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RE-RATING FOR MIXED BED DE-SULFURIZATION VESSEL FOR DE-BOTTLENECKING PROJECT

ITEM No.: 71-9105-001

ITEM: Mixed Bed Desulfurization Vessel

CURRENT RATING OF VESSEL: 497 PSIG / FV @ 900 °F

DESIRED RATING OF VESSEL: 570 PSIG / FV @ 797 °F

DISCLAIMER:

1. As per Metallurgical report dated Feb. 21, 1997 present in the available vessel documentation, there are cracks present in the bottom head of the vessel. There is no other report present in the file indicating that these cracks were further evaluated using fracture mechanics or ground to eliminate these. If the cracks are still present which are prone to crack growth, then these cracks should be evaluated before the revised pressure rating can be considered to be valid.

2. As per Metallurgical report dated Feb. 21, 1997 present in the available vessel documentation, the thickness measurements for top head, bottom head and shell was performed in 1997. There is no other report in the file indicating that any further thickness measurements were done after 1997. The thickness measurements should be repeated to make sure that the available thickness values for shell, heads and nozzles are still higher than the recommended minimum thickness values. This must be done for the revised pressure rating to be valid.

DEFICIENCIES / COMMENTS:

1. The vessel MDMT is calculated by COMPRESS to be 103.7 °F as compared to the design MDMT of -20 °F. The vessel was built in 1976. This is before the MDMT Code rules became effective in ASME BPVC in 1985. Also, there is no record that the vessel material was impact tested. This is an ASME Code related deficiency which should be addressed by meeting the MDMT requirement.

2. It has been found that the reinforcement limits for Manway M and nozzle A1 are overlapping. This is reported by COMPRESS as a deficiency with user intervention required. By hand calculations, it was found that the two reinforcing pads just touch each other with their outer fillet welds intersecting. This interference issue must have been resolved in the shop at the time of fabrication by slightly reducing the re-pad widths for these two nozzles. This must be verified by taking a photograph of these adjacent reinforcing pads to confirm that these pads or their associated fillet welds are not intersecting.

3. The minimum length of required taper at Main Cylindrical shell to top / bottom hemispherical head joint is 2.50". Per the vessel drawings, this taper length happens to be 12" for the top head and 12" for the bottom head. Hence, this meets the code requirement and this is acceptable.

4. The warning for all the nozzle flanges indicates that flange material should be normalized and tempered. The original fabrication drawings indicate that the flanges are constructed out of normalized and tempered material. Hence, this is acceptable.

RE-RATING DETAILS:

The vessel was modeled using Pressure Vessel software, COMPRESS. The Code calculations were performed in accordance with 1998 ASME BPVC Section VIII, Div-1 with A98 Addenda. It was found that the vessel can be re-rated to the new pressure rating of 570 psig / FV @ 797 °F. The associated minimum thickness values for various components of the vessel are listed as follows:

COMPONENT	RECOMMENDED MINIMUM THICKNESS
Top Head - Hemispherical	1.500"
Main Shell - Cylindrical	3.000"
Bottom Head - Hemispherical	1.500"
Nozzle A1 - 24"Dia.	0.500"
Nozzle A2 - 3/4" Dia.	0.150"
Nozzle B - 24" Dia.	0.500"
Manway M - 20" Dia.	0.400"
Nozzle K1 - 12" Dia.	0.380"
Nozzle K2 - 12" Dia.	0.380"
Nozzle T1 - 3" Dia.	0.200"
Nozzle T2 - 3" Dia.	0.200"
Nozzle D - 2" Dia.	0.250"

The thickness values listed here are exclusive of any corrosion allowance that may be needed for future operation of the vessel. The nozzle designations stated here are same as listed on the fabrication drawings.

CONCLUSIONS:

Excluding the disclaimers, deficiencies and comments listed above, the code calculations indicate that the Mixed Bed Desulfurization vessel (Item #: 71-9105-001) can be re-rated to the new design conditions of 570 psig / FV @ 797 °F. The disclaimers, deficiencies and comments must be addressed to sufficient degree of satisfaction for this re-rating to be valid.

ACTIONS:

The following actions must be taken for the new rating for mixed bed desulfurization vessel to be valid:

1. Please address above listed disclaimers, deficiencies and comments.
2. Please verify the current thickness values of various components to make sure that these are higher than the minimum thickness values listed above.
3. Perform NDE to size the cracks. These cracks should then be evaluated using fracture mechanics techniques to make sure that these will not propagate / grow in an unstable manner.
4. Perform hydrotest for the vessel at 855 psig @ 120 °F.
5. The relief scenario for the vessel in the system must be evaluated by a qualified Process engineer to make sure that the safe relief operation can take place for the new design conditions. This may require change of relief equipment and / or other checks and balances to handle an over-pressurization situation.
6. After successfully completing the above steps, please generate a name plate listing the new design conditions and attach it to the vessel before operating the vessel at the new design conditions.