

# Induction Straightening for CVN ManTech Project No. S2664

**NSRP All Panel Meeting  
March 7-9, 2017  
Charleston, SC**

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# Presentation Outline

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- Project Team
- Schedule
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- Next Steps

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# Acknowledgements



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- NSAM is a Navy ManTech Center of Excellence funded by the Office of Naval Research (ONR)
- We thank the NSRP Program for allowing us to brief the program to their membership

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# ManTech Program Overview



- **Project will be executed in two 12-month phases**

- Phase I will determine technical acceptability of induction straightening by executing a test plan to develop and evaluate induction straightening parameters that do not adversely affect Carrier material properties
- Phase II will determine the effectiveness of the developed induction heating parameters to straighten material
- Based on the results of this project, NNS will generate the data needed for a process qualification package to submit to NAVSEA, quantify the potential cost savings, and create a shipyard implementation plan

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# Project Goals / Objectives

- **Current construction uses flame straightening to flatten deck and bulkhead panels**
  - Although effective, flame straightening is time consuming and inherently inconsistent
  - Flame straightening requires numerous application zones across the full area of a panel that often need to be repeated multiple times
- **Dramatically different heating and cooling rates for flame straightening and induction straightening will require careful development of process parameters for Carrier materials**

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# Project Goals / Objectives (cont'd)



## ● Project Goals

- Implement induction straightening for FORD Class Carrier construction
- Realize cost savings upwards of 50%

## ● Project Objectives

- Determine induction straightening parameters to effectively straighten Carrier materials without adversely affecting material properties
- Quantify the anticipated cost savings associated with implementing induction straightening

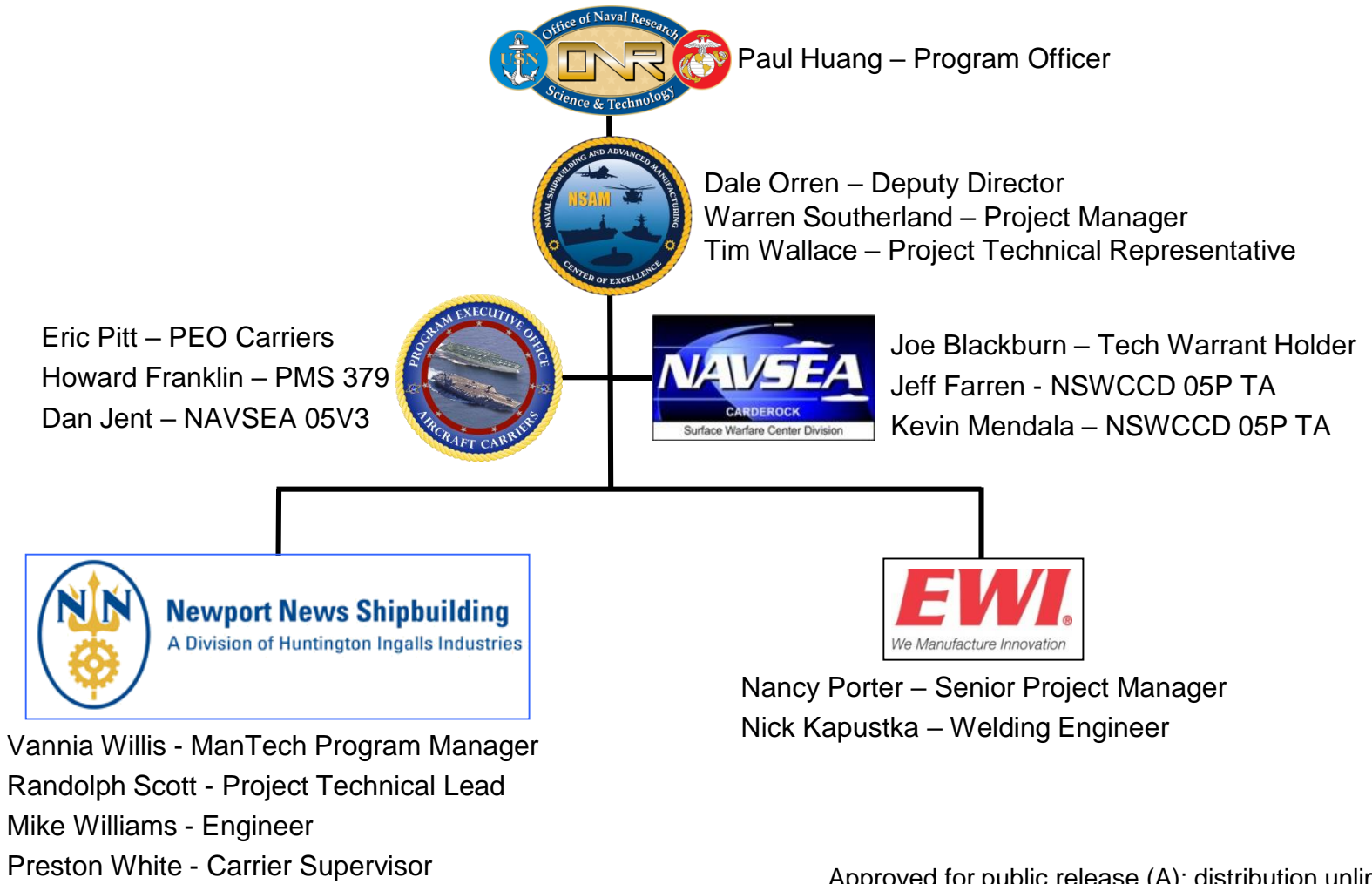
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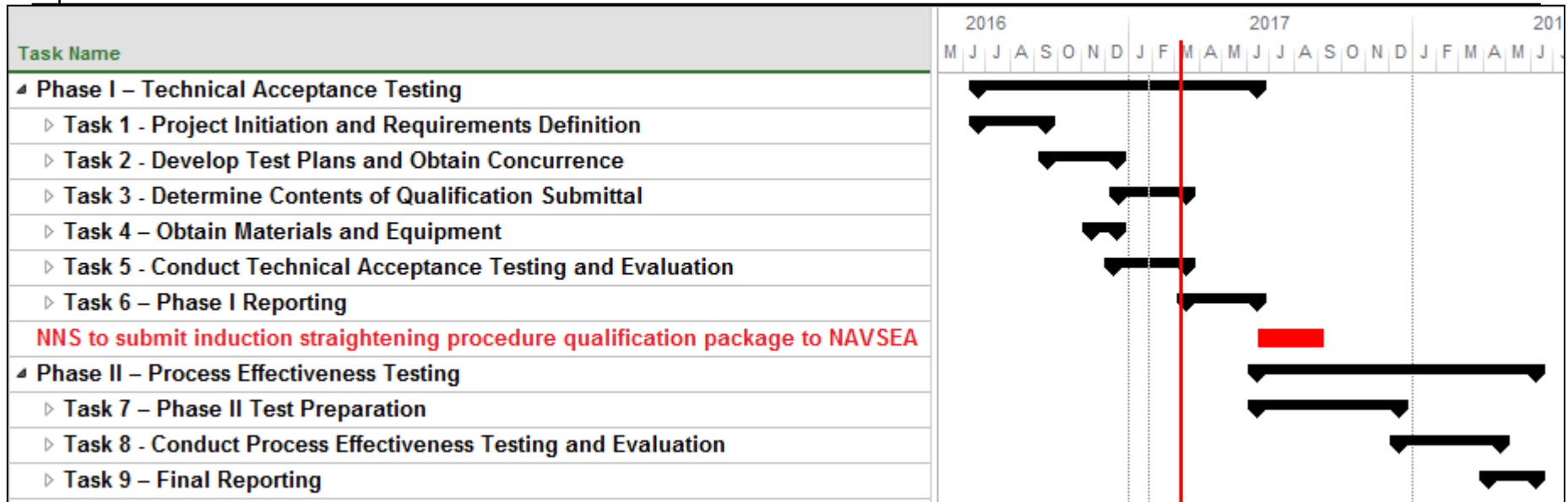


# Project Team



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# High Level Schedule



Today →

- Period of performance: 6-21-16 through 6-16-18
- This project started in June 2016
  - Ready to develop induction straightening parameters

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# Technical Approach



## ● Phase I – Technical Acceptance Testing

- Requirements Definition
- Develop Test Plans and Obtain Concurrence
- Determine Contents of Qualification Submittal
- Obtain Materials and Equipment
- Conduct Technical Acceptance Testing and Evaluation
- Go/No-Go Decision for Phase II Execution

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# Technical Approach (cont'd)



## ● Phase II – Process Effectiveness Testing

- Test Preparation
- Conduct Process Effectiveness Testing and Evaluation
- Go/No-Go Decision to Implement Based on Process Effectiveness Testing Results

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# Requirements Definition

- **Will evaluate 3 materials thicknesses**
- **Will apply the induction straightening to**
  - Decks
  - Bulkheads
  - Shell plating
- **Induction heating process parameters that need to be limited (or strictly controlled)**
  - Peak temperature
  - Number of permitted heat cycles

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# Requirements Definition

- **Material property requirements that must be maintained after induction straightening**
  - Charpy impact strength
  - Yield strength
- **Panel fairness not to exceed limitations defined in NNS drawings and the Carrier specifications**

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# Requirements Definition

- **Induction straightening will be applied**
  - To vertical or horizontal surfaces
  - With a hand held heating coil
  - On the top side of decks and occasionally on both sides of bulkheads
  - In any direction with respect to the material rolling direction
  - Heat bands can be overlapped if necessary
  - Heat treated areas will be water cooled or air cooled
  - Paint on the heated and unheated side of a plate shall be removed per NNS Health & Safety requirements

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# Induction Heating Equipment

- **EFD induction straightening equipment**
  - Power supply: Miniac 18/25
  - Coil: HHT 240 mobile induction heating gun system
- **Using EFD preferred standard methodology for setting up the equipment for induction straightening of deck plates**



Photo provided by EWI

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# Parameter Development

- Using EFD preferred methodology for applying induction heating to straighten deck plates



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Photo provided by EFD



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# Test Plans

- **Two Test Plans were Developed**

- **Technical Acceptance Test Plan**

- Defined testing to evaluate the technical acceptability of the process

- Quality accept/reject criteria
- Optimal specimen layout for required test specimens
- Mechanical testing to verify that process parameters don't adversely affect material properties
- Seeking Technical Warrant Holder (TWH) concurrence with the plan
- Will start testing after TWH concurrence with the plan

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# Test Plans

## ● Process Effectiveness Test Plan

- Defined the testing required to evaluate the straightening effectiveness of induction heating
  - Restrained mock-up panel designed
  - Quality accept/reject criteria after straightening
    - Fairness
    - Surface condition
  - Defined an induction straightening test sequence
    - Mock-up will be inspected after each step in the sequence
  - Will validate EWI developed induction heating parameters on plate in the shipyard using deck plate personnel

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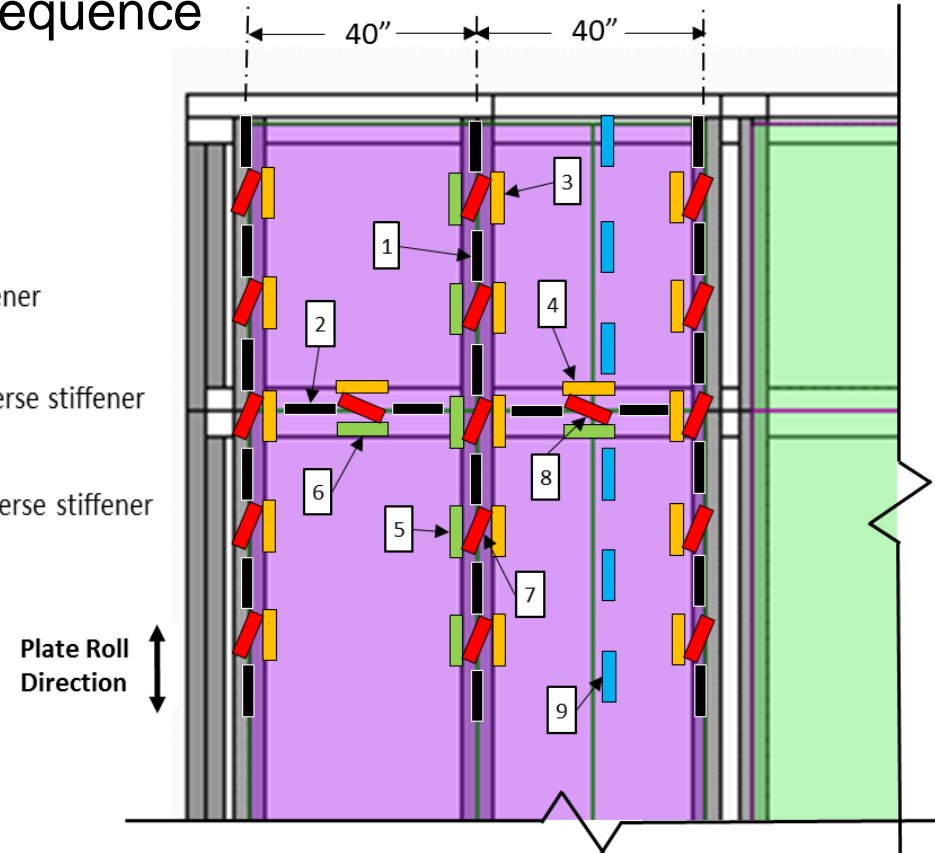


# Test Plans

## ● Process Effectiveness Test Plan (cont'd)

### ➤ Induction straightening test sequence

-  Induction Heating directly over longitudinal or transverse stiffener
-  Induction Heating to one side of the longitudinal or transverse stiffener
-  Induction Heating to the opposite side of the longitudinal or transverse stiffener
-  Induction Heating applied diagonally over the longitudinal or transverse stiffener
-  Induction Heating along the side of a butt weld



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Test Plan statement noted for a mockup

# Next Steps

## ● Phase I – Technical Acceptance Testing

- Complete induction heating parameter development
- Conduct Technical Acceptance Testing
- Go/No-Go Decision for Phase II Execution

## ● Phase II – Process Effectiveness Testing

- Test Preparation
- Conduct Process Effectiveness Testing and Evaluation
- Go/No-Go Decision to Implement Based on Process Effectiveness Testing Results

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# Questions?

