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Executive Summary

Before the fuelling stations in the LNG Blue Corridors project – an EU-wide project designed to establish liquefied natural gas (LNG) as fuel for road transport – can be fully operational, the logistics for delivering LNG fuel to the stations must be established. This deliverable describes the project partners' progress choosing suppliers to handle these logistics based on the daily/monthly consumption.

All partners are already working with different companies capable of delivering fuel to project stations, and even some partners have more than one providers. This is positive, as it demonstrates that there is abundant infrastructure in place to deliver LNG to fuelling stations. At first, fuel deliveries and logistics are governed by inventory control – until steady fuel demand can be determined, orders for more fuel will be placed when the amount on hand falls below a certain amount. Once normal demand is established, supply strategies involving deliveries at regular time intervals are implemented.

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Statement of originality

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1 Introduction

1.1 What is the LNG BLUE CORRIDORS Project?

The use of natural gas as a road fuel offers several strategic, technical, and societal advantages. Natural gas as vehicle fuel can reduce pollutant and greenhouse gas emissions, reduce noise emissions, lower fuel costs, and offer an effective alternative to the use of imported oil in transportation. In Europe, the use of natural gas engines in transportation applications has been well established in passenger cars and in short-range heavy-duty vehicles. However, the availability and use of natural gas in long-distance transportation has been very limited.

The DG-MOVE FP7-funded LNG Blue Corridors project is designed to overcome challenges by facilitating the simultaneous roll-out of vehicles and filling stations along major traffic corridors across the EU. By establishing 13 filling stations and partially funding the extra investment costs for LNG trucks, the project lays the groundwork to establish LNG in European road transport and to analyze its impacts over a three-year demonstration period.



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2 Regular fuel supply

2.1 Kallo station

Supplier

The companies able to provide fuel to this LNG facility are ENGIE, ENI Gas & Power and EFT TRADING.

LNG terminals

Fuel to be used at Kallo station will be transported from Zeebrugge, which is being operated by Fluxys.

Comments

The Kallo station will be widely well supplied by different companies. However, all of them will take the gas from the same terminal, which is quite reasonable due to proximity between Antwerp and Zeebrugge. Because of this it is quite an attractive area to deploy LNG facilities, as it reduces possible fuel transportation costs. The Zeebrugge area is considered to be the most important natural gas landing point in the EU. Connecting to a variety of pipe gas and LNG sources, it has an overall throughput capacity of about 48 bcm/y. As for pipe gas flows, the Zeebrugge area gives access to natural gas from Norwegian and British offshore production fields in the North Sea as well as from Germany and Russia. Worldwide LNG supply is available through the Zeebrugge LNG Terminal.

Its proximity makes the Drive station very well located. The cost of fuel transportation is considerably reduced. In the event of an unexpected extra fuel demand, the LNG tank could be refuelled quickly. Also, there are other LNG terminals nearby such as GATE Terminal in Rotterdam – 100 km away from Kallo.

2.2 Piacenza station

Supplier

The company in charge of the fuel supply is HAM.

LNG terminals

The terminals from which the fuel is transported are Barcelona Fos Tonkin.

Comments

The station is well supplied with LNG thanks to the round trips done by HAM trucks from France and Spain. Due to the high activity of the station, LNG carriers activity is done on daily basis.

2.3 Pontedera station

Supplier

The company in charge of the fuel supply is HAM.

LNG terminals

The terminals from which the fuel is transported are Barcelona Fos Tonkin.

Comments

The station is supplied with fuel thanks to HAM carriers from France and Spain.

2.4 Berlin station

Supplier

A list of potential companies could do it such as Gascom, Primagaz, Hoyer, Samat, TSL, Nijman, Klacska.

LNG terminals

The terminals from which the fuel is transported are GATE, Rotterdam, Zeebrugge, Swinoujsie.

Comments

Independently of the gas source, the station must be supplied frequently due to the expected high demand from clients. Thanks to this, boil-off effects will hardly be produced. The flexibility to choose the fuel source is wide. In general terms, from this German area upwards, any LNG refuelling points will be well supplied; as well as the ones close to the French and Benelux borders.

2.5 Matosinhos station

Supplier

Galp Gas Natural is providing fuel to this station.

LNG terminals

The fuel is taken from Sines.

Comments

Due to the distance between the station and Sines, where the LNG Terminal is located, a good supplying plan must be drawn up. The mileage in between is 445 km. This is mentioned because at

present the number of clients who are using the station is rather low, so if a high amount of fuel is transported and stored at station tank, boil-off effect might be produced.

2.6 Barcelona station

Supplier

Gas Natural Comercializadora provides fuel to this station.

LNG terminals

Due to its nearness, the fuel is taken from Barcelona LNG terminal. In turn, the gas is coming from Qatar, Nigeria, Algeria, etc.

Comments

The GNF station is definitely well located in terms of proximity with Terminals. There are roughly 40 km in between, therefore it seems logical to think that, firstly no other alternative LNG terminals are contemplated, and secondly journeys to load the station perfectly adapt to the facility demand. Due to that, there is a high capacity to react in case of unexpected high-consumption peaks.

Likewise, the cost of fuel transportation is low.

2.7 Paris station

Supplier

LNGeneration, HAM and LNG Solutions keep this station supplied.

LNG terminals

The LNG Terminals used are Montoir de Bretagne and Zeebrugge.

Comments

No comments.

2.8 Lyon station

Supplier

LNGeneration, HAM, Molgas, others keep this station supplied.

LNG terminals

The LNG Terminals used are Montoir de Bretagne and Zeebrugge.

Comments

No comments.

2.9 Nimes station

Supplier

LNGeneration, HAM, Molgas, others keep this station supplied.

LNG terminals

The LNG Terminals used are Montoir de Bretagne and Zeebrugge.

Comments

No comments.

2.10 Carregado station

Supplier

The supplier is GoldEnergy.

LNG terminals

The fuel is taken from Sines LNG terminal.

Comments

No comments.

2.11 Elvas station

Supplier

The supplier is GoldEnergy.

LNG terminals

The fuel is taken from Sines LNG terminal.

Comments

No comments.

2.12 Örebro station

Supplier

The supplier is AGA.

LNG terminals

The fuel is taken from Nynäshamn LNG terminal.

Comments

No comments.

3 Fuel supply planning

In this section, the planning when loading the LNG tank at stations is explained based on the current fuel demand. This might vary in the future.

3.1 DRIVE: Kallo, Antwerp, Belgium

It has been estimated that up to 21 T could be conveyed, that means 46 m³ can be refuelled. A fuel carrier could refuel 77% of the station capacity, although the same fuel carrier is used to offload at different stations.

At present, Drive station has reached a constant fuel demand. Either way, bearing in mind the crossing-routes point of this station, fuel consumption fluctuation might well occur.

It is worth mentioning as well that, although the maximum capacity of a fuel carrier is 21 T, the Kallo station is hardly charged with this amount. Normally up to 14 T of LNG is charged.

Kallo station has an average consumption around 1000 kg of LNG a day (although the sales figures are going up lately). Normally all stations are charged with fuel as soon as the LNG tank reaches 20-25% of its capacity. It can be concluded that this facility, at this fuel consumption rate, will have to be refuelled every two weeks at least.

As a matter of fact, Drive System declares fuel carriers pass by the station once a week, with 14 T each time.

The main reason to avoid charging the station to its maximum level is, of course, the possible boil-off effect that may occur if the fuel is not finally consumed. The station is charged with approx. 14 tons every week, the rest of the cargo goes to other stations. From these 14 tons, about 9 to 10 tons is dispensed to trucks (the station is frequented by 20-30 different trucks), the rest is converted to CNG for use on site and on a remote (daughter) station.

With the amount of LNG (10 T) charged at the Drive station:

- 23 Iveco trucks with double-LNG-tank could be refuelled,
- 46 Iveco trucks with a simple 500 L-tanks could be refuelled,
- 83 Volvo¹ trucks with a small LNG tank (280 L) could be refuelled.

Leaving aside the average Kallo consumptions, this facility is frequented by 6 trucks per day on average, normally Volvo or single-LNG-tank trucks.

To sum up, it can be concluded that the Antwerp area – and it can be extendable to Benelux area – are fairly well covered in terms of LNG as fuel for vehicles. The distances are close and doable by a container in a relatively short time in the case of an unexpected event. Based on the current fuel demand this station is well situated to be securely supplied. Based on the results, it is safe to say it is a good rate for the station to be charged with fuel on a weekly basis.

¹ Volvo trucks are referred to Euro V vehicles which were commercialized few years ago.

3.2 ENI: Piacenza, Italy

The fuel consumption of this facility is 8-10 T of fuel a day. It is, by far, the most demanded station in the project. Based on that, the station has to be charged with fuel very often. Taking into account this consumption rate, as soon as the station is charged, the fuel will last 8 days at the most.

In order to operate in a safe margin, according to ENI, the Piacenza station is supplied about every 2 days. There are considerations ongoing to step up to daily delivery since the very long supply lines generate considerable risk of disruption. A simple mechanical truck breakdown will determine the station running out of stock.

On the other hand, this facility is frequented by 50 trucks per day on average. The duration of the fuel will largely depend on the type of trucks that are refuelled at the station, being able to refuel up to 41 trucks in the worst case scenario – trucks with the largest LNG tank capacity.

In the case of this station, it is particularly dangerous to reach the 20% level of the tank capacity. Due to the high daily demand, the station would run out of fuel in just hours. This is because fuel carriers are continuously doing round trips from neighbour terminals to Piacenza.

In relation to this, it is important that ENI stations receive fuel from Barcelona and Fos Tonkin. In any case this means at least a two-day round trip.

This station is not very close to the terminals – mainly from the Barcelona one with 1.000 km in between, although it can be charged as well from the Fos Tonkin, 600 km away. Normally it is loaded with fuel from Barcelona, which means that at least 2 days would be needed to get to ENI stations (both Piacenza and Pontedera). With such conditions, a good refuelling schedule is needed in order not to leave the station without fuel. If the Fos Tonkin station is used as a fuel feeder, the journeys would be 600 m, which is doable in a day.

According to the information provided, as the station is refuelled every 2 days at the most, in that period 20 T of LNG may be consumed. Therefore, about 2-4 T are left in the LNG tank as fuel back-up. It is also important to consider this Italian station has a high CNG demand and, as explained above, the variety of LNG tank capacities that trucks mount are key when getting low LNG tank levels; hence it seems to be a good refuelling programme for this facility.

3.3 ENI: Pontedera, Italy

The same can be applicable to the second ENI project station located near Livorno. In May 2018 sales are around 2T a day and mostly in the form of L-CNG. Demand picked up with the introduction of the new Iveco Stralis truck. Delivery currently takes place once a month. This confirms the good thermal insulation of larger LNG storage tanks.

The economics of storage tank sizing is quite complex and requires a dedicated in-depth analysis. Apart from the cost for simply setting up the trailer truck – storage tank hose connection which can easily be estimated, factors such as station availability and future options for operation as a local distribution hub need to be priced in.

Due to the heating of the transported LNG a trailer truck can do a maximum of 2 deliveries in one trip. This is also a very limiting factor which may determine the occasional need to transport LNG back and forth.

Hence it is probable that the refuel will be done every 2-4 days with an average amount of fuel of 18-23 T each trip, but this will be dictated by the demand. It is foreseen that during the initial station's activities, the demand is low. After a settling down process and once the demand is steady, the number of supplying activities will be as in Piacenza. Now the figures are not comparable with the other Italian stations, but they are going up significantly.

In terms of fuel source, this facility has the same sources of the other Italian station: Barcelona and Fos Tonkin, with almost the same mileage in between. Therefore there is some flexibility in case of unexpected problems with any of the terminals.

The station has huge potential due to it being very close to Leghorn which is a probable site for the first terminal for LNG in liquid phase on Italian territory. This would create higher possible truck loading and very short supply lines, allowing competitive pricing and the highest possible availability.

All in all, due to its proximity and doable distances from ENI stations to Terminals, these two facilities – and it can be extendable to the rest of the northern Italian area – are well covered in terms of fuel, with back-up alternatives in case of incident. Additionally, because of the high demand from clients, these Italian stations must have a good planning when supplying fuel as they do.

3.4 UNIPER: Berlin, Germany

The 20 LNG trucks that are being refuelled at UNIPER facility are equipped with a double-LNG-tank, which means 0,43T will be consumed per truck. The fuel carrier loads the station every 3-4 days at least. Due to the distance and the expected high demand, the fuel carriers do round trips continuously. Normally, the station is fed with the Rotterdam LNG Terminal gas on a regular basis.

There is also the possibility that the fuel is transported from Swinoujsie, Poland. In that case, the distances will be significantly reduced, just 250 km. Finally, the station can be fed by gas from Zeebrugge, as a third source option.

3.5 GALP: Matosinhos, Portugal

Due to the distance between the station and Sines, where the LNG Terminal is located, a good supplying plan must be drawn up. The mileage in between is 445 km.

The distance is doable in order for the fuel carriers to make it in a day. Therefore, the station can be charged relatively quickly. For the time being, as said, since the station has a low amount of fuel sold, carriers are heading for the station just when the demand requires, with no fixed advanced schedule. As soon as the station has a steady number of clients and a stable number of refuellings a day, it will be determined how often the facility needs to be loaded with fuel.

Now the station has been charged with the lowest possible amount of fuel, in order to prevent boil-off effects.

As happened with the Barcelona station, with low numbers of refuellings per day, the station can be charged with fuel once per month, with an amount between 5-7 T, depending on the provisions – also taking into account the CNG deliveries. With that amount, up to 23 single-LNG-tank trucks might be refuelled, therefore it seems reasonable to operate under that regime.

3.6 Gas Natural Fenosa: Barcelona, Spain

Based on the actual figures and the clients' demand, this station has an average daily consumption of 260 kg of LNG, at least 2 refuellings a day. At present these fuel volumes are going up – mainly over the last months – although the general consumption is quite low mainly bearing in mind this is a transient area of heavy-duty vehicles. However, many other LNG facilities have been constructed nearby offering clients other possibilities.

According to the information provided by Gas Natural Fenosa, the Barcelona station is being loaded with fuel every 15 days on average, but obviously this much depends on the demand. The station has been charged after 3 days of activities under peak of high demand, or after 1 month due to the low consumption.

Normally up to 7 T is delivered in each fuel charge at the station. This is considerably lower than the Italian and Belgium cases, although in line with the fuel demand.

With 7 T of LNG, up to 16 new Iveco trucks with double-LNG-tank can be refuelled, or 32 single-LNG-tank trucks. Usually, unconsumed fuel is used to refuel CNG vehicles as well.

Moreover, it is fair to say that more and more trucks are being converted from conventional diesel to dual-fuel trucks in this area. Besides this, the new Iveco truck, which offers clients up to 400 hp, might change the current scenario significantly. As mentioned above, this is a transited area with a high activity of Heavy-Duty vehicles and most of them will go beyond the Pyrenees. Therefore, powerful enough trucks are needed to tackle these types of journeys.

In general terms, the current planning of fuel supply is working smoothly and adapted to the demand. In the event of high fuel consumption, Gas Natural Fenosa will react accordingly. Its location is close enough to prevent any incident.

3.7 ENGIE: Paris, France

In terms of fuel supply logistic operations, the station has a diversity of sources, which is important. The Zeebrugge LNG Terminal is 320 km away and Montoir de Bretagne is 420 km away -both journeys are perfectly doable and their locations are near enough in case the station needs fuel.

The station has an average of 10 trucks a day, which means that up to 2,3T of fuel could be delivered daily.

According to the information provided by ENGIE, the best way to do the logistics is to serve a few LNG facilities with the same trailer, so that it will be possible to have more flexibility and a low temperature in the refuelling stations can be ensured. That means that ENGIE is doing partial offloading: 1 fuel trailer to a few stations.

The Rungis station is fed with fuel 2 or 3 times a week. In that way the fuel availability of the LNG tank at the facility is maintained. Moreover, thanks to this supply procedure, the fuel temperature is steadily cold; in that way boil-off is prevented.

The amount of fuel that is delivered each time is around 10 tons, preventing the fuel level from going down and leaving a fuel back-up in the event of high demand.

3.8 ENGIE: Lyon, France

According to ENGIE, this station is supplied with fuel once per week. The procedure being used is the same as at Rungis, namely partial offloading is done to prevent venting by keeping the fuel temperature low. Since the demand is not high for the time being, one refuelling a week seems to be sufficient to prevent fuel depletion.

3.9 ENGIE: Nîmes, France

The gas coming from the LNG Terminal in Barcelona is also supplying this station. The distance between these two points is acceptable (400 km). Moreover, Ham or Molgas are doing round trips on a daily basis from Barcelona in order to supply stations in the Mediterranean area.

Therefore costs of fuel transportation, as with all refuelling points along the Mediterranean area, are reduced due to their good connection to neighbouring terminals.

Additionally, in line with the procedure described above, Nîmes LNG tank (20 m³, pending the definitive station) is being partially loaded with fuel. Because of its size, the LNG tank is being loaded twice per week. Between 3 and 4 T are delivered each offload.

This amount of fuel per week is sufficient based on the current demand (around 1000 kg a day).

3.10 DOUROGAS: Carregado, Portugal

Both Dourogas stations are really well located in terms of fuel transportation: 166 km in the case of Carregado, 260 km in the case of Elvas from the Sines Terminal.

Furthermore, the location of the Carregado station is fairly close to several fleet operators and is in the neighbourhood of one of the major logistics areas in Portugal, covering several fields of activity: food services, supermarket stores, industry raw materials, pharmaceutical products, and several others.

Both facilities are already in operation whose daily consumption figures were provided. Concerning the Carregado station, they have an average daily consumption of 1.300 kg of LNG (March/2018 values). This station was put into operation in October of 2014 and its consumption has been increased over time. Now they have a rate of 20 LNG trucks + 6 solid urban waste CNG trucks a day.

Regarding sales, Carregado station sold a total amount of 436T in 2016, 484T in 2017 and this value is expected to increase in 2018.

With this number of trucks, it is estimated that at least 2.5T of fuel must always be available daily at the station– 5T if the station is frequented by double-LNG-tank trucks-, in order for the station to have enough fuel.

Fuel carriers are able to transport 20T per trip in the Portuguese case.

According to Dourogas, the Carregado station is loaded with fuel every week, with 13T of LNG on average. Therefore, nearly 7 T are left in the LNG tank as fuel back-up. It is also important to consider this Portuguese station has a CNG demand as well, so gas can be further utilized. 44% of the total gas charged is consumed. In other words, just 12% out of the total LNG tank capacity is accumulated in the tank.

3.11 DOUROGAS: Elvas, Portugal

Concerning the Elvas station, the case is quite different since the LNG tank capacity at this station is 10 m³. Therefore the time between fuel charges is significantly longer, as described below:

The Elvas station was built bearing in mind that the initial fuel demand would be low, and presumably it will be higher in the years to come. This facility is loaded with LNG every two weeks. Each time the fuel carrier carries gas to the station, roughly 2,3T is delivered.

Several Iberian operators have been fuelling at this station, in a total of 8 LNG trucks, connecting some of the main cities of the Iberian peninsula such as Madrid-Lisbon, Huelva-Porto or Badajoz-Sines, for instance

In terms of consumption, the station is frequented by 3 trucks a day. On average, between 100 kg-110 kg are daily consumed. With these figures, it can be concluded that 60% of the fuel delivered is consumed. In other words, 20% of the total tank capacity is not consumed per fuel charge. Since the LNG tank capacity is smaller than others, this 20% might be consumed by 12 LNG trucks.

This amount is quite acceptable for dealing with any unexpected issues, providing CNG to other vehicles and even being utilized by other uses.

3.12 SGA: Örebro, Sweden

The station is used 1-4 times a day with a consumption of 100-190 kg per refueling. Most of the trucks that frequent this station are Volvo Dual-fuel. As a matter of fact, 0,12 T is exactly the amount of gas that is delivered to LNG tanks on Volvo trucks. Out of the 3 trucks that pass through this station on a regular basis, none of them are dedicated vehicles.

Bearing in mind that all LNG trucks consume a relatively low amount of fuel –half compared with Iveco single-LNG-tank trucks, and three times less compared with double-LNG-tank 400hp Iveco trucks – the total gas sold over the last years in the project can be considered low: 159.252 kg in 1290 days.

The Nynäshamn Terminal, where the LNG gas is carried from, is 220 km away from the station. That means due to the short distance between these two points and taking into account that other LNG refuelling points are also supplied with fuel from this terminal; there is no problem for Örebro station to be operative in terms of fuel availability. This entire area is well covered thanks to the Nynäshamn Terminal activity.

Partners

				
				
				
				
				