JOURNAL OF MARITIME RESEARCH

Vol XIV. No. III (2017) pp 24–30

ISSN: 1697-4040, www.jmr.unican.es

Establish Ship fueling terminals at western coast KSA and reflect on GDP

A. Elentably[1], S. Aldosari[1], M. Khandorth[1], A. Bawoly[1], M. Alsherif[1]

ARTICLE INFO

Article history:
Received 28 October 2017;
in revised form 10 November 2017;
accepted 27 November 2017.

Keywords:
Fuel, Floating, Terminals, Ethanol, Yanbu, Efficiency.

ABSTRACT

The Oil Price Information Service reports that there are 1,296 terminals storing transportation fuel nationwide. These terminals are constantly receiving, storing, and dispensing fuels. Over 1,200 of these terminals are either storing ethanol or are capable of storing it. Terminal equipment includes piping, valves, meters, pumps, truck and rail unloading skids, and tanks. Finished transportation fuels are dispensed to trucks for delivery to retail stations and other end use customers. This is achieved by complex control systems that pull fuels from various tanks gasoline blend stock, ethanol, and additives into a loading arm that delivers fuel into the truck. Interviews with companies indicate that there are minimal technical issues with storing and distributing more ethanol. However, there are several significant factors that could limit increased deployment of ethanol at terminals.

- The availability of land to add tanks and unloading equipment as well as land to accommodate increased truck traffic for ethanol deliveries.
- Permitting and regulatory processes to add tanks have become more time consuming and challenging in recent years.
- There are few existing tanks that are not already in use.
- It will be necessary to re-configure the existing loading racks and bay to accommodate additional equipment to fill trucks.
- A significant amount of capacity at terminals is leased to customers under long-term contracts to store specific fuels and volumes.

Terminals are capable of handling more ethanol if the market conditions indicate long-term demand sufficient to warrant building additional infrastructure. Terminal companies indicate that most of their tanks are in use; therefore, accommodating ethanol at a volume of 25% to 40% will likely require installation of new tanks and other equipment. Some terminal locations may experience land constraints to accommodate additional infrastructure and increased truck traffic for fuel deliveries. There are potential hurdles upstream to deliver more ethanol by rail. Further analysis is needed to determine the availability of rail cars and ability of transmodal facilities to handle more ethanol.

1. Terminal Information

Terminals are an important part of the transportation fuel supply chain, moving products to end user markets. Their primary function is to store and distribute fuels.

A typical terminal serving the on-road transportation fuels market would store regular and premium gasoline blend stock for oxygenate blending, diesel, denatured ethanol, and additives. These fuel types are stored in individual tanks. The number of tanks and the capacity for each fuel type are dependent on demand for the market the terminal serves. Terminals are constantly receiving and dispensing fuel-the mode of fuel receipt

[1]King Abdul-Aziz University. Jeddah Saudi Arabia.

varies and may include pipeline, truck, barge/ship, and rail.

A single terminal will serve many different customers through established contracts. Trucks arrive at a terminal and select fuels for their customer. Based on the fuels selected, products are pulled from various tanks to dispense a finished transportation fuel into the truck. Note that trucks can have multiple compartments and transport several fuels at one time.

2. Terminal Equipment

A terminal includes many pieces of equipment designed to safely offload fuel from multiple transportation modes, store it, and load it into trucks for delivery to fuel stations. provides an overview of fuel flow and major equipment at a terminal.

The most common equipment at terminals is pipes, valves, meters, and pumps. Pipes, usually made of carbon steel with welded joints, move fuel to storage tanks and deliver fuel to the loading rack.

Valves are used throughout the system to control the flow of fuel. Meters measure and control the flow rate of fuel to ensure an accurate blend, and pumps move fuel throughout the terminal. Trucks are loaded with finished fuel products at the loading rack-a sheltered area with multiple bays. Loading rack equipment includes loading arms that connect to the truck to deliver fuel, vapor recovery that is either burned off or collected to re-capture fuel products, a grounding line, a fire suppression system, and a computerized system for truckers to select fuels to be loaded. Fuel storage tanks, called tank farms, are typically large and almost always above-ground.

Tanks are usually made of mild steel and are erected on-site using American Petroleum Institute (API) standards. These large tanks have floating roofs that sit on the surface of the fuel and rise and fall as fuel is added and removed. The roofs serve as a method of controlling vapors. Diesel, or in some instances gasoline, tanks would have an external floating roof, so there is no permanent fixed roof. Ethanol is always stored in a closed, floating-roof tank due to its affinity for water. Small tanks with capacities below 1,190 barrels are generally.

3. Terminal Company Ownership

There are several types of companies that own terminals. The National Renewable Energy Laboratory classified these companies based on OPIS data to gain insight into ownership. by category.

- Oil: Vertically integrated companies that explore and drill for oil and refine it. These companies may also own pipelines.
- Pipeline: Companies that own pipelines and lease storage space to customers at their terminals.
- Refinery: Companies that own refineries and terminals. These companies may also own pipelines.
- Terminal: Companies that own one or more terminals, but do not own pipelines or refineries.
- The majority of companies are in this category, and there is not consolidation of ownership

Other: Companies with terminals that do not fit in other categories, including primarily asphalt, aviation, marine, and propane companies that store some on-road transportation fuels. This category also includes ethanol and biodiesel companies that own terminals.

4. Terminal Operations

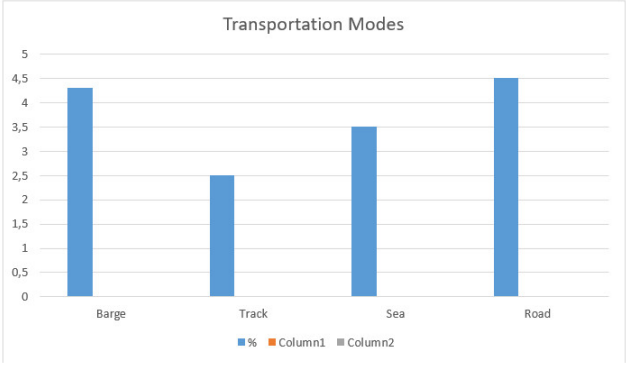
Terminals receive fuel by several transportation modes. Table 1 highlights that the majority of terminals can receive fuel by pipeline or truck. However, these data report on methods of receiving and out loading fuels; thus, there is an expectation that nearly all terminals could outload fuel by truck because the purpose of a terminal is to blend final fuel products for delivery to end users, usually retail stations.

The assumption for this discrepancy is that some of the data were incorrectly reported. While unit train typically ships ethanol, few terminals are equipped to receive unit trains. especially with the constraints affecting the availability of hazardous-fuel rail cars due to both new regulations and increased use of rail infrastructure to move crude oil.

Table 1: Terminal Transportation Modes

TRANSPORT	PERCENT
BARGE	36.5
PIPELINE	71.3
RAIL	22.0
SEA	14.7
TRUCK	88.4

Figure 1: Terminal Transportation Modes



Source: OPIS (2015), based on 1,196 terminals reporting transportation modes.

The majority of ethanol is delivered by rail to trans-modal facilities and then trucked to terminals. Some trans-modal facilities deliver fuel to a terminal by a short pipeline. Terminals located in areas of ethanol production may receive fuel directly

from an ethanol plant. Minimal ethanol is delivered by barge to terminals on waterways, primarily in the South and Northeast. Delivery of ethanol generally requires staff onsite because it is received by truck. Terminal companies reported ethanol and other fuels delivered by truck lack the flexibility for off-loading of petroleum fuels received by pipeline. Rail and truck deliveries are more likely to be impacted by weather events than pipelines. Fuel is constantly checked for quality as it is received and supplied, and many terminals test fuel quality of ethanol prior to off-loading the truck.

The total time for receiving and off-loading ethanol into a storage tank is approximately 30 minutes. Terminals often tie into a pipeline through a single pipe, and a series of valves and meters controls the flow of products from the pipeline to specific storage tanks for each fuel type. All fuels received by truck or barge/ship are off-loaded through pipes to the storage tanks. Tanks are constantly receiving and dispensing fuel, although some terminals do not fill tanks and dispense to trucks at the same time. Tanks are not filled to their full storage capacity. They have a working capacity that is anywhere from 80% to 95% of the storage tank capacity depending on company practices. This allows for a contingency space providing a buffer between the stored fuel and the tank top/roof to reduce the risk of fuel spilling out through vents and damaging the internal floating roof.

Complex computerized systems control the fuel's flow all time throughout a terminal. The most common method of blending gasoline fuel components is ratio blending, also referred to as inline blending. Ratio blending consists of two meters?one controls the flow rate of gasoline, and one controls the flow rate of ethanol. To maximize the flow rates of meters, many terminals will start loading a small volume of approximately 50 gallons of either gasoline or ethanol prior to loading both fuels at the same time. An injection system is used to blend additives. This method ensures an accurate blend if dispensing is interrupted. Another, less common method, is sequential blending, where a single meter is used and one fuel component is loaded at a time. If dispensing is interrupted, the blend will be inaccurate.

Terminals generally do not allow splash blending, i.e., loading gasoline and ethanol separately to the truck. Terminals enter into agreements with their customers which could be convenience store chains, branded or unbranded independent stations, or marketing companies or fuel service providers that deliver fuel to a station or other end users. Customers agree to buy fuel types with minimum and maximum volumes-the maximum volume can be exceeded if the terminal approves additional sales to a customer. Customers leasing space at a terminal enter into long-term contracts to store specific fuel types and volumes. Terminals do not own the refueling trucks that load at their facilities. These trucks may be owned by a convenience store chain, independent trucking company, marketing company, or other customers. Truckers receive training at each terminal, and their truck is tested to ensure vapor seals are working properly. Truckers must adhere to a list of rules set by each terminal location or risk being locked out for days or permanently based on the severity of the violation. At most terminals, a trucker will swipe a user card to enter the facility, and at all terminals, the trucker will swipe a card or enter a code at the loading rack. At many terminals, the trucker will enter a customer code, which will limit the list of fuels available based on the agreement with that customer. As an example, a truck picking up fuel for a Shell-branded station would not be able to select Conoco-branded fuel. The trucker connects the ground line and vapor recovery hose to their truck. The trucker will then connect the loading arm(s) and select the fuel types and quantities to be dispensed. After the trucker selects and confirms the fuel type and quantities, the terminal control system will release fuel from several tanks that will be delivered to the loading rack, which blends the fuels in-line through a loading arm into the truck. For example, if a trucker selects regular gasoline, the terminal control system will pull fuel from three tanks: gasoline, ethanol, and additives to provide a final finished gasoline product meeting fuel quality and EPA specifications. It takes 15 to 20 minutes to fully load a truck. Fuel delivery trucks typically haul 8,500 gallons; however, a truck?s capacity may range from 3,000 gallons to 11,500 gallons. These trucks have several compartments to store and deliver different fuel types to various customers.

5. Terminal Standards and Regulations

This section covers many, but not all, regulations and standards that apply to terminals. It is not meant to be an exhaustive list as requirements may vary based on size, location, transportation modes, and other terminal parameters. Aboveground storage tanks are subject to federal, state, and local regulations. Terminal companies design, build, and maintain tanks as recommended by API Standard 650, Welded Tanks for Oil Storage, which provides requirements for materials, design, fabrication, erection, and inspection of aboveground storage tanks. API Standard 653, Tank Inspection, Repair, Alteration, and Reconstruction, applies to tanks exceeding 50 feet tall or 30 feet wide. A key component of API Standard 653 is tank inspection. The standard recommends that the tank owner inspect monthly and that an independent, certified inspector perform an external inspection every 5 years and an internal tank inspection every 10 years. API Standard 2350, Overfill Protection for Storage Tanks in Petroleum Facilities, provides methods and equipment types to minimize risk of a release caused by an overfill event. There are several codes that terminals must adhere to that fall under both EPA programs and Occupational Safety and Health Administration jurisdiction. Title 40 Code of Regulations Part 112 (40 CFR 112) applies to terminals storing petroleum in tanks greater than 1,320 gallons. The code requires aboveground storage tanks to have a secondary containment area around the tank capable of holding 110% of the tank volume. Methods of containment include dikes, berms, liners, vaults, or double-walled tanks.

A sump pump must be used for rain water collection in the containment area, which could be an issue with an ethanol release due to the fuels? affinity for water. Tanks out of service one year or more typically require monitoring or removal. In most instances, a Spill Prevention Control & Countermeasures

Plan is required by 40 CFR 112 and is designed to prevent release of petroleum products to navigable waters. The plan would apply to terminals that store crude oil as well as gasoline blend stock, diesel, and other transportation fuels. Fuel terminals are also subject to regulations under the National Pollutant Discharge Elimination System to ensure that discharge of storm water does not contain any fuel products.

The EPA stated that aboveground storage tank releases are caused by holes from corrosion, piping failures, spills/overfills, equipment failure, and human error (EPA 2010). While not required by federal code, the following practices are recommended to minimize risk of a release that could contaminate water (EPA 2010). This includes corrosion protection, which is universally used on terminal tanks; pipes should either be double-walled, aboveground, or cathodic ally protected. Fuel-resistant coatings are recommended to be applied to floors, containment areas, and the sump pump pit. Terminals are required to obtain an operating permit to ensure compliance with air emission requirements per Title V of the Clean Air Act.8 The permit is typically issued by state or local permitting authorities as allowed under 40 CFR Chapter 1 Subchapter C Parts 70 and 71. An addition of a tank would result in the need to update the permit. CFR Title 40 Chapter 1 Subchapter C Part 63 Subpart BBB, National Emission Standards for Hazardous Air Pollutants for Source Category: Gasoline Distribution Bulk Terminals, Bulk Plants, and Pipeline Facilities, specify terminal emission limits and how to demonstrate compliance. The code also stipulates tank filling requirements, monthly leak inspection of all equipment, reporting requirements including number of tanks and capacity, and average monthly throughput. Terminals with an average throughput of 250,000 gallons per day must have a vapor collection system for their loading racks.

Terminals must submit a Notification of Compliance Status and any leaks to both their EPA Regional Office and the delegated state authority. The Occupational Safety and Health Administration oversees 29 CFR Subtitle B Chapter XVII Part 1910 Subpart A 1910.106, which regulates fuel terminals with a focus on requirements for equipment. 29 CFR Subtitle B Chapter XVII Part 1917 Subpart B has additional requirements for marine terminals. Terminals are also subject to local regulations. Local authorities having jurisdiction refers to regulating organizations, office or individuals responsible for overseeing codes and standards. Examples of authorities having jurisdiction include local fire marshals, state energy and environment offices, air and water boards, and similar organizations or offices.

Nearly all terminals store ethanol, and there are no technical barriers to store larger volumes. However, there are potential issues such as the availability of land for additional infrastructure as well as accommodating substantial increases in truck traffic to deliver ethanol. There will need to be a strong business case to justify the cost of adding additional infrastructure to accommodate an HOF of 25% to 40% volume ethanol. Terminals are designed to serve the current market and generally do not have excess tanks or capacity within existing tanks.9 Another potential constraint is that many terminals lease their storage tanks to customers under long-term contracts. Additionally, increased domestic crude oil production has resulted in some terminals storing crude prior to it being shipped by pipeline. This further constrains the availability of storage space at terminals. For E10, the business opportunity was clear as the introduction of the federal renewable fuel standard coincided with the discontinued use of a previous oxygenate, methyl tertiary butyl ether.10 E10 could be used in existing vehicles and station equipment. Terminals used existing tanks or built new tanks and infrastructure to accommodate ethanol for blending up to E10. Terminal companies interviewed for this report stated that they have few unused tanks and are not able to supply E15 to all their customers at this time because they do not have sufficient infrastructure to handle it, and the same is true for a high-octane ethanol blend. Therefore, the storage of more ethanol would typically require a new tank and the associated piping, valves, meters, pumps, and equipment to connect it with the loading rack. Space at the loading rack could be a limiting factor as well as land to add a new tank. Additionally, a terminal would need the ability to receive more ethanol by truck, which would require more truck-off loading equipment to accommodate increased truck traffic delivering ethanol. An analysis of upstream activities would need to be conducted to determine how terminals would receive additional ethanol supplies. Currently, the majority of terminals receive ethanol by truck either from a transmodal facility that receives ethanol by rail or directly from ethanol plants. It would need to be determined if the transmodal facilities serving terminals could handle more ethanol and if existing ethanol plants could supply more fuel. Additionally, with increased domestic crude oil production, there is competition for rail cars capable of transporting hazardous fuels. Some crude oil is being temporarily stored at terminals as centers of oil production have shifted with new extraction technologies. These areas may not have pipelines to move products. All terminal companies interviewed stated that it has become more challenging and costly compared to past years to expand infrastructure due to permitting issues and regulations. Equipment is aging, but it is difficult to upgrade or replace equipment while maintaining permits and normal operations. Another constraint is the availability of contractors to erect new tanks. As the economy has improved, terminals stated that there is a long wait for qualified contractors. A company with terminals would want to evaluate the impact of adding additional tanks and associated equipment on its EPA operating permit. It would also need approval from its state office having jurisdiction. Costs to add a new tank and associated equipment are averaging 40?50 per barrel of installed capacity, with some terminals stating costs could be as high as $80 per barrel. Those costs are for installed equipment and do not cover the costs for regulatory compliance. When asked about issues with ethanol storage, terminal companies reported that ethanol requires more maintenance and that there can be supply disruptions due to weather because ethanol is delivered most often by truck. Some companies stated that they reduce the risk of stress corrosion cracking that could occur with ethanol by lining tanks and pipes while others address it with more maintenance. Additional maintenance increases labor costs and typical activities include replacing valves and sealing materials more often. Some companies with fewer ter-

minals stated they had occasional issues with maintaining a consistent ethanol supply. They thought the supply issue was largely a result of the ethanol traveling by rail and then truck to the terminals, as these same companies have not experienced supply issues with petroleum products delivered by pipeline. Some terminal companies stated that they avoid switching fuel stored in a tank unless it is necessary.

Terminals have installed new tanks to accommodate biodiesel, which is stored in smaller, heated tanks. Biodiesel infrastructure was added due to customer demand for the product. This indicates that if enough customers ask for a product, there is the potential for a terminal to add infrastructure. Terminal companies interviewed for this report stated they were obligated parties under the renewable fuel standard, and these organizations could consider renewable identification number market values and volume requirements as a motivation to increase ethanol storage.

6. Construction of floating fuel terminals proposed in the west coast of the Kingdom

Floating fuel terminal (FFT) arises as more suitable alternative environmentally instant heavy fuel oils, which used at the current time to ship fueling. And more suited for consideration on the use of these oils to the environment and also to reduce operating costs for shipping lines to become more effective, in the short run has already starting the effective use of (FFT) in rarely number of ports and ships around the world.

It is expected that this trend will developing and that the use of floating fuel terminal as fuel with engine and machinery will see a constant increase. As a result, it would be the appropriate ports on the rebuilding of a number of facilities for the economy of FFT bunkering facilities activities, in addition to the traditional marine services.

Where supply ships by floating fuel require adjustments and some amendments linked to the transport, storage and supply pipelines and help bunkers by the appropriate prequalifying to receive the ships which expectation that depend on FFT as a good method fuel-friendly environment (less affecting pollution) and be more positive for the owners of ships in terms of reducing variable operating expenses moreover the fixed cost, which are closely linked to the cost of voyage fuel.

Moreover, requires the deal with FFT to a careful analysis of these risks. In this issue, and to be ensure the safety of vessels which at the present time and in the long run will supplying the fuel by the floating terminal in the marine ports and analysis of the requirements of the storage and handling by this future way, plus the Possibility supply routes FFT analysis of marine fuel to ships in port.

This issue also addresses the possible modifications to the requirements of the ships to change its style of Supply customary normal fuel to supply by FFT in addition the port?s facilities modifications.

Figure 2

Source: Authors.

The Kingdom of Saudi Arabia and in order to achieve the maximum use of the passage of about 18000 vessels annually in the shipping passages in the Red Sea basin, especially after the completion of the expansion and construction of the first phase of the Suez Canal and to achieve high economic returns due to the high costs implemented at the Saudi ports and the first phase In the western coast of the Kingdom, the use of these floating terminals will generate more financial returns than the current ones.

Therefore, through the marine survey, we have reached to several marine sites suitable for the operations of floating fuel terminals in the suburbs of the ports on the west coast, through which the establishment of these terminals can also due to increase national and foreign investments in offshore services are as follows:

The locations of the floating fuel terminals have been determined so as to take into consideration the limits of the territorial waters and to observe the maritime safety regulations for the shipping lines and the vessels. During this phase, the following three sites were identified. The research team completes the Remaining of the proposed marine sites during the next phase:

6.1. Yanbu Commercial Port

Yanbu Commercial Port is located on the western coast of the Red Sea, about 460 nautical miles south of the Suez Canal and 168 nautical miles north-west of the Islamic port of Jeddah, a natural port protected by land on the north and east, and the coral reef on the south and southeast. In addition, the following three locations selected;

Figure 3: Study area of Yanbu commercial port.

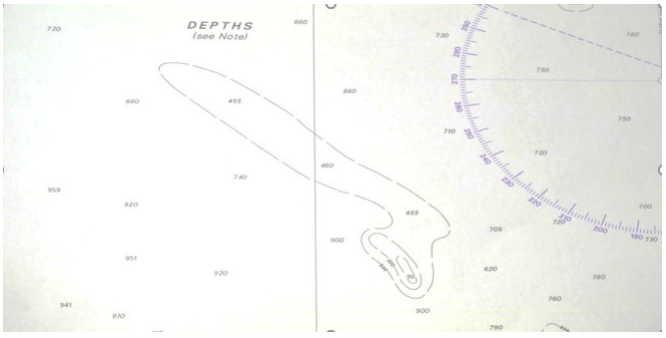
Source: Authors.

Location (1) - Figure 4.

- The total area of the site (1) is approximately 13 km2 and Site approved an area facing the commercial port of Yanbu and the port is 20 nautical miles from the port.
- The length of the site is 5 nautical miles and 2 nautical miles.
- The average depth at site 1 is about 35 m.

It is considered as site approved a safe area for maritime navigation.

Figure 4: The proposed location No. 1 of Yanbu commercial port



Source: Authors.

Location (2) - Figure 5.

- The total area of the site (2) is approximately 6 square kilometers, it site approved in addition considered an open area on the sea and close to the international shipping line, and the port is 20 nautical miles from the port.
- The length of the site is 2 nautical miles and 1.5 nautical miles wide.
- The average depth at site 2 is about 35 m.

It is considered a safe area for maritime navigation.

Figure 5: The proposed location No. 2 of Yanbu commercial port.

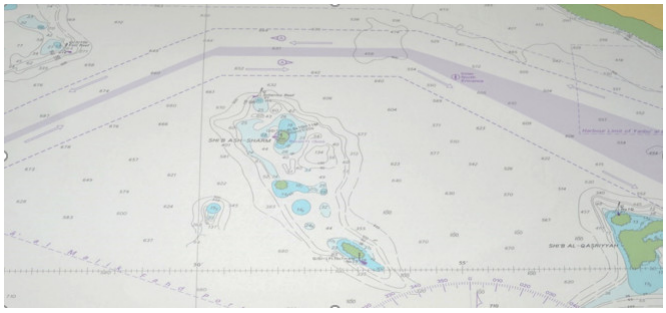
Source: Authors.

Location (3) - Figure 5.

- The total area of the site (3) is approximately 20 square kilometers and is considered an open area on the sea and close to the international shipping line, and the port is 19 nautical miles from the port.
- The site is 4 nautical miles wide and 2 nautical miles wide.
- The average depth at site 3 is approximately 270 m.

It is considered a safe area for maritime navigation.

Figure 6: Proposed location No. 3 of Yanbu Commercial Port.

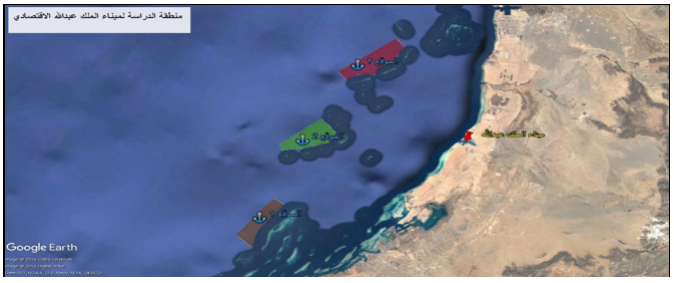


Source: Authors.

6.2. *King Abdullah Economic Port*

A strategic location serving several major markets where the port is a major attraction for trade between the two continents of Asia and Europe. The port has an important geographic location suitable to serve the Middle East, Arabian Gulf and Saudi Arabia markets. The port is close to industrial projects in Jeddah, Rabigh and Yanbu, In Jeddah, Makkah and Medina.

Figure 7: Study area of King Abdullah Economic Harbor.



Source: Authors.

Location (1) - Figure 8.

- The total area of the site (1) is approximately 7.5 square kilometers and is considered an open area on the sea and away from the King Abdullah Economic Harbor 17 nautical miles.
- The length of the site is 4.5 nautical miles and 2 nautical miles wide.
- The average depth at site 1 is about 35 m.

It is considered a safe area for maritime navigation.

Figure 8: Proposed location No. 1 of King Abdullah Economic Harbor.

Source: Authors.

Results

1. Reduce dependence on crude oil, heavy
2. Optimal utilization of the infrastructure of the ports in Saudi Arabia
3. Increase the strategic reserves of crude oil to the Kingdom of Saudi Arabia
4. The project pre-feasibility may form the basis of an important investment decision and in order to serve this objective, the necessary terminals such as the environment
5. Dependence on FFT as the economy fuel method for ships
6. Reduce carbon emissions and reduce its negative effects on the environment
7. Improved data availability, openness, visualization, and access for research.
8. Improved human resources quality, quantity, and education.
9. Improve oil recovery and proven reserves.
10. Reduced exploration and production transport cost.
11. Improve and increase efficiency of oil gas exploration and drilling operations.
12. Reduced well pollution and emission.
13. Complete the geological information needed for oil and gas upstream
14. Development and localization of technology services for oil and gas.

Conclusions

Terminals are midstream in the transportation fuel supply chain and are capable of receiving, storing, and dispensing various fuel types. To accommodate an HOF with 25% to 40% volume ethanol, additional infrastructure will need to be added, including tanks and additional truck unloading equipment as well as modifications to the loading rack and bay. In addition, there would be a significant increase in truck traffic delivering ethanol. There will need to be a strong business case to justify the costs to install additional infrastructure to accommodate more ethanol at terminals. A potential significant barrier is the availability of land to accommodate additional infrastructure and increased truck traffic delivering ethanol. Further analysis of upstream activities is needed to determine the availability of fuel rail cars and the ability of transmodal facilities to handle more ethanol.

Aknowledgment

I am pleased to extend my thanks to KACST's support as included in the Regulations of Research Funds (article 36-2): "This Article /Paper/Thesis/ Establish Ship fueling terminals at western coast KSA and reflect on GDP contains the results and funding's of a research project that is funded by King Abdul-Aziz City for Science and Technology (KACST) Grant No. LGP-36/12"

References

Handboek Faalfrequenties voor het opstellen van een veiligheidsrapport, Vlaamse Overheid, Departement LNE, Afdeling Milieu-, Natuur- en Energiebeleid, Dienst Veiligheidsrapportering, 2009.

Achtergronddocument RBM II, versie 1.2, Adviesgroep AVIV, in opdracht van het Ministerie van Verkeer en Waterstaat (Nl), maart 2008.

Risk Assessment Data Directory - Land transport accident statistics, Report No.434 ? 9, International Association of Oil & Gas Producers, 2010.

PGS3 Guidelines for quantitative risk assessment (purple book), Publicatiereeks Gevaarlijke Stoffen, Ministerie van VROM, Nederland, 2005.

A quantitative risk analysis approach to port hydrocarbon logistics, Ronza A., Carol S. et al., Journal of Hazardous Materials, volume A128, 2006.

Canvey: an investigation of potential hazards from operations in the Canvey Island/Thurrock area, Health and Safety Executive (UK), 1978.

Oil Petroleum Information Service (OPIS). 2015. Petroleum Terminal Encyclopedia, A Comprehensive Guide to Bulk Liquid Storage Throughout North America. 26th Edition. OPIS/-Stalsby. July 2015. Accessed August 10, 2015