Safer Offshore Energy Systems Grants 1
Final Report

Project Title: Virtual Offshore Disaster Training (VODT) Site
Award Amount: $125,000
Awardee: Houston Advanced Research Center
Award Start Date: 09/01/15
Award End Date: 12/31/16
NAS Grant ID: 2000006007

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I. ORIGINAL PROJECT SUMMARY (from proposal)

The Environmentally Friendly Drilling System (EFD) program, managed by the Houston Advanced Research Center (HARC), provides unbiased science to address environmental and societal aspects associated with petroleum drilling and production. The objective of the EFD program is to identify, develop, and transfer critical, cost effective technologies that can provide all stakeholders, including industry and policy makers, with the ability to develop reserves in a safe and environmentally friendly manner.

In response to the Gulf Research Program's 2015 RFA, the EFD team seeks to develop the Virtual Offshore Disaster Training (VODT) Site for the middle-skilled O&G worker. Built with pioneering gaming technology, this innovative approach to training proactive and reactive measures to disasters offshore can advance the understanding of the Gulf of Mexico region as a dynamic system with complex, interconnecting human and environmental systems, functions, and processes while fostering innovative improvements to safety and culture as well as the environmental protection systems associated with offshore oil and gas development. Employing a virtual reality based interactive educational tool that is accessible through a free website, oil and gas workers learn about the equipment and practices that address the potential for and effects of offshore disasters. Using various 'hot spots,' the VODT would demonstrate actions and behaviors that the middle-skilled worker can practice to minimize and mitigate environmental impacts from disasters. Spill containment and clean up, equipment malfunctions and maintenance/repair, and exercises aimed to prevent personal and/or environmental harm are examples of potential hot spots on the VODT site. These hot spots will be designed so that they may be easily modified and updated as new practices and technologies evolve.

Training middle-skilled workers in the offshore oil and gas industry presents challenges that could be minimized through the use of the VODT. Time, geography, and cost are factors that might inhibit training efforts for underprivileged workers seeking to improve their knowledge of disaster preparedness as well as those seeking to advance in their careers, thus providing economic stability to families and communities along the Gulf Coast and beyond. One of the aspects that makes the VODT site so innovative is the users themselves determine where they go on the virtual rig and what they click on to learn more about, thus increasing their knowledge retention.

Workers need to understand the connection between human health and the environment. Effective training of middle-skilled workers in disaster preparedness and response through the VODT site would contribute greatly to enhancing safety culture and environmental stewardship while helping to support the continued development of healthy and resilient Gulf communities.

Future outcomes of the VODT include a workforce that may more easily identify and mitigate potential threats to personal and environmental health. The behaviors they learn from this program can be transferred to other communities across the country. Another outcome is that since it will be free to use for individuals, trainers, and other organizations and programs for their own educational efforts, knowledge and skills vital to personal and environmental safety will continue for generations to come.

II. PROJECT RESULTS

Accomplishments

The EFD team was awarded an exploratory grant from the Gulf Research Program of the National Academy of Sciences to develop a virtual offshore site designed for the middle-skilled O&G worker to learn more about disaster training and/or emergency preparedness. Awareness of middle-skilled workers in disaster preparedness and response through the site can contribute to enhancing safety culture and environmental stewardship. This innovative approach to help foster improvements to safety technologies and culture as well as environmental protection systems associated with offshore oil and gas development can also help open doors to communication across industries and locations.

The project team employed a virtual reality based interactive educational tool that is easily accessible through a free website, and used interactive 'hot spots,' so that users can learn about the equipment and practices that address safety measures. Subject matter experts (SMEs) from the oil and gas industry as well as Health, Safety, and Environmental representatives/specialists were consulted throughout the development of the virtual site so that priority safety issues could be appropriately conveyed.

This project was initially called the Virtual Offshore Disaster Training Site. After meetings and discussions with SMEs, it was recognized that the name would not be ideal for this project as it would not substitute or replace existing training programs and/or certifications currently required for employees offshore. Additionally, just as training requirements may vary by operator, drilling contractor, and/or service provider companies, training requirements can vary from location to location. We also recognized that our project would greatly complement required training, serving as another way to remind offshore personnel about the safety and environmental stewardship. Several practices commonly encountered in offshore oil and gas operations so that middle-skilled workers, educators, and the general public can have

a better awareness of the measures in place to protect the environment and employees are focused upon, therefore, the project was updated to be referred to as the Virtual Offshore Safety Awareness (VOSA) Site.

The VOSA interactive site was completed and released in December of 2016 after several beta-tests. The site shares information links to descriptions, animations, and glossaries to help demonstrate actions and behaviors that O&G employees can practice in order to address safety.

While the grant/funding has ended, the site will be heavily promoted to continue engaging middle-skilled oil and gas workers, as well as the Gulf coast communities wherein O&G activity takes place.

Initial Outcomes

Those that have visited the site have expressed very favorable 'reviews' (via personal communication and correspondence). Upon witnessing how much more engaged audiences remain while demonstrating the Virtual Site, it became even more apparent that the use of interactive learning appeals to more than just a younger generation.

Because the award was an exploratory grant, the budget was quite limited as to how many hotspots/web resources and supporting materials could be included on the virtual site as well as abstracts, publications, and presentations submitted for conferences and workshops.

Feedback will be collected as to priority updates and funding for such additions will be necessary. While this project could not utilize cost-share, a HARC-EFD sponsor made available material that would have well exceeded the entire grant and a separate EFD sponsor agreed to share animations via web links, however this project does not own them or the rights to them. (All correspondence relating to sharing of animations and video links have been compiled and stored in the Data Management Plan – Underlying Data to be provided to NAS.)

Unexpected Results

The 'virtual game' component appealed to all generations of individuals and groups seeking additional information extending beyond middle-skilled oil and gas workers. Audiences from age 4 to age 81 were engaged with the ability to 'walk around an offshore rig' to learn about what can take place and how energy is developed every day. The results appeal to all stakeholders, professional as well as non-professional, interested in energy production.

Project Relevance

Researchers, educators, community leaders, state government officials, federal government officials, the private sector, middle-skilled oil and gas workers, and the general public would be interested in the results of this project.

Each of the stakeholders in can learn more about offshore oil and gas processes, safety and environmental aspects by 'walking around' on an offshore rig. Communities, educators, private sector members, officials, and the general public are not often provided an opportunity to visit an actual oil and gas rig. The ability to experience the sights and sounds of an offshore site, decide where they'll venture, and learn about some of the required and/or most applicable practices in place every single

day that prevent environmental and/or personnel harm can help assuage fears of the unknown. Middle skilled oil and gas workers can share their jobs with those outside of the O&G industry. Students can learn about careers in this industry as well as pursue education in the various physical and natural sciences.

Education and Training

Number of students, postdoctoral scholars, or educational components involved in the project:

- Undergraduate students: 0
- Graduate students: 0
- Postdoctoral scholars: 0
- Other educational components: 1

The virtual site is free and open to all those that are interested in actively engaging in self-education about offshore safety. (www.efdvirtualsite.org) The web site went 'live' at the end of 2016. We will be tracking the number of site visits in the future.

In addition, through other programs, we will be reaching out to universities and other educational institutions and events (Energy Day, IADC Forums, service company training events and others) to instruct others on how to access and use the site.

III. DATA AND INFORMATION PRODUCTS

This project produced data and information products of the following types:

- Websites or data portals

INFORMATION PRODUCTS

Websites and data portals:

1. http://www.efdvirtualsite.org

We will maintain the first website for three years minimum. HARC will archive the website after it ceases to be active for a minimum of three additional years.

Other activities to ensure access to information products: HARC and EFD Newsletters (~8000 readers), flyers and brochures at various conferences, references at various conferences and industry meetings, press releases, cited in Digital Journal, and have been advised that other organizations will be actively sharing information about the website.

Gulf Research Program Exploratory Grant Award
Grant 2000006007 Virtual Offshore Safety Awareness Site
2018 Follow-up Report

The Environmentally Friendly Drilling (EFD) program, managed by the Houston Advanced Research Center (HARC), works with the oil and gas industry, numerous universities, national laboratories and environmental organizations/NGOs to provide unbiased science to address environmental and societal aspects of all drilling and production activities, from site selection to natural gas storage. HARC is a non-profit research hub providing independent analysis on energy, air, and water issues to people seeking scientific answers, focusing on building a sustainable future that helps people thrive and nature flourish.

Grant Summary

HARC-EFD launched the **EFD Virtual Site** in 2012. This free, interactive tool was created to help foster environmental stewardship into the mindset of oil and gas employees. With this came the added benefit of communicating with those outside of industry about the processes of energy production and the various improvements to safety technologies and environmental protection systems being used to address issues associated with development. The EFD Virtual Site invites users to walk around, via virtual reality, an active drilling rig, hydraulic fracturing site and/or a production pad site without leaving their desk. Interactive '*hot spots*' located throughout these sites provide general information, introduce environmentally friendlier alternatives, and provide literature, case studies and/or videos on various equipment/practices.

HARC-EFD was awarded the Gulf Research Program (GRP) of the National Academy of Sciences Award Number 2000006007 from the 2015 Exploratory Grants selections to develop the offshore virtual site, supporting GRP's exploratory approach for effective education and training of middle-skilled workers in the offshore oil and gas industry. The objective is to help foster innovative improvements to safety technologies and culture as well as the environmental protection systems associated with offshore oil and gas development. The result of this project, referred to as the **Virtual Offshore Safety Awareness** (VOSA) Site, is free to use and easily accessible to actively engage all stakeholders.

Data Management

A data management plan was developed in accordance to NAS-GRP grant award requirements. The plan addressed hosting and accessibility of the VOSA website, as well as the data that fell under the plan: the code written to build the site and the 'underlying data' (research and collection of information utilized to build the website).

Website Hosting and Accessibility

The Virtual Offshore Safety Awareness (VOSA) site is hosted on the Houston Advanced Research Center (HARC) servers throughout the funding award period and for a minimum of three years thereafter. The site and educational material therein became available for sharing upon rollout of the VOSA site in December, 2016. The EFDVirtualSite.org website serves as a web portal to connect users to all of the virtual sites developed by HARC-EFD, including the VOSA site. This website is registered with the major search engines and utilizes a sitemap and metatags to ensure search engine discovery.

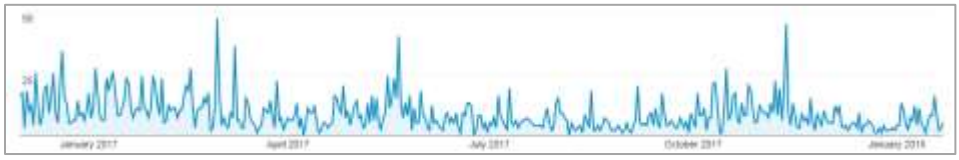
Code and Underlying Data

Unity WebGL gaming software was used to develop the interactive website depicting an offshore semisubmersible rig and typical equipment. The website and associated material are publically available, located at the portal: www.EFDVirtualSite.org. Underlying data including literature research/review, case studies, web resources, publications and presentations are all stored in Microsoft Word, Excel, Adobe PDF and/or other readily accessible formats. This collection of information was utilized to help build the site and select the 'hot spots' and points of interest to be highlighted upon the interactive VOSA site and is stored within HARC's internal storage. All material can be shared with others via email (through compressed folders) or through online file transfer options ('dropbox,' 'we-transfer,' etc.).

VOSA Website Users

Team members involved in the development of the Virtual Offshore Safety Awareness site promoted this outreach and awareness tool across various industries. As the site was being created, it became more and more apparent that many outside of industry have a keen interest in understanding how energy is developed and provided to homes and businesses. HARC's unique cross-boundary connections continues to serve as tremendous vehicles for promoting the mission to foster some of the innovative safety technologies and environmental protection systems in the oil and gas industry. A vast majority of visitors to the website (72%) are driven equally from email campaigns and referral web links from other sources (newsletters, presentations, etc.).

In 2017, the website had close to 15,000 page views. Spikes in visits correlate to various speaking events as well as social media campaigns, including an electronic newsletter, Twitter activity and LinkedIn articles. According to Google Analytics, 69% of site users are returning visitors and 31% are new.



Also noted while reviewing Google Analytics, within the past year, public and educational institutions such as the New Mexico Energy, Minerals and Natural Resources Department and Western Texas College in Snyder, Texas further utilized the site, sharing accessibility with their stakeholders. In the United States, 54% of site visitors were located in Texas. A suprising 6% of visitors were located in Massachusetts. A potential driver of this unexpected increase from this particular state may stem from various new funding proposals submitted over the past year that reference the Virtual Site and the applicability of interactive learning in other initiatives.

Considering the EFD Virtual Site as a whole, featuring a drilling rig, hydraulic fracturing spread, a production pad site and the Virtual Offshore Safety Awareness site, thousands of hours of research, training, graphic and gaming artistry, marketing, and technology transfer have gone into this program. As a result the entire site is used by a diverse audience across the globe, including:

- Operator and service provider companies for employee training and outreach
- Schools and universities for energy education
- The general public (non-industry stakeholders) to learn about oil and gas processes
- Environmental groups to see how industry is protecting the ecosystem
- State agencies to share information and foster open communication with constituents

2018 and Beyond

The EFD Virtual Site's original interactive tools featured an active drilling rig and a hydraulic fracturing site and were created using then state of the art gaming software technologies. The Virtual Offshore Safety Awareness site incorporated advanced design through improved gaming software, providing increased availability to more visitors as well as ensuring that users do not need special high-tech software and/or hardware to access of these remarkable, interactive resources. To continue what has proven to be a tremendous educational and outreach tool, updating the drilling rig and fracturing sites with the current gaming software is a priority, hence HARC-EFD continually seek funding in order to update the virtual site in order to further advance understanding and awareness of energy development as well as the processes that protect land, sea and human well-being.

The image above highlights just some of the web resource pages accessed through VOSA 'hot spots.'

The Virtual Offshore Safety Awareness Site is promoted at conferences, workshops, educational and community outreach events through printed flyers as well as a stand-up banner.
The banner, shown here, was displayed at the 2017 Offshore Technology Conference, various EFD hosted workshops and meetings and other public events.

Web links and informational flyers are shared across the U.S. and globally through EFD's monthly newsletters and special announcements.