LETTER BALLOT

Subj: NB11-701 Tube Replacement Procedure

Explanation: The change is a generic procedure for replacing tubes in a heat exchanger.

PM: Andy Stupica

Background: Common repairs to graphite heat exchangers are repair of cracks, replacement of tubes, and plugging of tubes. This procedure is a generic method for the replacement of tubes, and is a compliment to the plug stitching procedure.

Existing Text: None

Proposed Revision: See the attachment

Rationale: It is the intent of the subgroup that this procedure will provide a level of quality for the replacement of tubes in heat exchangers acceptable to industry.

Notes during discussion:

Tracking Number: 11-701

~~3.5.x.x~~ ~~Tube Replacement~~ S3.5.4 TUBE REPLACEMENT

Tubes shall be replaced with like tubes supplied by an ASME certificate holder using certified material (tubes, cement, matching sleeves, fillers.. etc) in accordance with the requirements of the ASME Boiler and Pressure vessel code Sect VIII ~~div~~ 1 part UIG. It is suggested work is done with at least two trained persons and the unit to be horizontal, as work in the vertical position is the most difficult. Below are general steps used in a horizontal tube replacement.

a) Determine thickness of the tube-sheets and the inside distance between the two tube-sheets to obtain proper tube lengths, sleeves and details for the work. (drilling/reaming tools required).

b) Access the tubesheet faces and clearly identify at both ends the openings in the tubesheet corresponding to the tube-hole for tube(s) to be replaced. Multiple tube replacement will require additional considerations as one should **avoid replacing adjacent tubes at one time** and if more than 20% of the tubes are in need of replacement it may be more feasible to replace the entire bundle.

c) Prepare/clean or ream as needed the existing tube-holes in preparation for extracting the damaged tube. Some holes may be plugged and may require extra caution and alignment to bore out.

d) Drill/ream out the tube-hole in the tubesheet straight in toward the damaged tube at each end at a diameter slightly greater than the outside diameter of the tube being extracted.

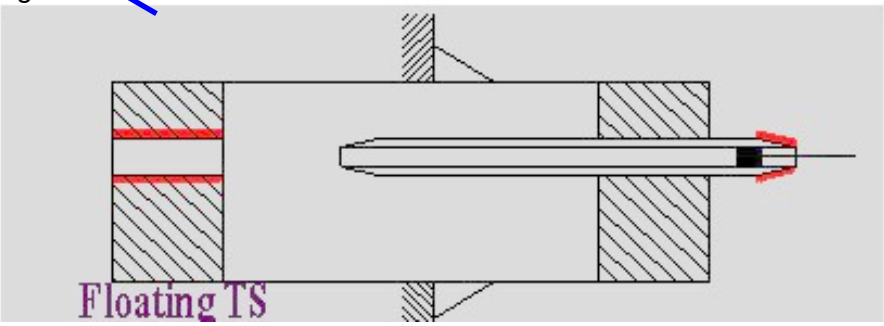
e) The damaged tube should disengage and become loose. Using guides, remove the damaged tube. Check that no debris is trapped in the space where the tube was removed.

f) The open bore in the tubesheet is now ready (a dry fit is suggested for this new tube and both end sleeve parts.) The replacement tube will fit back in the tubebundle, supported partway into the tubesheets by sleeves at each end of this tube, (reference Fig. 3.5.1-b&c). The tube is usually the exact size of the original but sleeves may vary and need trimming (reference Fig. 3.5.1-c). They shall be marked for placement in the tubesheet location during the dry fit. Prior to applying the cement, prepare and clean all surfaces to be cemented.

g) Cementing steps may vary but all parts are required to be well coated, then aligned, set and allowed to cure. Use qualified cementing procedures and the cement is to be applied by certified cementing technicians. Begin at a designated end or the floating tubesheet side.

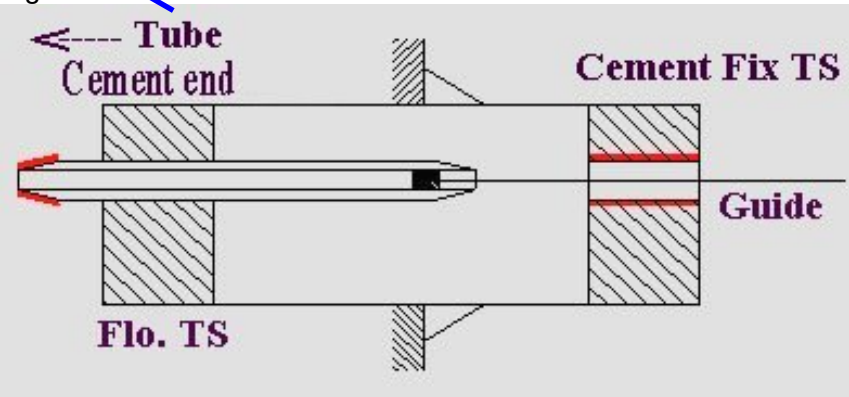
h) Cement the ID of the drilled/reamed tube hole in floating tubesheet and the tube (opposite side) fixed end tube joint. See Fig abc.

~~Fig abc~~ FIGURE S3.5.4.1



i) Insert the tube (dry floating side) in through the opposite (or fixed) tubesheet to this far side cemented hole and through so it protrudes past the floating tubesheet (allow the fixed tubesheet bore hole to be clear, see position of tube in Fig. def). Cement this fixed tubesheet bored hole also, Fig def. Use of dowels can assist in tube handling/alignment.

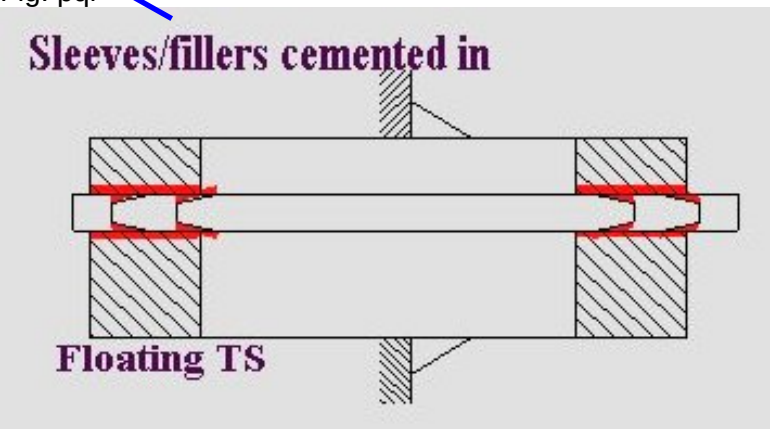
~~Fig. def~~ FIGURE S3.5.4.2



j) Cement the floating tube end joint (see tube in Fig def) and mating sleeve surface. Cement this sleeve end for the tube and fit it to the cemented tube end and push the assembly part-way into this floating tubesheet. Coat the remainder of the sleeve OD of the mating floating tube end sleeve. This sleeve end shall be completely coated with cement. Push this cemented assembly the rest of the way into the floating tubesheet and slightly past the positioning mark.

k) Properly apply cement to the final sleeve contact surfaces for the fixed end side tubesheet and insert it until it mates with the tube end inside. Clean/wipe any excess cement at this and the next step. Push together cemented tube/sleeve assemblies, and slide to positioning marks. (see as assembled in Fig pqr)

~~Fig. pqr~~ FIGURE 3.5.4.3



l) From both sides, apply a slight pressure on the sleeve ends and hold for a short time to seat the joints. Remove/wipe excess cement runs. (Spatulas, rags and bristle tube brushes are used with the assistance of compatible solvents to clean out excess cement before curing the assembly.

FIGURE 3.5.4.4

m) Cure both ends of the cemented assembly. The tube and sleeve joints will be contained within the boundary X of the tubesheet. See ~~Figure~~ ~~x.y.z~~ . Any excess sleeve length that protrudes past the finish tubesheet face can now be trimmed.

n) The replaced tube(s) shall be tested in accordance with approved procedures to ensure the repair is leak free.

FIGURE 3.5.4.4 REPLACED AREA INSIDE TUBESHEET

~~Figure **x.y.z.** of replaced area inside tubesheet~~.

If protruding at face trim sleeve end after cement curing and before the hydrotest.