Status Update
API Standard 6ACRA

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Denver, Colorado
Status Update: Ballot For API 6ACRA Addendum 2

• An SR³ was approved in 2016 for revisions to API 6ACRA

• Ballot #4471 was issued to SC6 on May 8, 2018 and covers:
  1. A procedure for balloting a new alloy or material class
  2. A revision to Table 1, Footnote d on Chemistry Limits.
  3. A revision to Section 4.2.4.3 on CVN retest requirements

• Ballot #4471 closes on June 19, 2018.
Status Update: Addition Of UNS N09955

• Foroni Metals requested UNS N09955 be added to API 6ACRA

• SR³ for this issue was approved in February 2017

• This new alloy has been balloted for inclusion in NACE MR0175 / ISO 15156 and now appears in ISO 15156-3:2015/Circ.2:2018 published on 1 June 2018.

• Foroni Metals has already submitted the documentation package used to ballot UNS N09955 for NACE MR0175 / ISO 15156 to the API TG Chairman

• Task Work on this issue will start after the API 6ACRA procedure for balloting a new alloy or material class has been approved .
• Böhler Edelstahl and VDM Metals requested a 150 KSI strength class of UNS N07718 be added to API 6ACRA

• An SR³ for this issue was approved in August 2017

• The new strength class has been balloted for inclusion in NACE MR0175 / ISO 15156 and now appears in ISO 15156-3:2015/Circ.2:2018 published on 1 June 2018.

• Task Work on this issue will start after the API 6ACRA procedure for balloting a new alloy or material class has been approved.
New Proposed SR³ For API 6ACRA: Reducing The HE Risk

- There have been several field failures of precipitation hardened nickel alloys that are in API 6ACRA
- The mode of crack initiation has been identified as intergranular cracking resulting from hydrogen embrittlement
- Laboratory testing has demonstrated different heat/heat treat lots of the same alloy can have widely varying resistance to hydrogen embrittlement
- There is concern that the current API 6ACRA Charpy V-notch acceptance criteria and microstructural analysis technique and acceptance criteria may not be sufficient for identifying material that has detrimental grain boundary precipitates
# New Proposed SR³ For API 6ACRA – Field Failures

<table>
<thead>
<tr>
<th>Component</th>
<th>Application</th>
<th>Alloy</th>
<th>Fractography</th>
<th>Potential Hydrogen Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface safety valve</td>
<td>Seawater injection well</td>
<td>UNS N07716</td>
<td>Brittle IG fracture with multiple initiation sites</td>
<td>Galvanic couple with carbon steel casing in contact with 1.09 sg NaCl brine treated with oxygen scavenger and biocide ¹</td>
</tr>
<tr>
<td>Tubular crossover</td>
<td>Deep water well</td>
<td>UNS N07725</td>
<td>TG brittle fracture</td>
<td>Reaction of chemicals and dope compounds sealed within the box connection ²</td>
</tr>
<tr>
<td>Subsea seals</td>
<td>Subsea</td>
<td>UNS N07725</td>
<td>IG brittle fracture</td>
<td>Cathodic Protection (CP) ³</td>
</tr>
<tr>
<td>Casing hanger</td>
<td>HTHP Production well</td>
<td>UNS N07718</td>
<td>Brittle IG fracture</td>
<td>Chemical decomposition of completion brine (Cesium formate)</td>
</tr>
<tr>
<td>Tubing hanger</td>
<td></td>
<td></td>
<td></td>
<td>Cu-plating and/or by galvanic coupling with carbon steel in contact with CO₂-containing brine.</td>
</tr>
</tbody>
</table>

1. P. Nice et al. NACE CORROSION 2014, Paper no. 3892  
2. S. Shademan et al. NACE CORROSION 2012, Paper no. 1095  
New Proposed SR$^3$ For API 6ACRA: JIPs

Joint Industry Projects on Hydrogen Embrittlement of API 6ACRA Alloys

- **DNVGL**
  Rapid Characterization of Materials Performance for HPHT Applications
  Status: Ongoing

- **DNVGL**
  Development of Guidelines for Use of PH725/625+ for O&G Applications
  Status: Scoping phase

- **Institut de la Corrosion / Southwest Research Institute**
  Hydrogen Stress Cracking of PH Nickel Alloys
  Status: Completed

- **Material Center Leoben (MCL)**
  High Strength Hydrogen Resistant Alloys – Module 2: Role of Microstructure on HE resistance of Precipitation Hardenable Ni-alloys
  Status: Ongoing
New Proposed SR\(^3\) For API 6ACRA

Action proposed:

- First, the Task Group should develop a ballot for a revision of Section 1.1 that more accurately addresses the benefits and limitations of the current processing requirements, raw material manufacturer qualification requirements, or production testing requirements in API 6ACRA.

- Second, the Task Group should review the findings of the current and future JIPs and individual company research related to this issue, and if sufficient information is available, propose new processing requirements and/or new raw material manufacturer qualification requirements and/or new production testing requirements.

Work Group Volunteers:

**OEMs**
- Tim Haeberle, BHGE
- Joel Russo, Technip-FMC
- Kevin Johnson, SLB
- William Howie, Weatherford

**Alloy Manufacturers**
- Sarwan Mannan, Special Metals
- John Goetz, ATI Metals
- Stan Gregory, Foroni Metals
- Thomas Williams, Carpenter

**End Users**
- James Buchannan, Chevron
- Brett Puckett, Shell
- Lee Smith (BP)
New Proposed SR³ For API 6ACRA

- Motion to approve the SR³
- Second?
- Discussion?
- API SC6 Vote
Thank you.