REPORT ON THE RESULTS AND CONCLUSIONS ON SEA TRIALS OF A RETROFITTED LNG SUPPLY BARGE

D5.2

Ente Vasco de la Energía (EVE)

CORE LNGas hive

CORE LNGas hive

Core Network Corridors and Liquefied Natural Gas

2014-EU-TM-0732-S

D5.2 – REPORT ON THE RESULTS AND CONCLUSIONS ON SEA TRIALS OF A RETROFITTED LNG SUPPLY BARGE

Due date of deliverable: Dec. 2019

Actual submission date: Dec. 2021

Start of project: 01 January 2014 Duration: 60 Months

Lead Contractor for this deliverable: Ente Vasco de la Energía (EVE)

Co-financed by the European Union
Connecting Europe Facility

Dissemination level		
PU	Public	
CO	Confidential, only for members of the consortium (including the Commission Services)	X

Revision History

Deliverable Administration and summary		
Project Acronym: CORE LNGas Hive		INEA/CEF/TRAN/M2014/1026196
Document Identifier: Deliverable D5.2 EPA2		
Leading partner: Ente Vasco de la Energía / Basque Energy Agency		
Report version: 01		
Report preparation date: 21 December 2021		
Classification:		
Nature:		
Author(s) and contributors: Juan Manuel Fernández, Jaime Menendez, Juan Manuel Pérez		
Status		Plan
		Draft
		Working
	X	Final
		Submitted
		Approved

The Core LNGas Hive consortium has addressed all comments received, making changes as necessary. Changes to the document are detailed in the change log table below.

Date	**Edited by**	**Status**	**Changes made**
16/11/2021	Enagás		

Copyright

Citation

Iñaki Bóveda Uriarte (2021). Deliverable 5.2 – REPORT ON THE RESULTS AND CONCLUSIONS ON SEA TRIALS OF A RETROFITTED LNG SUPPLY BARGE. CORE LNGas Hive consortium, **www.corelngashive.eu**

Acknowledgements

The work presented in this document has been conducted in the context of the action INEA/CEF/TRAN/M2014/1026196 CORE LNGas Hive. CORE LNGas HIVE is a 60 months project started on January 1, 2014.

The project consortium is composed of: Enagás Transporte, S.A.U. (Enagás), Sociedad de Salvamento y Seguridad Marítima (SASEMAR), Universidad Politécnica de Madrid (UPM), Universidade de Santiago de Compostela (USC), ENTE VASCO DE LA ENERGÍA (EVE), Autoridad Portuaria de Barcelona - Port de Barcelona (APB), Port Authority of Cartagena (PAC), AUTORIDAD PORTUARIA DE FERROL-SAN CIBRAO (APF), Autoridad Portuaria de la Bahía de Algeciras (APBA), Port Authority of Huelva (PAH), COMPAÑÍA ESPAÑOLA DE PETRÓLEOS S.A.U. (CEPSA), Regasificadora del Noroeste, S.A. (RdN), HAM CRIOGENICA, S.L. (HAM), BUREAU VERITAS IBERIA SLU (BVI), GUASCOR POWER SA (GP), IDIADA AUTOMOTIVE TECHNOLOGY S.A. (IAT), FLOTA SUARDIAZ, S.L. (Suardiaz), ITSAS GAS BUNKER SUPPLY S.L. (ITSAS), COMPAÑÍA DE REMOLCADORES IBAIZABAL, S.A. (IBAI), TERMINAL DE CONTENIDORS DE BARCELONA, S.L. (TCB), Terminal Catalunya, S.A. (TC), UTE REMOLCADORES DE BARCELONA-SAR, UNIÓN TEMPORAL DE EMPRESAS, LEY 18/1982 (URB), ASTILLEROS ARMON, S.A. (AA), GAS NATURAL SDG, S.A. (GN), INSTITUTO ENERXÉTICO DE GALICIA (IEG), Fundación de la Comunidad Valenciana para la Investigación, Promoción y Estudios Comerciales de Valenciaport (Fundación Valenciaport) (FV), Planta de Regasificación de Sagunto, S.A. (PRS), MOLGAS ENERGÍA, SAU (ME), Autoridad Portuaria de Valencia (APV), SEAPLACE SL (Seaplace), BOLUDA CORPORACION MARITIMA S.L. (BCM), Autoridad Portuaria de Bilbao (APBi), RENFE MERCANCÍAS S.A. (Renfe), Puertos del Estado (PdE), Dirección General de la Marina Mercante (DGMM), Port Authority of Gijón (PAG), Port Authority of Melilla (PAM), Santander Port Authority (SPA), Port Authority of Tarragona (PAT), Port Authority of Vigo (PAV), Port Authority of Santa Cruz de Tenerife (PASCT) and REN Gasoductos, S.A. (RENG).

More Information

Public CORE LNGas HIVE reports and additional information related to the project execution and results are available through the CORE LNGas Hive public website at **www.corelngashive.eu**

Table of contents

List of tables

List of figures

List of pictures

1. Introduction

The purpose of the report is to document the LNG reception and supply trials and operations carried out during the operational monitoring period of the vessel Oizmendi (formerly *Monte Arucas*), which, within the framework of the EPA2 sub-activity of the CORE LNGas hive project, has been retrofitted for the supply of LNG as a marine fuel.

2. Monitoring of sub-activity EPA2

2.1. Description of the sub-activity

Adaptation of an existing vessel to an LNG bunker barge prepared for bunkering operations (ship-to-ship) at the port of Bilbao and on the Cantabrian coast. The purpose of the sub-activity was the retrofitting of MV OIZMENDI (previously known as MV MONTE ARUCAS), originally intended for oil recovery and conventional fossil fuel bunkering. The cargo area has been redesigned and the vessel equipped with two LNG tanks, with a total capacity of 600 m^3.

Picture 1. MV Oizmendi.

2.1. Monitoring operations

The operations performed by the MV Oizmendi are part of the supply process to the MV Ireland in the port of Bilbao. This bunkering operation (OP. #2) took place on 3 February 2018, after the MV Oizmendi had been loaded with LNG at the BBG regasification terminal facilities (OP. #1), where it had arrived from the Murueta Shipyard subsequent to its retrofitting in that same shipyard.

OP. #	DESCRIPTION	DATE
1	Loading at BBG terminal under real operating conditions	31 January, 2018
2	Ship-to-ship bunkering operation to supply LNG to M/V Ireland in the port of Bilbao	3 February, 2018

Table 1. List of operations

2.1.1 Operation #1: Supply from BBG to MV Oizmendi

Loading operation of 85 m^3 of LNG for subsequent supply to MV Ireland. The loading took place at the jetty specially adapted for this purpose at the BBG regasification terminal facilities (Figure 1).

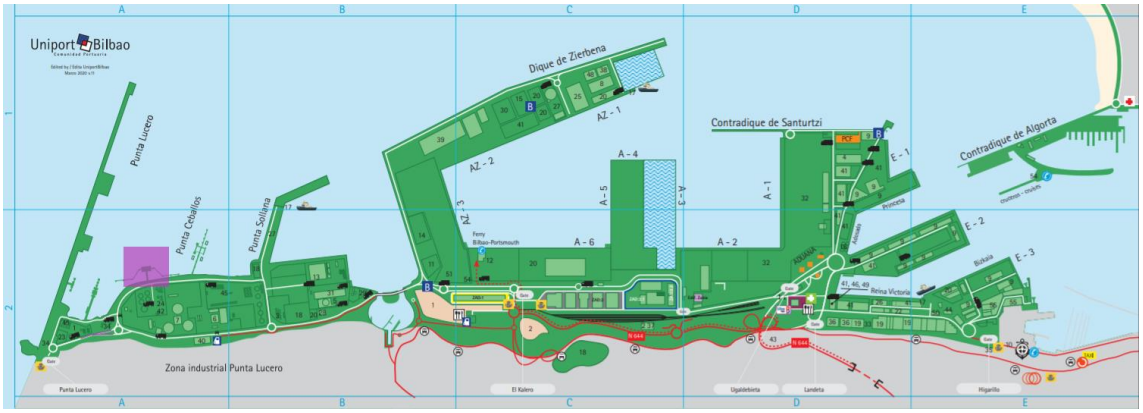

Figure 2. Location of OP. #1 in the port of Bilbao.

The entry and berthing manoeuvre took place on 29 January 2018 without incident and in good sea and wind conditions. Certain issues were noted in the reports (OP-IF-0008-18) regarding the gangway to connect vessel and terminal, due to the variation in tidal height.

Communications between vessel and terminal were established (ESD, walkie-talkie and mobile phone) and the BOG and liquid hoses were connected without incident. Pressure tests were then carried out.

A meeting was held prior to the start of operations, the ESD system was tested and the vessel was cooled down.

On the mornings of 29, 30 and 31 January, various loading and unloading tests were successfully carried out between the vessel and the terminal, without incident (OP-IF-0008-18).

The loading operation took place on the afternoon of 31 January and lasted 36 minutes. The maximum flow rate reached was 235 m^3/h.

Subsequently, the arms were drained and disconnected, the post-operation meeting was held and the vessel was unmoored.

In short, the loading operation was carried out satisfactorily, with no incidents of any kind and in the appropriate safety conditions. Sea and wind conditions were very favourable, and the loading was performed quickly and efficiently (OP-IF-0027-18).

LNG SUPPLY OPERATION			
GENERAL INFORMATION			
OPERATION	Short description.	Loading of MV Oizmendi at the BBG LNG terminal (Bilbao) for subsequent STS bunkering for the MV Ireland.	
Type of operation		Terminal-to-Ship	
Facilities/Supplier vessel		BBG Terminal	
Receiving vessel		MV Oizmendi	
Supply site		BBG Terminal Port of Bilbao	
Location		MV OIZMENDI moored at BBG jetty	
Delivery date		31 January 2018	
Docked	h	8:18 (29 January)	
Connected	h	10:30 (29 January)	
Started	h	16:42	
Completed	h	17:18	
Disconnected	h	18:12 (disconnection began at 18:00)	
Total time	h	N/A	
Actual loading time	h	36 mins. (0.6 h)	
Quantity supplied	m^3 | kWh	86,097	568,796
High heating value	kWh/Nm^3	11,753	
Initial tank pressure	bar	0.3	
Final tank pressure	bar	0.3	
KPIs			
Ratio actual loading time/total time	h/h	N/A	
Ratio quantity supplied/total time	m^3/h	N/A	
Pumping rate	m^3/h	85/0.6 = 142 m^3/h Max. 235 m^3/h	
Ramp-up	h	N/A	
Ramp-down	h	N/A	
QUALITATIVE ASPECTS			
Cooling	Incidents	No comment	
Mooring	Incidents	No observations to be made	
Berthing	Incidents	No incidents. Manoeuvre in 48 mins.	
Hoses and/or arms	Incidents Manoeuvrability	5 bar pressure drop at 250 m^3/h	
BOG/LNG Management	Incidents	No observations to be made	
Communications		ESD, walkie-talkie, mobile phone	
OTHERS			
Attached documentation	OP-IF-0008-18 Oizmendi trials OP-IF-0027-18 Partial loading of MV Oizmendi OP-IF-0031-18 Inerting of MV Oizmendi TESTS at BBG Checklist		

Table 2. OP. #1 KPI and indicators

Picture 2. MV Oizmendi at BBG jetty: view from seaside.

Picture 3. MV Oizmendi at BBG jetty: view from vessel.

Picture 4. MV Oizmendi at BBG jetty: hoses.

2.1.1 Operation #2: Bunkering from MV Oizmendi to MV Ireland

Bunkering operation of 85 m^3 of LNG from MV Oizmendi to MV Ireland, in the first ship-to-ship (STS) operation conducted in the Iberian peninsula and in the south of Europe.

After the MV Oizmendi had been loaded with LNG at the BBG regasification terminal, the operation was performed at the AZ-2 and AZ-3 docks of the port of Bilbao (Figure 2), with the MV Ireland moored at the AZ-3 dock, and the MV Oizmendi alongside the former and moored to the AZ-2 dock (Figure 3).

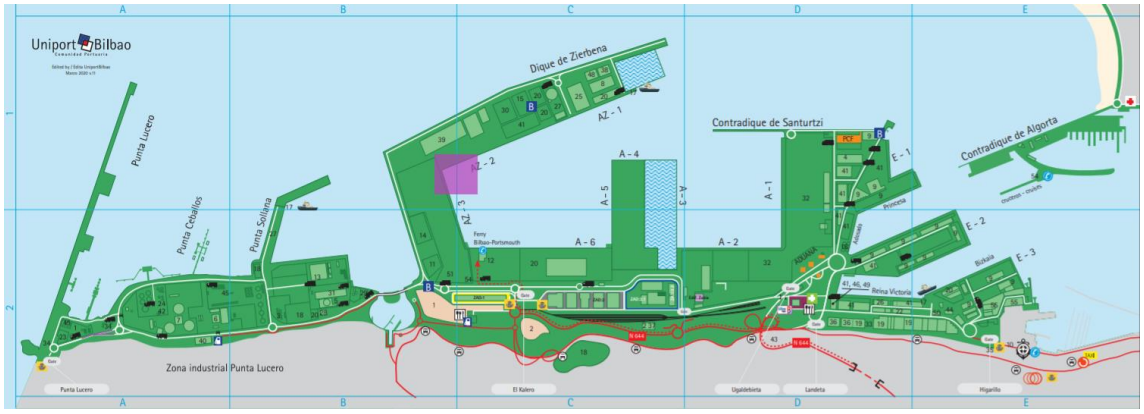

Figure 2. Location of OP. #2 in the port of Bilbao.

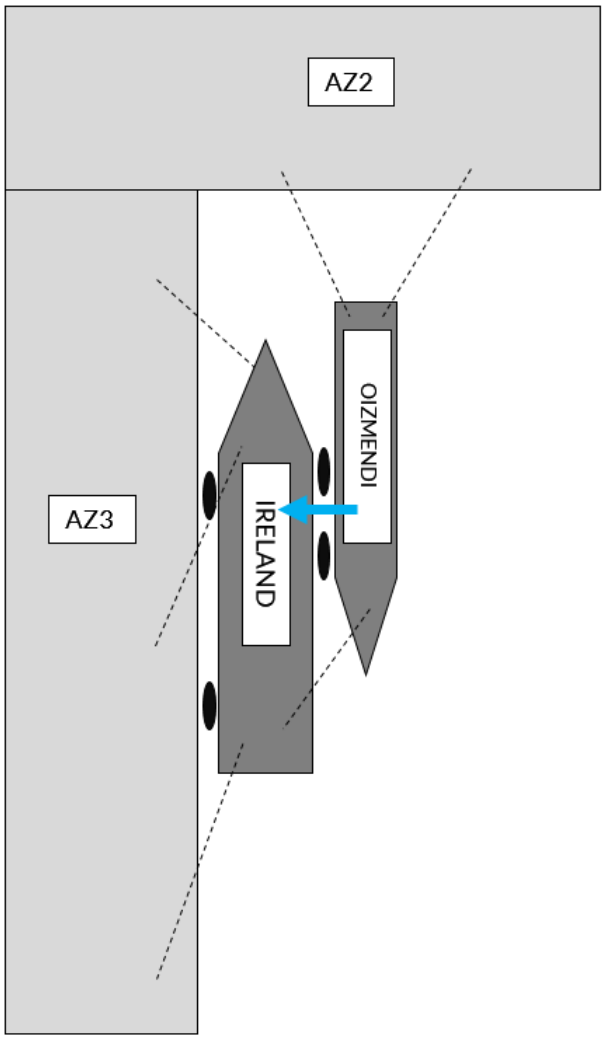

Figure 3. Arrangement of OP. #2.

The compatibility of the vessel, the mooring and the bunkering station had been analysed in a previous meeting held on Tuesday 30 January, attended by the port authority, the shipyard that had adapted the vessel, the captain of the MV Oizmendi and the owner of the MV Ireland. This meeting defined how the manoeuvre to berth the vessel alongside the MV Ireland was to be carried out.

The supply operation lasted one hour and a half. No incidents were recorded, either in the supply operation itself or in the disconnection and unmooring operations.

All in all, the supply operation was carried out satisfactorily. Sea and wind conditions were favourable and the process was conducted under the appropriate safety conditions and with no incidents.

At the end of the operation, the MV headed to the BBG regasification terminal facilities to proceed with the inerting of the LNG facility.

LNG BUNKERING OPERATION			
GENERAL INFORMATION			
OPERATION	Brief description	Bunkering of the cement carrier MV IRELAND by the MV OIZMENDI in the port of Bilbao	
Type of operation		Ship-to-Ship	
Supplier vessel		MV OIZMENDI	
Receiving vessel		MV IRELAND	
Supply site		Port of Bilbao Docks AZ-2 and AZ-3	
Location		MV IRELAND moored at AZ-3 MV OIZMENDI alongside MV IRELAND and moored to AZ-2	
Delivery date		03/02/2018	
Docked	h	8:00	
Connected	h	13:00	
Started	h	14:00	
Completed	h	15:30	
Disconnected	h	16:00	
Total time	h	8	
Actual loading time	h	1.5	
Quantity supplied	m^3 | kWh	86,097	568.796
High | Low heating value	kWh/Nm^3	15.282	11.753
Initial tank pressure	bar	N/A	
Final tank pressure	bar	N/A	
KPIs			
Ratio actual loading time/total time	h/h	1.5/8 = 0.1875	
Ratio quantity supplied/total time	m^3/h	86,097/8 = 10.8 Nm^3/h	
Pumping rate	m^3/h	86.097/1.5 = 57.4 Nm^3/h	
Ramp-up	h	N/A	
Ramp-down	h	N/A	
QUALITATIVE ASPECTS			
Cooling	Incidents	No comment	
Mooring	Incidents	No incidents	
Berthing	Incidents	No incidents	
Hoses and/or arms	Incidents Manoeuvrability	No incidents	
BOG/NG management	Incidents	No incidents	
Communications		No comment	
OTHERS			
Attached documentation	Bunkering Delivery Note Delivery checklist MV Ireland Delivery checklist MV Oizmendi		

Table 3. OP. #2 KPI and indicators

Figure 5. MV Oizmendi alongside MV Ireland.

Figure 6. MV Oizmendi and MV Ireland: hose and yokohamas.

Figure 7. Hose management.

3. Conclusions

At the time of writing this report, the MV Oizmendi had performed two LNG supply and loading operations.

In both operations, mooring, berthing alongside, connection, disconnection and unmooring manoeuvres have been carried out without incident and with all required safety measures in place.

The specific loading and supply operations have been performed in reasonable times, effectively and with no incidents. No difficulties in terms of compatibility with the BBG regasification facility or with the MV Ireland have arisen in relation to the vessel.

As the ramp-up and ramp-down processes are not fully documented, no quantitative conclusions can be drawn. However, from the data available and the comments provided in the attached reports, it can be concluded that all operations were carried out as planned.

The pumping rates achieved were those agreed with the BBG plant and MV Ireland managers. In no case were the pumping rates close to the maximum admissible values.

In addition to the operations described in this document (OP.#1 and OP.#2), during the days prior to these operations, on 29 and 30 January 2018, a series of cooling, loading and unloading tests were carried out between the BBG terminal and the MV Oizmendi, the latter being loaded at a pumping rate of up to 350 m^3/h, checking load losses and even returning the load to the BBG terminal using two different systems: the BBG pumps and pressurising the tanks with BOG. All these test operations were carried out successfully without incident.

Finally, despite the small number of operations carried out during the monitoring period, it can be concluded that the MV Oizmendi is perfectly suitable for the provision of a bunkering service within its capacity range of up to 600 m^3.

4. Appendices

OP-IF-0008-18 Oizmendi trials
OP-IF-0027-18 Partial loading of MV Oizmendi
OP-IF-0031-18 Inerting of MV Oizmendi
TESTS at BBG Checklist

Bunkering Delivery Note
Pre-delivery checklist / Ireland
Pre-delivery checklist / Oizmendi
Post-delivery checklist

5. List of Acronyms and Abbreviations

LNG	Liquefied natural gas
MV	Motor vessel
ESD	Emergency shut-down
BOG	Boil-off gas