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Case Study: Monroe Energy, Monroe, Trainer, Pennsylvania, Crude Heater Mechanical Decoking Using a Header Delivery System

During the spring turnaround in 2017 a header delivery system was used to aid in mechanical cleaning of the radiant section of a 6-pass crude unit fired heater.

Client:	Monroe Energy
Date:	April 9 th , 2017
Location:	Trainer, Pennsylvania
Heater type:	Radiant section of a crude heaters (544 CRUDE)
Header diameter:	24" (24.0" O.D., .375" wall ASTM A155, Class 2, C55, Clad W/ 7/64" 11-13% Cr)
Number of headers:	1
Tube diameter:	8" SCH 40 (8.625" O.D., .322" thick)
Tube material:	ASTM A 335 Gr P5 (5 chrome)
Number of passes:	6
Year built:	2011 (last date of re-tubing)
Date of last cleaning:	Never been pigged before.
Reason for cleaning:	Localized as well as some global hot spots were observed using radiograph inspection and it was suspected that a heavy amount of coke had built up.

Technology description: A new tool was designed to deliver the mechanical cleaning pigs without requiring removal or modification of the common header. This tool was inserted inside the common header through each end of the header, and mated itself to the tube to be inspected on each end of the header, thus creating a closed loop system that launchers can be attached to. The tool creates a seal by pressing a custom manufactured rubber gasket that is contoured to the inner diameter of the header using a hydraulic cylinder. The tubes to be cleaned are located using a high pressure, ruggedized camera which is built into the tool to ensure proper alignment of the tool to the tube.

Case study:

Prior to the development of this custom common header delivery system (HDS), a plan was developed to cut off the common header from the radiant section and weld flanges on to each of the 6 passes. The flanges could then be used to attach a launcher to each pipe and pigged in a conventional manner. All welds would require x-ray inspection due to the service of the heater and the limited access to the header itself would require an extensive rigging and lifting plan with an overhead crane. Due to the limited access inside the refinery, crane operation would be extremely difficult in the space of the heater. If the HDS was not used, the scope of the project was estimated to take over 10 days to:

1. cut off the header
2. weld on the flanges to the 5-chrome tubes
3. mechanically pig the furnace
4. cut off the flanges
5. weld back on the header
6. x-ray inspect the new welds

The common header delivery system required no cuts to the common header and two blinds were removed on each end of the header for access. The personnel required to prep the furnace for pigging was therefore vastly reduced and x-ray inspection was not required since there were no new welds or cuts to the furnace. Two passes at a time were looped together and the mechanical pigs were launched and retrieved inside the common header. The furnace was heavily coked up and took 36 hours per set of passes to clean, with a total project duration of 5 total days, including set up time for the header delivery system. Therefore, the total project scope was reduced by a minimum of 50% in duration. The total project cost was also approximately 55% cheaper using the common header delivery system compared to the option of cutting off the header and enabled the job to not approach the critical path for the shutdown. Tube damage was eliminated due to water hammer, which occurs during mechanical decoking. Integral pressure relief valves set on the header delivery system right before the pig enters the heater tubes eliminated pressure spikes.

Photos of the original plan and a picture of the common header delivery system tool which was used on the job are shown as follows:

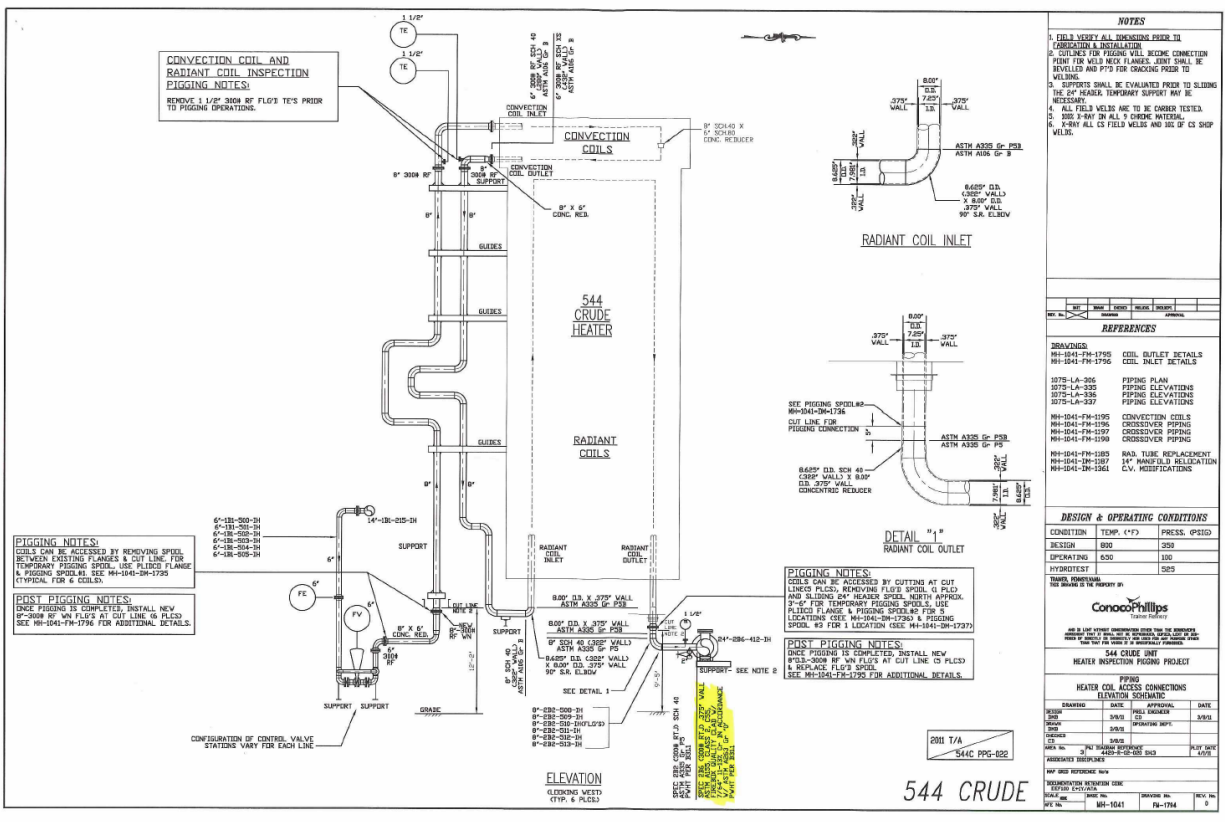
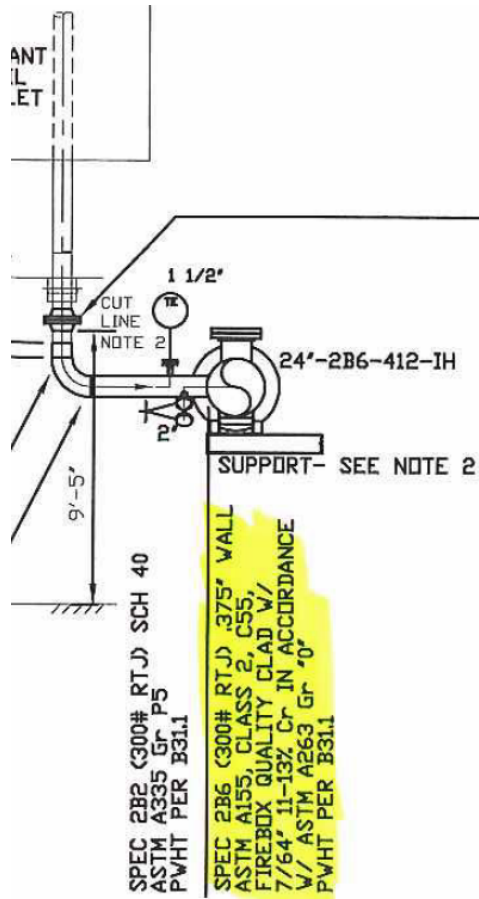


Figure 1: 544 Crude Heater Original Pigging Plan (Not Executed)

DETAIL 1
RADIANT COIL OUTLET



PIGGING NOTES:
COILS CAN BE ACCESSED BY CUTTING AT CUT LINE (5 PLCS), REMOVING FLG'D SPOOL (1 PLC) AND SLIDING 24" HEADER SPOOL NORTH APPROX. 3'-6" FOR TEMPORARY PIGGING SPOOLS, USE PLIDCO FLANGE & PIGGING SPOOL#2 FOR 5 LOCATIONS (SEE MH-1041-DM-1736) & PIGGING SPOOL #3 FOR 1 LOCATION (SEE MH-1041-DM-1737)

POST PIGGING NOTES:
ONCE PIGGING IS COMPLETED, INSTALL NEW 8"D.D.-300# RF W/ FLG'S AT CUT LINE (5 PLCS) & REPLACE FLG'D SPOOL
SEE MH-1041-FM-1795 FOR ADDITIONAL DETAILS.

2011 T/A
544C PPG-022

544 CRUD

Figure 2: Common Header Removal Plan (Not Executed)

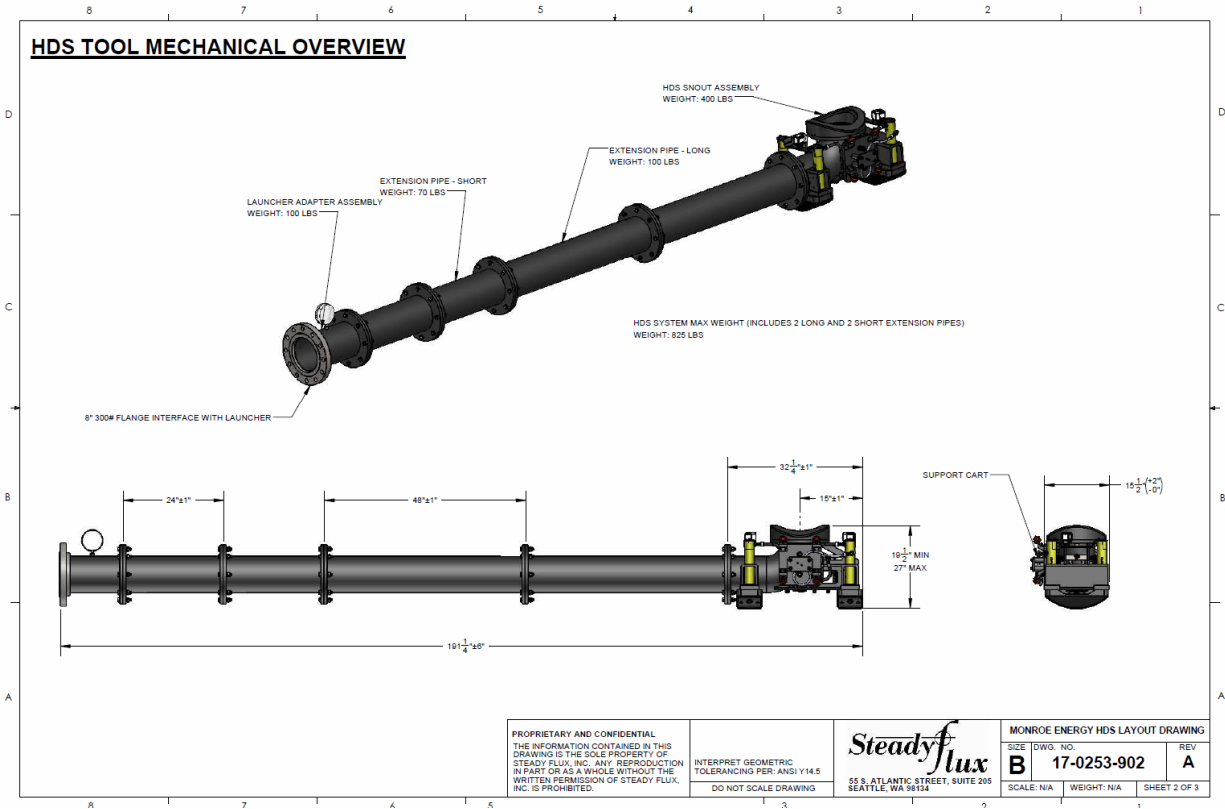


Figure 3: Common Header Delivery System

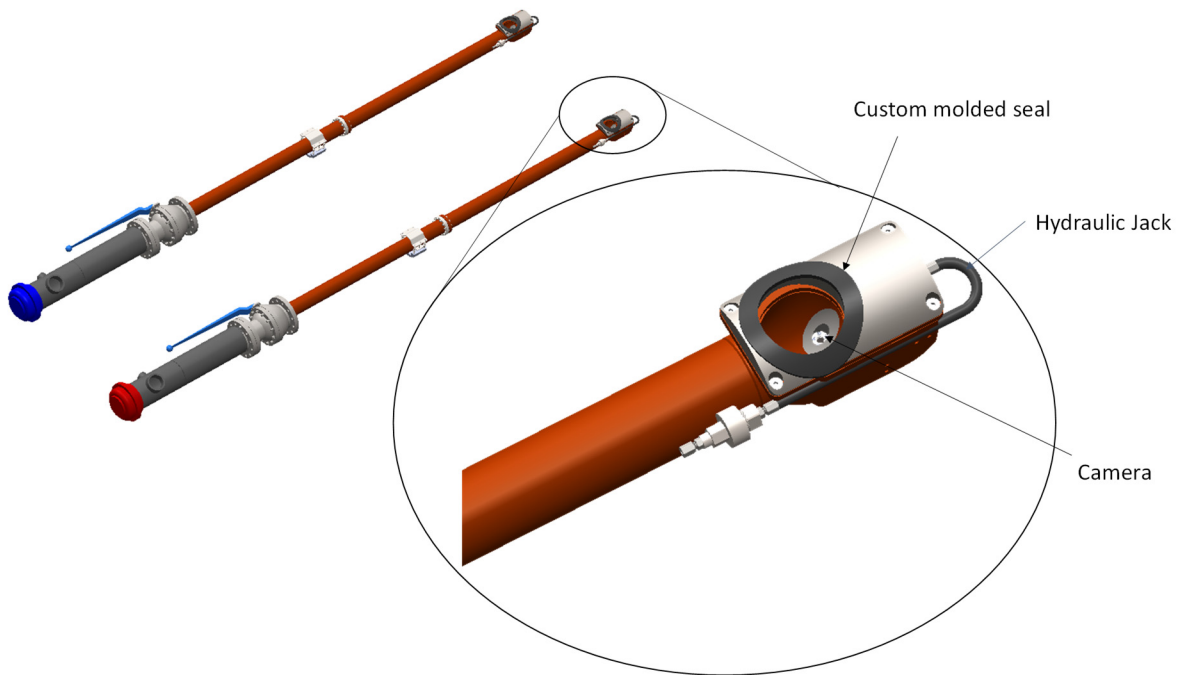


Figure 4: Common Header Delivery System

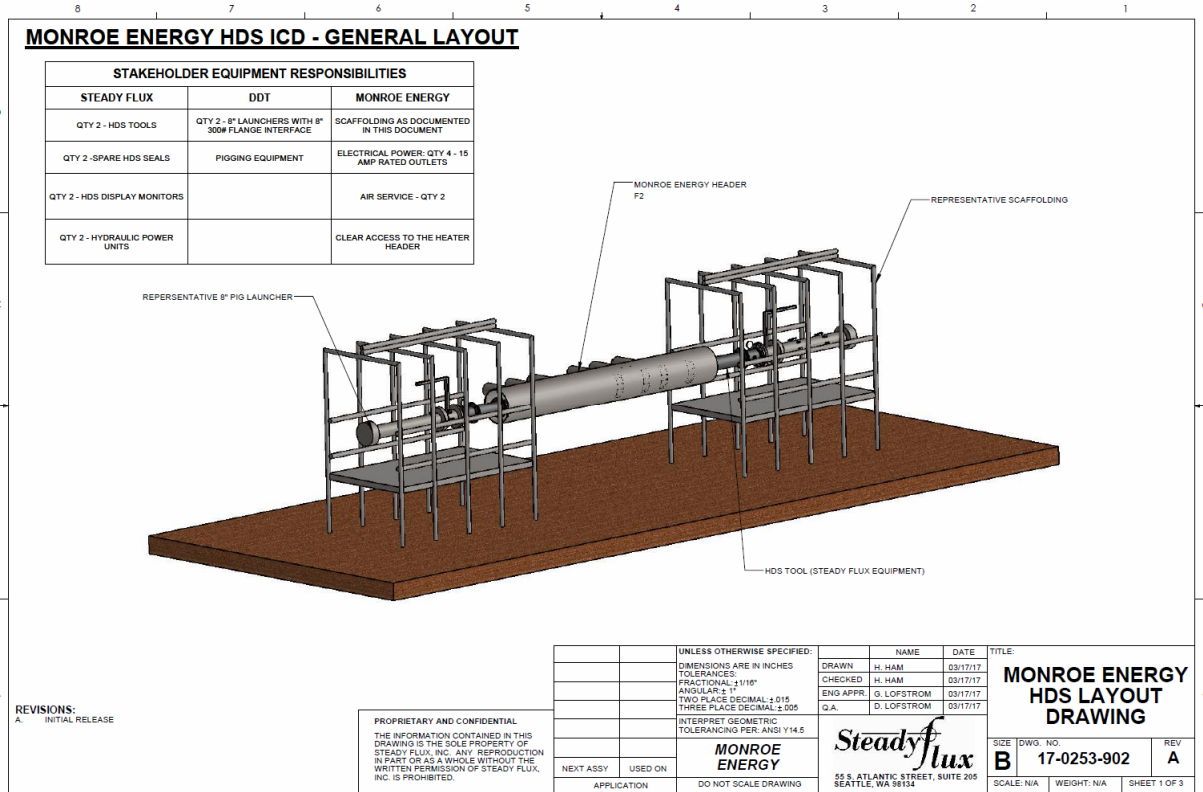


Figure 5: Header Delivery System Plant Layout Diagram

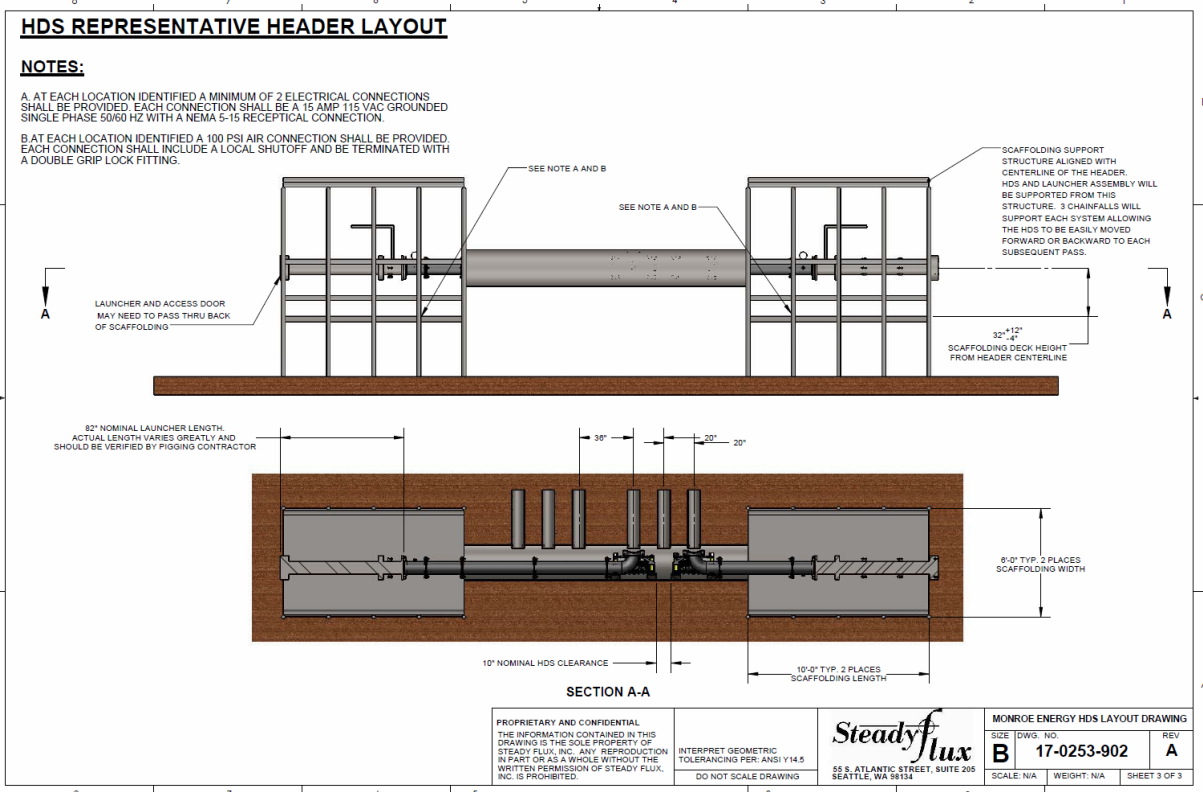


Figure 6: Header Delivery System Plant Layout Diagram

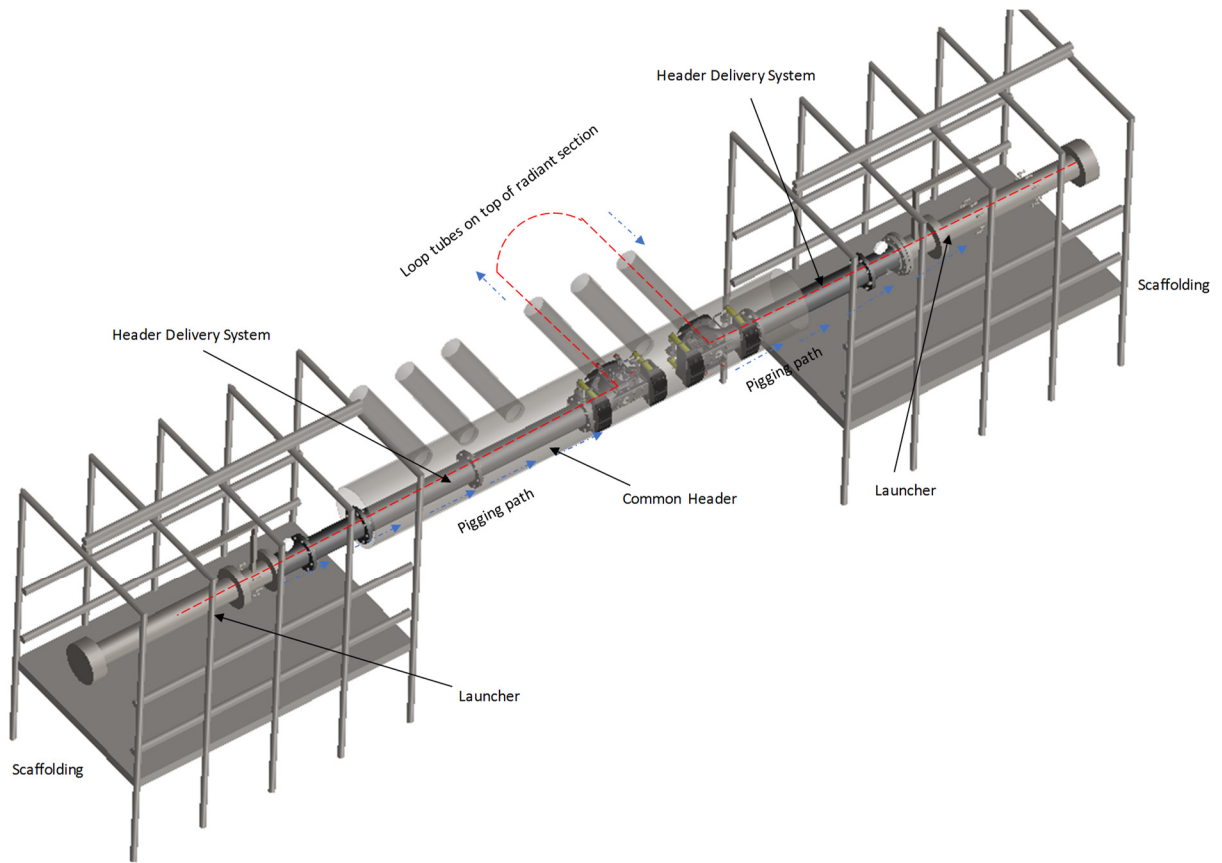


Figure 7: Header Delivery System Installation and Operation (Executed)



Figure 8: Tubes Looped at Top of Radiant Section

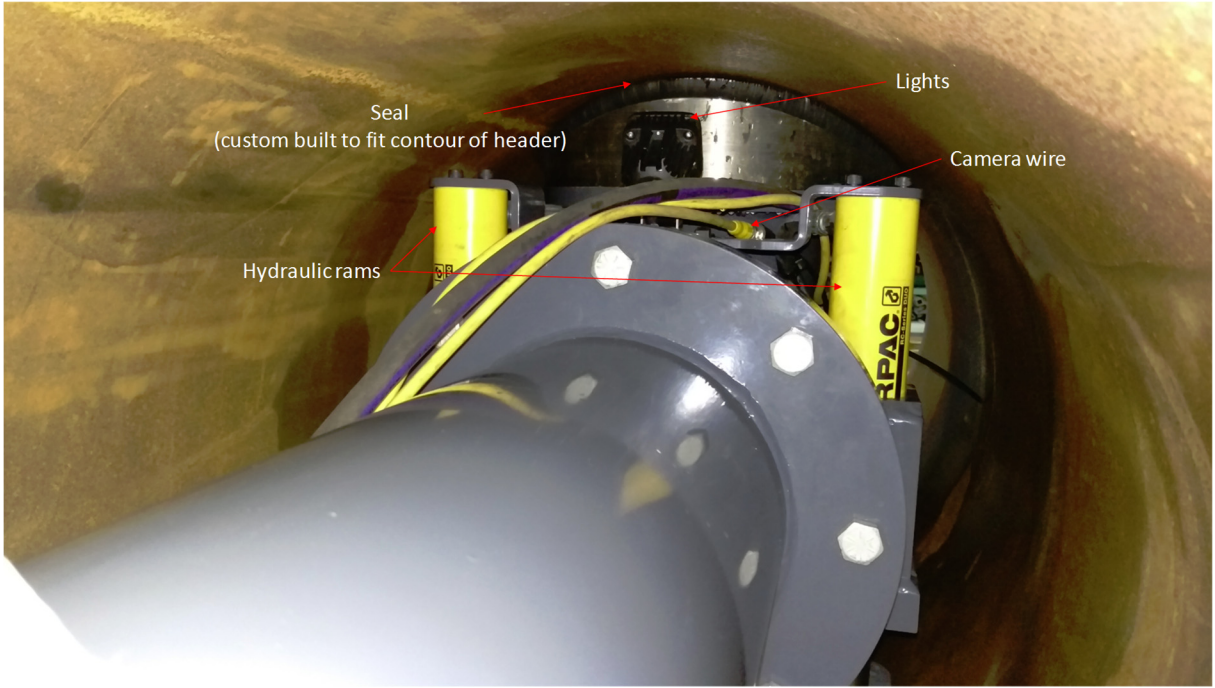


Figure 9: Header Delivery System Mated Inside of Header