Transfer solutions for LNG bunkering

June 1st, 2016 – G.GATOUILLAT
“114ème session de l’ATMA”
Agenda

- **FMC Technologies**
  - Group overview
  - Loading Systems Division

- **LNG Bunkering market**
  - Context
  - LNG as fuel instead of cargo
  - Comparison with conventional LNG application
  - New LNG global chain

- **LNG Bunkering transfer solutions**
  - Loading arm: basic principle
  - Key drivers
  - FMC solutions
  - Others existing solutions

- **Conclusion**
FMC Technologies at a glance
FMC Technologies Inc. (FMCTI)
An oilfield services and equipments company

66% Subsea Technologies
- Subsea Systems
- Schilling Robotics
- Multi Phase Meters
- Separation Systems
- Direct Drive Systems

34% Surface Technologies
- Surface Wellhead
- Fluid Control
- Completion Services
- Measurement Solutions
- **Loading Systems**
- Automation and Control

$7.9B Revenue in 2015
FMC Technologies and Technip to combine

Technip + FMC Technologies

TechnipFMC
FMC Technologies : Loading Systems division

- 3 Facilities: France, US and Singapore
- Main production plant in France
- 320 skilled employees worldwide
- Sales and Marketing, R&D, Engineering, Production, Supply Chain…
- +100 Marine Loading Arms shipped every year since 2009

Certifications
ISO 9001 v2008 Design, manufacture and marketing of oil and gas equipment
ISO 14001 v2004 Environmental certification
OHSAS 18001 v2007 Occupational Health and Safety Management System
Products range and market covering

Onshore
- Truck to Shore
  - LNG TLA
  - TLA
- Ship to Shore
  - Refined MLA
  - LNG SKIDs
  - HPNG
- Side by Side
  - LNG Port Protected
- Offshore
  - FSRU
  - FLNG
  - OLAF
  - ATOL@

Shore

- • TLA = Truck & Rail Car Arms
- • MLA = Marine Loading Arms
Our LNG experience: more than 45 years
Our last achievements: Shell Prelude
Our last achievements: Petronas PFLNG Satu
LNG Bunkering market
LNG Bunkering: context

- The meeting point between fuel bunkering and conventional LNG transfer
LNG Bunkering: Fuel instead of cargo
LNG Bunkering: what does it change?

- **Common point**: LNG

- **New market needs**:
  - Large range of vessels to bunker,
  - Different types of application,
  - Volume to be transferred,

- **Impacts (on loading arms)**:
  - Reduced transfer flow rate and duration,
  - Number of arms and diameter,
  - Shape and size of the working envelope,
  - Type of loading arm,
New LNG global chain

- Nearshore FLNG
- Large Import/Export Terminal
- Nearshore FSRU
- Small Scale LNG Carrier
- Bunkering Vessel Small < 1000m³
- Bunkering Vessel Medium 1000m³ < - < 5000m³
- Bunkering Vessel Large > 5000m³

Flow:
- Truck to Ship
- Shore to Ship
- Ship to Ship

Legend:
- Small Scale LNG
- LNG Bunkering

Dedicated to Adaptable Small Scale LNG Fuels
LNG Bunkering transfer solutions
Loading arm : Basic principle

• Rigid links articulated by swivel joints,
• Balanced system (in empty condition),

• Especially for LNG :
  – Supported product line,
  – ERS (Emergency Release System),
  – Coupler (Manual or hydraulique),
Key drivers for LNG transfer system selection

**Performance**
- The performance is defined by the ration diameter versus flow rate and pressure loss.
- Flow rate is limited in transfer system to maximum flow speed: i.e. for liquid 12 m/s in rigid piping (which is by construction the more efficient solution for this purpose)

**Reliability**
- Using Proven components technology
  - (ERS, QCDC...)
- Qualified components
- Monitoring
- Transfer system experience

**Safety**
With regards of:
- Product
- Process
- Operators
- Transfer system itself
- Other equipment
- Environment
How to maximize these key drivers?

- By using rigid pipes:

  **Performance**
  - Higher Flow Rate
  - Lower Pressure Drop
  - Fast draining after transfer

  **Safety**
  - Reduced Human Interfaces
  - Better Resistance to Burst & Fire

  **Reliability**
  - Field Proven Technology

Bonus: High OPEX efficiency (especially for recurrent operations)
LNG transfer solutions: Basic design parameters

- **Bunkering Infrastructure (Application)**
  - Truck to Ship
  - Shore to Ship
  - Bunkering vessel

- **Transfer Rate & Diameter**
  - 2” – 3” (100-200 m3/h)
  - 4” (350 m3/h)
  - 6” – 8” (800-1400 m3/h)

- **Operating envelope size**
  - Dedicated fleet Vs Adaptable fleet
LNG transfer solutions: FMC philosophy

• Provide a dedicated design to define the most appropriate solution (technically and economically) based on our large range of products and experience:

• Skid & TLA (Truck Loading Arm)
LNG transfer solutions: FMC philosophy

- Provide a dedicated design to define the most appropriate solution (technically and economically) based on our large range of products and experience:

- Conventional MLA (Marine Loading Arm)
LNG transfer solutions: FMC philosophy

- Provide a dedicated design to define the most appropriate solution (technically and economically) based on our large range of products and experience:
  - Trailer mounted MLA
  - Horizontal MLA
FMC last projects realized

- 6” x 50’ CMA
FMC last projects realized

- 8”/6” x 57’ BOA (Bunkering Offloading Arm)
FMC last projects realized

- 8”/6” x 57’ BOA
Others existing solutions

• Ferry + hose
Others existing solutions

• Ferry + Loading Arm
Others existing solutions

- Truck to ship
Others existing solutions

- Trucks to ship via skid
Conclusion
Conclusions

- The LNG transfer system is identified as part of the top critical elements for the LNG installation.
- Any LNG transfer system is a balance between:
  - Safety
  - Economics
  - Operation Efficiency

- A transfer system is a solution integrated in an overall operation and project context.
Thank you

Questions ?