Portland energy recovery facility

Shore power strategy report

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Powerfuel Portland Ltd

Powerfuel Portland ERF

Shore Power Strategy Report

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1 Introduction

This report is prepared in support of Powerfuel Portland Ltd's (Powerfuel) application for planning consent for an ERF at Portland Port. The report describes Powerfuel's proposals for provision of Shore Power (also referred to as cold ironing) – electricity for docked ships, which will avoid the need for ships to operating fossil fuelled generators while docked.

The report is separated into the following chapters:

Chapter 2 considers the case for Shore Power. It describes the current situation with docking shipping and highlights the need for a shore power solution. It estimates the likely use.

Chapter 3 considers options for delivery of Shore Power. It assesses the options available from provision of grid electricity, the potential for on-port generation solutions and the potential for other forms of local generation and associated electricity storage.

Chapter 4 describes Powerfuel's plan for delivery of Shore Power. How electricity is provided and distributed from the Energy Recovery Facility (ERF) to the dockside.

Chapter 5 considers the benefits that Powerfuel's plan will provide. It covers emissions reductions and economic benefits to the port and surrounding areas.

Chapter 6 summarises the report with a conclusion.

2 Case for Shore Power

General Case

Shipping is an essential element of the UK economy, however, as with most other elements, it requires to reduce greenhouse gas (CO_2) emissions and pollutants harmful to human health: nitrogen oxides (NO_x), sulphur dioxide (SO_2), particulate matter (PM2.5 and PM10), volatile organic compounds (VOCs) and ammonia (NH_3).

The UK's Clean Maritime Plan[1] indicates that in 2017 UK's domestic and international shipping together were responsible for 13.87MT/CO_2. This is 3.4% of UK's overall greenhouse gas emissions.

In 2016 UK's domestic shipping accounted for 11% of UK's NO_x emissions, 2% of primary PM2.5 and 7% of SO_2. International shipping with the UK as a destination has been estimated to be three times larger.

The UK Government's Clean Maritime Plan sets out how the UK will transition to zero emission shipping. In the short term, this includes Shore Power as an interim measure to avoid vessels operating diesel engines to run non-propulsion

[1] Department for Transport, 'Clean Maritime Plan', UK Government, July 2019.

electrical system whilst in port. In the longer term, Shore Power could be used for charging fully or partially battery powered shipping.

It is important that Shore Power is provided through low carbon electricity. Whilst the carbon content of grid electricity is declining, using electricity with a lower carbon content than grid is a benefit.

Shipping sectors have different drivers for moving to shore power. The cruise industry has strong customer-based pressure in improve emissions; there are already signs that it is at the vanguard of the use of Shore Power. Military shipping, being government owned, is also incentivised. The UK Government plays a major role in the process of reducing emissions through legislation and as owners of shipping needs to be seen to be at the forefront. Whereas commercial shipping is likely to lag behind other shipping sectors, driven by legislation alone.

Case for Portland Port

Portland Port has provided information on shipping. In 2019 there were 794 calls by shipping of which 41 were cruise ships. The port had 43 bookings for 2020 and already 45 for 2021. The port is planning for expecting cruise ship visits to increase to 65 by 2025. This is driven by multiple factors, including the UK's departure from the European Union, which will diminish the current benefits of visiting the Channel Islands.

Currently just over half the cruise ships visiting Portland have the facilities for connecting to Shore Power. There is a strong trend for new cruise ships to have such facilities and as new ships tend to serve European, Caribbean and North American cruise voyages, this proportion will increase.

Portland Port has a contract with the UK Navy to provide berthing for Royal Fleet Auxiliary (RFA) ships. All thirteen RFA ships which use the port are equipped with facilities for connecting to Shore Power.

Given the already strong availability of shipping docking at Portland Port with facilities for connecting to Shore Power, there is a ready-made market for a Shore Power service. Such a service would offer a cheaper means of providing electricity to docked ships, than operating marine diesel fuelled generators, and one that has environmental benefits to the port and surrounding area.

3 Shore Power Options

Shore Power requires significant new electrical infrastructure at any port and, in most cases, significant additional electricity capacity. Both these are the case with Portland Port.

Shipping being considered for Shore Power at Portland Port, cruise and RFA, typically have electricity demands of 8MW (with a maximum of 12MW) and 2.75MW respectively.

There are principally two options, Grid Connected (whether directly from the grid of through generation connected to the grid) or Island Systems where connection to shipping from dedicated generation is totally independent of the grid.

Island System Options

Island System options consist of generation and electrical infrastructure totally independent of grid and dedicated to Shore Power.

Shipping typically uses electricity at a frequency of 60Hz, so electricity generated has to be at 60Hz. This is a non-typical frequency in UK.

Shipping will require connection at different voltages, often depending upon the size of vessel. Generation schemes do not typically have different voltage options so island system options either require substations to transform voltage or generators with different voltage outputs.

There are two options for island systems:

- Generation located at dock side for direct connection to vessels
- Remote generation with associated electrical distribution to dock side for connection to vessels.

Given the high electrical demand from docked ships, the only current feasible dockside generation is from containerised internal combustion engines. Such engines typically operate on diesel or potentially bio-diesel. Providing Shore Power through a diesel generator would have no benefit in reducing greenhouse gas (CO_2) emissions or reducing the emission of other pollutants. Bio-diesel would be considered to have some greenhouse gas (CO_2) emissions reduction from a global perspective, though not at the port itself. It provides no reduction in the emission of other pollutants.

Hydrogen fuelled internal combustion engines are feasible, but are currently produced in limited numbers and with outputs well below that needed for shipping at Portland. They would provide greenhouse gas (CO_2) emissions reduction at the port, though whether they provide global reduction would depend upon the production and transportation methods of the hydrogen. There would be reduction of other pollutants.

Remote generation has the potential for other forms of generation and renewable generation in particular, for instance wind, solar photo voltaic and tidal. All of these forms of generation are intermittent and without grid connection require electricity storage to be able to provide a continuous Shore Power service. With the annual energy required of between 20GWh and 25GWh, the scale of generation required is 9MW to 11MW wind or 13MW to 15MW solar photo voltaic. Both would require substantial battery storage. There is insufficient suitable unallocated space on the port for such installations. Tidal generation is not sufficiently developed to be considered.

Island System are not feasible options for Shore Power at Portland Port due to latent emissions or scale of renewable generation required.

Grid Connected Options

Grid Connected options are connected to the UK electricity grid and may in addition have generation providing electricity for Shore Power.

Shipping typically uses electricity at a frequency of 60Hz; UK grid frequency is 50Hz. Therefore, conversion of electricity from 50Hz to 60Hz is required.

The scale of demand from shipping at Portland, up to 12MW requires substantial distribution infrastructure to the docking points at high voltage, and transformation to connection voltages at the docks.

The electricity infrastructure at the port will be required whether electricity is supplied from the grid, generation or both.

Docks are typically supplied with electricity from the UK transmission and distribution grid (grid). Substantial additional capacity above that needed for general port operation is needed for Shore Power. This can be provided by one of the following ways:

- Upgrading of the existing port grid connection.
- New grid connection and independent infrastructure for Shore Power.
- On or near site generation, connected to existing port electrical infrastructure.
- On or near site generation, connected to independent infrastructure for Shore Power.

For Portland Port to delivery Shore Power to the largest cruise ship and an RFA ship simultaneously, additional capacity of circa 15MW would be required.

Electricity on Portland is distributed by local distribution network operator (DNO) Scottish and Southern Energy (SSE). Portland is supplied from Chickerell Bulk Supply Point, which feeds nine other primary substations: Cerne Abbas, Charminster, Chickerell, Dorchester, Maiden Newton, Piddlestrentide, Puddletown, Redlands and Weymouth. SSE's forecast data indicates that Chickerell Bulk Supply Point will have just 15.97MW spare capacity by 2023/24. Adding 15MW for Shore Power will have a significant impact upon SSE's network which will require investment by future parties requiring further electricity capacity.

Upgrading of the port's existing grid connection to circa 20MW will have serious impacts upon the port. SSE will require the port's existing connection to be upgraded from 11kV to a new primary substation connected at 33kV. This in turn will require significant upgrading of the existing port electrical infrastructure. The cost for such an arrangement is likely to be prohibitive.

For a new grid connection for 15MW, SSE will offer a connection at 33kV from its circuit which feeds Portland Primary Substation from Chickerell Bulk Supply Point. The cost for such an arrangement is likely to be between £20,000,000 and £26,000,000 and will make provision of Shore Power by the port uneconomic.

Generation, whether connected directly to grid or connected to Portland port infrastructure requires approval from SSE as local DNO. It is understood from

SSE that Chickerell Primary Substation has little or no capability for further generation to be connected to it without the addition of an additional 132/33kV transformer. The cost for such an arrangement is likely to be prohibitive.

The proposed Energy Recovery Facility (ERF) already has a connection contract with SSE for a 33kV connection. Its generation capacity of 15.2MW enables it to supply the Shore Power infrastructure at 33kV with a simple cable connection.

There are currently no commercially viable alternative options to provide grid connected Shore Power for Portland Port other than from the proposed ERF.

4 Powerfuel’s Shore Power Delivery Plan

Powerfuel’s delivery plan is based upon utilising electricity generated by the ERF to provide Shore Power to docked shipping.

Powerfuel will provide high voltage (33kV) electricity infrastructure from the ERF to the Coaling Pier and Queens Pier. This will consist of a cable connection from the ERF to a Converter Station to convert 50Hz grid connect ERF electricity to 60Hz, which is required by most shipping. This will be located between Main Road and Old Depot Road.

There will be two cable connections from the Converter Station. One to the Coaling Pier where a substation will be installed to provide up to 12MW capacity. The other to the Queens Pier where a substation will be installed to provide up to 10MW capacity.

The 12MW substation will be able to provide capacity for the largest cruise ship that can dock, or several smaller ships simultaneously. The 10MW substation is designed for smaller ships and can provide connection for several. Temporary cabling will be used to connect the substations and shipping.

The ERF will have a 5MW grid connection, so Shore Power will be delivered from the grid during the ERF’s annual maintenance shutdown. In addition, in the unlikely short-term event that more Shore Power capacity is needed that the ERF can generate, the grid will be able to supplement the capacity. However, for most of the time the ERF will export to the grid as well as provide Shore Power for shipping.

The equipment locations and cable route for Powerfuel’s delivery plan are included within the application red line and shown on the application drawings.

5 Benefits of Shore Power Solution from ERF

Shipboard diesel generators produce emission of CO_2, NO_x particulates and SO_2. A Shore Power solution from the ERF will eliminate these emissions whilst ships are docked.

From information provided by Portland Port, it is estimated that 36 cruise ships will used Shore Power in 2024, rising to 65 from 2044. In addition, Portland Port’s contract with the Royal Navy provides for RFA ships to be docked for a large proportion of days per year. Between these two vessel types it is estimated that 20GWh electricity will be supplied to shipping in 2024, rising to over 24GWh in 2045.

This will add to the ERF's carbon emission saving by 4,500 to 5,000 tCO_2/annum (refer to Fitchner's Carbon Assessment Report).

In addition, it will eliminate emissions of NO_x, particulate matter and SO_2 whilst ships are connected to Shore Power.

By taking electricity generated locally at the ERF, the pricing will be lower than both grid electricity and electricity generated from diesel. This will act as an incentive for shipping to connect, and in the case of the RFA ships represents a saving to the public purse. Dialogue has commenced with the Royal Navy through the port regarding the RFA ships using Shore Power.

As indicated in the Economic Impact Assessment, Shore Power has beneficial impact upon local tourism spend and associated jobs. The proposed solution from the ERF will enable this. There is also a risk to the port if Shore Power cannot be provided. It will potentially reduce the number of cruise ships visits which would impact port income and potentially reduced employment.

6 Conclusion

Should Powerfuel's application for consent for an ERF at Portland Port be successful, Powerfuel will be able to provide Shore Power to the port. There is currently no viable alternative for provision of Shore Power.

Through provision of Shore Power for cruise and RFA ships, the ERF will save an extra 4,500 to 5,000tCO_2/annum (refer to Fitchner's Carbon Assessment Report) and eliminate emissions of NOx, particulate matter and SO_2 while ships are connected to Shore Power.

By being connected to the ERF, Shore Power electricity can be sold at a lower cost than either grid electricity or electricity generation from diesel, making it commercially attractive to shipping.

As indicated in the Economic Impact Assessment there is a net benefit to the local economy from Shore Power and a potential loss without it.