Hydrogen Integration in Utility, Transportation, and Expeditionary Systems

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Ben Wilcox
Navy Shore Energy Program
NAVFAC EXWC
benjamin.p.wilcox@navy.mil

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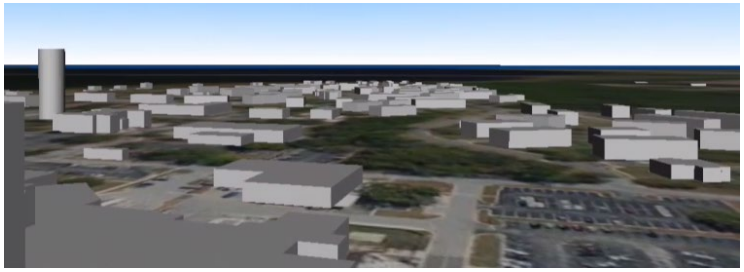
- Good Morning. My Name is Ben Wilcox. I work for the Navy Shore Energy Program. I am going to share time with Professor Don Brutzman of the Naval Postgraduate School. Our address is 10 minutes long.

- The United States has rejoined the Paris Climate Accord. Yesterday was Earth Day, yesterday and today there is an International Climate Change Summit in Washington, tomorrow there will be a call to action to address climate change.

- Hydrogen will play a key role at large scale to address climate change. There is lack of knowledge by planners and acquisition program managers in the Department of Defense about what this will look like. How do you plan for something when you don't know what it will look like?

- Our message to you to address climate change is to replace one to one diesel fuel with hydrogen fuel produced from renewable energy. And use SPIDERS3D visualization software to plan for it.

- To my mind SPIDERS3D is like a flight simulator. When you enter the environment its like the birds-eye view of the pilot. When you're close to the ground the field of view is small, the runway, air traffic control tower, and buildings cleared at takeoff. As you gain elevation the field of view is large, ports, roads, power plants, transmission lines, and water towers. It's the built environment (infrastructure). Today, SPIDERS3D hosts the built environment of more than 100 Navy and Marine Corps Installations.



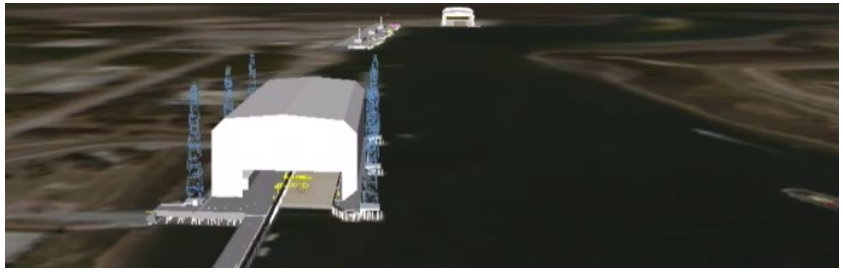


Figure 1. SPIDERS3D and X3D Graphics of the built environment

- **SPIDERS3D has been used to study, and plan for, the integration of major platforms into the built environment, ships, submarines, air planes. These platforms appear as a library of X3D models that are added to and moved around in the built environment, visualization that supports planning. Today the library has more than 300 X3D models of these platforms, support vehicles, support buildings, and related infrastructure. More X3D models are being added all of the time. Our proposal is to add a hydrogen library of X3D models and then demonstrate visualization and planning of hydrogen integration in the SPIDERS3D built environment.**

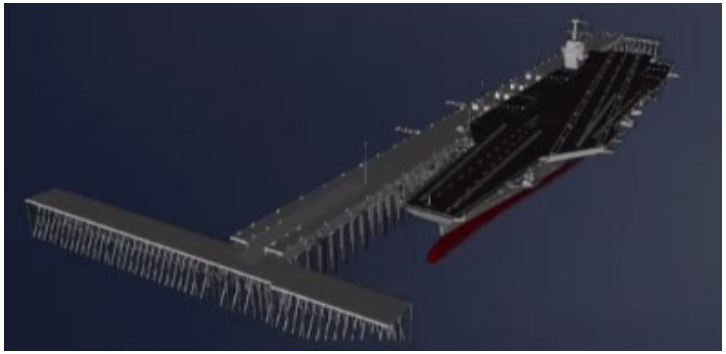


Figure 2. SPIDERS3D uses library of X3D Models to plan integration of platforms

- **Where there is a diesel fuel storage depot there can be a hydrogen fuel storage depot, a diesel generator power plant a stationary fuel cell power plant, a diesel engine bus a fuel cell bus, a marine diesel engine ferry a fuel cell ferry, a diesel engine train a fuel cell train. I've surveyed industry contacts at our largest manufacturers; General Motors, Cummins, Huntington Ingalls Industries, large vehicle and stationary power is the space where hydrogen has the greatest application.**

- We will study and plan for green hydrogen, where hydrogen fuel is produced from solar arrays and wind farms. At the scale to address climate change solar arrays and wind farms are large, 10 MW, 100 MW, 1,000 MW, 10,000 MW. The footprint spans 10s or 100s of square miles. Yet these are the easiest X3D models to create. I can create any size solar array or wind farm and export as a stand-alone X3D model in just a few hours work using the Solidworks repeat function. Take a solar panel and repeat it at the selected spacing and number to make a row. Take the row and repeat it at the selected spacing and number to make an array. Remove sections of the solar array to conform to the property boundary. Same with wind farms, onshore or offshore.

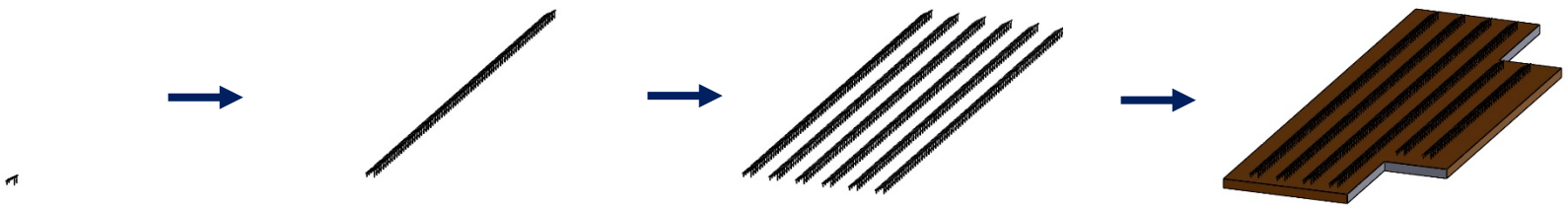


Figure 3. Creation of X3D Model of solar array that conforms to property boundary

- **The most asked question by the Public Works Officer or Installation Commanding Officer during project development are: How will this connect to the electrical system / have you talked to the utility? and How is the hydrogen fuel safely stored / what are the safe stand-off distances?**

- **We will include information about electrical point of interconnection and hydrogen fuel storage in the SPIDERS3D built environment in the form of post-its next to the related X3D models. Inclusion of this information is needed to complete the project site plan and site approval checklist necessary to make the project construction ready.**

- **In addition to construction planning the visual model in the SPIDERS3D built environment is the perfect reference for the Proposed Government Action and Alternatives in an Environmental Assessment to comply with the National Environmental Policy Act (NEPA).**

SPIDERS3D Program Overview and Collaborative Walkthrough

- **https://gitlab.nps.edu/Savage/Spiders3dPublic/-/blob/master/videos/demonstrations/NRWG2020/README.md**