

**For submission to:**

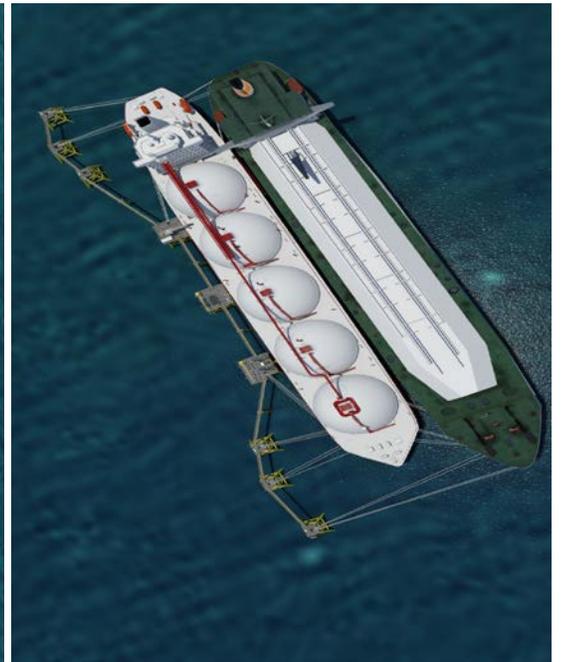
**The National  
Environment &  
Planning Agency  
(NEPA)**  
10 & 11 Caledonia Avenue  
Kingston 5  
Jamaica

**Prepared on behalf of:**

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# Rationale For Route Change of NG Pipeline From FSRT to Old Harbour for NFE South Holdings Limited

**December 6, 2017  
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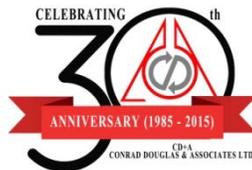
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## 1.0. Background and Introduction

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NFE South Holdings Limited is an affiliate of New Fortress Energy and sponsored by Fortress Investment Group. Fortress Investment Group is a highly diversified global asset management firm with approximately \$70.64 billion of assets under management and an experienced investor in transportation, infrastructure, & energy assets around the world.

- Founded in 1998, Fortress Investment Group LLC (NYSE:FIG) was the first New York Stock Exchange listed alternative asset manager
- Headquartered in New York, Fortress has 1,130 employees across 15 offices worldwide
- NFE has a strong commitment to environmental protection and corporate responsibility to ensure that their project meet all regulations while maintaining as small as possible a small project footprint with as little risks of environmental damage as is possible.

NFE South Holdings Limited (NFE) was chosen by the Jamaica Public Service Company Limited (JPS) to supply natural gas to Old Harbour Power Station Plant. Additionally, natural gas will be provided to potential future industrial users, including power generators. To meet the needs of JPS and other future users, Liquefied Natural Gas (LNG) will be transported to Jamaica from the U.S. or another location to a new LNG Off-Shore Terminal. The new fuel supply will be re-gasified and distributed by a new natural gas pipeline from the off shore facility via an undersea gas pipeline to the JPS Old Harbour 190 MW Power Plant.

An EIA was submitted based on preliminary designs of the pipe-routing, metering station and gas storage and distribution technology. The permitted project proposed to construct a marine terminal facility comprised of a vessel berth and off-shore offloading and regasification platform at the general location approved by the Port Authority of Jamaica in the Portland Bight area of Jamaica. This facility should accommodate a Floating Storage Unit (FSU) vessel for LNG storage along with a LNG carrier delivering LNG to the FSU. The FSU is a LNG carrier refitted for use as a storage vessel. LNG was to be delivered by the carrier from various potential locations in the United States or other locations. A platform was to be constructed and would contain equipment to regasify LNG as well as related process and safety equipment. The LNG from the FSU would be regasified on the platform and fed into an undersea pipeline. This undersea pipeline was to be directionally drilled southward from the vicinity of the JPS plant under the coral reef and from the point of exit immediately beyond the reef, trenched.

This submerged line should have been a route parallel to the general route of an existing Automotive Diesel Oil (ADO) line which runs from the existing mooring facility to the JPS plant in Old Harbour. The two main components of the project are therefore:

1. Establishment of a Floating Storage and Regasification Terminal (FSRT)
2. Establishment of a pipeline to deliver NG to the JPSCo Power Plant

## Rationale for Route Change of Old Harbour NG Pipeline for NFE South Holdings Limited

In addition, the project should have constructed a new ADO line to storage tanks in close proximity to the new power plant in order to enhance the reliability of the facility in case of LNG delivery interruptions.

While finalizing negotiations with JPSCo, detail designs and ensuring that the company's environmental standards were maintained, a number of updates and amendment to the preliminary designs were necessary.

These include changing:

1. the location of unloading and storage facility
2. the type of LNG storage facility,
3. the location of the re-gasification unit
4. the route for the pipeline
5. the pipelaying technology
6. the location of the metering station
7. The logistics of the management of Automotive Diesel Oil

The rationale and justifications for the changes proposed above are presented herein. The benefits of the changes are also included.

## **2.0. Rationale for Changes**

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In an attempt to make the project more environmentally friendly and reduce risks for environmental damage as well as meet the negotiated conditions of the contract with project partners such as JPSCo, a number of changes are proposed for both components of the project.

### **2.1. The location of unloading and storage facility**

#### **2.1.1. Original Rationale for Location of Terminal**

*“The proposed marine facility location was selected after consideration of environment, operations, and constructability. The marine facility will be constructed off-shore in the western side of Portland Bight, at a distance about 200 meters from the shipping channel to Port Esquivel in approximately 14 meters of water depth. This location offers sufficient depth to berth the FSU and the LNG carrier vessels without the need for dredging, yet has sufficient protection from storm wave impacts as a result of the shape of the Bight. This general location was reviewed by staff of the Port Authority of Jamaica and does not interfere with on-going marine activities in the area’.*

### 2.1.2. Amendment Rationale

The main rationale is the need for deeper waters to accommodate deeper draft vessels for delivery and storage of LNG. The proposed location was also relatively close to the shipping lanes (within 200 m) and in fourteen meter deep water. For safety reasons the location was of concern so moving the berthing facility further away from the active shipping channel increases the safety of the facility. The location was recommended and approved by the Port Authority. Figure 1 shows the proposed new location of the FSRT.

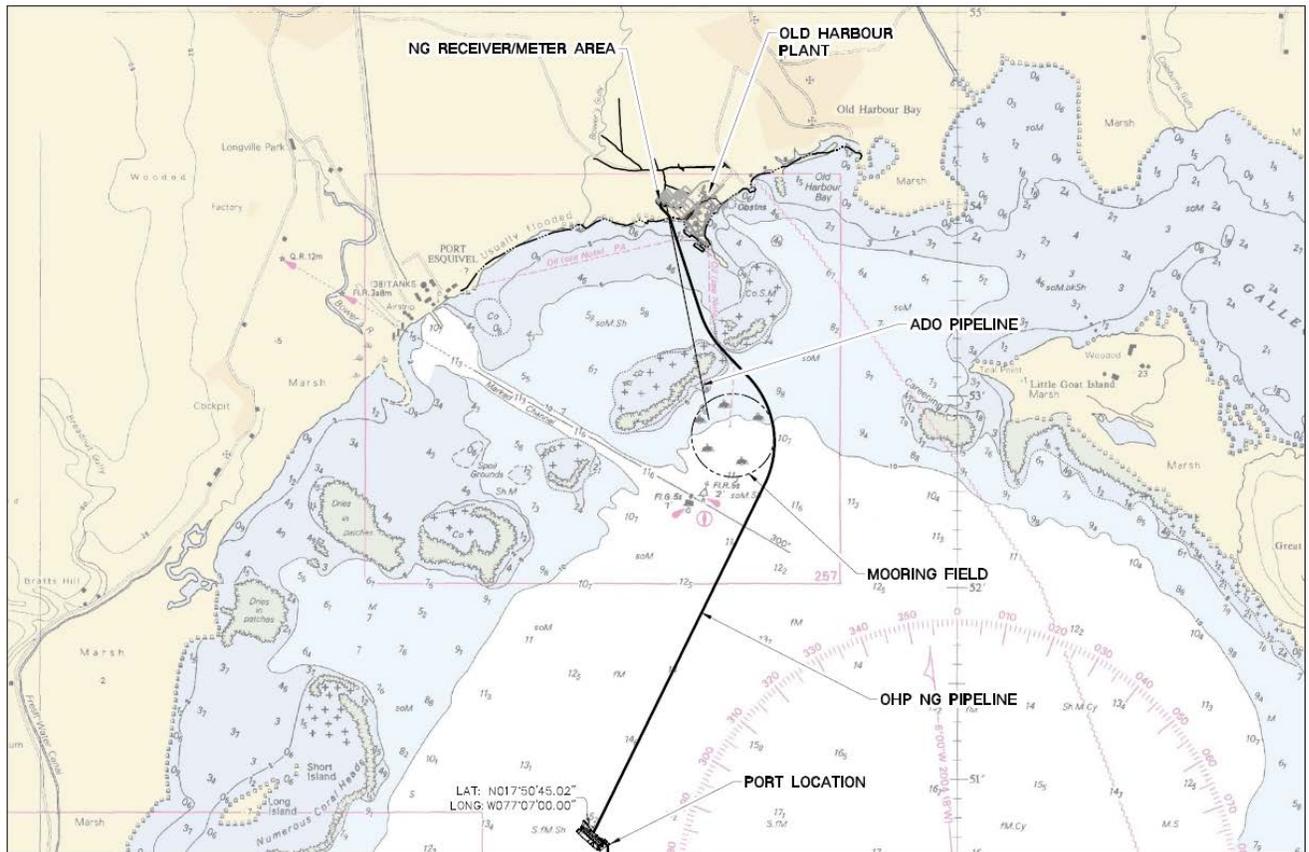


Figure 1. Proposed new FSRT location (1.6 km south of permitted location)

## 2.2. The type of LNG storage facility

### 2.2.1. Original Rationale

*The FSU will be designed to allow storage of LNG prior to being regasified at the off-shore facility and before it is then sent to the mainland via the subsea pipeline. It is anticipated that this FSU will be moored at the off-shore facility but it will be able to undock and move to shelter in case of pending hurricane conditions.*

### **2.2.2. Amendment Rationale**

The Golar Freeze is proposed to be used at Old Harbour Bay. Golar Freeze is the result of the conversion of an LNG carrier into a floating terminal that can be situated offshore or at a new or purpose-built jetty/pier. The FSRT will receive liquid natural gas (LNG) from offloading LNG carriers, and the onboard regasification system provides gas send-out through flexible risers and pipeline to shore.

The Golar Freeze has sufficient regasification capacity to support JPSCO OHP power plant and Jamalco's proposed power plant. This type of facility has enabled far more countries to become LNG importers and enabled them to enter the market far faster and at a substantially lower cost compared with building a conventional onshore receiving terminal. NFE has bought into this philosophy since the EIA was completed and has negotiated access to the Golar Freeze. The benefits are numerous for the proponent and also the country hosting the Golar Freeze. This facility will bring the completing of the project to an earlier time and allow Jamaicans to start benefiting from the use of LNG earlier. Any future FSRT would be similar to the Golar Freeze.

## **2.3. The location of the re-gasification unit**

### **2.3.1. Original Rationale**

*LNG is pumped from the FSU tanker via marine loading arms to the LNG booster pumps located on the regasification platform. The pumps boost the pressure of the LNG to approximately 650 psig and send it to vaporizers which use warm sea water to vaporize the LNG and heat it to a temperature in excess of freezing point to prevent ice formation on the outside of the pipe. Vaporized gas proceeds to a metering skid and to the undersea, off shore pipeline. Seawater pumps are used to pump seawater to the vaporizer. Seawater flowing out of the vaporizer is mixed with warm seawater to stabilize water temperature, which then discharges back into the ocean.*

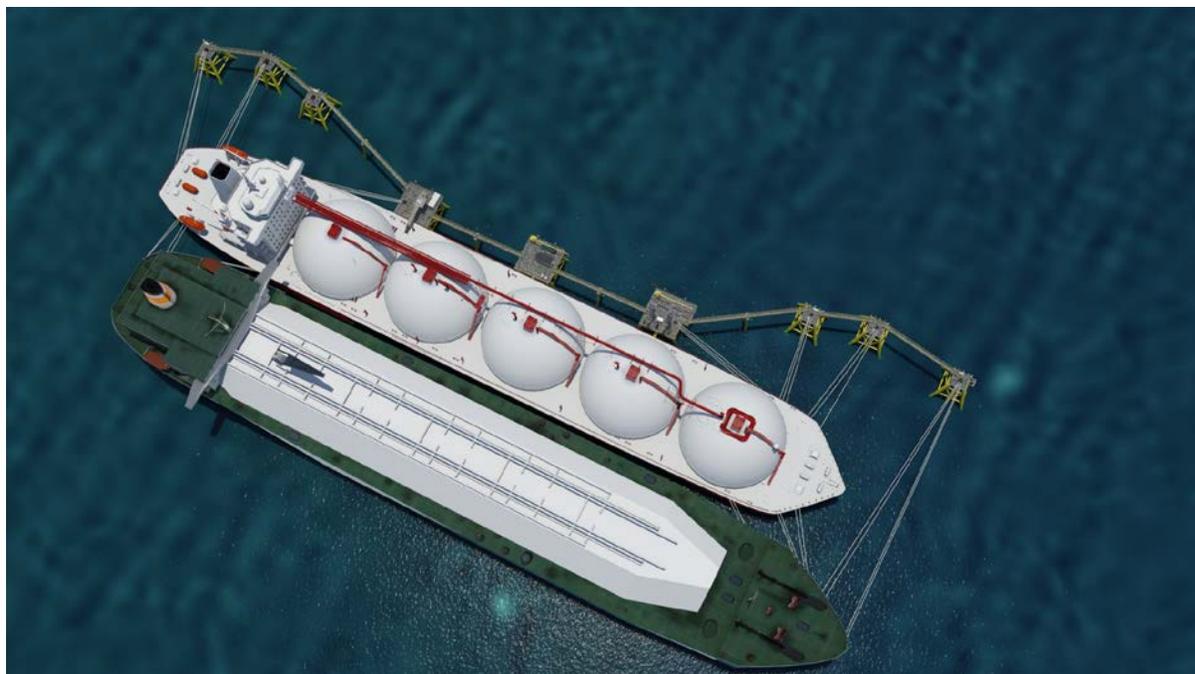


**Figure 2. Rendering of Originally proposed infrastructure – Regas unit of Terminal Adjacent to vessels**

### **2.3.2. Amendment Rationale**

The regasification unit will be located on the FRST as opposed to the marine terminal as was proposed. The packaging of storage and regasification makes the system more robust as the entire infrastructure can be moved during adverse conditions. The start-up after such an event can therefore be guaranteed since all critical equipment will be mobile.

Having the regasification unit on the LNG storage vessel reduces the amount of infrastructure that has to be laid down for the system to be function. Resulting in a smaller footprint facility. A smaller footprint coupled with the ability to move critical equipment to a safe location in the event of adverse weather conditions.



**Figure 3. Proposed amendment – larger storage and regasification on FSRU and no terminal for regasification**

The Original proposal had 11 structures in the sea, including a large berthing facility to house the Re-gasification unit 6 mooring dolphins and 4 breasting dolphins.

Using the FSRT all equipment (storage and regasification) will be on the ship which will be moored at the location significantly reducing the foot print of the system. Using the FSRT the phase platform will no longer be needed along with one of the breasting dolphins.

This setup makes the facility more resilient as it can move out of the way of incoming storms without leaving vulnerable important equipment in the path of the storms. This will ensure quick recovery of the system after extreme events.

## **2.4. The route for the pipeline**

### **2.4.1. Original Rationale**

***The NG pipeline route was selected to be mostly directionally drilled from the on shore facility to the off shore platform in a relatively straight line in order to lessen the potential for impact to the seabed from this line. Similarly, the new ADO line route was selected to be mostly directionally drilled in a straight line from shore to the existing ADO location in order to minimize environmental impacts and also the most direct route to the JPS plant. Both pipelines are planned to run underneath the degraded coral reef community to minimize environmental impacts.***

The alternative being proposed for this amendment was rejected in the EIA with the following reason: “these alternative locations for the LNG and ADO lines are longer in length (and therefore

## Rationale for Route Change of Old Harbour NG Pipeline for NFE South Holdings Limited

*with higher expense) as well as environmental impacts associated with placing these lines on the sea bottom with resulting disruption of the seabed life”. It was thought that “Instead, a direct route with a longer directional drill is proposed for both lines which will result in no disturbance of the seabed near or in the reef area. This approach will clearly have less impact on the seabed environment at the site”.*

This was mainly an economic decision, however the availability of newer equipment with technologies which make it possible to lay pipes in confined spaces has caused a revisit to the routing as well as the possibility of reef damage due to HDD has led NFE design team to reconsider the routing.

This proposed alternative has the following rationale:

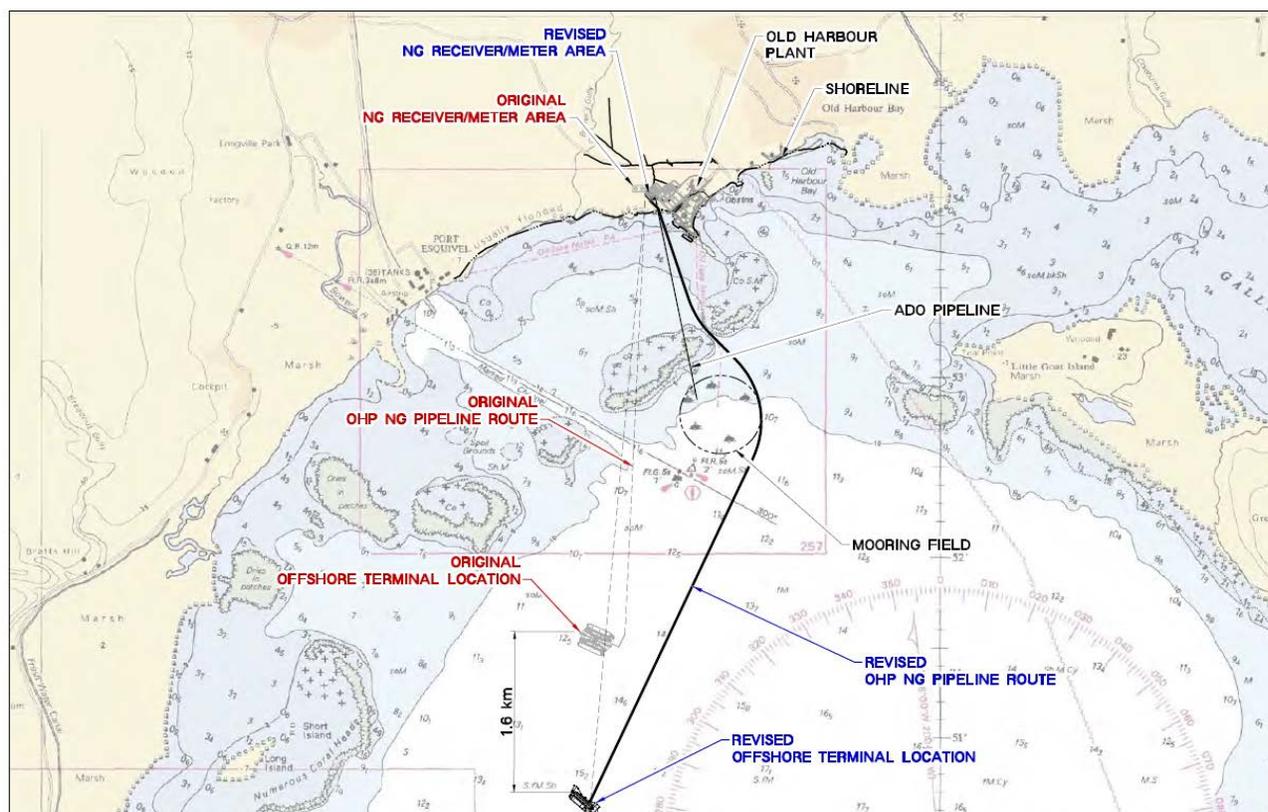
1. Reduce risk of possible impacts on the coral.
  - a. Equipment to be used is able to fit between the coral
    - i. Reduced risk of damage to corals from equipment used.
    - ii. Directional drilling has the potential to cause severe damage to coral if the drilling equipment does not fully bypass the coral underside.
      1. Depth of coral cannot be accurately known without drilling into the coral via boreholes to establish its depth.
      2. When drilling equipment comes into contact with coral underground the impacts are undetected will significant damage can be done to its foundations and structure.
      3. Unstable coral poses great risks to the pipeline
    - iii. Laying the pipe on the seafloor surface is faster therefore less time would be spent in the vicinity of the coral reefs.
  - b. The pipeline would be removed from below the coral therefore the risk of future impacts as a result of maintenance and operations will be reduced.
2. Space is available for the pipe laying between the two major coral heads
3. Both pipelines will be along the same route reducing the overall footprint of the project
4. All other pipes have run in this area without significant adverse impact on the environment. The existing ADO pipeline is in this area.
5. No dredging would be required for pipe transition from HDD to trenching
6. The developer has accepted that there is a significant risk to the reef structure and is willing to expend the additional cost to re-route the pipe along the longer route.
7. The reef as they exist now are in poor shape with algal growth dominating the reef. The developer is willing to engage in reef rehabilitation initiatives in conjunction with the regulators.
8. The introduction of clay mixtures for HDD poses a risk to water quality if effluent is managed properly. This risk will be avoided as the management of waste material from the HDD process is a removed from the project.

## Rationale for Route Change of Old Harbour NG Pipeline for NFE South Holdings Limited

- Using the equipment available for HDD would require 3 to 4 taps to cover the distance being proposed. This increases the risk of spills of slurry into the environment and could lead to adverse impacts.

At the time of permitting, NFE did not know what pipelay vessel would be available to perform the work. As a result, it was not known whether the size of pipelay vessel available could fit through the opening in the reef and perform the operation without risk. In addition, NFE did not yet have the detailed underwater 3D mapping that has been developed closer to the construction start date.

Presently, NFE design and planning team has knowledge of the vessel, the underwater conditions and the subsea conditions as a result of detailed site investigations performed as a part of our pre-construction phase. Based on this information, NFE is now confident that a route which goes outside of the entrance to the shipping channel and through the existing opening between the reefs would be the least impactful environmentally and the best route from an operational perspective. NFE have done extensive modeling of the pipelay vessel operation and simulated its activity through the reefs and now know that it can perform the pipelay in the space available. NFE is certain that this route and method of installation is less risky than going underneath the existing reef where we have less information about the subsea conditions. Figure 4. Shows the proposed route and locations of the infrastructure in the original submissions.



**Figure 4. Proposed new route and New location of FSRT compared to originally permitted infrastructure.**

## 2.5. The pipelaying technology

### 2.5.1. Original Rationale

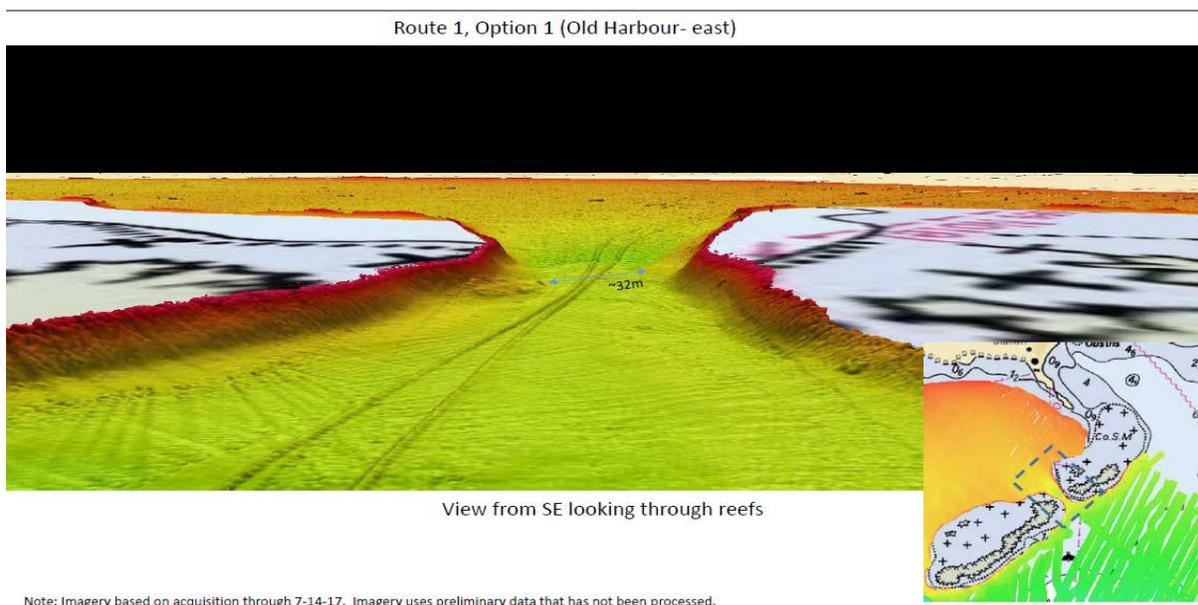
*The natural gas pipeline will be mostly directionally drilled using a horizontal directional drill (HDD) from the planned metering facility at the JPS plant to offshore for a distance of approximately 5,410 meters. The length of the HDD will allow the proposed pipeline to go under the coral and the ship channel.*

### 2.5.2. Amendment Rationale

The significant risk of accidental damage to the coral reef being by passed by HDD encouraged NFE to consider other methods of pipe laying. The risk associated with improper management of the slug used in directional drilling and the deteriorated/fragile nature of the existing coral lead the planning team to look at other methods and equipment for pipe-laying. Laying on the seafloor would eliminate the need for excavation thus reducing the possibility of excess sediment becoming entrained which can cause damage to coral reefs.

NFE also acquired pipelaying equipment that is small enough to traverse the opening between the two reefs without impacting them.

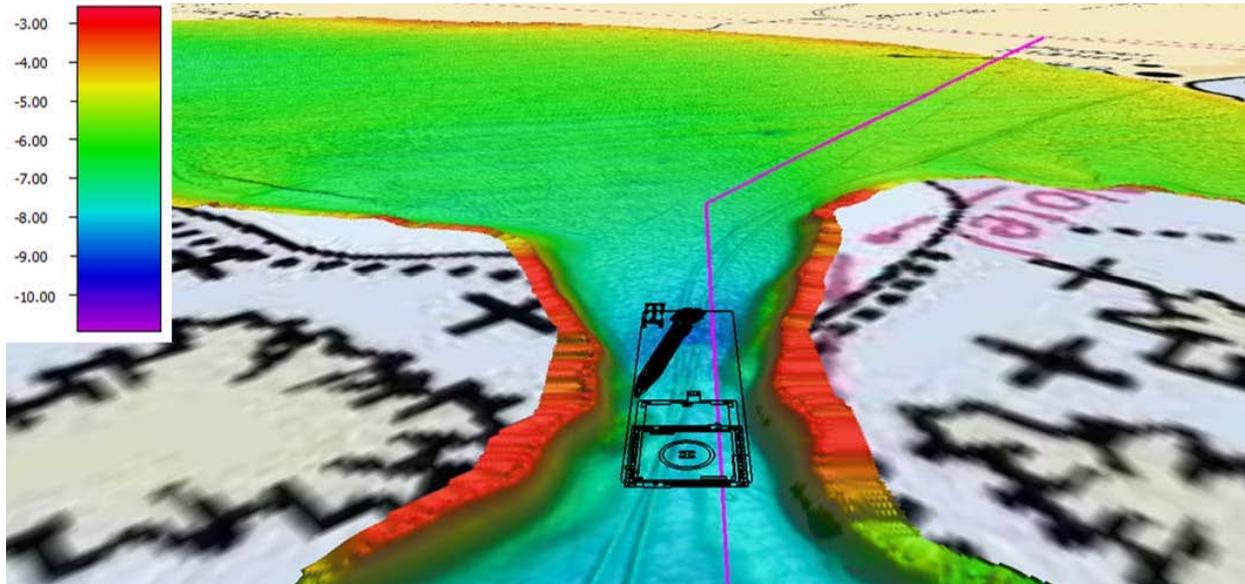
Figure 5 shows a 3D rendering of sonar data of the opening in the reef.



**Figure 5. Distance between reef sections in Old Harbour Bay that NG pipeline will dissect. .**

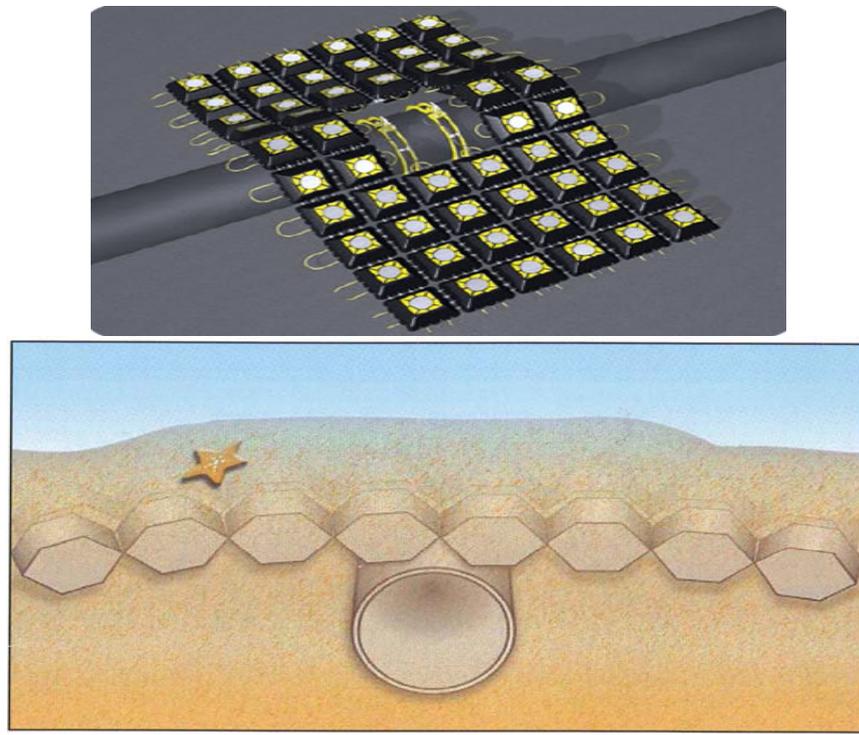
NFE has contracted the Swiber Quetzal which has a breath of 31.7 m that will be able to traverse the opening without impacting the reef. Figure 6 shows a model of the pipelaying boat passing

through the opening in the reef. There is safe passage - no contact with the reef on the sides or by draft.



**Figure 6. Model of Swiber Quetzal traversing the reef**

The pipe will be buried and covered with a concrete mat as shown in Figure 7



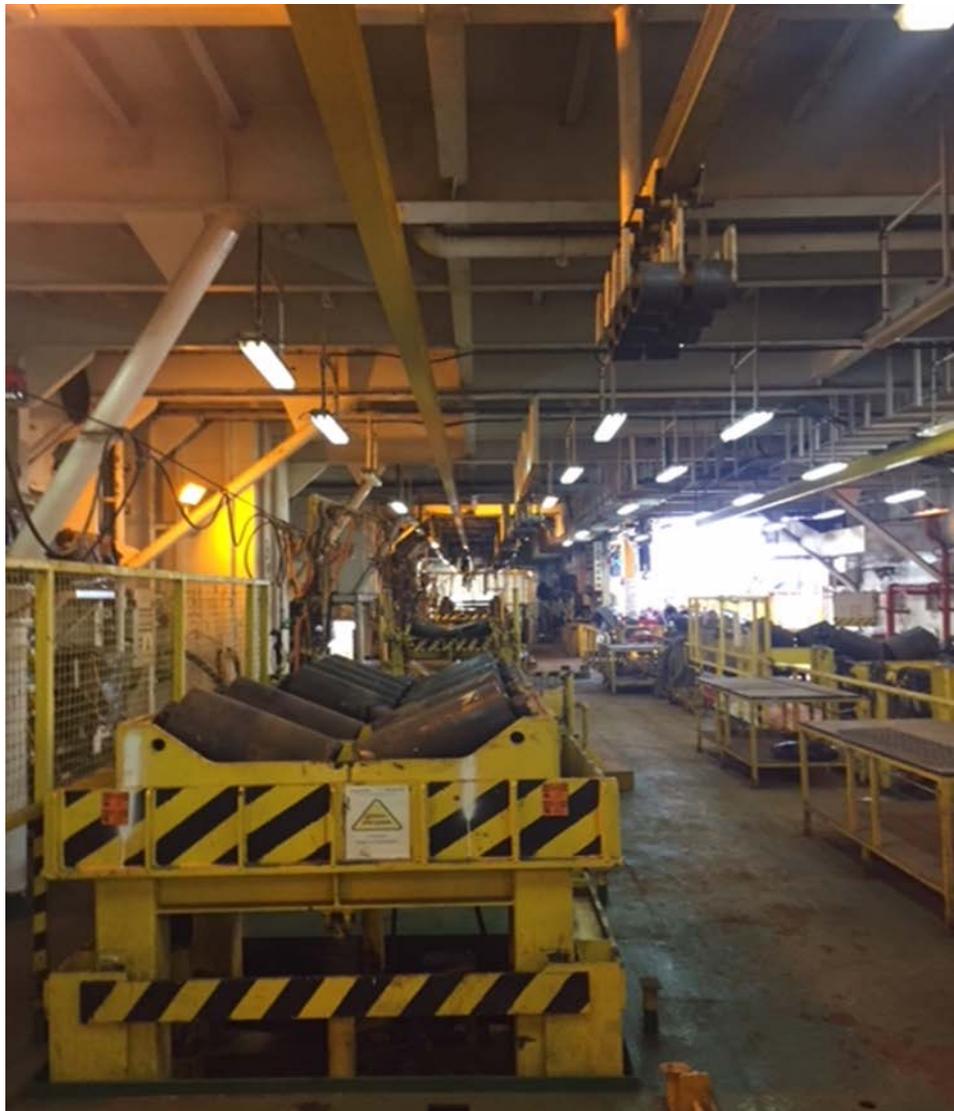
**Figure 7. Concrete mat on pipe under water**

## Rationale for Route Change of Old Harbour NG Pipeline for NFE South Holdings Limited

The new pipeline will be a nominal 10” vs 8” in the current permit; however our EIA contemplated up to 16”. Based on the hydrology of the line and operational requirements of the power plant 10” is the necessary diameter.

Because of the route change, the project will longer need to directionally drill the line. The intent is to do a traditional pipelay with proven methodologies used all over the world. The EIA always contemplated a traditional installation beyond the reef exit of the HDD so the only change is using that method through the reef opening to the shore.

One vessel will prepare pipelines by welding onboard and laying on seafloor. The equipment available will excavate a shallow trench and cover the pipe at the same time. This will reduce sedimentation. The pipeline once laid will be covered by a concrete mat as shown in Figure 7. A section of the assembly line setup on the vessel is shown in Figure 8



**Figure 8. Pipeline assembly station on pipelaying vessel**

## **2.6. The location of the metering station**

### **2.6.1. Original Rationale**

*A metering facility will be constructed at the on-shore end of the pipeline to measure the gas before it enters the JPS facility. This facility will be constructed to allow additional connections for gas distribution to future customers as demand requires.*

### **2.6.2. Amendment Rationale**

Land has been acquired closer to the power plant.

Less impact on healthy mangrove stand

Less infrastructure to be implemented reducing footprint of the project.

Improved security for metering station as security at the power plant will be in closer proximity to metering station.

Bringing the metering station closer to the power plant will improve its security and safety while reducing the impact on the wetlands in the area.

NFE will be building a longer pipeline to OHP as a result of the new route BUT the pipeline to Jamalco is now shorter. The overall length of the OHP pipeline plus Jamalco pipeline is about the same under the previous scenario and the new scenario.

## **2.7. The logistics of the management of Automotive Diesel Oil**

### **2.7.1. Original Rationale**

*A new (or refurbished) up to 8-inch (20.32 cm) ADO pipeline will run from the existing power plant and end at the pipeline end termination near the existing multipoint mooring buoys. This pipeline will be mostly directionally drilled from the shore and under the coral to a point near the mooring field.*

*The onshore facility will include up to two 50,000 barrel storage tanks with approximately 55,000 barrels of containment in close proximity to the proposed new 190 MW power plant to be operated by JPS. This ADO line will provide a back-up fuel source to the JPS plant in case of interruptions in LNG delivery due to storms or other factors. The ADO will likely be supplied around once a year by ship and off loaded using a process similar to the existing process that the JPS plant uses.*

### **2.7.2. Amendment Rationale**

The JPSCo in the negotiations process thought it prudent to be the owners of the backup facility for their plant. The NFE agreed and has subsequently given all the responsibility to the JPSCo for the development and operations of the ADO facilities associated with the project.