



Bureau of Safety and Environmental Enforcement

# **BSEE Bolts Technical Evaluation Approach**

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BSEE - API Meeting  
Houston, Texas  
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*"To promote safety, protect the environment and conserve resources offshore through vigorous regulatory oversight and enforcement."*

# **BSEE Research Activities**

- **National Academy of Science (NAS) Bolts Root Cause Analysis (RCA) Workshop**
- **BSEE Current Bolts Research & Analysis**
  - **Lawrence Berkeley National Laboratory (LBNL)**
  - **National Aeronautics and Space Administration**
- **QC-FIT Evaluation**
- **Future Research Project**

# NAS Bolts RCA Workshop

- Past NAS work for BSEE
  - Best Available Safest Technology (BAST) (Sept. 2013)
  - Real Time Monitoring (RTM) (April 2015)
- NAS Bolts RCA workshop approach is to seek expert opinion and input on bolts issue for critical components
- Bolts issue is of high importance for critical components such as: Blowout Preventer (BOP), Blind Shear Ram (BSR), Lower Marine Riser Package (LMRP), H4 Connector Bolts, Pipelines, etc.
- Safety and environment protection is very important.

# NAS Bolts RCA Workshop

- NAS Bolt RCA Workshop Details:
  - Who: Industry (Public) meeting
    - NAS selects the Industry Bolt Subject Matter Experts
    - NAS elects the chair person
    - Chair to host the meeting
    - Anyone can attend
  - When: Late 3<sup>rd</sup> or early 4<sup>th</sup> Quarter 2016
  - Where: Washington, DC

# NAS Bolt RCA Workshop Themes

- Evaluate connectors (bolts) currently in use for offshore oil and natural gas operations
  - Selection of design factors, fatigue cyclic loading, connectors and bolt manufacture, etc.
  - Bolt/bolt equipment Manufacture processing condition factors: raw material, forging, heat treatments, machining, coatings, etc., associated design standards
  - Material properties requirements: mechanical properties (Yield Strength, Ultimate Tensile Strength, Hardness), coatings, corrosion performance, and cathodic protection
- Focus on issues that have potential industry wide (global) impact(s)

# NAS Bolt RCA Workshop Themes

- Identify gaps in industry requirements, best practices, standards and regulations for offshore oil and gas.
- Draw upon bolt usage strategies across other industries :
  - Onshore oil and gas,
  - Refineries
  - Pipeline,
  - Aerospace, aviation,
  - Nuclear, military, naval (submarine and ship),
  - Automotive and jurisdictions;
- QA/QC concerns that may impact safety and the environment on the OCS
- Quality Management Systems (QMS)

# BSEE Attempt to form a Bolt JIP

- BSEE met with industry and tried to develop a Bolt Joint Industry Project (JIP) through DNV in 2015
- 6 industry participants were initially interested.
- Goal was to initiate work based on BSEE GE H4 Connector QC-FIT Report's conclusions and recommendations.
- Potential industry participants withdrew from the Bolt JIP
- BSEE initiated other measures to address Bolt concerns on its' own

# BSEE Current Bolts Research

## ● BSEE Initiated Research Activities

- Lawrence Berkeley National Laboratory (LBNL)
  - National Aeronautics and Space Administration
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- Results from these activities will dictate any future BSEE research projects
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- BSEE is monitoring industry research/standards activities



# Lawrence Berkeley National Laboratory (LBNL)

## Bolts Research

- BSEE has a five year Inter Agency Agreement (IAA) with Department of Energy (DOE) - Argonne National laboratory (ANL)
- BSEE thru ANL contracted LBNL to conduct research on bolts because of their materials science expertise with focus in following areas:
  - GE QC-FIT - Quality management process was limited to prime contractor or 1<sup>st</sup> tier level and did not address to 2<sup>nd</sup> and 3<sup>rd</sup> sub-tier levels
  - Variation in standards (material properties)
  - Inconsistency in material properties
  - Zinc coating process and post heat treatment process relating to Hydrogen Embrittlement
- Global standards evaluation and gap analysis:
  - API, ASTM, ISO, etc.
- LBNL to conduct mechanical testing of BSR bolt failure

# National Aeronautics and Space Administration (NASA)

- BSEE has a five year agreement with NASA focusing on the following areas:
  - Quantitative Risk Assessment
  - Best Available Safest Technology
  - Failure Analysis and Testing Services associated with QC FIT evaluations
    - Bolts

## QC – FIT: GE H4 Connector Bolts failure on LMRP

- Connector and Bolt Failure evaluation:
  - Contributing factors for the cause of the bolt failure:
    - Inconsistencies across industry standards for material properties requirements related to fasteners (bolts/connectors)
      - Hardness, YS, UTS
    - Industry Standards with different material property requirements
      - Zinc Electroplating and Post Heat Treatment issues
    - QMS audited to 1<sup>st</sup> tier subcontracted vendors but not further down to 2<sup>nd</sup>, 3<sup>rd</sup> tier and lower sub-contracted vendors.

# QC – FIT: GE H4 Connector Bolts failure on LMRP

## ○ Connector and Bolt Failure evaluation:

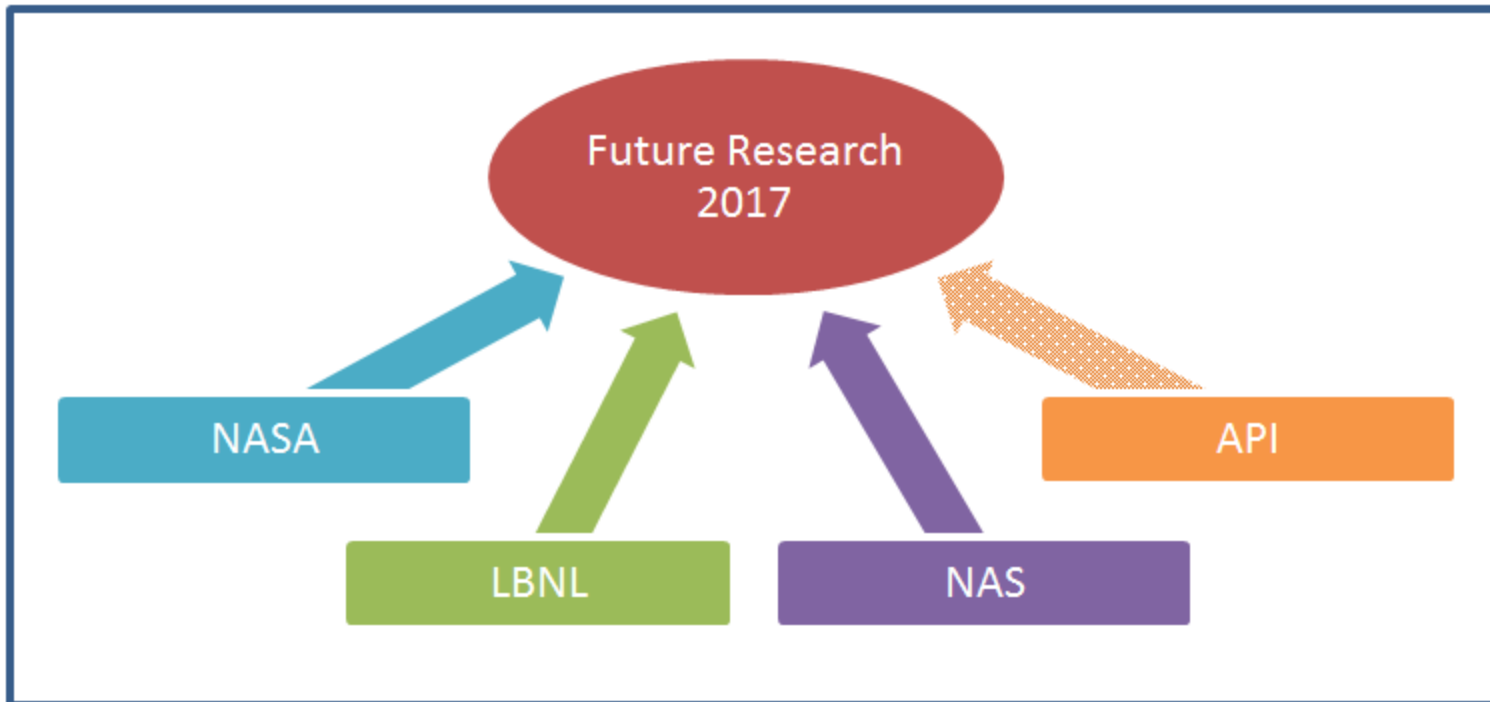
### ○ Recommendations:

- Consistent material property requirements for fasteners among standards
  - Material Properties (Hardness, YS, UTS)
  - Coatings
- OEM needs robust QMS oversight of 2<sup>nd</sup>, 3<sup>rd</sup>, and lower tier subcontracted vendors (Quality Standards)
- OEM to perform qualification and audit of 2<sup>nd</sup>, 3<sup>rd</sup>, and lower tier sub-contracted vendors

# Bolts Summary Overview

- Public NAS Bolt RCA Workshop
  - Identify gaps in industry requirements, best practices, standards and regulations
- LBNL to conduct
  - Research on bolts
    - Material properties, gap analysis, variation in standards
  - Material testing to validate material properties for failed component
- NASA to conduct
  - Failure analysis and materials testing associated with QC-FIT evaluations
- Results from the above activities will be shared for the benefit of the industry.
- Outcome of these activities may dictate future research on bolts

# Future Bolts Research



BSEE Website: [www.bsee.gov](http://www.bsee.gov)



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