MARKET POTENTIAL

Innovation to Sustainability

Energy *Environment* *Sustainability*

AAPA Energy & Environment Seminar
Energy Technology Deployment Panel
September 16, 2014
Chicago, IL

AAPA American Association of Port Authorities

Alliance of the Ports of Canada, the Caribbean, Latin America and the United States

MARKET POTENTIAL

Innovation to Sustainability

HELPING ORGANIZATIONS OPERATE SUSTAINABLY

Energy *Environment* *Sustainability*

- 28 Years of Experience - Adoption Clean Energy and Environmental Technologies
- Experience Extends Across Ports, Power Generation, and Numerous Industrial Facilities
- Actively Track Regulatory and Market Drivers for Energy and Environmental Markets

REGULATORY AND MARKET DRIVERS

- Regulatory Drivers:
  - Renewable Energy Tax Credit – American Tax Payer Relief Act(2013)
  - State Greenhouse Gas Regulations
  - EPA 111(b & d): Carbon Pollution from Electric Generating Units (proposed)
- Market Drivers:
  - Reliability from Self-Generation (over taxed, aged grid)
  - Physical Attributes (e.g. Sun, Wind)
  - Populace – Requesting Sustainability

MARKET POTENTIAL

Innovation to Sustainability

PANELISTS

Energy Technology Deployment Panel

- Bill Buchan, P.E., CEO
  Market Potential, Inc.
  Moderator
- Andrew J. Skok, Sr. Director, Bus Dev
  Fuel Cell Energy
  Fuel Cells
- Kat Janowicz, LEED GA, Sr. Project Manager
  WorleyParsons
  Solar
- Jeff Keever,
  Keever Consulting
  Virginia Offshore Wind Coalition
  Wind

FuelCell Energy

Ultra-Clean, Efficient, Reliable Power

AAPA Energy & Environment Seminar

Energy Technology Deployment Panel

Fuel Cell CHP for Port Applications

September 16, 2014

Andrew Skok

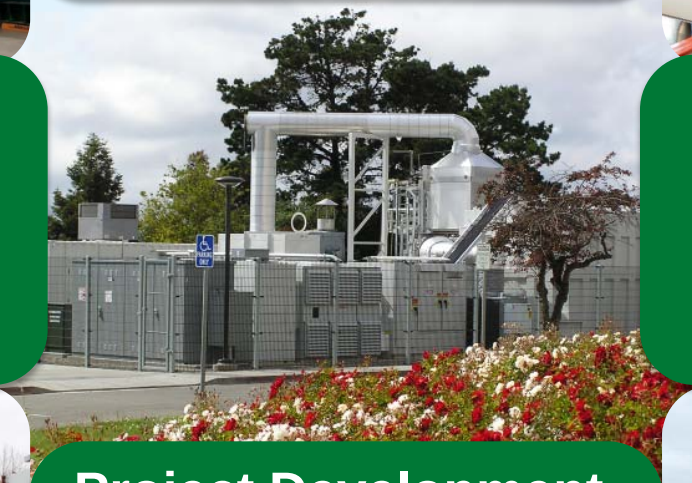
Integrated Fuel Cell Company

Design & Manufacture

Megawatt–class power generation solutions

Services

Over 100 DFC® plants operating at more than 50 sites – two billion kWh ultra-clean power produced



Direct Sales & Sell via Partners

Installations/orders in 9 countries

Project Development, Engineering & Construction

Over 300 megawatts installed and in backlog

DFC® Fuel Cell Application Diversity

Diversity of Fuels plus High Efficiency – High Sustainability

FUEL RESOURCES

- NATURAL GAS
- METHANOL
- ETHANOL
- PROCESS METHANE
- BIOGAS
- COAL GAS

INTEGRATED SYSTEMS IMPROVE EFFICIENCY

- DFC – (47%)
- DFC – CHP (60-80%)
- DFC – ERG (55-70%)
- DFC/T – (60-70%)
- DFC H2 (50-60%)

Support at Ports

Micro grid Implementations:

Central CT State University
- Gensets & 1.4MW fuel cell

San Jose Water Treatment Plant
- Gensets & 1.4MW fuel cell

Santa Rita County Jail
- DOE Smart Grid Demonstration
- Facility Static Switch Disconnect
- 1MW Fuel Cell
- Gensets,1mw solar,
- 2MW energy storage

DFC® for Port Applications

15 MW Plant in Bridgeport CT

- Installed in ~1 Year; No Emissions Permitting Required
- Powers the Utility side of the Substation for the Port of Bridgeport
- Heat used to generate additional Power for Utility (ORC Bottoming Cycle, ~55% electric Efficiency)
- Supplies power in Dense, Urban I-95 Corridor near Port on Remediated ~1.5 Acre Brownfield site
- Could keep some circuits Powered during Grid Disturbances
- Possible on Customer (Port) side of Utility substation with excess power going to Utility

AAPA Energy & Environment Seminar
Energy Technology Deployment Panel

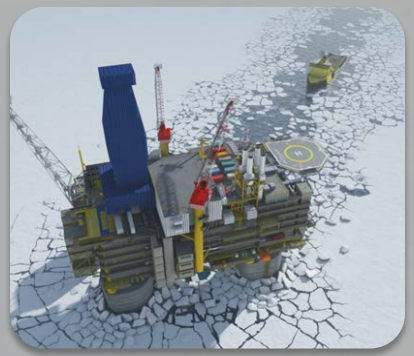
Kat Janowicz, MSME, MBA, LEED GA, CEM

September 16, 2014

WorleyParsons Consulting

EcoNomics™

WorleyParsons Overview



Infrastructure

- Ports & Marine Terminals
- Rail & Intermodal
- Power
  - Gas & Coal-fired
  - Nuclear
  - Renewable Energy
  - Power Networks
- Specialist Capabilities
  - Energy Storage
  - Energy Efficiency
  - Advanced Coal
  - Distributed Energy
- Environment & Society
- Operational Compliance
- Water & Wastewater
- Soil & Sediment
- Air Quality & Emissions
- Demolition, Decommissioning, Remediation
- Restoration
- Response Plans
- Permitting

Minerals, Metals, Chemicals

- Base Metals
- Coal
- Chemicals
- Petrochemicals
- Fuel Additives
- Ferrous Metals
- Alumina
- Aluminum
- Iron Ore
- Gas Cleaning

Hydrocarbons

- Arctic & INTECSEA
- Gas Processing
- Heavy Oil & Oil Sands
- LNG / LPG / CNG
- Onshore Production & Enhanced Oil Recovery
- Pipeline Systems
- Offshore Topsides
- Petrochemicals
- Refining
- Sulfur Technology
- Unconventional Oil & Gas

Exelon
THE PORT AUTHORITY OF NY & NJ
TVA
ExxonMobil
bp
U.S. TRADE AND DEVELOPMENT AGENCY
The Shipping Association of Trinidad & Tobago
ALSTOM
Xcel Energy
AECON
ConocoPhillips
FPL
SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL Company
THE PORT OF LOS ANGELES
Port of LONG BEACH
The Green Port
FirstEnergy
AEP
CANAL DE PANAMÁ
SIEMENS
Westinghouse
WorleyParsons Consulting
OneWay
to zero harm
EcoNomics

Photovoltaic Power Systems

Energy Generation

- Direct conversion of solar energy into DC electrical energy
- Size range: 0.001MW - 500MW

Energy Storage

- Ensure power during periods of high demand
- Enhance grid reliability
- Smooth intermittent supply fluctuations

Emerging & Future Solar Technologies

- Curtain Walls / BIPV
- Smart Modules (Module level control)
- Float-o-voltaics (floating PV systems)
- Rooftop concentrating solar PV (CPV)
- Electricity from Space
- SolarPaint based on Organic Photovoltaics (OPV)

PV, at first glance, appears a very simple technology. But at scale this is deceiving, as siting, designing, and integrating large-scale PV power systems with all the performance expectations of utility-grade generation, while keeping costs manageable, can be challenging.

Solar PV Case Studies

CUSTOMER: SOUTHERN CALIFORNIA EDISON (SCE)
PROJECT: UTILITY-SCALE 250 MW ROOFTOP PV
LOCATION: CALIFORNIA, USA
SERVICES: OWNER'S ENGINEER AND PROJECT MANAGEMENT

- Site assessment, civil and structural engineering review, electrical interconnect review, PV panel and balance of system review and assessment
- Assisted in reaching projects' financial, operating, technical goals
  - Assessed overall engineering and technical feasibility
  - Reviewed, selected, validated the overall design, technical components and project costs
  - Ensured compliance with all essential permits and regulations
  - Reviewed of planned test and commissioning procedures
  - Developed of the Operations and Maintenance program
- Detailed engineering and construction support on two (2) rooftop PV systems (2.25MWdc) and one ground mount system (7MWdc)

CUSTOMER: HYPOWER, INC.
PROJECT: VETERAN'S ADMINISTRATION HOSPITAL - CARPORT PV
LOCATION: LOUISIANA, USA
SERVICES: FEED - FRONT-END ENGINEERING DESIGN

- Design of 1.4MW of PV using multiple carport structures and interconnecting in three different locations

Solar PV O&M Challenges

Minimize

Inverters failures - most frequent loss of generation

•

POI switchgear failure - biggest impact on loss of generation

•

PV Arc faults

•

Ground-fault protection blind spot

•

Solar panel cleaning

•

Fall potential

•

Lack of Preventive Maintenance Plan

RISK

CONSUMER BENEFIT

Availability and Performance

•

Safety and Reliability

•

Ground-fault detection and protection improvements to prevent fires

•

O&M Program

•

Accessibility for inspection and maintenance

•

Public support

•

Positive impact on carbon footprint

Maximize

WorleyParsons Consulting

EcoNomics™

AAPA Energy Technology Deployment Panel

Jeff Keever

Chicago, Illinois

September 16, 2014

Keever Consulting, LLC

Government Relations

Business Development

Virginia Offshore Wind Coalition

Advocacy Trade Association

For

Offshore Wind Development

&

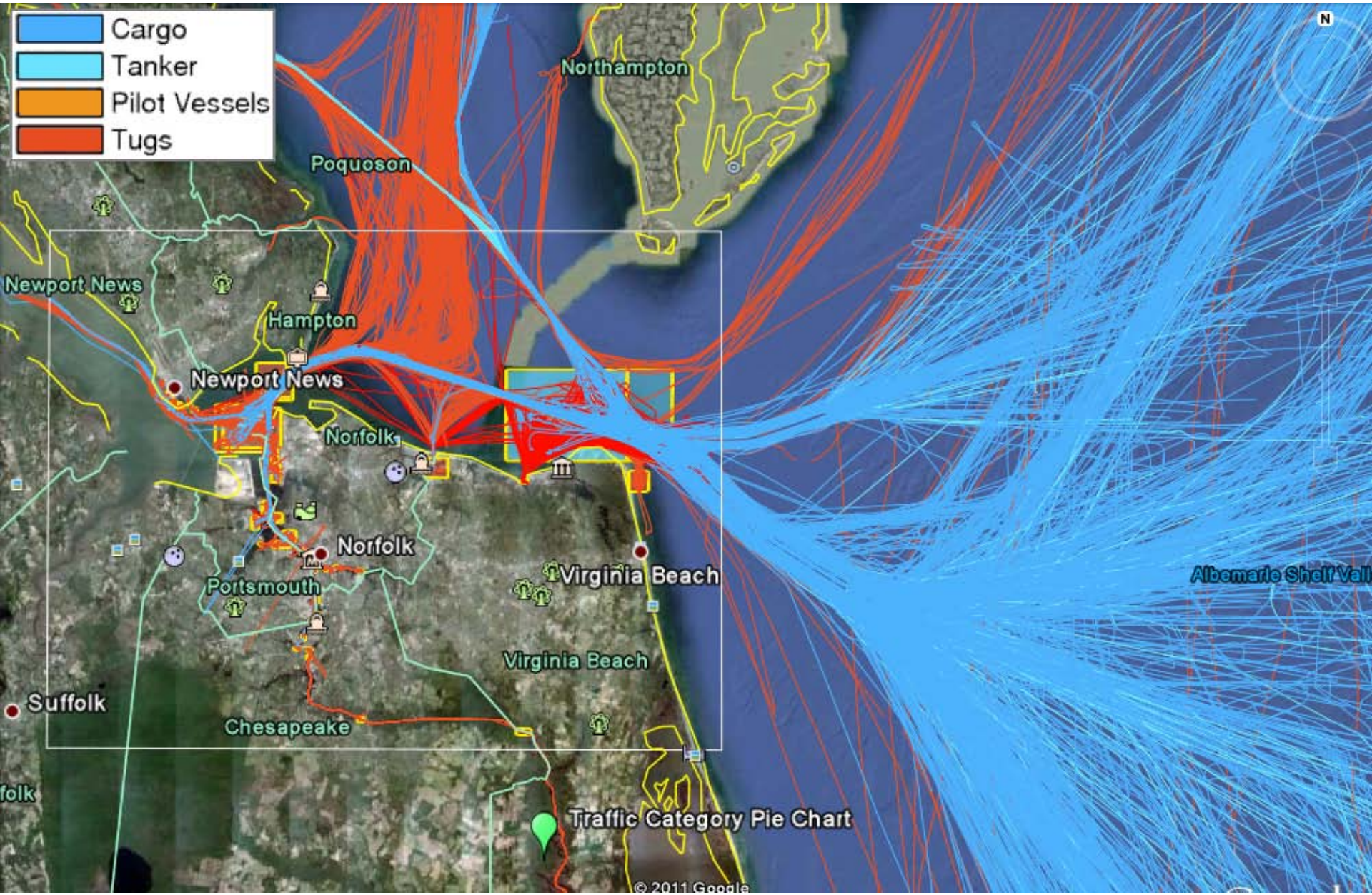
Supply Chain Industry

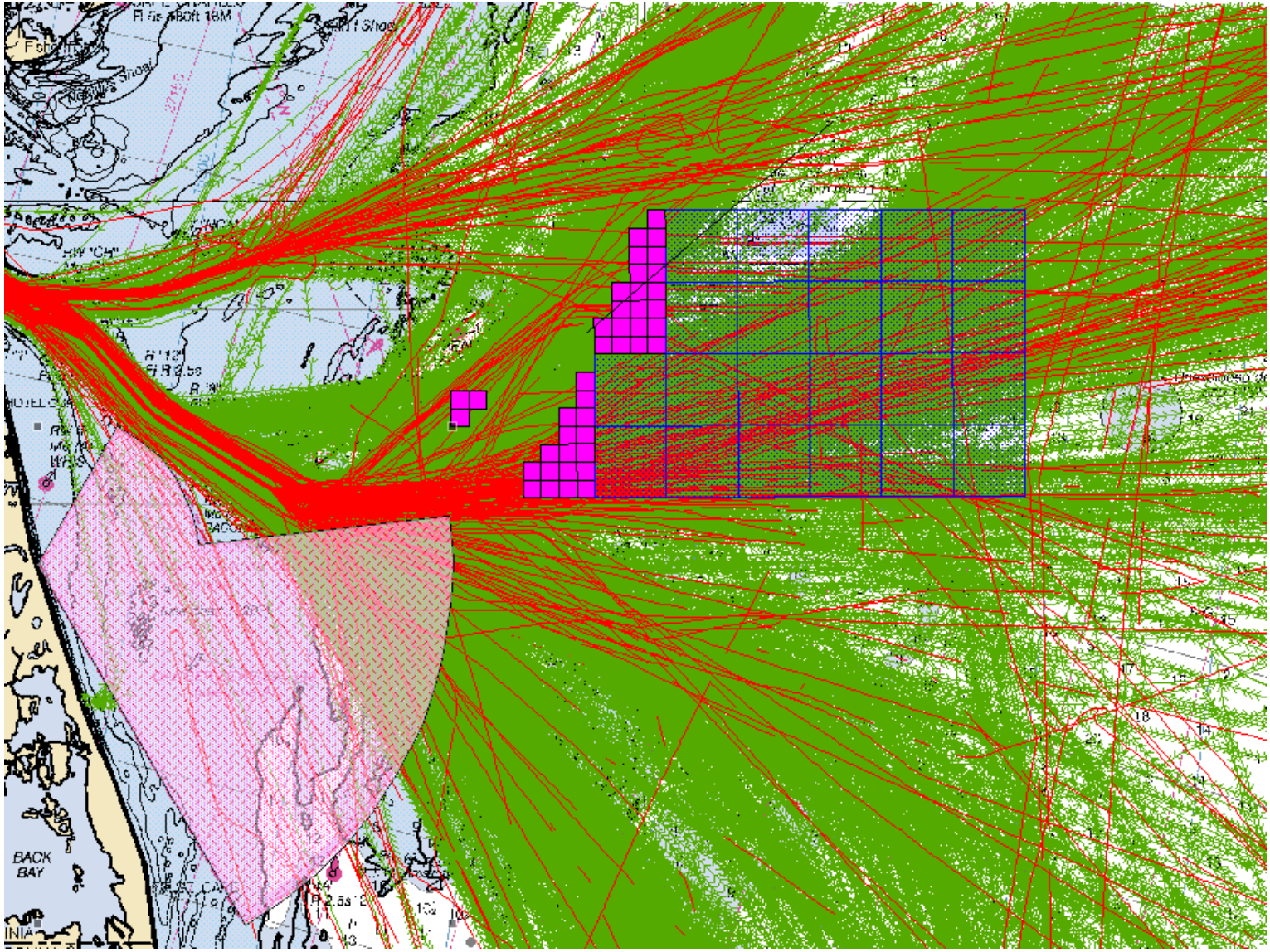
Alstom Haliade 150-6MW Offshore Wind Turbine

Virginia Offshore Wind Technology Advancement Project

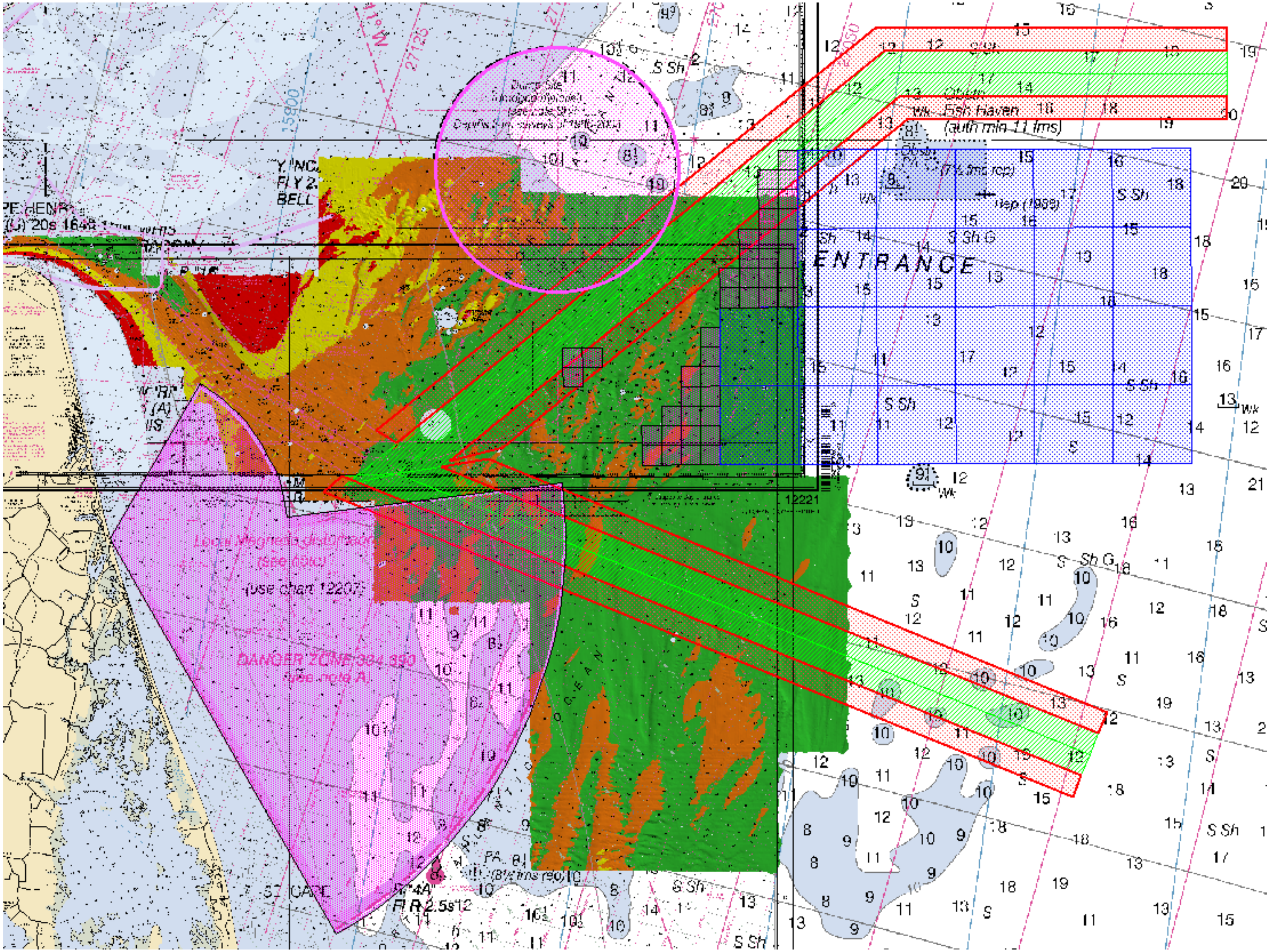
Two Alstom 6-megawatt turbines mounted on innovative twisted jacket foundations

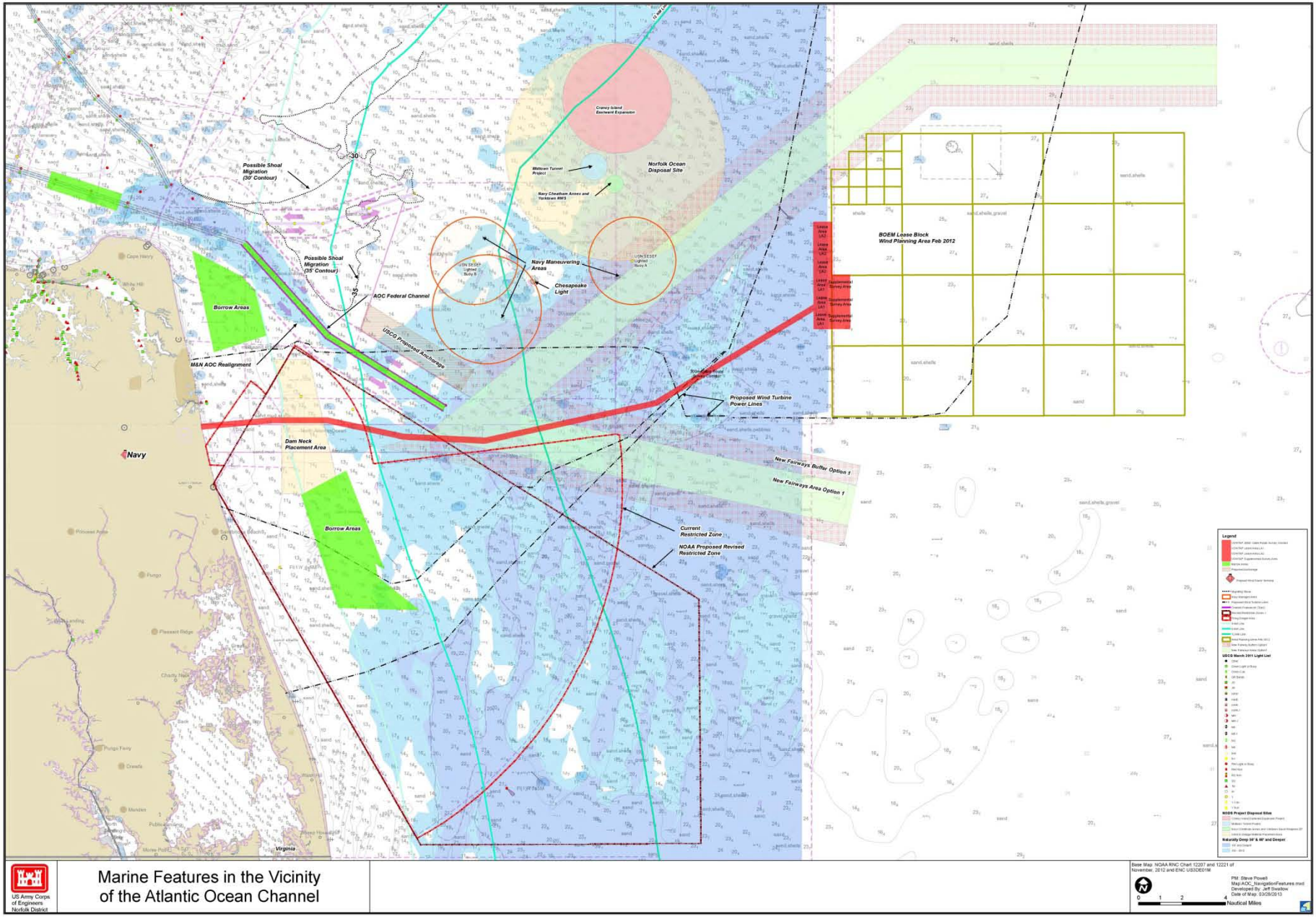
27 miles off the Virginia Coast


Cargo
Tanker
Pilot Vessels
Tugs
Northampton
Poquoson
Newport News
Hampton
Newport News
Norfolk
Norfolk
Portsmouth
Virginia Beach
Virginia Beach
Suffolk
Chesapeake
Albemarle Shelf Vall
Traffic Category Pie Chart
© 2011 Google



AIS Tracking of Vessel Traffic


ENTRANCE
Fish Haven
(auth min 11 fms)
(use chart 12207)



US Army Corps of Engineers Norfolk District

Marine Features in the Vicinity of the Atlantic Ocean Channel

Base Map: NOAA RNC Chart 12207 and 12221 of November, 2012 and ENC US3DE01M

0 1 2 4 Nautical Miles

PM: Steve Powell
Map:AOC_NavigationFeatures.mxd
Developed By: Jeff Swallow
Date of Map: 03/28/2013

THANK YOU!

Energy Technology Deployment Panel

- Bill Buchan, P.E., Market Potential, Inc.
  510 928 5786 buchan@mktpotential.com
- Andy J. Skok, Fuel Cell Energy
  203 825 6068 askok@fce.com
- Kat Janowicz, LEED GA, WorleyParsons
  626 599 7497
  kat.janowicz@worleyparsons.com
- Jeff Keever, Keever Consulting, LLC
  757 636 0561 jj@keeverconsulting.com

MARKET POTENTIAL
Innovation to Sustainability

FuelCell Energy
Ultra-Clean, Efficient, Reliable Power

WorleyParsons
Consulting

KEEVER
CONSULTING