

## SSC Project Recommendation for FY 2019

### **A Survey of Safety and Materials Guidance for Ammonia Fueled Ships**

#### **1.0 OBJECTIVE.**

- 1.1 This project is designed to develop safety and materials guidance documentation for ammonia fueled ships, with a particular focus upon the structural standards and regulations for the carriage, storage, and transmission of anhydrous ammonia fuel.

#### **2.0 BACKGROUND.**

- 2.1 Ammonia has long been mass-produced and used as a refrigerant and as a key ingredient in fertilizer for the agricultural industry. Only recently has it gained traction as a viable option for fuel or energy storage due to its lack of hydrocarbon byproducts. Even more recently, efforts to produce mass quantities of ammonia without the need for hydrocarbon inputs—as was typically the case in the industry—have been seriously explored and considered viable on an industrial scale.
- 2.2 Thanks to its ubiquity in global industries, ammonia has an existing infrastructure in place for storage and transportation, and it can be easily produced from gaseous hydrogen or other carbon free inputs [8.5, 8.10].
- 2.3 Ammonia has been shown to be a versatile fuel source, either in the fuel cell form or for combustion in turbines and internal combustion engines [8.9].
- 2.4 The United States Coast Guard, in partnership with other industry experts, develops rules and regulations regarding the safe use and transport of various hazardous substances for both cargo and fueling purposes. As of yet, there is no such documentation for ammonia fuel, especially as it pertains the structural modifications necessary to viably transport it.

#### **3.0 REQUIREMENTS.**

- 3.1 Scope.
  - 3.1.1 The Contractor shall identify and conduct an assessment of existing documentation pertinent to the safe handling, storage, and use of ammonia as a fuel source.
  - 3.1.2 The Contractor shall address the existing research and documentation to establish a sound technical basis for regulations, guidance, and necessary structural modifications related to the carriage of ammonia as fuel.
  - 3.1.3 The Contractor shall compile and expand upon existing documentation from worldwide resources and their respective research and expertise, in order to create the definitive documentation for the proper carriage of ammonia as fuel aboard ships.

3.2 Tasks.

- 3.2.1 The Contractor shall compile and maintain a chronological record of the general commercial and industrial production and uses of ammonia.
- 3.2.2 The Contractor shall compile and maintain a chronological record of existing documentation pertinent to the safe handling, storage, and use of ammonia as a fuel.
- 3.2.3 The Contractor shall develop documentation for recommended practices and structural modifications necessary for safe handling and storage of ammonia used as a fuel source on sea-going vessels.
- 3.2.4 The Contractor shall develop documentation for recommended practices and structural modifications necessary for the auxiliary equipment and materials that must be in place to support the use of ammonia as a fuel source upon sea-going vessels.
- 3.2.5 The Contractor shall develop documentation pertinent to the safe handling, storage, and use of ammonia as a fuel upon sea-going vessels intended as the definitive reference material on the topic for the Ship Structures Committee and other entities, including but not limited to the US Coast Guard Office of Standards Evaluation and Development (CG-REG).

3.3 Project Timeline:

This project is estimated to be performed over a nine month period from the date of the award. Over the first two months, relevant literature will be reviewed and a comprehensive chronology of the commercial and industrial use of ammonia will be compiled. Over the next four to five months, existing technical documentation will be reviewed and studied in tandem with performing independent research on the topic for which the technical documentation does not yet exist. The last two to three months will then be spent producing our own documentation, contained within the final SSC work product.

**4.0 GOVERNMENT FURNISHED INFORMATION.**

- 4.1 Standards for the Preparation and Publication of SSC Technical Reports.

**5.0 DELIVERY REQUIREMENTS.** (Identify the deliverables of the project).

- 5.1 The Contractor shall provide quarterly progress reports to the Project Technical Committee, the Ship Structure Committee Executive Director, and the Contract Specialist.
- 5.2 The Contractor shall provide a print ready master final report and an electronic copy, including the above deliverables, formatted as per the SSC Report Style Manual.

**6.0 PERIOD OF PERFORMANCE.**

- 6.1 Project Initiation Date: date of award.
- 6.2 Project Completion Date: 9 months from the date of award.

**7.0 GOVERNMENT ESTIMATE.** These contractor direct costs are based on previous project participation expenses.

- 7.1 Project Duration: 9 months.

- 7.2 Total Estimate: US \$50,000.00
- 7.3 The Independent Government Cost Estimate is not attached to this document and is to be provided upon endorsement of project.

## 8.0 **REFERENCES.**

- 8.1 29 CFR § 1910.111 - *Storage and handling of anhydrous ammonia*. (2007, December 14). Retrieved February 22, 2019, from <https://www.law.cornell.edu/cfr/text/29/1910.111>
- 8.2 46 CFR § 98.25 - *Anhydrous Ammonia in Bulk*, (2009). Coast Guard, DHS.
- 8.3 *Ammonia Energy*. Retrieved February 22, 2019, from <https://www.ammoniaenergy.org/>
- 8.4 De Vries, N. (2018, April 23). *Ammonia: A new way of fueling the marine industry*. Retrieved February 22, 2019, from <http://www.cruiseandferry.net/articles/ammonia-a-new-way-of-fuelling-the-marine-industry>
- 8.5 *Electricity Network Transportation Roadmap: Final Report*. (2017). Retrieved February 22, 2019, from Energy Networks Australia & CSIRO website: [https://www.energynetworks.com.au/sites/default/files/entr\\_final\\_report\\_web.pdf](https://www.energynetworks.com.au/sites/default/files/entr_final_report_web.pdf)
- 8.6 Hattenbach, R. *The Key to U.S. Energy Independence*. Presentation. Retrieved February 22, 2019, from <https://nh3fuel.files.wordpress.com/2012/05/chemicalmarketingservices.pdf>
- 8.7 Laursen, R. S. *Ship Operation Using LPG and Ammonia as Fuel on MAN Dual Fuel ME-LGIP Engines*. Presentation. Retrieved February 22, 2019, from [https://nh3fuelassociation.org/wp-content/uploads/2018/12/0900-Ammonia\\_vision-Rene-Sejer-Laursen-MAN.pdf](https://nh3fuelassociation.org/wp-content/uploads/2018/12/0900-Ammonia_vision-Rene-Sejer-Laursen-MAN.pdf)
- 8.8 *NH3 Fuel Association*. Retrieved February 22, 2019, from <https://www.nh3fuelassociation.org/>
- 8.9 *Options for producing low-carbon hydrogen at scale*. (2018, February 08). Retrieved February 22, 2019, from <https://royalsociety.org/topics-policy/projects/low-carbon-energy-programme/hydrogen-production/>
- 8.10 Van Wijk, A. (2017, October). *The Green Hydrogen Economy in the Northern Netherlands* (Publication). Retrieved February 22, 2019, from Noordelijke Innovation Board website: <http://verslag.noordelijkeinnovationboard.nl>
- 8.11 Webb, D. *Large Scale Ammonia Storage and Handling*. Presentation. Retrieved February 22, 2019, from <https://www.irc.wisc.edu/export.php?ID=17>
- 8.12 Webster, S. (2012, February 23). *Understanding Anhydrous Ammonia*. Retrieved February 22, 2019, from <http://cgmarinesafety.blogspot.com/2012/02/understanding-anhydrous-ammonia.html>

## 9.0 **SUGGESTED CONTRACTING STRATEGY.**

- 9.1 It is suggested that the project be executed by the engineering staff at Martin, Ottaway, van Hemmen & Dolan, who are well equipped with the knowledge and resources to conduct a comprehensive survey and to compile the necessary tools and information in the development of ammonia fuel documentation.