

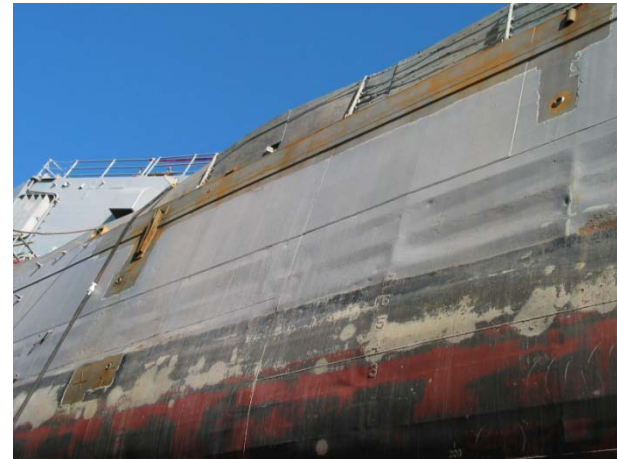
Review of Acceptable Flash Rusting for Ship Coatings

Final Report – March 24, 2009

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The Problem:

“Hand Lance Areas” Develop Moderate Flash Rust which must be Remediated



Background

- FY07 NSRP project
 - Ship inspection data suggest no significant performance difference between MFR and LFR
 - Round robin suggested that inspectors should be able to differentiate between MFR and HFR
- NSRP FY08 follow-on study
 - Based on feedback from Fleet Forces Command
 - Confirm that results are not unique to the shipyard/primer which was observed
 - Continue to collect data defining the risk of painting over MFR
 - Work with NAVSEA 05P23 to develop basis for CWP-351



Project Status

- Draft Final Report Nearly Completed
 - Collected Data from Ships in Service
 - Performed visual and/or physical inspection on eight ships
 - Have anecdotal inspection data from six additional ships
 - Evaluation of coating performance over Heavy Flash Rust
 - Testing per NAVSEA 05P23 guidance
 - Provided Basis for Navy CWP-351
- SSRAC Proposal
 - To be developed tomorrow

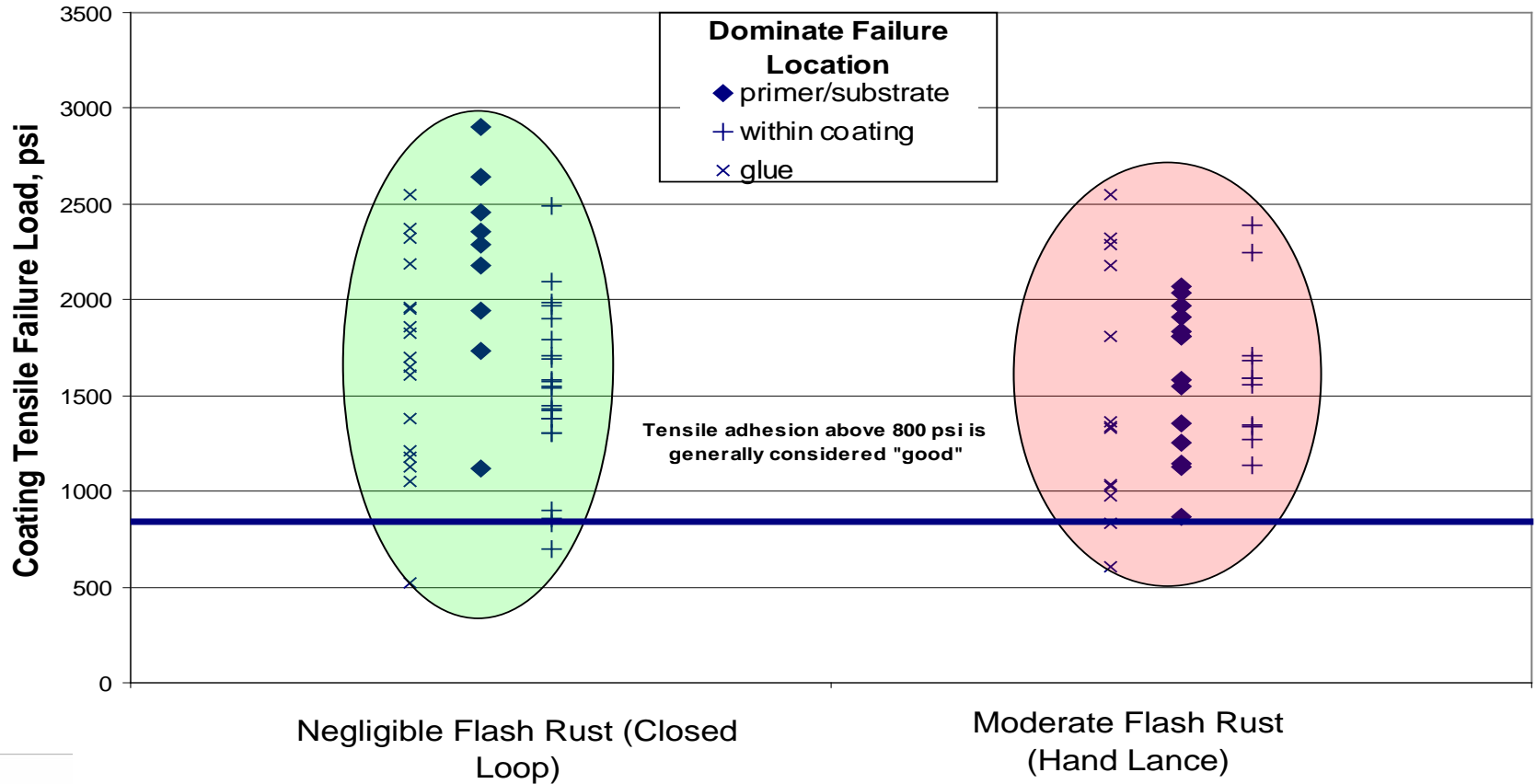


Navy Ships with Coating over MFR

- No evidence of catastrophic failure
- Work performed at multiple yards by various contractors
- Time in service up to 9 years
- USS KLACKRING (FFG 42)
- USS HUE CITY (CG 66)
- USS ROBERTS (FFG 58)
- USS BOONE (FFG 28)
- USS STENNIS (CVN-74)
- USS ENTERPRISE (CVN-65)
- USS HALYBURTON (FFG-40)
- USS THE SULIVANS (DDG-68)
- USS BELLEAU WOOD (LHA-3)
- USS LAMOURE COUNTY (LST-1194)
- USS ASHLAND (LSD-48)
- USS ESSEX (LHD-2)
- USS NASSAU (LHA-4)
- USS DULUTH (LPD-6)



Adhesion Data from Navy Ships In Service



Testing per 05P23 Recommendation

- Prepare flash-rusted panels that have “worst possible” heavy flash rust
 - What is the risk?
- Began preliminary evaluation of quantifiable tests for excessive flash rust
 - Is there a indisputable test where we can all agree on the results?

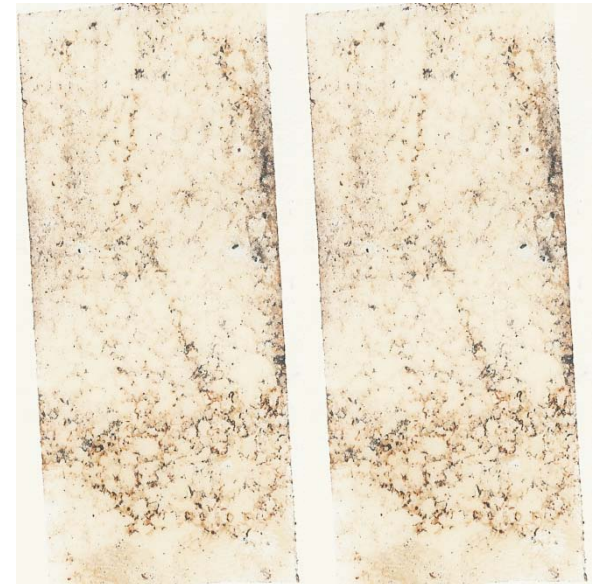
Panel Preparation

- Panels cut from heavily rusted steel plate
- Hand lance UHPWJ
- Flash rust developed over 8 days exterior exposure at Atlantic Marine in late July



“Heavy” Flash Rust Characterization – Current Methods

- SP-12 Evaluation
 - Red-brown
 - Hides the initial surface condition completely
 - Exhibits a layer of heavy...rust
 - Evenly distributed
- Wipe Test
 - Exhibited significant marking when lightly wiped with a white cloth wrapped around a 4-inch paint brush.
- Tape Test
 - All panels transferred some flash rust to the 10th tape applied in the same location
- Surface Conductivity
 - <30 to 72 uS
- Pull-off adhesion
 - Could adhesion tests with quick-cure epoxy be a viable QA tool?



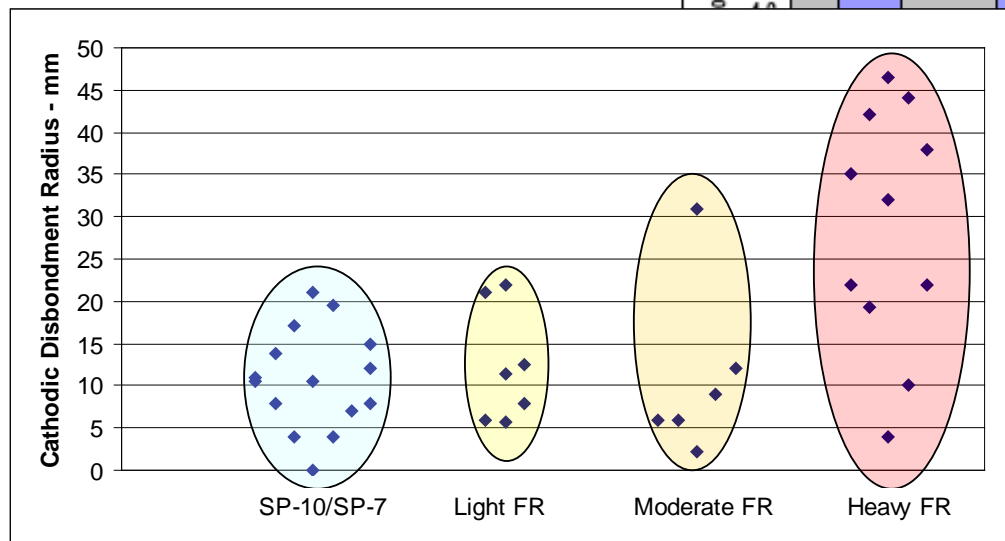
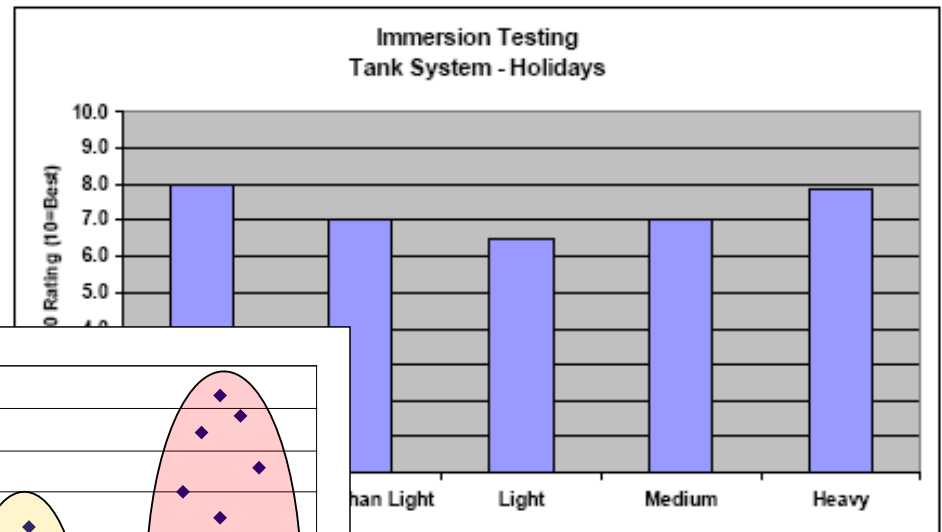
Coating Performance over Heavy Flash Rust

- Pull off Adhesion
 - Glue failures between 1300 and 2600 psi (Good result)
- Cathodic Disbondment Test
 - Failure radius similar to that previously observed



Corroborated by Laboratory Data

- Navy-sponsored lab testing suggests Heavy Flash Rust does not catastrophically impact coating performance
- More testing by CWP-351



Panel Testing Summary

- Suggests that existing condition descriptions should be able to discern Heavy Flash Rust
 - Provided basis for CWP evaluation of twelve or more alternative techniques
- Suggests that coating performance over Heavy flash rust will not be severely compromised
 - Risk associated with incidental application over Heavy Flash Rust is acceptable

Hand-off to CWP-351

- Provided a process for panel testing
 - The NSRP work formed the basis for CWP panel tests performed at NNSY and PSNSY
- Provided a basis for investigating more quantitative tools
 - The NSRP work investigated preliminary ideas which were the starting point for the CWP effort



Tape Test w/Transmittance Measurement

- Adaptation of Hempel “10 tape” test
 - Apply tape to flash rust
 - Rub ~10X with finger, using nail if necessary
 - Affix tape to clear glass slide
 - Measure transmittance at a location where the light intensity is less than 50 foot-candles
 - Retain glass with tape on it



Results from BOONE & NNSY Panel Preparation



Concluding Comments

- For the materials and service under consideration, allowing Moderate levels of flash rust introduces an acceptable risk
 - Differences in observed performance are at the margins of that which is detectable in the lab
 - Practical observations indicate any performance differences would not be catastrophic
- Be careful about extending the results
 - Some coatings may be more sensitive
 - Other environments (e.g., tanks) may have different issues

One last thing...

- Some project funds remain as a result of eliminating ship tests from the SOW
 - Propose making a draft addendum to VIS-4 based on the body of NSRP flash rust work

