



# Just patch it up

You have recently graduated from college in engineering, and are excited about your new job at a large-scale production facility. Like any “new hand” working the facility, you are put with the old gray-haired guys to mentor you and get you up to speed about the “real world.” Recently, one of the towers was found to be experiencing an unexplained rapid corrosion/erosion, and there are questions of mechanical integrity, as well as to what the root cause of the problem may be. To mitigate the problems with the tower so the plant can get up and running, a fillet weld patch was installed on the outside of the vessel. A leak in this vessel would be an EPA reportable event, and could be a safety hazard. Your immediate boss tells you this should be your No. 1 priority, and gives you directions. While you are grateful your boss gave you some directions, you are used to a GPS and prefer to have specifics. You develop a plan, and the first items you collect are the following: guidelines from OSHA; applicable ASME, National Board Inspection Code and API codes; and your company procedures.

One of the first considerations for a prob-

lem of this magnitude is simply what is causing the problem. An erosion rate has to be determined, and that determination must have good basis. In this situation the repair of the vessel must meet the design requirements of the vessel, or in other words the nameplate conditions must be met.

A mechanical analysis of the patched vessel must be performed to validate the structural integrity. Depending on the situation, since corrosion was found all over the vessel, a Level 3 Fitness for Service (FFS) might be performed. This would include the patch, and no credit would be taken for the area behind the patch. In general only flush patches are allowed as a permanent fix, so the fillet welded patch can only be used until the next planned outage, or as the team and analysis deems necessary. In effect, the fillet welded patch becomes a temporary patch. If the analysis determines the temporary patch that was installed cannot satisfy the acceptance criteria established by the investigation team, an unplanned outage might be necessary to rectify the situation. Now the next issue is what is the root cause? Once that solution is determined, the date of the planned outage

can be set accordingly. Let’s assume for this case the cause of the erosion/corrosion is complex, and by hand calculations the measured vessel wall thicknesses are below the minimum required for structural integrity.

In general the way to handle a problem like this may be as follows:

1. During an outage take detailed readings of the vessel.
2. Perform a preliminary analysis of the vessel to determine if there is a structural problem with eroded thicknesses as measured. In this case, a finite element analysis would have to be performed to assess the conditions. If a patch is put on, also validate the thickness and areas covered. It is advised to take no credit for the metal under the patch to be conservative.
3. Perform a root cause analysis to determine the cause of the problem and the corrosion rate.
4. Perform an FFS Level 3 analysis using the thicknesses measured and the erosion rate including the date of the planned outage.
5. In-service monitoring might need to be performed to ensure the corrosion or erosion rate is under control and in line with the FFS

analysis assumptions. This may be thickness readings, or in some cases it might be thermal imaging if there is a sufficient temperature gradient to make this useful.

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6. Field engineering and analysis should be conducted to ensure a safe replacement and repair of the patch.

7. Detailed review and approval should be conducted by the investigative team to ensure all the bases are covered.

Every situation is unique and should be reviewed on a case-by-case basis. Any solution should be in accordance with the code.

These types of problems are often complex and challenging and should be reviewed and approved by a professional engineer with experience with these type problems.

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