



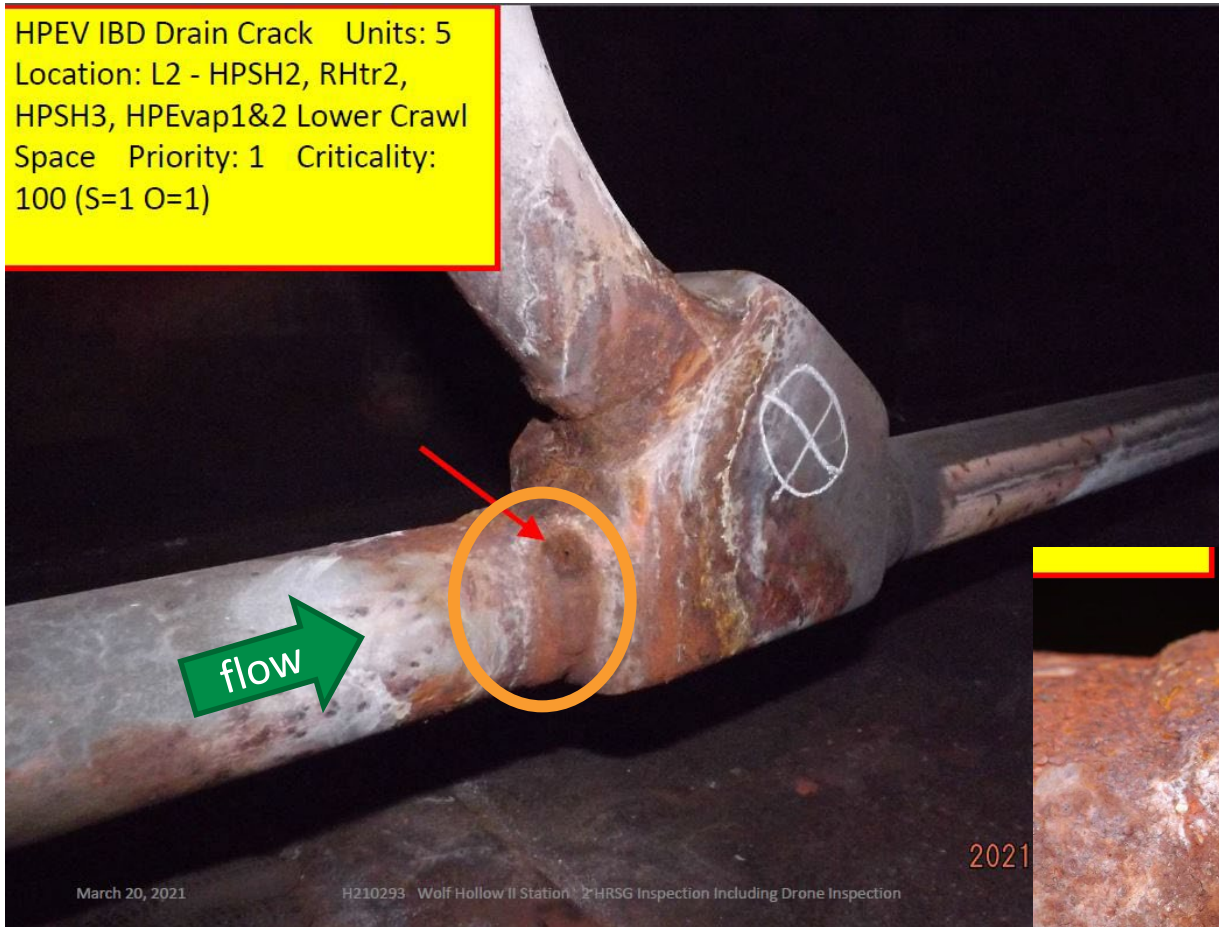
Why it is Important to Perform Failure Analysis

Albert Olszewski

April 4, 2022

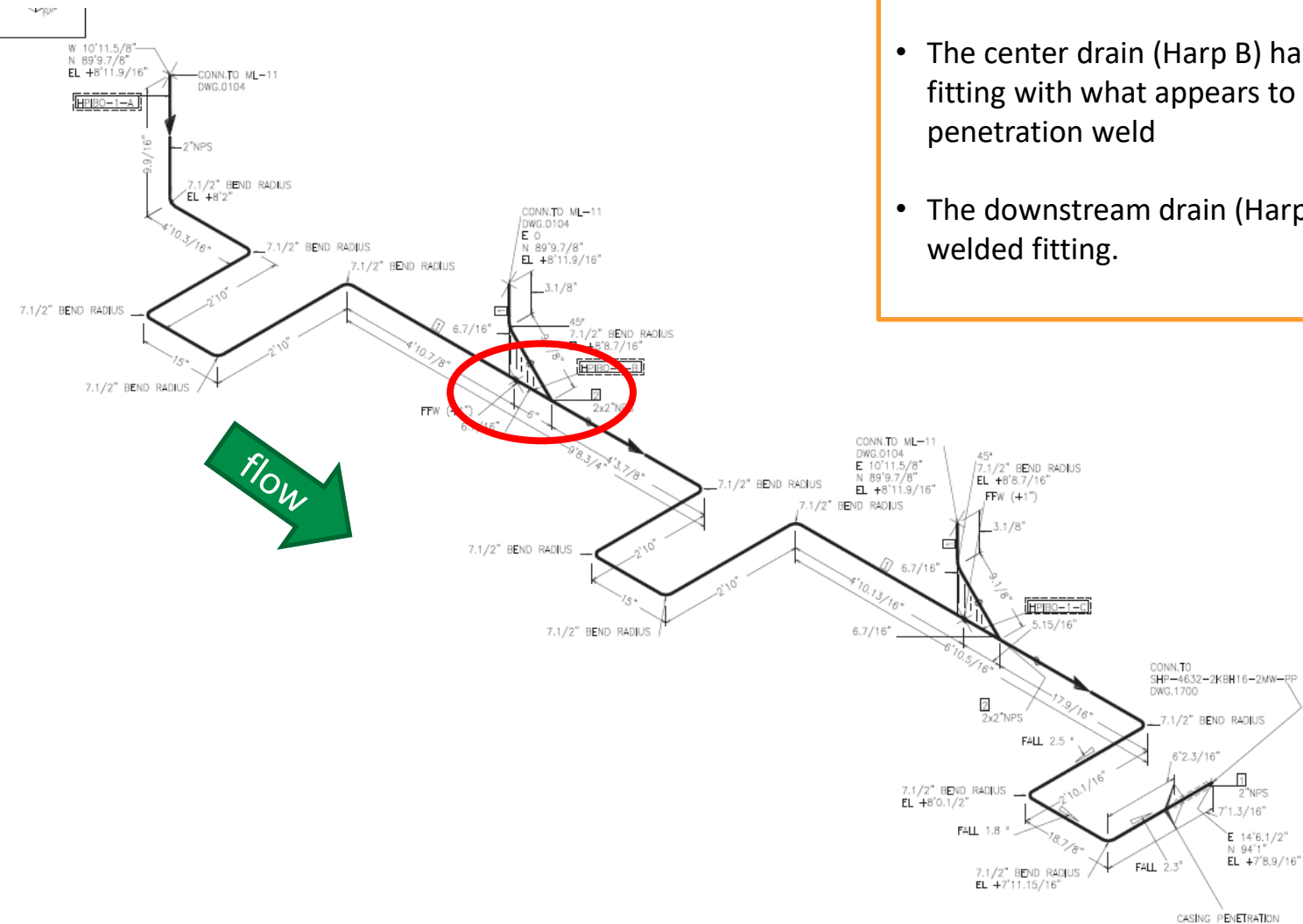
Failure Location

HPEV IBD Drain Crack Units: 5
Location: L2 - HPSH2, RHtr2,
HPSH3, HPEvap1&2 Lower Crawl
Space Priority: 1 Criticality:
100 (S=1 O=1)

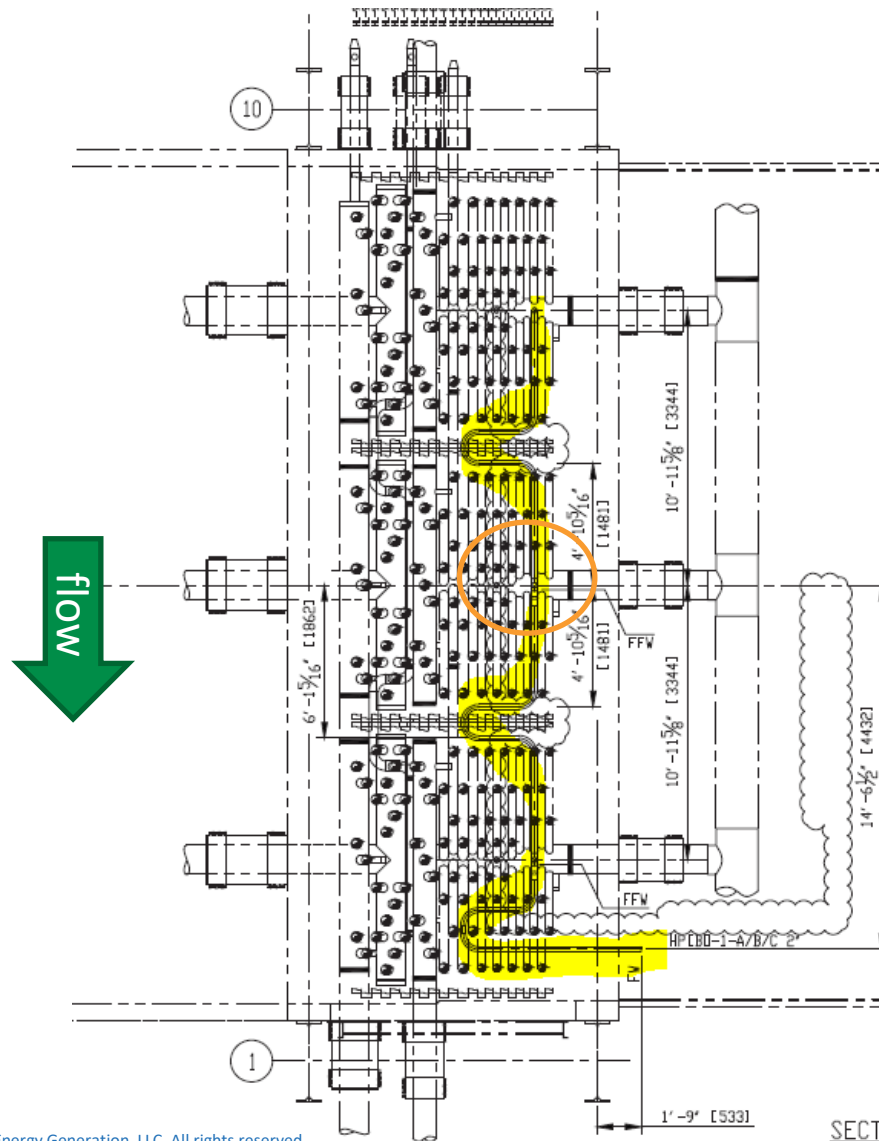


HP Evaporator – Intermittent Blowdown

- Material – P22; 2" NPS; Schedule 160
- The center drain (Harp B) has a Wye block fitting with what appears to be a full penetration weld
- The downstream drain (Harp A) has a socket welded fitting.



HP Evaporator – Intermittent Blowdown



History

1) 2018 April

- At Wye from middle header (harp B)
- Leaking weld location was not identified
- Excavated and weld repaired

2) 2018 September

- At Wye from middle header (harp B)
- Leaking weld location was noted on the same weld previously repaired
- Excavated and weld repaired



History

3) 2019 February

- At Wye from middle header (harp B)
- Leak at upstream weld
- Excavated and weld repaired



History (cont.)

4) 2019 April – INSPECTION

- No leaks
- Visual inspection with Niton chemistry check
- Chemistry was as expected except for taper on Block Wye that is welded Harp B drain (has not leaked) contained other continents not expected for P22
- This suggest that this area is possibly a different material and if that was the case for the failed leg on this wye it could explain the weld cracking. The increased alloying element and the difficulty in filing this tapered area suggest it could be very hard which could make it susceptible to Hydrogen cracking. If this is true the existing higher alloy leg and the previous repair area are at risk of another failure.

History (cont.)

5) 2019 October – REPLACEMENT

- No leaks
- Replaced Wye from middle header due to April findings of abnormal chemistry

History (cont.)

6) 2021 March

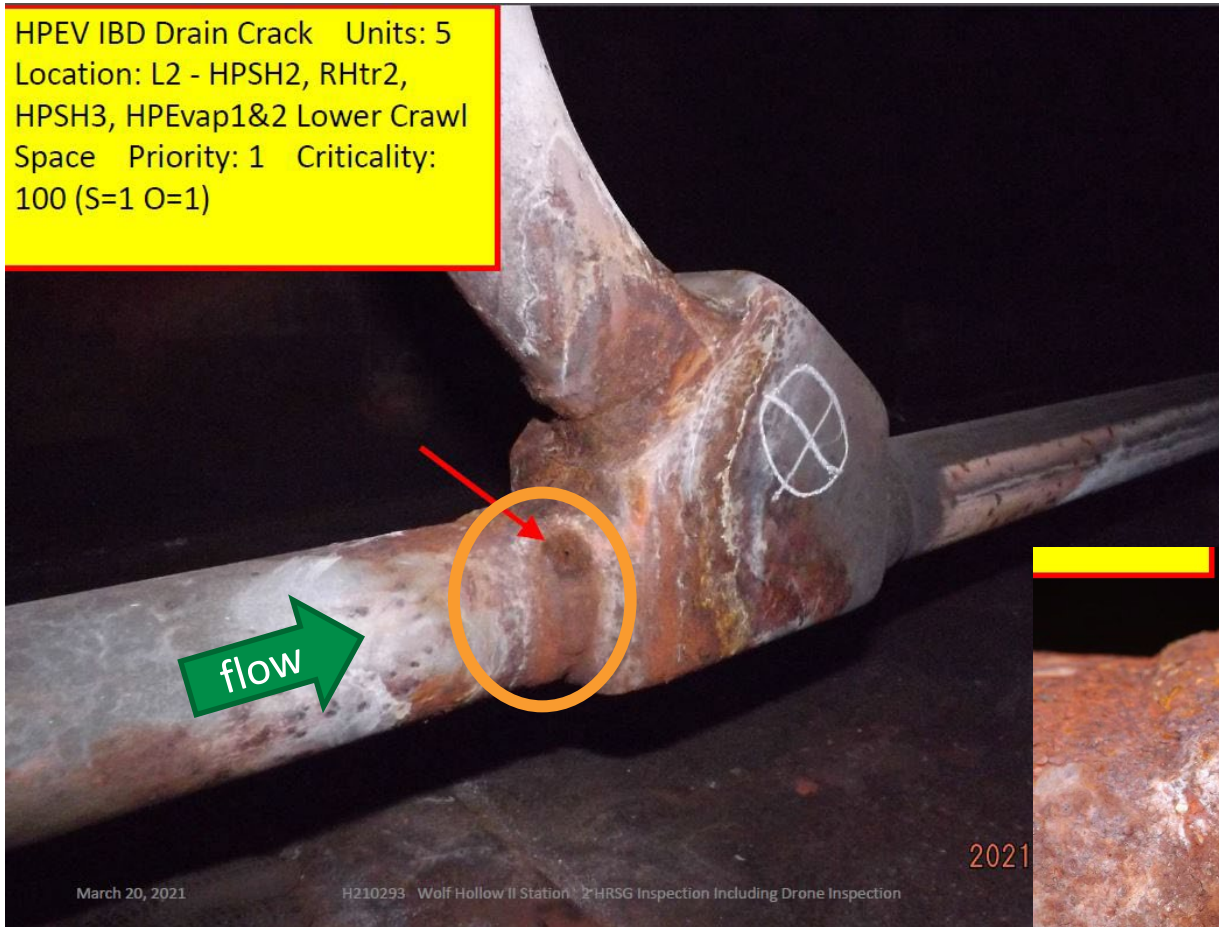
- At Wye from middle header (harp B)
- Leak at upstream weld
- Excavated and weld repaired

7) 2021 June

- At Wye from middle header (harp B)
- Leak at upstream weld
- Excavated and weld repaired

2021 March Failure

HPEV IBD Drain Crack Units: 5
Location: L2 - HPSH2, RHtr2,
HPSH3, HPEvap1&2 Lower Crawl
Space Priority: 1 Criticality:
100 (S=1 O=1)



2021 June Failure



WELD 6 INITIAL PT LINEAR INDICATION NOTED

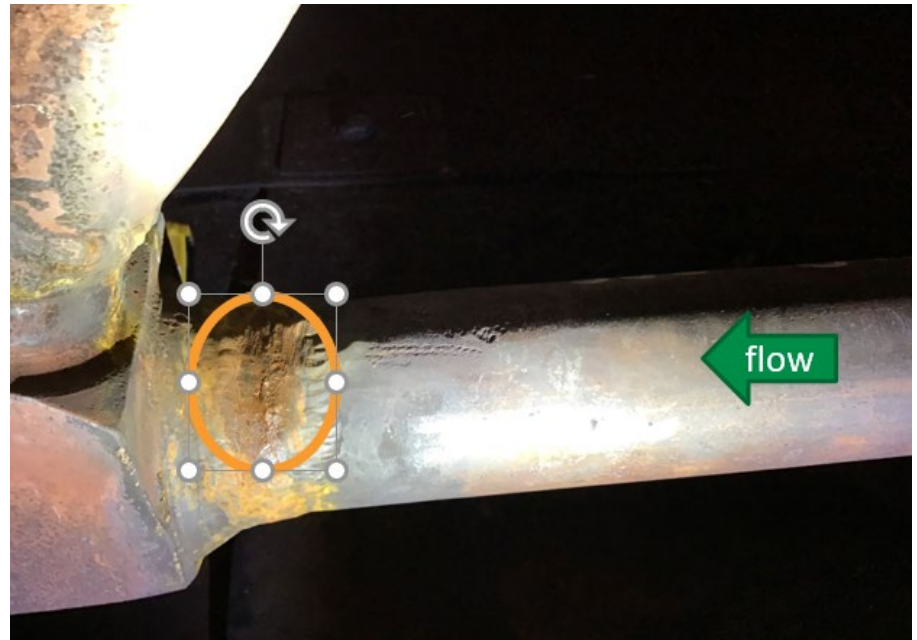


WELD 6 PREP/EXCAVATION

History (cont.)

8) 2021 October – Replacement

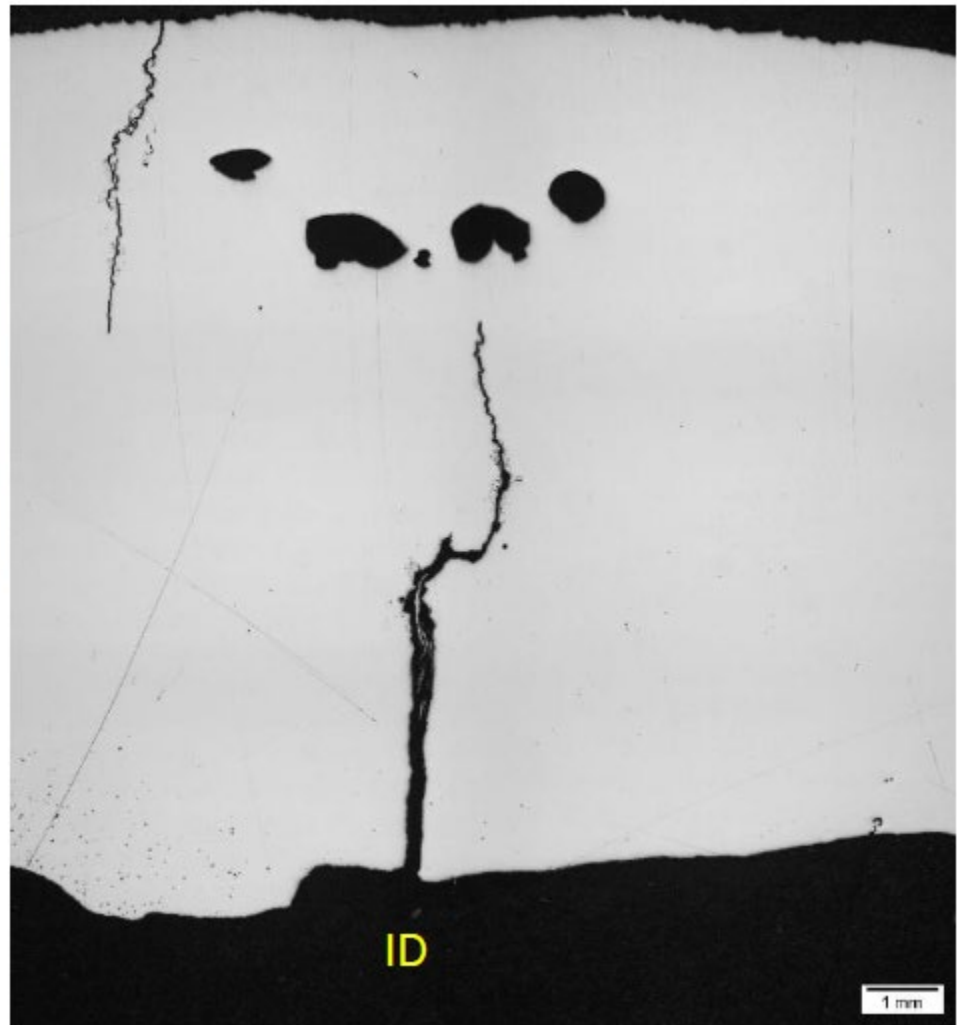
- At Wye from middle header (harp B)
- Leak at upstream weld
- Tube spool ~14" length removed u/s of wye w/ leak still intact
- New weld to wye and butt weld for pipe to pipe



Pipe Sample Removed



Metallurgical Failure Analysis



Metallurgical Analysis

- Failure analysis finally performed
- Stainless steel weld filler discovered
- Likely used during construction of field weld
- Subsequent repairs covering/hiding improper weld filler
- Remnants of improper weld filler since construction explain the repeated leaks and how often they occurred.

Metallurgical Failure Analysis

