare parts list.
- Transition spool piece design.
- Transition spool piece mechanical calculation report.
- Transition spool piece stress analysis regarding fatigue due temperature and pressure cycling, using Finite Element Analysis (FEA), with special attention to the side feed entry and the connection with the Coke Drum.
- Transition spool piece fabrication and detailing drawings.
- Steam manifold arrangement and recommendation documents.
- Coke Drum bottom and top flanges design.
- Coke Drum bottom and top flanges mechanical calculations.
- Coke Drum bottom and top flanges fabrication and detailing drawings.
- WPS and PQR.
- Weld map with the WPS and NDT to be applied to each weldments, before and after PWHT and after Hydrotest pressure.
- Location and welding procedures of repairs in pressure containing parts.
- NDT procedures.
- NDT certificates.
- RT films.
- PWHT procedure.
- PWHT graphs.
- Hydrotest procedure.
- Hydrotest pressure certificate.
- Field assembly procedure.
- All documents necessary to the operation, maintenance and repairs training in Portuguese language.
- At least a month before the foreseen date to the beginning of the pre-operation of the systems, supplier shall issue the complete Operation and Maintenance Manuals (3 CDs with its electronic file) in Portuguese language.

23. Spare parts

Vendor/Manufacturer shall guarantee that, according to the user's experience, the SYSTEM and its spare parts can perform continuously and safely the duty, considering 6 (six) years between turnarounds.
Spare parts shall be supplied for commissioning, start-up and two years operation, for all devices and accessories, and shall be delivered clearly identified with name and part number. The proposal shall list spare parts in detail, with name, part number and prices.

24. Conclusion

All deviations and exceptions from this specification shall be clearly identified in the proposal and submitted for approval. Any deviation or exception not clearly mentioned in the proposal will be considered as full acceptance of this specification.

Compliance with this specification does not exempt Vendor/Manufacturer from the responsibility of supplying any accessory suitable for the intended service.

After completion, Client will perform the final inspection and supervise the tests to be done at factory.
Client shall be notified forty days in advance of factory tests.

Vendor/Manufacturer's specialist technicians shall be present at Plant site to participate of the SYSTEM installation, commissioning, pre-startup, startup and local training.

Pre-startup, Calibration and Test shall include, at least:
- Field work management of accessories connected to valves.
- Functional inspection of all devices and instruments.
- Calibration and operation of actuators to assure performance guarantees.

Startup shall include, at least:
- SYSTEM operation stability supervision for final acceptance.

Local training for operation and maintenance staff shall include, at least:
- Training program organization and application.
- Material for training, such as, handouts, manuals, tools, videos shall be prepared in Portuguese language and deliver to Plant site, before field inspection, tests and start up.
- Classroom instructions, concerning SYSTEM operation and all devices maintenance.
- Practical training during field inspection and testing.

Vendor/Manufacturer shall execute a routine inspection program during the first year of operation and shall be prepared to assist Client for emergency maintenance services in a schedule time of one (01) day from the official convocation.

25. Guarantees

Vendor/Manufacturer shall guarantee that the SYSTEM as supplied in accordance with this specification will be capable of sustaining operation at the described conditions.
Vendor/Manufacturer shall also guarantee the entire SYSTEM assembly and all equipment entering into its construction against defects in design, materials and workmanship.

Vendor/Manufacturer shall guarantee that the valves, actuators, HPCUs and other devices and accessories are free from defects of workmanship, materials and design, during one year from the unit startup or two years after delivery at the refinery, whichever occurs first.

Vendor/Manufacturer shall make any alterations or replacements required in part or entire SYSTEM, without additional cost to Client, in case of any defect in design, material, transport from the factory to the Plant, workmanship or operating performance, developed during the period stated by contract. Any replaced equipment shall be subject to the same guarantee as in the case of the original materials.

26. Approval

All required documents are subject to the Client approval.
However, approval by Client, or the adoption of changes as recommended by Client, shall not relieve Vendor/Manufacturer of any of the above guarantees of his contractual obligations to Client.
The required documents shall be provided in magnetic media, according to the following softwares:
Drawings: AUTOCAD, last version;
Text: MS-WORD, last version;
Forms: MS-Excel
For the final issue of the documents, Vendor/Manufacturer shall provide digital certification (digital signature) for every document.
Field Assembly Procedure shall be submitted for approval together with the manufacturing drawings.

23 Patent protection

Vendor/Manufacturer agrees to indemnify and hold harmless Client from any loss, damage or injury arising out of claim or suit for alleged infringement of patents relating to the assembly of the SYSTEM and/or any of its component parts and will assume the defense of any and all such suits and shall pay all costs and expenses incidental thereto.