

## Vogle PEmails

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**From:** Hoellman, Jordan  
**Sent:** Tuesday, April 12, 2016 8:00 AM  
**To:** Vogle PEmails  
**Subject:** Non-Proprietary - NDE for Welds Joining Couplers to SS and CS Embedment Plates  
**Attachments:** 2016-04-14 NDE for Welds Joining Couplers to Stainless and Carbon Steel Embedment Plates - Non-Proprietary.pdf

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ENCLOSURE 5

APP-GW-GLY-095, Rev. 0, "NDE for Welds Joining Couplers to Stainless and Carbon Steel Embedment Plates (Non-Proprietary)"

# Non-Proprietary Version of the Presentation



# NDE for Welds Joining Couplers to Stainless and Carbon Steel Embedment Plates (Non-Proprietary)

April 14, 2016



# Meeting Purpose and Agenda

## Meeting Purpose

- Discuss the proposed resolution paths for nondestructive examination (NDE) code nonconformance regarding carbon steel (CS) and stainless steel (SS) embedment plates with weldable coupler populations at Vogtle and V.C. Summer (VCS)
- Receive and address Staff feedback

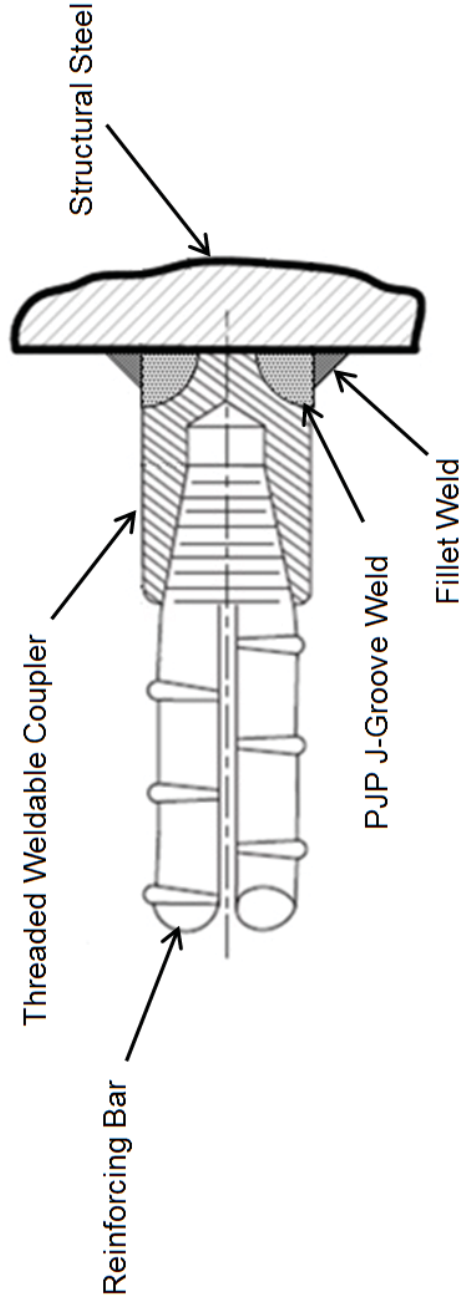
## Agenda

- Background
- Problem Statement & Proposed Resolution Paths
  - Vogtle Carbon Steel Couplers
  - VCS Carbon Steel Couplers
  - Vogtle/VCS Stainless Steel Couplers (Including Testing)
- LAR Submittal Timing



# Background Information

- Weldable couplers are utilized in the AP1000 design where reinforcing bars are attached to structural steel
- The coupler is connected by a weld to the structural steel
  - The coupler is welded via a PJP J-Groove with fillet reinforcement
- Per UFSAR subsection 3.8.4.5, “Structural Criteria,” the analysis and design of concrete and structural steel conform to ACI 349-01 and AISC N690-1994.



# AISC N690-94 Q1.26 Nondestructive Examination Requirements

## Q1.26.2 MINIMUM EXAMINATION OF WELDS

All welds shall be visually examined in accordance with Section Q 1.26.1.5 for 100 percent of their length.

### Q1.26.2.2 PARTIAL-PENETRATION WELDS

Partial-penetration welds shall be 10 percent inspected by magnetic particle examination or liquid penetrant examination. The examination may be 10 percent of each weld or 100 percent of one weld in ten.

### Q1.26.2.3 WELD SAMPLES

If a weld inspected in Section Q1.26.2.1 or Q1.26.2.2 does not meet the acceptance criteria given in Section Q1.26.1, a second 10 percent sample shall be taken. The second sample should include any weld immediately adjacent to the first sample, to determine the extent of the defect found in the first sample. If this sample does not meet the acceptance criteria, all welds represented by the samples should be inspected.

### Q1.26.3 REPAIR AND REEXAMINATION

All unacceptable welds shall be repaired using an Owner approved repair procedure. After repairs have been made, the repaired weld shall be 100 percent examined with the same method that disclosed the original defect(s).



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**All welds shall be visually examined.  
PJP welds shall be 10% MT or PT examined.**



# Summary - Problem Statement & Proposed Resolution

## Problem Statement:

- Contrary to AISC N690-1994, Q1.26 MT/PT examination requirements, populations of CS and SS embedment plates with weldable couplers were installed at Vogtle and VCS without this requisite NDE having been performed

## Proposed Resolution Paths:

- NDE code nonconformance is addressed via three independent LARs:
  1. LAR-134 for CS weld population at Vogtle
  2. LAR-140 for CS weld population at VCS
  3. LAR-129 for SS weld population at Vogtle & VCS
- The three LARs address similar NDE code nonconformance issues, but LAR technical evaluations vary based on gathered data
- As the work related to these LARs is currently ongoing, the data presented in later slides is subject to change pending LAR finalization



Proposed resolution paths presented in  
more detail on following slides

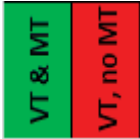
# LAR-134: Vogtle Carbon Steel



## Location - Vogtle Carbon Steel

- Location of installed population of CS embedment plates with weldable couplers:
  - Cives fabricated population:
    - Vogtle Units 3 & 4 under CA01 & CA05 modules
    - Vogtle Unit 4 under CA20 module
  - Joseph Oat fabricated population:
    - Vogtle Unit 3 under CA20 module

# Vogtle Cives Carbon Steel Data



Reason for LAR: MT not representative  
of entire population.

# Vogtle Joseph Oat Carbon Steel Data



# LAR Approach

- Licensing Basis Change
  - LAR to demonstrate that the coupler welds are suitable for performing their intended design function
- The evidence of suitability to perform intended design function will be demonstrated by a combination of:
  1. VT successfully performed on original weld population
  2. Static testing successfully performed on original weld population
  3. MT successfully performed
    - Recognizing that the MT sample population was not completely representative of the installed welds

# Vogtle Carbon Steel LAR Justification Status

a,b,c

## Vogtle Carbon Steel LAR

- Scope: Combine J. Oat & Cives
- Reason: MT not representative
- Justification:
  - VT Examination
  - Static Testing
  - MT Examination

# Vogtle Carbon Steel Licensing Basis Changes

## 3.8.4.5.2 Supplemental Requirements for Steel Structures

[Supplemental requirements for use of AISC-N690 are as follows:

- [In Section Q1.26.2.2, for the nonconforming partial penetration welds associated with reinforcement bar size #9 C3J couplers installed on carbon steel embedment plates under CA20 at Vogtle Unit 3 that did not undergo nondestructive examination at the time of fabrication, the strength and behavior of the welds is demonstrated through static testing and nondestructive examination of an additional population as follows:
  - o Visual Examination: 872 visual examinations were performed on coupler welds from the original fabricated population. The visual examinations provided satisfactory results.
  - o Static Testing: 15 static tensile tests were performed on coupler welds from the original fabricated population. The testing demonstrates that the coupler, partial penetration weld, and reinforcement bar system develops at least 125% of the specified yield strength  $F_y$  of the reinforcement bar.
  - o Nondestructive examination of an additional population: Additional embedment plates were procured from the same fabricator utilizing the same weld procedures. Magnetic particle examination was performed on 110 coupler welds, representing 10% of the total population of welds fabricated by the supplier. The magnetic particle examination provided satisfactory results.



# Vogtle Carbon Steel Licensing Basis Changes (cont.)

- In Section Q1.26.2.2, for the nonconforming partial penetration welds associated with reinforcement bar size #9 C3J couplers installed on carbon steel embedment plates under CA01 and CA05 at Vogtle Units 3 and 4 and under CA20 at Vogtle Unit 4 that did not undergo nondestructive examination at the time of fabrication, the strength and behavior of the welds is demonstrated through static testing and nondestructive examination of the original population as follows:
  - Visual Examination: 1214 visual examinations were performed on coupler welds from the original fabricated population. The visual examinations provided satisfactory results.
  - Static Testing: 20 static tensile tests were performed on coupler welds from the original fabricated population. The testing demonstrates that the coupler, partial penetration weld, and reinforcement bar system develops at least 125% of the specified yield strength  $F_y$  of the reinforcement bar in 18 tests. In 2 of the tests, breaks in the bar and the thread occurred before exceeding 125%  $F_y$  of the reinforcing bar, but no failure of the couplers or the coupler welds occurred during this testing.
  - Nondestructive examination of the original population: Magnetic particle examination was performed on 122 coupler welds, representing 10% of the total population of welds fabricated by the supplier. The magnetic particle examination provided satisfactory results.]\*



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Cives Weld Population Changes to  
UFSAR Tier 2\* Section 3.8.4.5.2

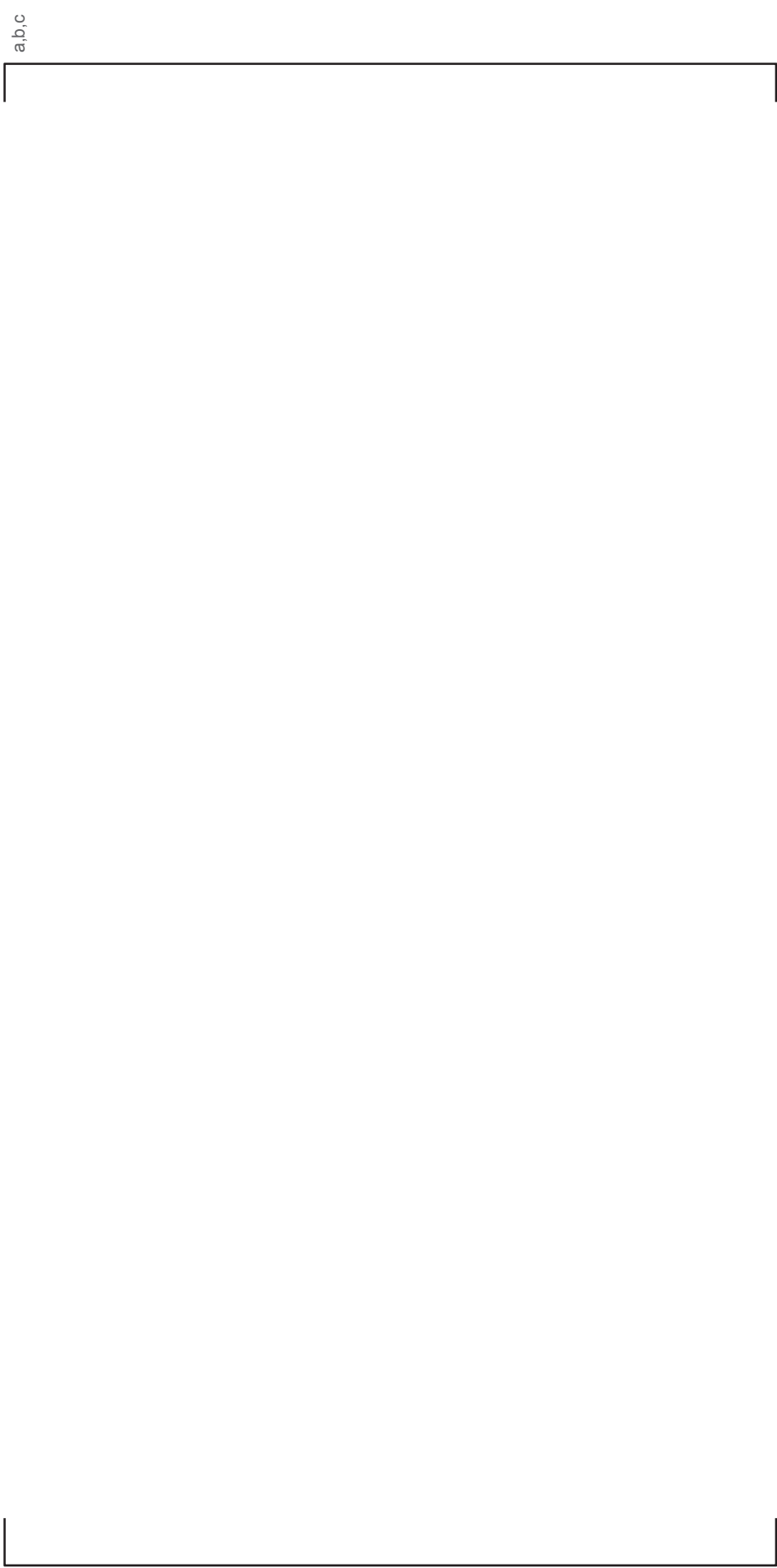
# LAR-140: V.C. Summer Carbon Steel



## Location - VCS Carbon Steel

- Location of installed population of CS embedment plates with weldable couplers:
  - Cives fabricated population:
    - VCS Units 2 & 3 under CA01, CA05, & CA20 modules

# VCS Cives Carbon Steel Data



Reason for LAR: MT not representative  
of entire population.

# LAR Approach

- Licensing Basis Change
  - LAR to demonstrate that the coupler welds are suitable for performing their intended design function
- The evidence of suitability to perform intended design function will be demonstrated by a combination of:
  1. VT successfully performed on original weld population
  2. Static Testing performed on Vogtle original weld population
    - Vogtle static testing results utilized due to differences in site test configurations. Use of Vogtle test results is justified due to overlap between Vogtle & VCS Load VT timelines
  3. MT successfully performed
    - Recognizing that the MT sample population was not completely representative of the installed welds



LAR Justification shown on the following slide

# VCS Carbon Steel LAR Justification Status

a,b,c

## VCS Carbon Steel LAR

- Scope: Cives
- Reason: MT not representative
- Justification:
  - VT Examination
  - Static Testing
  - MT Examination

# VCS Carbon Steel Licensing Basis Changes

- UFSAR markups are still in development
- Intention is to add similar supplemental requirements to UFSAR Subsection 3.8.4.5.2, as seen in LAR-134 draft markups

# LAR-129: Vogtle & VCS Stainless Steel

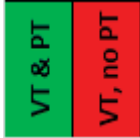
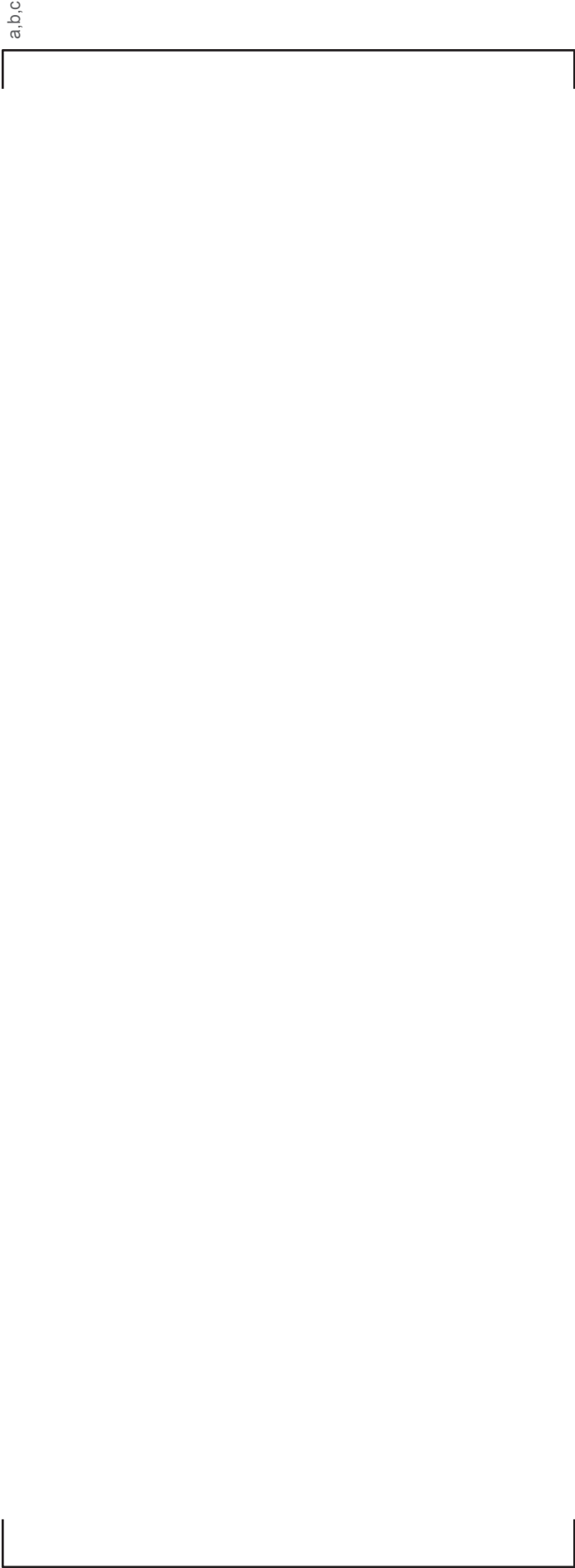




## Location – Vogtle & VCS Stainless Steel

- Location of installed population of SS embedment plates with weldable couplers:
  - Cives fabricated population:
    - Under CA01 module and supporting PXS screens and raceways/cable trays

# Vogtle Cives Stainless Steel Data



Reason for LAR: PT sample not representative of entire population.

# V.C. Summer Cives Stainless Steel Data



Reason for LAR: PT sample not  
representative of entire  
population.

# Stainless Steel VT & PT Results

a,b,c

- Additional PT was performed at Vogtle to investigate weld profiling impacts on NDE results
- Additional PT at VCS was performed as initial PT results were not representative of all SS loads provided to site



## Stainless Steel VT & PT Results (cont.)

- AISC N690-1994 PT samples at Vogtle along with additional PT samples at Vogtle and VCS yielded indications
- These PT indications, along with the PT samples not being representative of the entire installed population, result in the need for a LAR

# LAR Approach

- Licensing Basis Change
  - LAR to demonstrate that the coupler welds are suitable for performing their intended design function
- The evidence of suitability to perform intended design function will be demonstrated by a combination of:
  1. VT successfully performed on original weld population
  2. Static (Tensile) testing method developed and performed on uninstalled couplers from original population
    - Tensile testing to demonstrate that the strength of the welds meets or exceeds the design strength
    - Test samples include an array of couplers with PT indications after conditioning, couplers with indications but with no conditioning, and couplers distributed amongst Cives fabrication loads for Vogtle and VCS

# Vogtle & VCS Stainless Steel Licensing Basis Changes

- UFSAR markups are still in development
- Intention is to add similar supplemental requirements to UFSAR Subsection 3.8.4.5.2, as seen in LAR-134 draft markups

# Stainless Steel Coupler Testing

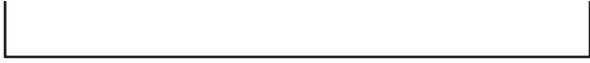




# Stainless Steel Coupler Test - Overview

- Tensile testing is performed to demonstrate that the strength of the coupler welds is sufficient so that they are capable of performing their intended design function
- Discussions on the following slides provides detail regarding the stainless steel coupler testing method and test samples

# Coupler Body Weld Build-up



a,b,c

# Coupler Specimen Testing Fixture Installation



# Representative Test Specimen Configuration



# Representative Testing Machine Configuration



# Stainless Steel Pretest Results



# Stainless Steel Pretest Results (cont.)

[Redacted]

[Redacted]

a,b,c

# Stainless Steel Coupler Test

- Selection of welding considered factors such as: Welder ID, Welding Process and Procedure, Coupler Size, Start & Finish Date of Plate Production and NDE Status

a,b,c



## Discussion on test plan

# Summary



# Summary

- NDE code nonconformance is addressed via three LARs:
  1. LAR-134 for CS weld population at Vogtle
  2. LAR-140 for CS weld population at VCS
  3. LAR-129 for SS weld population at Vogtle & VCS
- Each of the three LARs intend to demonstrate that while not in conformance with AISC N690-1994 requirements for NDE, the coupler welds are suitable for performing their intended design function

# LAR Submittal Dates

	a,c

# Questions & Discussion

