Presentation on LNG Bunkering
AAPA Facilities Engineering
Panel IX: LNG Terminals
April 26, 2019
01 HDR Fast Facts
02 LNG as a Marine Fuel
03 LNG Bunker Operations
04 LNG Bunkering in Jacksonville, FL
HDR FAST FACTS

- Founded in 1917
- More than 9,900 employee-owners across 200+ locations worldwide
- Projects in all 50 states and in 60 countries
- Operations in 8 countries
- Approximately 800 staff in Florida
- ENR No. 6 in Marine & Port Facilities
- LNG services over 20 years
## What We Do

### Architecture
- Academic
- Civic
- Corporate
- Healthcare
- Justice
- Science + Technology

### Federal
- Architecture
- Engineering
- Planning
- Environmental
- Energy
- Construction

### Industrial
- Chemical & Pharmaceutical
- Food & Beverage
- Manufacturing & Basic Industry
- Primary Metals & Steel
- Pulp & Paper
- Agribusiness

### Mining
- Markets & Economics
- Exploration
- Feasibility & Permitting
- Development
- Operations
- Closure

### Transportation
- Aviation
- Freight Rail
- Highways and Local Roads
- Maritime
- Transit

### Oil & Gas
- Upstream
- Midstream
- Downstream

### Power
- Power Delivery
- Power Generation
- Renewable Energy

### Waste
- Solid Waste Facilities & Landfills
- Energy-from-Waste & Organics Management
- Planning & Program Development
- HTRW & Environmental Restoration

### Water & Natural Resources
- Water
- Wastewater
- Water Resource Management

### Private Development
- Civil Design
- Environmental
- Master Planning & Urban Design
- Transportation Infrastructure
WHY LNG AS A MARINE FUEL?
October 27th, 2016 – IMO announces that the MEPC (Marine Environmental Protection Committee) agreed to a 0.5% global sulfur cap on Marine Fuel commencing January 1st, 2020

- IMO cast aside concerns as to shortage of fuel to meet new cap
- Existing ECA’s (including North American) will stay in place
  - N. American ECA has 0.1% sulfur cap
- Only exception to this limit are those vessels with abatement (scrubbing technology)

Emission Containment Area (ECA) – North America
Figure 1 - Post 2020 Global Bunker Demand by Product

Source: MECL (Marine Energy Consulting Limited)
WHERE IS THE BREAKEVEN BETWEEN LNG AND MGO?

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<th>Fuel Spreads $/MMBtu</th>
<th>Houston Spot</th>
<th>NYMEX Cal 2017</th>
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Note: MGO = Marine Gas Oil, LNG = Liquified Natural Gas
WHAT IS LNG – WHY IT’S GOOD FOR SHIP FUEL

- LNG is natural gas (95% methane) that has been cleaned and cooled to -260F. By doing so, it has 1/600\textsuperscript{th} of the volume of ambient gas. Thus lots of gas in a small volume.

- LNG burns cleanly - emits 85% less nitrogen oxide (NOx) and sulfur oxides (SOx), 90% less particulate matter compared to Heavy Fuel Oil.

- Price is more stable than traditional bunker fuel oils.
  - Currently, diesel somewhat cheaper on a $/BTU basis.

- Safety
  - A very narrow range of flammability in air (5%-15%) making it safe to handle on ships and at marine terminals.
WHO’S DOING WHAT WITH LNG?

- Cruise Market
  - Royal Caribbean - 2 ships
  - MSC – 5 ships
  - Carnival – 9 ships
  - Disney – 3 ships

- Ferries
  - Europe
  - Canada – British Columbian ferries starting Spring 2019

- Closed loop cargo routes
  - Tote – Jacksonville to Puerto Rico – 2 ships
  - Crowley – Jacksonville to Puerto Rico – 2 ships
  - Returning to home base justifies investment in LNG facilities
LNG BUNKER OPERATIONS

- Bunker operations
  - Shore/Pipeline-to-Ship (PTS) - requires LNG plant and marine facility
  - Truck-to-Ship (TTS) – common with new installations, less capital investment
  - Ship-to-Ship (STS) - requires marine facility and bunker barge
  - Portable tanks - ISO containers (40-foot lg.) brought in by rail or truck

- Simultaneous Ops (fuelling while discharging cargo)
04 LNG BUNKERING IN JACKSONVILLE, FL
LNG BUNKERING IN JACKSONVILLE, FL

- **JAXLNG**: Northstar/Pivotal built an LNG plant, pier and bunker barge for fueling TOTE’s LNG cargo ships (*waterside* bunkering)

- **Eagle LNG**: Eagle LNG built LNG FACILITY at the JaxPort Talleyrand Terminal to fuel Crowley ships dockside; new LNG facility in Maxville, FL provides LNG for this bunkering operation (*shoreside* bunkering)
JAX LNG

LNG PRODUCTION AND DISTRIBUTION SITE
(FUEL FOR 2 NEW TOTE MARITIME SHIPS)
**JAX LNG**

- TECO/peoples gas feed
- 120,000 gallons per day liquefaction
- 2,000,000 mg LNG storage tank
- Pier for bunker barge loading
- Truck bays (2) for tanker truck loading
- On-site power generation (JEA grid backup)
- Power generation uses bog and feed
- Future expansion to 360,000 GPD and 4mg storage
JAX LNG
DUE DILIGENCE AND CAPEX BUDGETS

CERTAINTEED GYPSUM
JAX LNG BUNKERING

- Barge for bunkering 2 Tote Maritime LNG powered container ships
- Clean Jacksonville (barge)
  - 232’ LOA, 49’ beam, 9.4’ draft fully laden
  - LNG storage 2,200 m³ (580,000 Gal)
JAX LNG
BUNKER BARGE

582,000 USG / 2 200 m³ BUNKER BARGE
JAX LNG
MARINE LOADING ARMS (2)
JAX LNG
PIER RECONSTRUCTION

BUNKER BARGE

BERTH ARRANGEMENT PLAN
JAX LNG
SITE/CIVIL DEVELOPMENT
JAX LNG

16” WATER MAIN EXTENSION
**JAX LNG**

TEMPORARY BUNKERING

- Tote Maritime Temporary LNG Bunkering Station
- JAXPORT’s Blount Island Marine Terminal
EAGLE LNG

- Maxville LNG Plant
  - 100,000 GPD LNG Production Capacity
  - 1M Gal LNG Storage Tank
EAGLE LNG BUNKERING (SHORESIDE)

- Talleyrand Marine Terminal LNG Bunkering Site
  - 2 each 250,000 Gal LNG Storage Tanks
EAGLE LNG
TALLEYRAND MARINE TERMINAL FUEL DEPOT

- LNG Transfer Unit
- Pipe Trench
- Elevated Control Building
- LNG Tanks
- Containment Pit
- Fire Wall
- LNG Truck Offload Lane
- Nitrogen Tanks and Process Equipment
EAGLE LNG
PHASE 1 – GET READY FOR TANK DELIVERY

LNG TANKS
EAGLE LNG
PILEs FOR TANK SUPPORTS
EAGLE LNG
250,000 GALLON LNG STORAGE TANKS
EAGLE LNG
LOADING ONTO GOLDHOFER TRAILER
EAGLE LNG
HAULING TANK TO FOUNDATIONS
EAGLE LNG
LIFTING TANK WITH GANTRY SYSTEM
EAGLE LNG
NITROGEN TANKS
EAGLE LNG
CONTAINMENT PIT FLOOR
EAGLE LNG
PIPE TRENCH
EAGLE LNG
PIPE TRENCH AND CRANE BEAM REBUILD
EAGLE LNG
CRANE BEAM REBUILD
SHORESIDE OR WATERSIDE

- **Shoreside Pro**
  - **Low initial capital cost** – Doesn’t require LNG barge for conventional waterside bunkering or LNG load out facility for the barge.

- **Shoreside Con’s**
  - **Bunkering restricts operations** – Ship-to-Shore Cranes have restricted access to portions of the vessel, trucks need to drive around the bunkering station.
  - **Higher operating cost?** – Trucks need to deliver LNG to the fuel depot.
  - **Infrastructure required in Container Yard** – Facility occupies prime real estate, facility must be compact
QUESTIONS