ACC Steamside Finned Tube Corrosion Downstream of Tube Entries

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Erosion and corrosion of carbon steel in the LP turbine exhaust

Primary factors:

- velocity and/or corrosion

Structural steel vs. thin-walled ACC HX tubes:

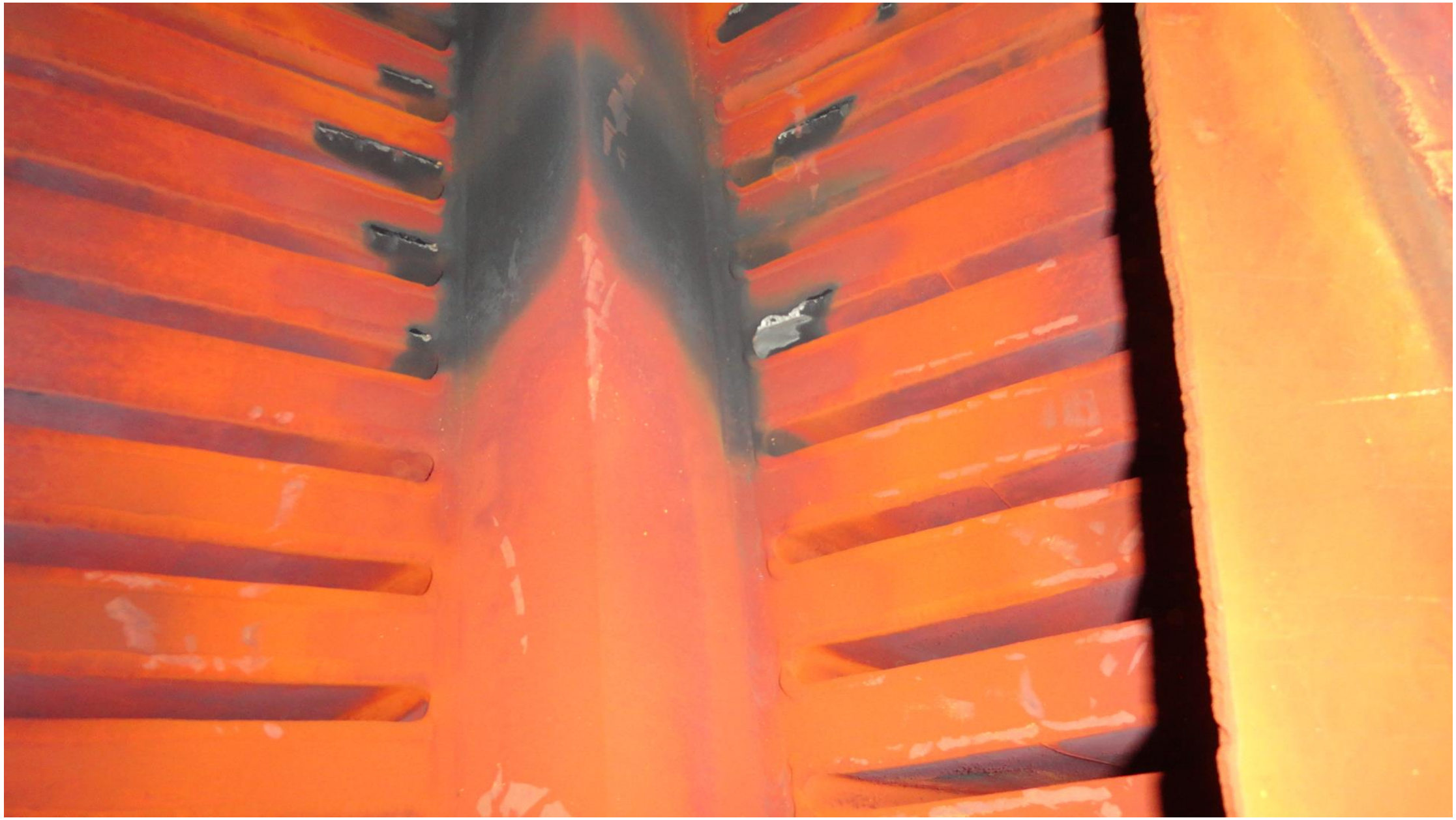
- contribution of iron oxide to condensate by both
- most of surface area in HX tubing
- low probability of through-wall leaks except for finned HX tubing

Metal loss on duct walls from LP turbine steam exhaust

Metal loss in the LP turbine exhaust steam turning vanes

Metal loss in the ACC Steam Distribution Upper Duct

Metal loss at HX tube entries in the steam distribution upper duct



Focus of metal loss assessment: velocity + corrosion

Tube entries in upper duct:

- location of highest turbulence (highest velocity)
- initial steam condensate is most corrosive (lower pH)

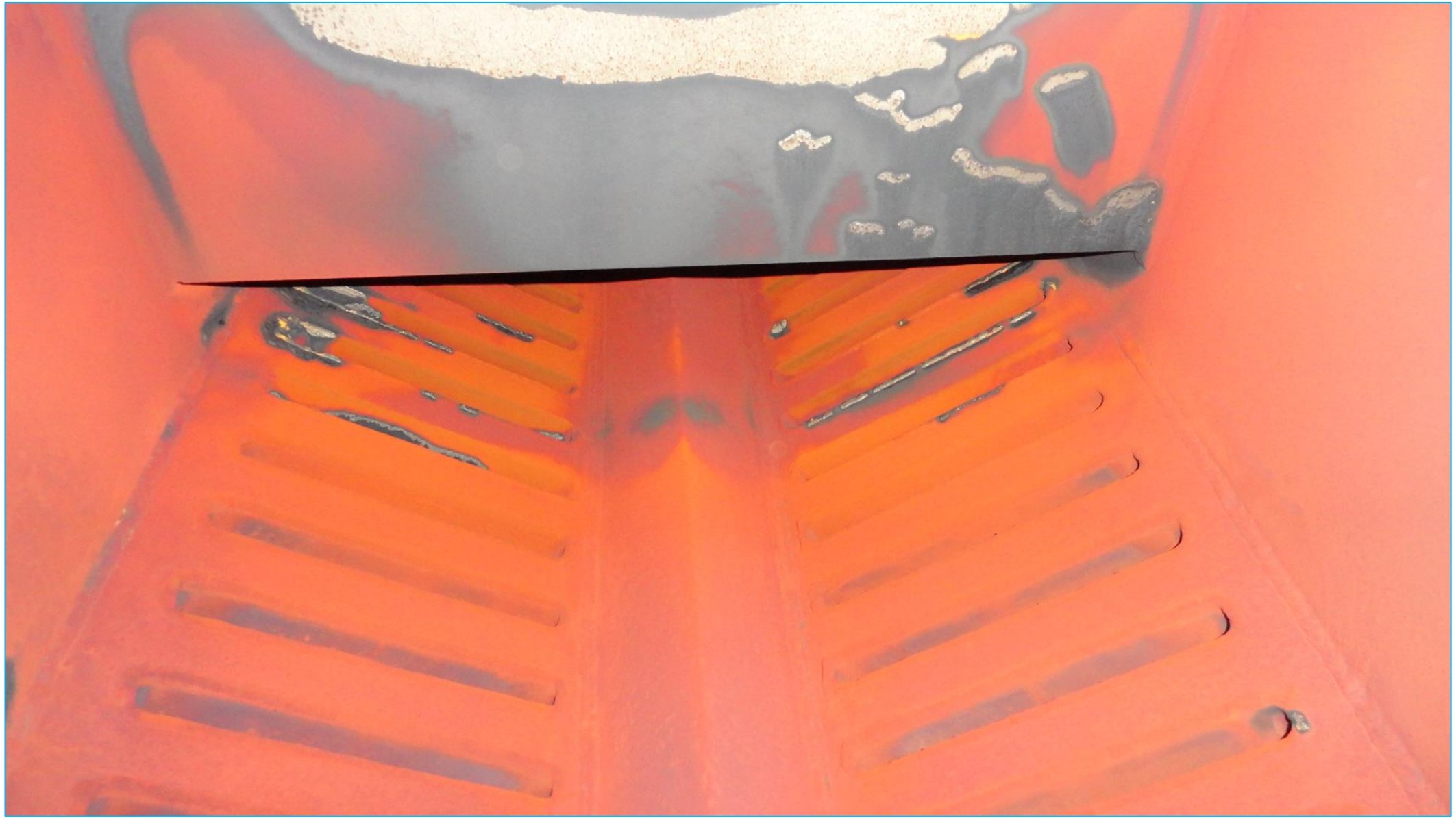
Confirmation by observations of metal loss:

- dominant beneath turbulence-inducing structures
- located within a few cm of the tube entry

Confirmation by pH adjustment

- reduction of corrosion with pH elevation

Focus of metal loss assessment: velocity + corrosion

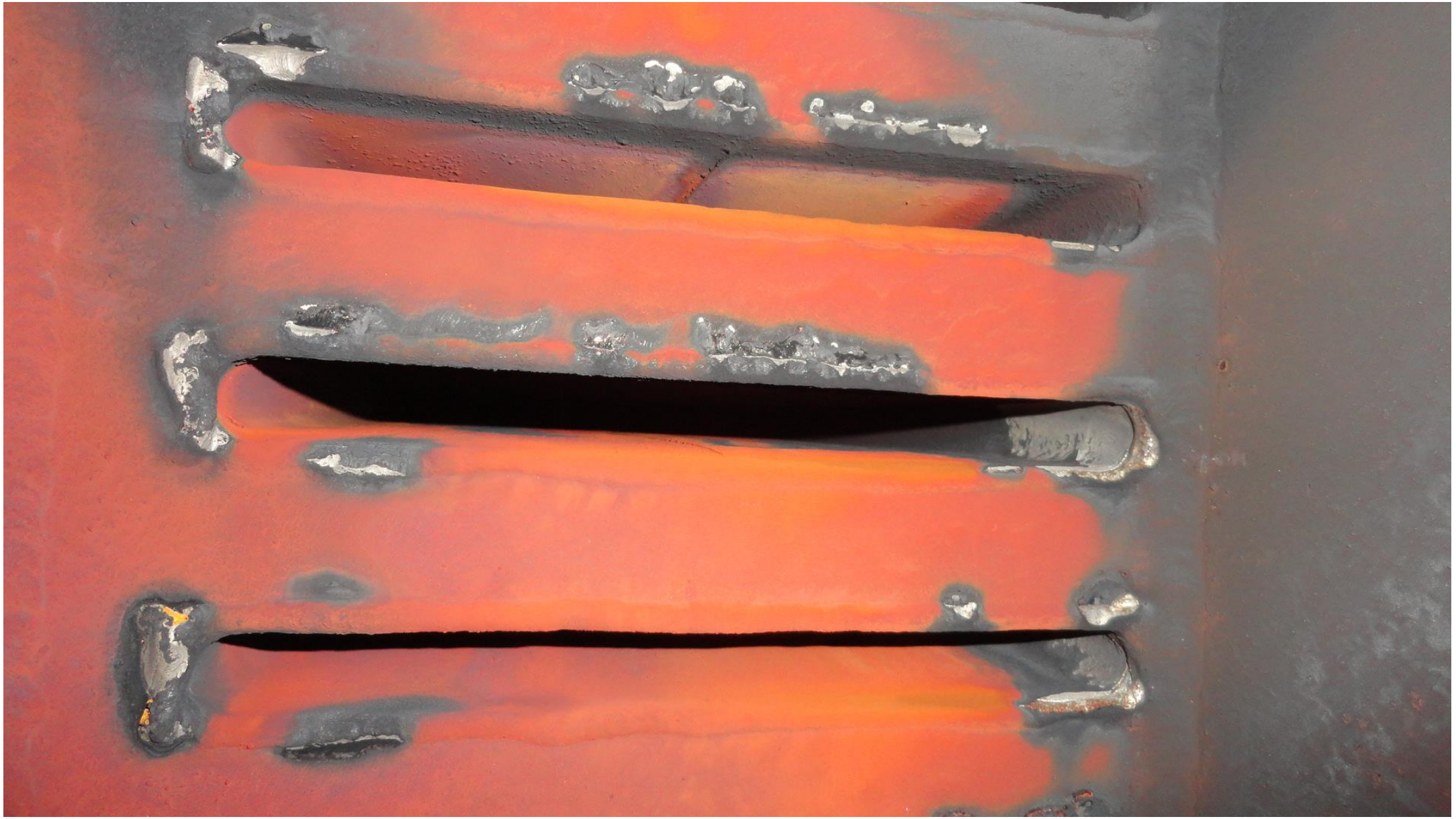


Confirmation by repeated observation during inspections

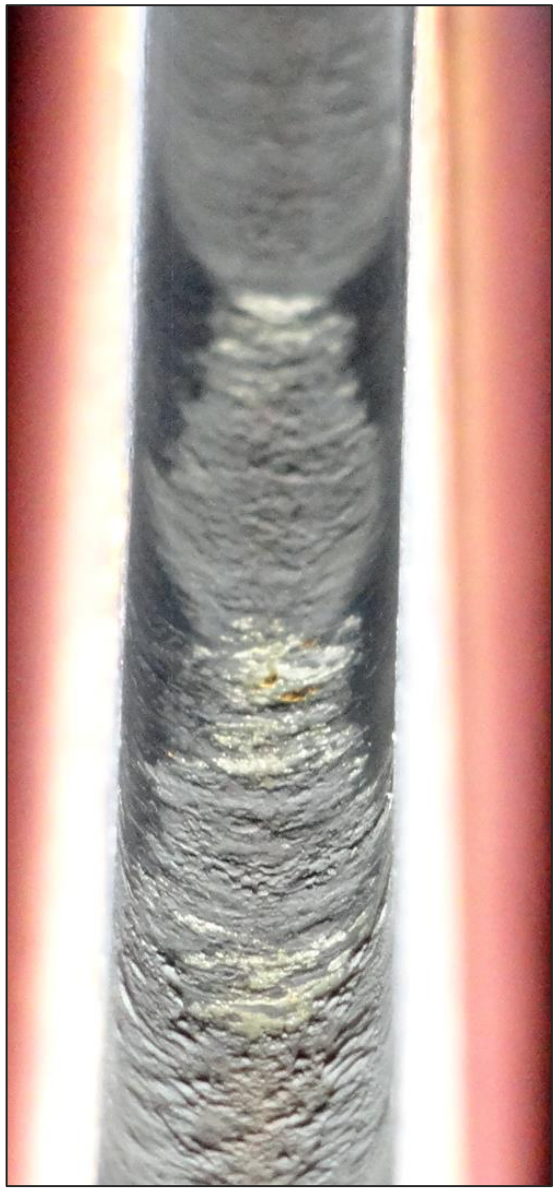
Recent observation (2022): Metal loss downstream of tube entry

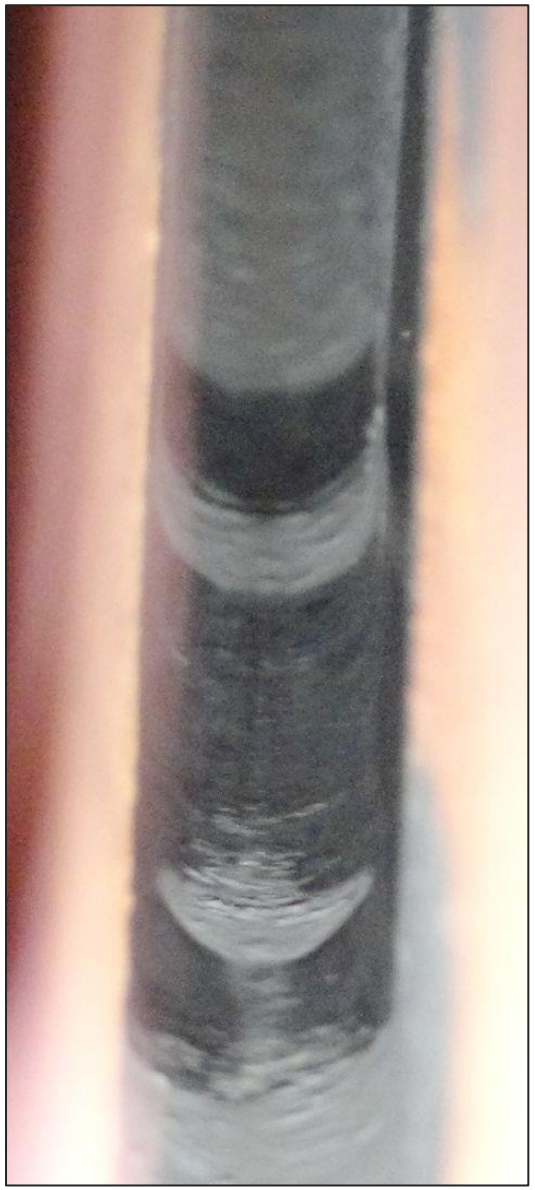
Metal loss at HX tube inlet

Metal loss at HX tube inlet



Metal loss downstream of HX tube inlet (about 3-6 ft, 1-2 m)

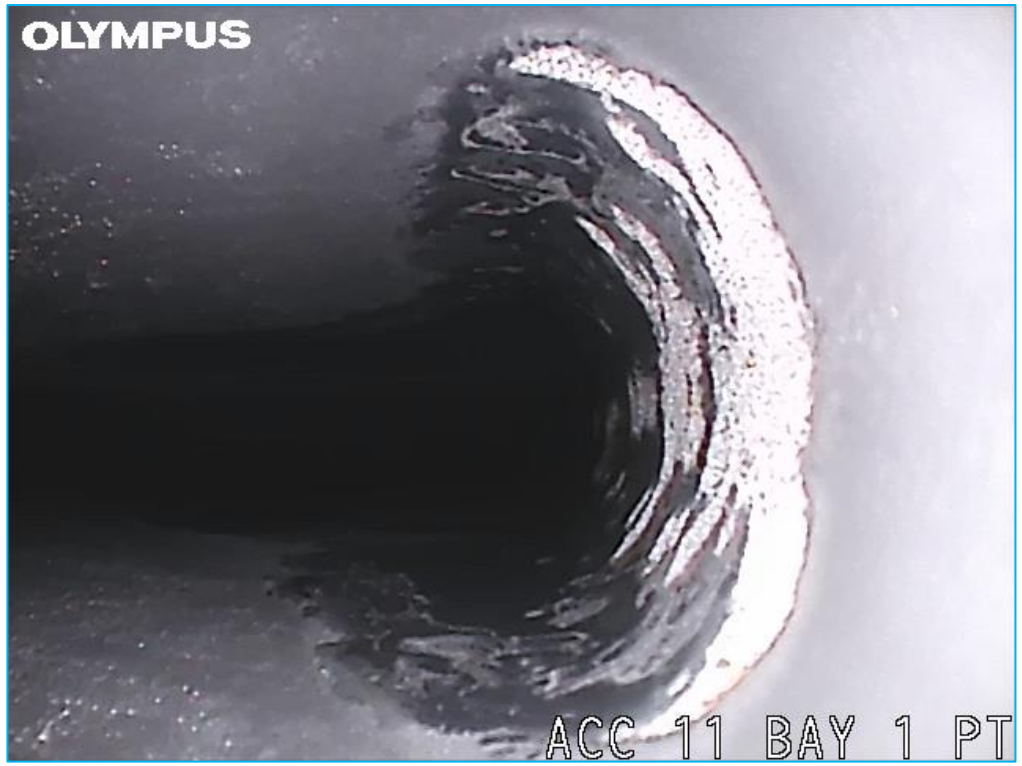


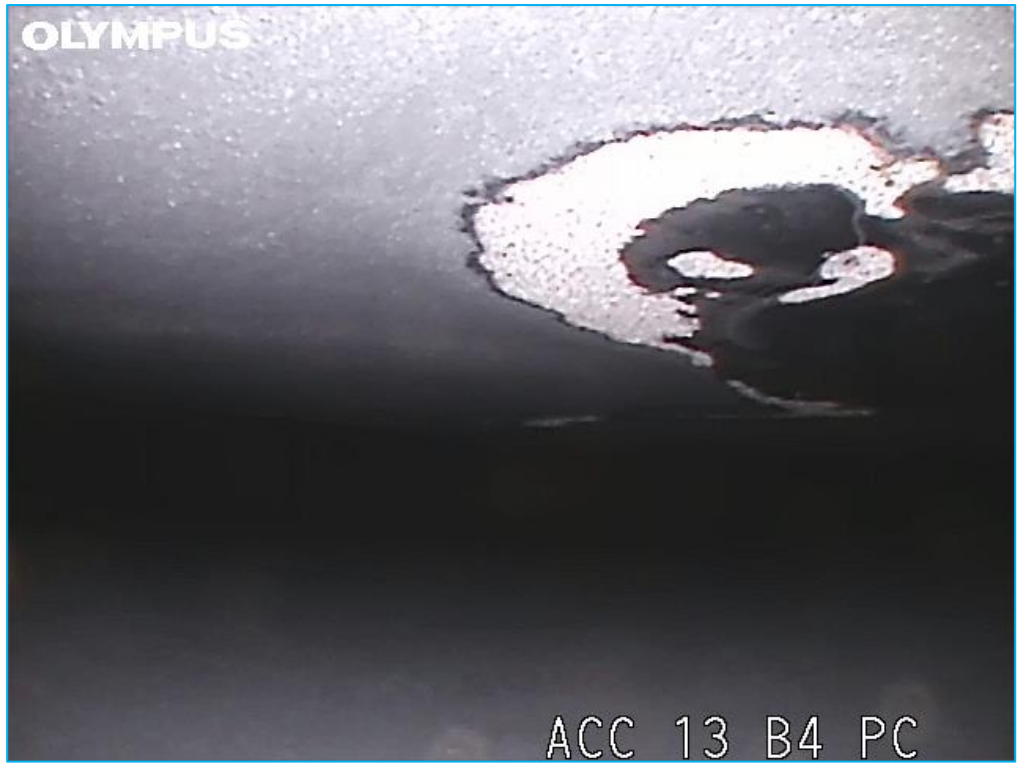


Confirmation

The plant started up in 2007 and had reported routinely observing this feature in ACC inspections beginning in 2010.

Confirmed by borescopic record in 8 different upper ducts during the same outage:





Why was this not observed previously?

1. After a few inspections without seeing any corrosion down the tube, little attention was given to this area.
2. The reasoning behind tube entry being the focus of corrosion was solid.
3. No down-tube corrosion failures are known to have occurred at any ACC, which would have alerted to the situation.
4. While some ACC borescoping has been done, no downtube corrosion has been widely reported.
5. A “super-bright” flashlight was provided by the plant that perhaps viewed areas previously missed by “ordinary” flashlights.

A similar situation was subsequently identified at a different ACC plant, although details were limited (distance down the tube, frequency of occurrence etc.).

What are the implications of ACC down-tube corrosion?

- May be a major source of iron transport
- Potential for down-tube leaks
- Need to better define the mechanism of metal loss downtube
  - may clarify whether all ACCs are susceptible
  - may provide opportunity to reduce metals transport

Current need – to determine the extent of this issue by making downtube observations during upper duct steamside inspections (consider borescoping)

Conclusions

- Flow-induced or -accelerated corrosion has been detected further down ACC heat exchanger tubes than was previously understood.
- The extent of this corrosion in operating ACCs is uncertain but should be investigated.
- Implications of this finding include a need to identify the mechanism, the contribution of this corrosion to iron transport, and the potential to reduce the amount of iron transported from the ACC to the steam cycle.

Questions / Discussion