



# CARNIVAL CORPORATION & PLC.

## Experiences of LNG Fuel supply to AidaPrima

18 October 2016



# Carbon reduction...The first of our 2020 sustainability goals

## CARBON FOOTPRINT

Reduce the intensity of CO<sub>2</sub>e (equivalent carbon dioxide) emissions from our operations by 25% by 2020 relative to our 2005 baseline, measured in grams of CO<sub>2</sub>e per ALB-km.

## AWWPS TECHNOLOGY

Increase Advanced Waste Water Purification System (AWWPS) coverage of our fleet wide capacity by 10 percentage points by 2020 relative to our 2014 baseline.



## WASTE REDUCTION

Continue to reduce waste generated by our shipboard operations by 5% by 2020 relative to our 2010 baseline, as measured by kilograms of non-recycled waste per person per day.



## DIVERSITY & ETHICS

Continue to build a diverse and inclusive workforce and provide all employees with a positive work environment and opportunities to build a rewarding career to further drive employee engagement.



## BUSINESS PARTNER CODE OF CONDUCT AND ETHICS

Further develop and implement vendor assurance procedures ensuring compliance with Carnival Corporation & plc's Business Partner Code of Conduct and Ethics.



## EXHAUST GAS CLEANING TECHNOLOGY

Continue to improve the quality of our emissions into the air by developing, deploying and operating Exhaust Gas Cleaning Systems across the fleet capable of reducing sulfur compounds and particulate matter from our ship's engine exhaust.



## COLD IRONING CAPACITY

Increase Cold Ironing coverage of our fleet wide capacity in relation to future port capabilities.



## WATER EFFICIENCY

Continue to improve water use efficiency of our shipboard operations by 5% by 2020 relative to our 2010 baseline, as measured by liters per person per day.



## GUEST AND CREWMEMBER HEALTH, SAFETY & SECURITY

Striving to be free of injuries, we continue to build on our commitment to protect the health, safety and security of our guests, employees and all others working on our behalf.



## OUR COMMUNITY

Continue to work on initiatives and partnerships that support and sponsor a broad range of organizations for the benefit of our local and global communities throughout our brands, in particular Fathom.



# Why LNG?

- When we considered the environmental benefits of LNG in combination with recent changes in regulatory and supply chain factors, it all aligned in favor of building the world's first LNG-powered cruise ships.

## Benefits of switching from Marine Diesel to LNG

25% reduction in carbon emissions

95-100% reduction in particulate matter

85% reduction in nitrogen oxides

Zero sulfur dioxide emissions

# Carnival's LNG strategy

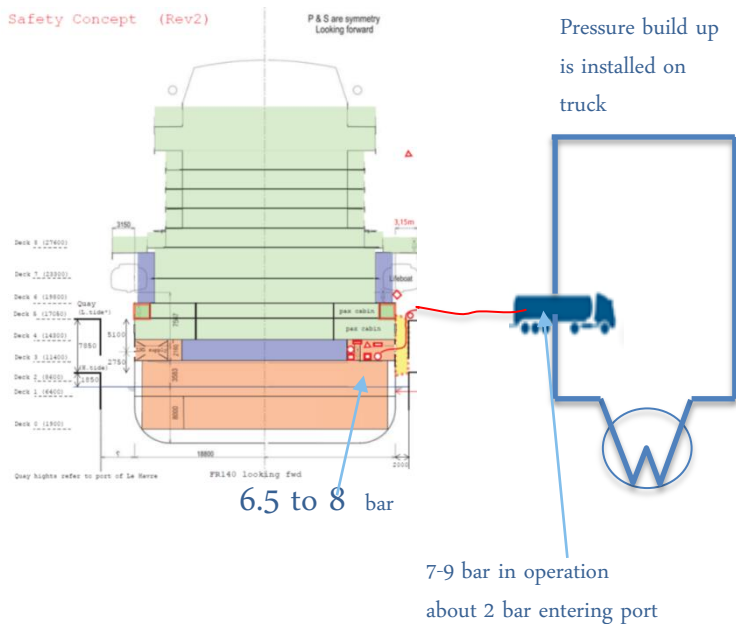
- In 2015, AIDA Sol was the first cruise ship in the world to be supplied with electricity from an LNG-Hybrid barge
- The AIDAprima was delivered in 2016 and uses LNG in port
- We have seven LNG-powered next-generation cruise ships on order
- By 2019 we will be the first cruise company to use LNG on the open sea and in port when our first LNG-powered ship enters in to service



# AIDAprima - Technical solution

One main engine is dual fuel, with on-board vaporiser and gas conditioning.  
No on-board LNG storage

Pressure Build Up – instead of mobile pump unit



- Use of pressure build-up results in reduction of possible sources of release next to the vessel (less flange connections, simpler operation)
- Silent and automated LNG transfer process
- Risk contours created for transfer via pressure-build up no greater than pumped system considering
  - 5 sec ESD
  - Double walled hoses
  - Quick dry and break away couplings on loading and vent lines
  - All valves fail safe close

Reliable, safe and practical fuelling system

# AIDAprima - Technical solution

## ENHANCED SAFETY FEATURES

- Truck protected from collision on quayside by concrete blocks
- No operation above the Fuelling Arrangement
- ESD Buttons at Fencing / Truck / Vessel – 5 sec response
- Double walled LNG transfer hose with inter-barrier monitoring
- Gas detection at cabinet of the truck / onboard
- Emergency release coupling (messenger wire for drift protection)
- Vent system of truck connected to ship vent system
- Regular Checks and Maintenance
- Hose handling procedures
- Training of truck driver and Crew – permanent manning of transfer process
- Control of sources of ignition
- Checklists
- Hose chute

# AIDAprima - Technical solution



SAFETY ZONE – CONCRETE BLOCKS TO PREVENT ACCIDENTAL COLLISION  
AND FENCING TO PREVENT UNAUTHORISED ACCESS

# AIDAprima - Technical solution



HANDLING OF TRANSFER HOSE



# AIDAprima - Technical solution



CONNECTIONS BETWEEN SHIP AND CONTAINER

# Experiences of LNG Fuel supply to Aidaprima

## HAZARD ANALYSIS

- Hazid carried out early in project with Port Authorities
- Detailed Risk Analysis have not shown large credible release scenarios of LNG due to the safeguards (5s ESD, double walled transfer hose, robust impact protection PRV of truck connected with vent system of the vessel etc)
- Atex zones have been evaluated by third party and within the safety zone
- Safety Zone (as per ISO /TS18683) has been evaluated on a “deterministic” risk based approach
- Class and Flag approval with no restrictions during fuelling operation

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## APPROVAL CONCERNS

- QRA have different acceptance criteria by country – *should be agreed prior to analysis*
- Different approval authorities and stakeholders by country – *to be identified at early stage*
- Different documentation requirements (including language) - *to be identified at early stage*
- Interpretation of ISO /TS18683 required due to lack of clarity on how define reasonable basis for risk assessment (ie a combination of worst case parameters will result in unreasonable safety distances) – *parameters to be agreed at early stage*

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