

## **Appendix B**

### **STFT as an energy node**

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Project name:: Sea Tech Floating Terminal (STFT)

Reference TRV 2022/108064

#### **Abstract**

The new ways of producing electric energy by large scale wind farms will require offshore energy hubs – HVDC substations. The idea of using the STFT floating transshipping terminal for this purpose is not farfetched. In shallow waters, i.e. water depth of 50 – 70 meters the existing solutions are mature and perfectly dimensioned for the purpose of the planned windfarm. A safe distance between floating transshipping platform STFT to windfarms is about one nautical mile. An inter-array cabling from a wind farm to an offshore HVDC substation of one nautical mile is not a problem.

For its own need, the transshipment platform STFT will most likely be run on electricity from gensets, initially on MDO and later on green diesel fuel when available in quantities.

The upcoming and promising Small Modular Reactor (SMR) are probably not to be installed in the STFT of safety reasons, at least not for any years.

In the future at later stage, the separate floating terminal STFTe with the sole purpose of producing, collecting and distribute energy will supply the transshipment platform with electricity from Small Modular Reactors (SMR). Then it is most likely beneficial to give such a platform surplus capacity for delivery to the coast. If wind farms or wave plants are nearby, STFT can be used as a complete energy node collecting electricity from wind farms and wave farms and by transformation equipment make distribution to consumers most efficient. However, of economic reasons this must be planned in good time so that investments will be operated without much delay.

This analysis is motivated by the need of fully understand the societal expectations and the business environment that STFT and STFTe will meet in the effort to contribute to a sustainable society.

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## **1. Introduction**

With shortage of exploitable land around larger cities close to the coasts there is a need to utilise the sea water around cities. Research and development of floating port terminals has gained momentum based on world trade's need for well-functioning efficient ports as central logistics nodes. Container ships are growing in size and more volumes need to be handled in the ports at the same time as higher demands are placed on service and efficiency. In the green transition the ports not only need to act as a logistics node but also an energy node. Large scale wind farms and wave plants are established and planned in the sea waters around Sweden. These all need to be connected to offshore high voltage direct current substations. In cases where windfarms can utilise the Sea Technology Floating Terminal as such a substations it may be beneficial from economical point of view.

## **2. Background**

A floating port terminal can be used for other activities than transshipment. "Green energy" is produced offshore by wind farms and wave energy farms. The energy needs to be collected for transformation to fossil free fuel or transformed to high voltage for transfer through cables to shore. The maintenance of offshore wind power and other aquaculture industries (Tamis et al., 2021, Flikkema and Waals, 2019) will need a substantial and complete base close to the facilities for the operations.

The transition to renewable energy is not only about the production units themselves such as the wind turbines but it is also important to have efficient logistics both during the construction and also the maintenance of wind turbines. This applies above all to offshore wind power (Stentoft et al., 2016) and here floating terminals may act as a node for their supply. Furthermore, ports as an energy node play an increasingly important role in the energy transition (Acciaro et al., 2014).

## **3. Limitations**

The study of STFT as an energy node is limited to analyse the logistics and functionality. Any further study on the economics of the solution remains to be studied. In some cases, economic basic facts are given without further comments.

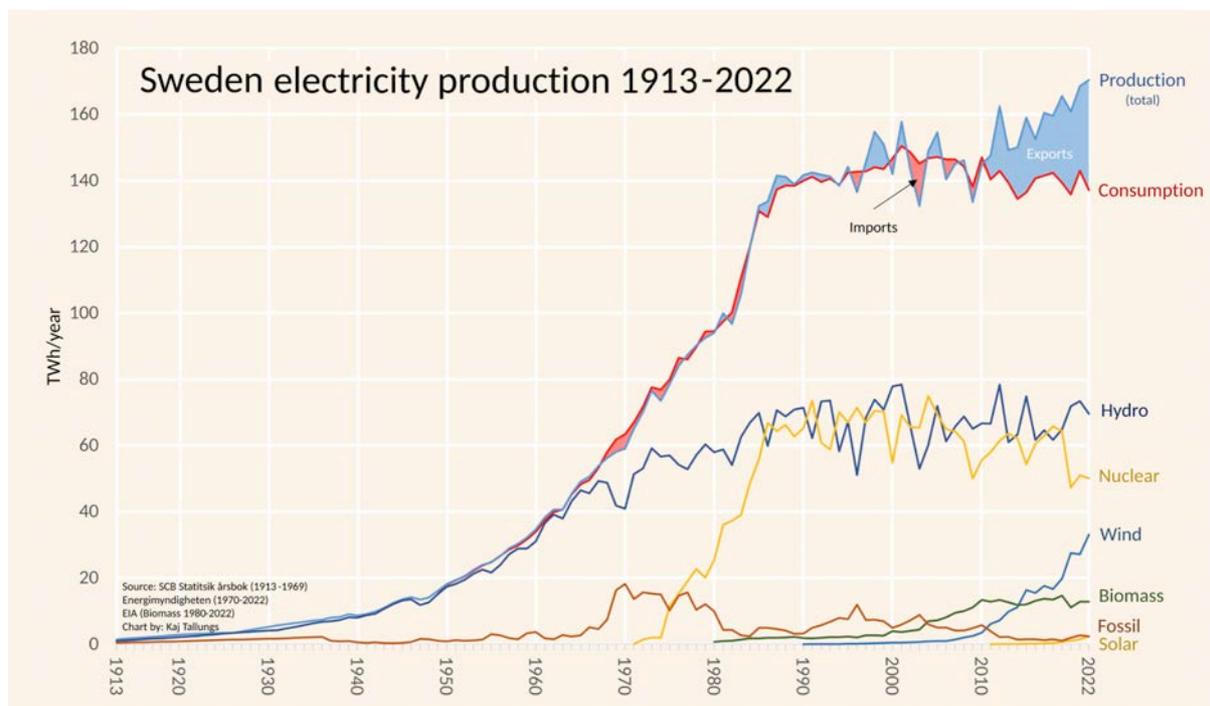
Safety aspects of nuclear reactors SMR in the STFT are commented upon but not studied in depth.

## **4. Method**

The method is based on literature surveys of open sources like homepages of wind power or wave power entrepreneurs. Some interviews have been performed with managers of relevant companies.

## **5. Overview of historic and existing electricity supply in Sweden**

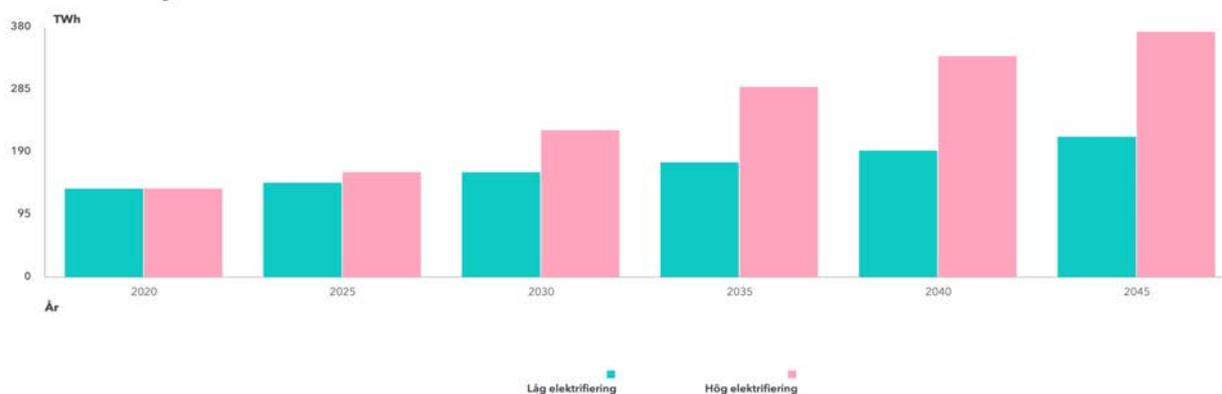
This overview is motivated in order to give information about the business environment that the STFT platform will meet. There is a strong competition between concepts to contribute to a sustainable future with regard to the supply of fossil free energy to the society including the transport sector. Find below a graph that shows the accelerating demand for electricity in the society.



**Figure 1** The graph is reproduced from Wikipedia. Energimyndigheten/Kaj Tallungs<sup>1</sup>

Consumption, that increased very much after WWII has since levelled out at about 1990. We can see that fossil fuel has not been used very much for electric production. When fossil fuel is phased out for heating of buildings and for the transport sector there will be further expansion of demand for electricity supply. The plans are to meet this with renewable energy from wind and sun and also from more nuclear energy. There is lot of development work going on for Small Modular Reactors. We have contact with and follow the development in Blykalla, Core Power and Terrestrial Power.

#### Scenarioanalys av framtida elbehov



Källa: Energimyndigheten

ekonomifakta

**Figure 2** Scenarios of future energy need in Sweden

Sweden's total electricity needs<sup>2</sup> are expected to increase from present 135 TWh to be between 264 and 349 TWh in 2050. This is a doubling in 25 years if realised. Exactly how big the need is unknown. According to a scenario analysis from the Energy Agency it is primarily large investments in industry that are the contributing cause of the increased need.

We know about Hybrit and Northvolt, but we also know that heating of houses will turn to electricity as we need to follow the expectations of a fossil-free society.

## **5.1 Existing offshore green energy establishments and plans**

### **13. wind and solar power fields and plans**

In order to reach EU climate-neutral goal as published 2020 in the European Commission Strategy increased production of renewable energy at sea will be needed. The strategic goal is to increase the capacity for offshore wind power from the about 12 gigawatts to 300 gigawatts before 2050. The electricity production potential of offshore wind power is significantly greater than land-based wind power. Wind conditions at sea are stronger and more even. It is also possible to build considerably larger and more efficient power plants at sea than on land due to less turbulence. Furthermore, it is possible to carry out larger projects at sea as the restrictions are often fewer than on land. The Baltic Sea has enormous potential for offshore wind, but today it has just over 2.8 GW of installed capacity (mostly in Danish and German waters). The 8 countries have in 2022 committed to increase the capacity to 19.6 GW by 2030 and they plan to consider a 2040 target at a later stage.

The challenge is to reach continuous flow of electric energy without wasting any opportunity utilise the energy flowing in the wind or the radiation from the sun. This will need a system with storage of energy in batteries or methanol or hydrogen or other concentrated storable energy carriers. There are many research and development projects going on and on the web-site you can find numerous of projects, quite a few with developed overview of opportunities.

We have followed the technology presented by OX2 both over the web-site and in seminars. Find below a general picture of a complete system for renewable energy availability 24 hours a day seven (7) days a week.

### **Overview of a complete system called ReNOWable 24/7 (FörNUbart)**

Siemens Energy OX2 and Svensk Vindenergi have jointly produced a report on how we can reach the industry's combined demand for both energy and power by the beginning of the 2030s with the help of renewable electricity production. They have developed a modular concept that is based on the system's needs reduces system costs and is 100 percent fossil-free according to the developers Thanks to its scalability the system can be adapted both for local conditions or more extensive geographical areas. They call this concept Renewable 24/7 because they are based on renewable technologies that can realistically be built today and be in place until the early 2030s. The concept includes electricity production from solar and wind power storage in batteries and storage in the form of e-fuels (electro fuels), which are then re-electrified in turbines when needed. It is also otherwise a concept that is completely technology neutral and fully possible to integrate with other types of fossil-free electricity production in the future, i.e. Small Modular Reactors (SMR)

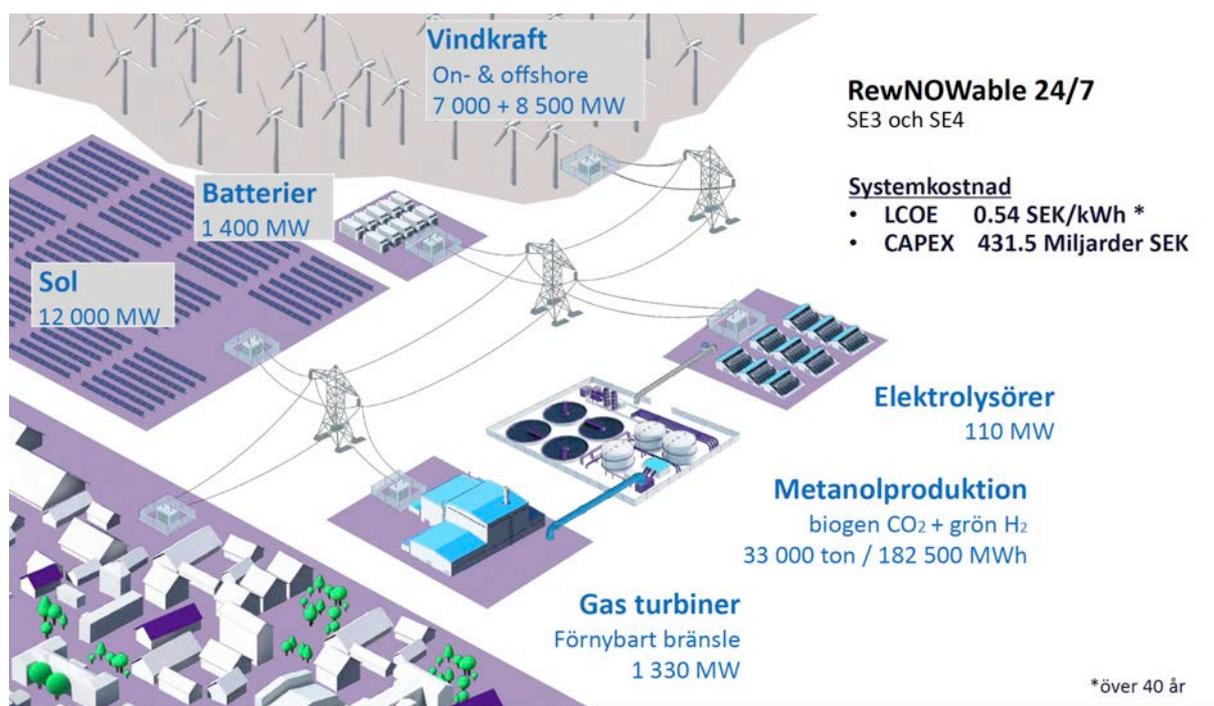


Figure 3 The graph is published here by permission<sup>3</sup> by Henrik Sjöström OX2

The system described above will be a large contribution to electric power and storage compared to what we have so far anticipated in Sweden. Installed capacity in windfarms and solar panel parks is in the order of 30.000 MW compared to abt. 18.000 MW that was installed 2022.

Of more interest is of course what is available as customers demand. What is of particular interest in ReNOWable 24/7 is that fossil free wind and solar energy are the contributors to the energy supply. Direct distribution to customers is seen in the picture while when customer demand is low – price is low - the electricity is used for storage in batteries and gas production. Gas is used when needed to produce electric energy to the electric main net. Hydrogen can be used directly in gas turbines but also – safer – in methanol production for cars, aeroplanes and ships. An comprehensive overview of wind power in the European Union<sup>4</sup> is given in a report. The project report<sup>5</sup> gives an overview in “Wind power in Sweden”

### Solar power

An impressive number of solar parks<sup>6</sup> exist in Sweden 2023. Solar PV capacity in Sweden reached 3.9 GW (3900 MW) in 2023 up from 0.14 GW in 2016. Solar power accounted for roughly 1% of the nation's total electricity consumption in 2022.

As of 2023 Sweden's largest solar park is an 18MW facility in Skurup built by solar developer Alight AB, which produces energy for Martin & Servera.

### Kattegat Offshore Wind Farm

Kattegat Offshore Wind Farm<sup>7</sup> is a 1,500MW offshore wind power project. It is planned in Baltic Sea, Blekinge, Sweden. According to GlobalData, who tracks and profiles over 170,000 power plants worldwide, the project is currently at the announced stage. It will be developed in a single phase. The project construction is likely to commence in 2028 and is expected to enter into commercial operation in 2032.

### ***OX2 - Offshore Wind Farm***

OX2 works with all steps in the value chain of a wind power establishment and has delivered to more than sixty parks in Europe<sup>8</sup>. OX2 has together with its partner Ålandsbanken Fondbolag plans for large-scale offshore wind farms on Åland. The areas that have been defined as suitable for wind power in the marine plan for Åland from Ålands Landskapsregering. The total height of the power plants in the Aurora offshore wind farm which OX2 is planning in Swedish territorial waters is 370 meters. The OX2's total output is 5.5 GW. For comparison, the total effect in the largest land-based wind farm of Europe today is 600 MW.

The planned Aurora wind farm area is located approximately 34 kilometres east of Öland and 24 kilometres south of Gotland's southern tip. The area is about 775 km<sup>2</sup> and the depth varies between 50 and 76 meters. OX2 began construction of Bredhälla, located in Uppvidinge municipality in southern Sweden, at the end of 2022. The facility consists of batteries with lithium-ion technology with a total capacity of more than 40 MWh in 20 containers.

### ***Galene Wind Farms and Kattegat Syd Wind Farm***

The offshore wind farms Galene and Kattegat Syd<sup>9</sup> are granted permits (published May 16, 2023). The government has decided to give permission to Galene and Kattegat Syd to build and operate two wind farms outside Sweden's territorial waters outside Varberg and Falkenberg respectively.

The park Kattegat Syd is expected to generate approximately 5 TWh per year, which currently constitutes approximately 3 percent of Sweden's total energy production and corresponds to the electricity needs of 780,000 villas. The project area extends over 103 square kilometres and is located approximately 25 kilometres outside Falkenberg within Sweden's economic zone. The area has undergone adaptations to take into account the Natura 2000 areas Stora Middelgrund and Röde bank in the south, Lilla Middelgrund in the north, as well as fairways and areas with the presence of bubble reefs.

### **Baltic Seas**

This document<sup>10</sup> provides an overview of benefits and actions needed to exploit the full potential of offshore wind in the Baltic Sea

### **Wind Farms in Denmark**

List of offshore wind farms in Denmark<sup>11</sup>

Anholt, Rødsand II, Rødsand I, Horns Rev, Middelgrunden, Samsø, Sprogø, Rønland / Nissum/Bredning.



**Figure 4 Locations of offshore wind farms in Danish water**

### **Wind farms in the North Sea**

The electrical energy produced by Norway's 65 active wind<sup>12</sup> farms, including one offshore farm, was 14.8 TWh for 2022. This is an increase of 25% compared to the year before.

Large-scale offshore wind farms at Sørlige Nordsjø II (SN2) will deliver renewable energy to Norway and potentially Europe, contributing to further develop the North Sea as an offshore energy hub, and create new industrial opportunities for Norway as an energy nation.

RWE AG is a German multinational energy company headquartered in Essen. It generates and trades electricity in the Asia-Pacific region Europe and the United States. RWE Renewables is one of the world's leading renewable energy companies. With around 3500 employees the company has onshore and offshore wind farms photovoltaic plants and battery storage facilities with a combined capacity of approximately 9 gigawatts.

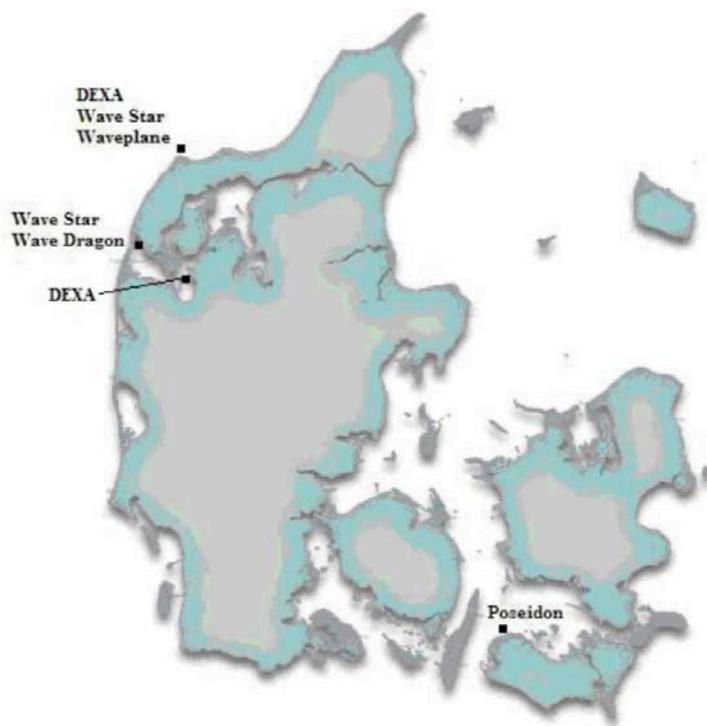
### ***Services of Wind Power Installations***

Leading wind turbine installation shipowner Cadeler<sup>13</sup> has announced the signing an agreement with an undisclosed client reserving future vessel capacity for wind farm installation projects. The deal potentially worth between EUR 400-700 million is the largest in Cadeler's history if all options are exercised. The Vessel Reservation Agreement which spans four years guarantees the availability of one or more vessels from Cadeler's fleet of jack-up vessels including a new A Class vessel currently under construction. The operations are scheduled to start in 2027.

Jan De Nul Group<sup>14</sup> announced a major expansion to their fleet with the order of an additional XL cable-laying vessel. This move is another significant investment in the transition to renewable energy demonstrating the company's ongoing commitment to the sector.

## 5.2 Wave Energy fields

Wave power plants is a promising but yet immature technology for renewable electricity. Denmark has been hosting some demonstration plants<sup>15</sup> at sea based on different concepts but no commercial success so far



**Figure 5 Map from Wikipedia, that has a comprehensive article about wave power<sup>16</sup>**

### **WINDEED**

Windeed<sup>17</sup> is a Swedish company that develops innovative floating offshore wind power solutions has been selected to Sting's Incubate Deeptech program. Windeed receives support and coaching from Sting's experienced entrepreneurs and experts as well as access to a network of investors partners and customers.

### **6. Known obstacles of wind and wave farms**

Offshore wind farms are promising as wind is usually more stable at sea – less turbulence due to forests, buildings and mountains.

Offshore wind turbines are more expensive and difficult to build and maintain than turbines on land. It is difficult to build robust and safe bottom-fixed wind farms in water deeper than about 60 m. Floating wind turbines are beginning to overcome this challenge. Sea waves and ice may damage wind turbine foundations. The production and installation of undersea power cables to transmit electricity back to land is expensive.

The effects of offshore wind farms on marine animals and birds are not fully understood. The impact on commercial fishing is another consequence.

Offshore wind farms built overlooking the coast can be unpopular with local residents and can affect tourism and property values.

The Swedish Armed Forces often have requirements that prevent expansion.

The surveillance of the radar stations along the coast may be disturbed. However, it has been overcome by new installations of radar system along the edge of a wind farm.

## **7. General observations about existing and planned offshore green energy establishments**

General observations about existing and planned offshore green energy establishments and plans is that in the short term – time span 30 years from today - offshore wind farms will contribute the most to the strongly increased electricity energy demand. In the long run – after 2035 - nuclear power from SMRs is more likely to take over the expansion of electricity input to grids worldwide.

This gives STFT an opportunity to contribute to the efficient collection of electricity from wind farms and wave farms. As a large floating platform, it can function as a node by hosting large transformation stations and most likely also large hydrogen power generators. The platform can in the future include SMR. We have cooperation with Terrestrial Energy, Core Power and Blykalla.

### **Nuclear Power as fossil free energy supplier**

#### ***Terrestrial Energy***

Terrestrial Energy<sup>18</sup> develops an Integral Molten Salt Reactor: Carbon-free Low-cost High-impact. Flexible and Resilient

#### ***Core Power***

A Molten Salt Reactor (MSR)<sup>19</sup> is an advanced nuclear reactor that uses a liquid fuel instead of solid fuel like most conventional reactors. The fuel-salt in an MSR contains the nuclear fuel which keeps the fuel-salt liquid at a high temperature. CORE POWER TerraPower and Southern Company forms the team with other collaborative partners which is building the Molten Chloride Fast Reactor (MCFR) the world's first fast spectrum molten salt reactor. The primary foundations of the MCFR technology date back to homogeneous reactor research and development (R&D) programs that were initiated shortly after the discovery of uranium fission and the later military aircraft nuclear propulsion and commercial civilian molten salt reactor (MSR) programs originally launched in the 1950s. The MCFR has been designed through years of engineering supplemented by robust test campaigns to combine the considerable technological advantages of liquid-fuelled reactors MSR technology and fast reactor technology concepts. This elegant yet simple solution enables clean safe reliable and affordable nuclear energy.

#### ***Blykalla***

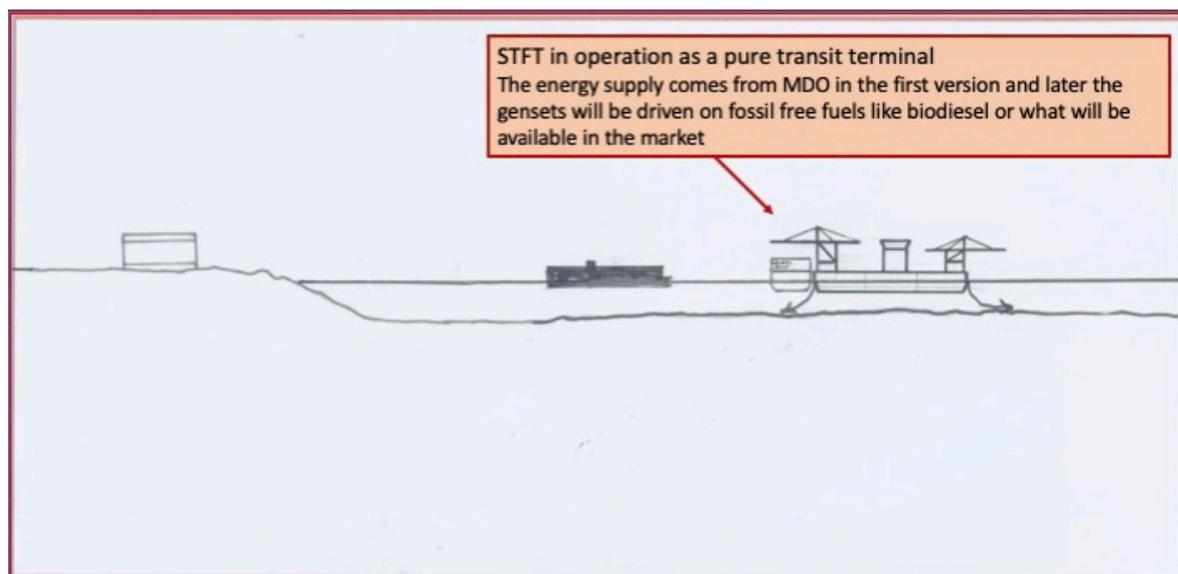
Blykalla<sup>20</sup> is developing and building small modular reactors to deliver the next generation of clean energy. We take leading research to industrialization through the Swedish Advanced Lead Reactor (SEALER).

Blykalla will have a 55 MW prototype running 2030, which will be scaled for serial production in the coming few years.

Sea Technology has started formal cooperation with Blykalla in order to design a floating pontoon including Blykalla SMR.

### STFT as a transit terminal

The main purpose of the STFT floating terminal is to perform as a transit port for ULCV and feeder vessels, figure 6



**Figure 6 STFT in operation as a transit terminal for container shipping**

### 8. STFT as a base for green energy

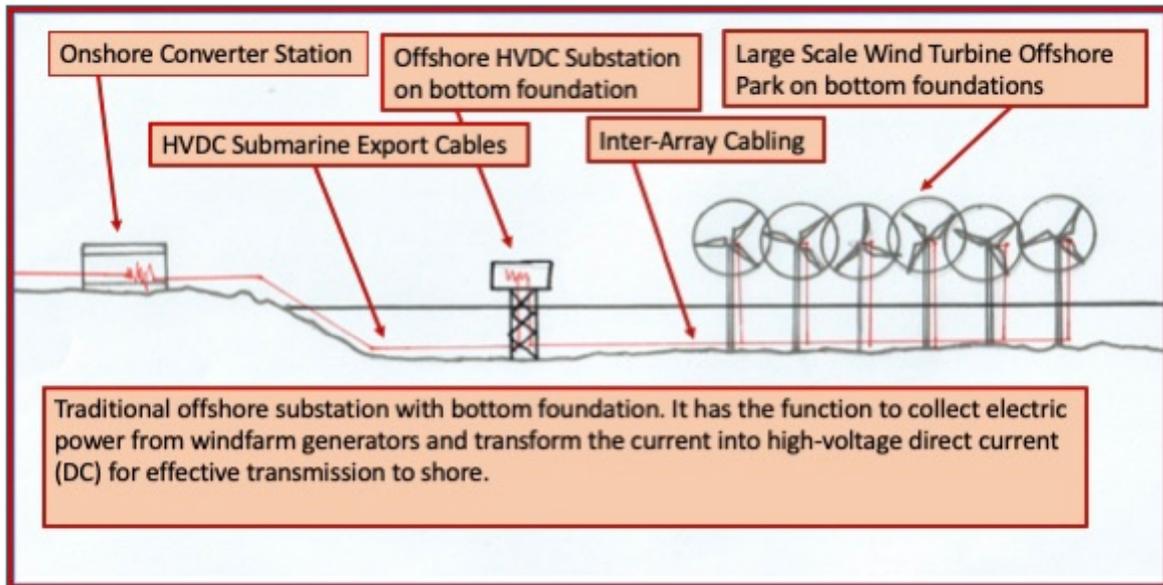
There is the potential for a floating port to be a suitable location for small modular reactors (SMRs) for energy production. For that purpose, we have developed a technical specification STFTe. The outcome of recent the development work with the concept “STFT as a base for green energy” is that it is beneficial to have a separate floating platform STFTe in a reasonable distance of the transshipment terminal STFT.

The new ways of producing electricity energy in large scale without carbon emissions are driving this development. The upcoming and promising Small Modular Reactor (SMR) that we soon use will probably not be installed in the STFT of safety reasons, at least not for any years.

Most likely the transshipment platform STFT will be run on electricity from the gensets, initially on MDO and later on green diesel fuel when available in quantities. In future later stage the floating terminal STFTe will supply the transshipment platform with electricity from Small Modular Reactors (SMR).

The first graph below is shown as a reference for further discussion. It shows a “conventional” solution for a large scale wind farm offshore. The electricity from the individual wind turbines is collected within an Inter Array Cabling and transmitted to the transformer in the Offshore High Voltage. The High Voltage Direct Current (HVDC) is transferred through a

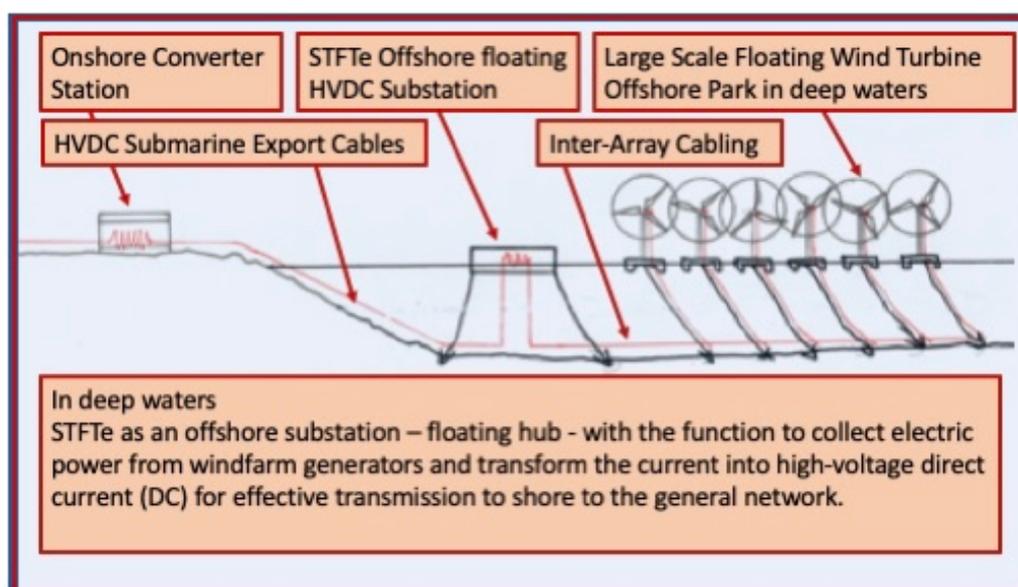
submarine cable to shore where there is a converter station before the current enters into the general grid, i.e. to the customers onshore.



**Figure 7 A traditional offshore wind park with offshore hub on bottom foundation**

In shallow water this solution with a substation supported by a bottom foundation is regarded as optimal by the developers of large scale wind- and solar farms offshore. When electricity is cheap because of continuous good winds and solar radiation compared to customer demand the surplus energy is used either to charge batteries or to produce hydrogen for storage or for transformation into green energy carrier in fluid condition, i.e. methanol or ammonium.

In deeper waters STFTe can be used as a substation, most likely then including some of the equipment for transformation of surplus electric energy to other forms of green energy carriers, batteries, hydrogen, methanol and ammonium.



**Figure 8 STFTe as an offshore floating HVDC substation**

## 9. STFTe as energy hub with SMR

Floating barges for electric energy production from SMRs are known as concept<sup>23</sup>. At an IAEA symposium on floating nuclear power plants that took place from 14-15 November 2023 in Vienna legal experts nuclear and maritime regulators and industry leaders discussed the benefits and challenges of FNPPs and exactly what role they could play in the fight against climate change and the transition to Net Zero.

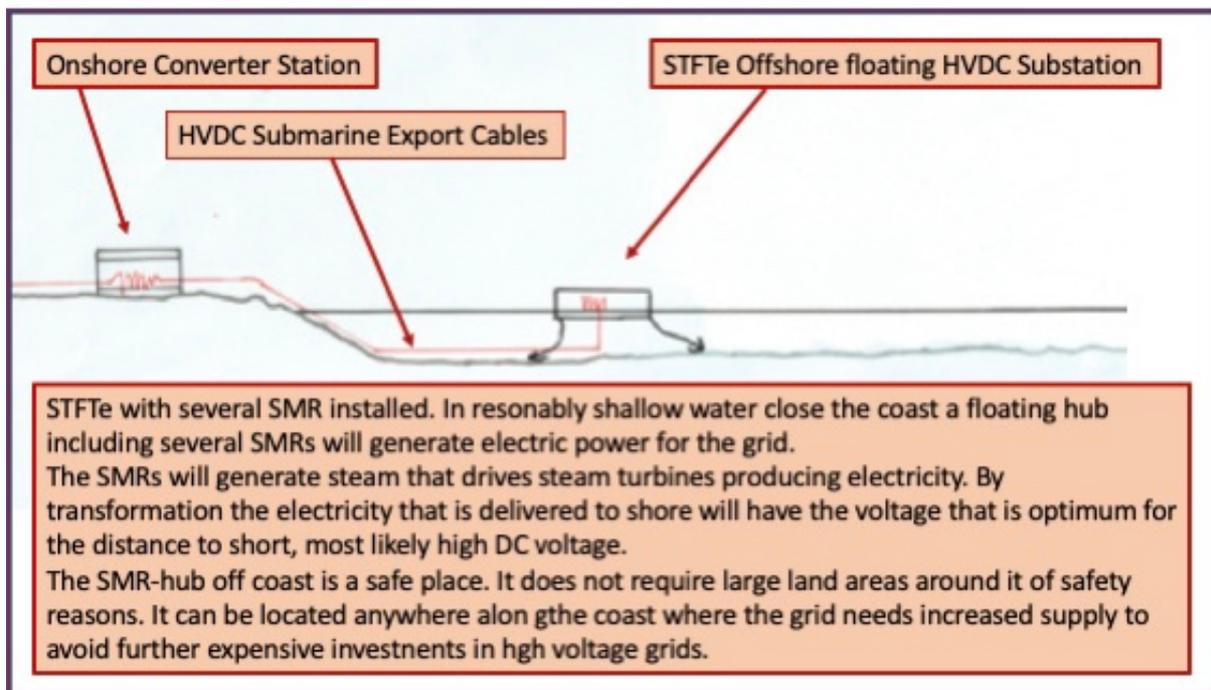
“The IAEA is working with our Member States to determine what further guidance and standards might be needed to ensure the safety of floating nuclear power plants”, IAEA Deputy Director General and Head of the Department of Nuclear Safety and Security, Lydie Evrard, said at this symposium.

In efforts to find a use for the transshipment platform STFT as a hub for efficient green energy supply we have developed cooperation with research and development teams for SMR. With the Swedish company Blykalla we have agreed to cooperate.

It is most likely that for many years to come the energy from SMRs will be produced in pure barges or pontoons like STFTe separate from the pure transshipment platform STFT.

In a longer term the combinations may appear when the experience from SMR is such that the risk levels of radiation is known to be low also in the neighbourhood of the reactor. The experience from nuclear submarines is pointing in that direction.

Some years into the 2030s STFTe will be offered to grid owners to strengthen the electric grids along the Swedish coast.



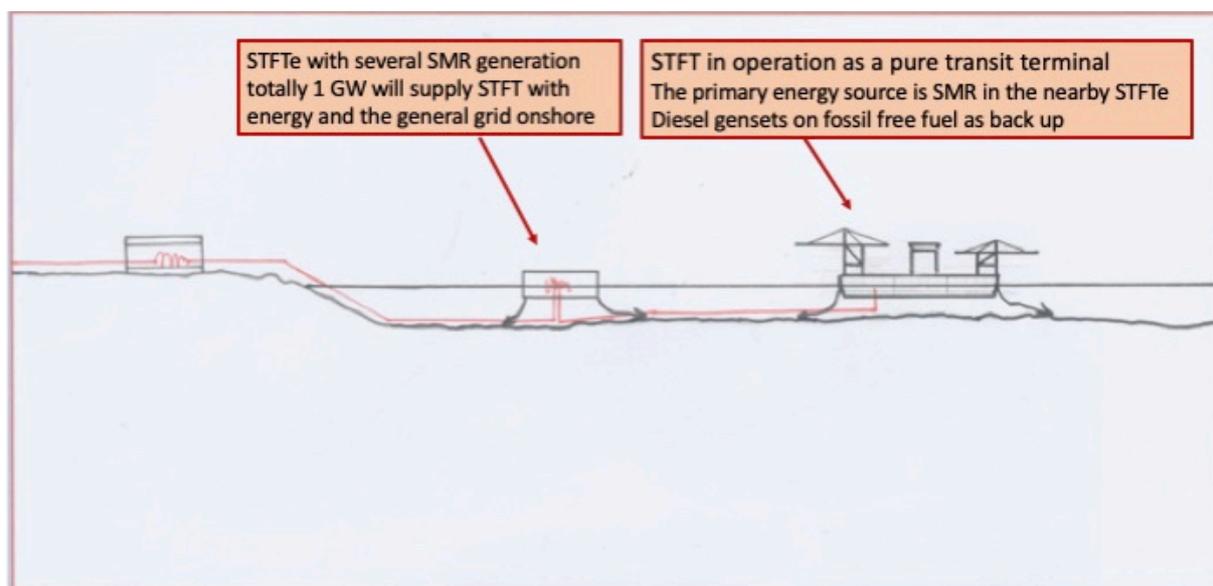
**Figure 9 STFTe with several SMR installed located along the Swedish coast**

The first version of STFT that will be produced an operational - the trans-shipping terminal – has all together 20 diesel driven gensets of 100 MW electric power to make all container cranes moving and also pumps for pumping water around. In the future the demand may

increase when feeder ships has electric propulsion on batteries. The feeders will need charging. We expect that another 100 MW will be needed.

In the early 2030s we will see prototypes of Small Modular Reactors be further developed to serial production. The demand is expected to grow. We hope that installation in floating barges and pontoons may have priority due to safety consideration. Then STFTE will be one of the first large scale floating sources of nuclear energy in Scandinavia as we already prepare a design for the purpose, see technical specification in Enclosure A.

The STFTE will be able to replace the suggested a bottom-founded hub for electric and H2 energy supply. If and when it is located close to an STFT it will also supply the STFT with all energy, figure xx



**Figure 10 STFTE supplies STFT with energy. STFT is the transshipping terminal.**

## 10. Discussion

From the literature survey in this report it is evident that there are many mega-projects with the aim to give the society a fossil free future, a demanding task. Conflicts are evident. Most people want to have cheap energy for heating and transportation and manufacturing while enjoying an untouched nature free from the sound and visual pollution of wind turbines. The “green” industry has turned to the ocean for expansion of wind turbines and wave power plants. The cabling between individual wind turbines form a grid to collect electric power to transmit to a transformer in a hub – an offshore HVDC substation. This hub consists of a big building that is located above the water surface on a frame work resting on the sea bottom.

The idea to have the STFT as a nearby floating hub for the same function is reasonable. However, during the progress of this work and as a result of interviews with managers of wind farms, the bottom fixed hubs are most likely efficient in waters of between 50 and 75 meters depth. In deeper waters a floating hub/platform will be motivated for the purpose of transforming electricity. The expectations of STFT – the trans-shipping terminal - to function as an energy node in addition to the main function of container handling were high. These combined functions would have involved the task to receive and transmit electricity from offshore wind, wave energy systems and offshore solar energy systems. The outcome of the analysis work and interviews is that the platform for transshipping STFT may not be useful for

these combined efforts in a foreseeable future. Instead the team has developed a pure floating energy hub with Small Modular Reactors.

This will be very useful to increase the availability of planned electricity to the grid. The safe realisation of floating barges for electric energy production by SMRs are known from an international symposium 2023 as realistic concept for development<sup>23</sup>. Within our project we have developed a detailed technical specification for a floating energy hub. The next stone is to offer the design to customers in Scandinavia and world-wide. The technical specification is seen in Enclosure A.

## **11. Conclusion**

STFT will be a valuable contribution to the major container ports of Europe and Scandinavia with its developed function as a trans-shipment node. In its first version the energy supply for the service of ships is realised with gensets driven by MDO or green fuels when green fuels are available in the market in large quantities.

SMR will be available in mid 2030. When the experience of this source of energy shows high degree of safety concerning the work environment of people close to the reactors we may see the gensets replaced by SMRs.

Large wind turbine farms and wave energy plants in reasonable deep waters are today connected to transformation hubs – HVDC substations – resting on frame works supported by the sea bottom. This is a mature solution and not likely to be replaced by a floating platform even if it is specialist on green energy. In deeper water where the wind turbines need to be afloat it is another situation and the floating hubs for transformation of energy is a requirement.

Within this century electric power demand more than doubles. The national grid needs to transmit more power than it presently has capacity for. Small Modular Reactors on floating platforms can be placed along the grid and thereby reduce the requirement of enormous investments in cabling from north to south of Sweden. The cities and industries along our coasts require a lot of electric power. The floating power plants opens up for Sea Technology Floating Electric Terminal, STFTe.

## **12. Acknowledgement**

Naval architect Bengt Lundqvist developed the transshipping platform STFT together with ship broker Clarkson, the classification society DNV and the three ship yards in South Korea Samsung, DSME and Hyundai. Bengt Lundqvist also developed the technical specification of STFTe in dialogue with Terrestrial Energy, Core Power and Blykalla.

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- 22) <https://parc-eolien-en-mer-de-fecamp.fr>
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- 24) On 7<sup>th</sup> of October telephone interview with Martti Simojoki (Swedish Club) and Johan Gahnström (CompetenSEA)

## Enclosure A

### Sea Technology AB Floating Electrical Terminal, STFTe.

**A Floating Nuclear Power Package. FNPP. Power up to 1 Gigawatt.**

**Production of clean Electricity and large Quantities of Fresh Water.**

**This STFTe is a large steel construction, very seaworthy. Anchored with 24 anchors. Or moored to a strategically located safe port. It may contain up to four SMRs of 250 MW or 1 GW. Or other SMR's. With the Double Power System. To be deployed free at water depths of 25 to 200 meters. For Europe, USA or Asia. Fulfilling all rules. Easily movable. Protected from earthquakes and tsunamis and pirates. Unsinkable. 60/100 years life time.**

**Length: 400 meters.**

**Beam: 220 meters. Inclusive 3 m double hull.**

**Depth: 32 meters.**

**Draft at normal operations: 22 meters.**

**Freeboard, normal operations 10 meters.**

**Area of Terminal Deck: 88.000 m<sup>2</sup>.**

**Displacement at operational draft of 22 meters: 1.936.000 tons, m<sup>3</sup>.**

**Fresh water/BW/Fuel oil. 800.000 tons**

Internal large tank capacities provided for storage of Fuels, Fresh Water and Ballast Water. Two 400 m long quays for large vessels with moving 50 tons quay cranes arranged alongside, if moored to low tidal water quay. If anchored, 4 pillar-mounted 50 ton cranes will be installed, one at each corner. The STFTe may act as a technical service station for vessels. Double hull barrier all around. Will hold two superstructures for crew, living quarters, offices, Heli-decks, administration systems. All power systems will be located on the internal decks. The 2:nd deck will accommodate the large, voluminous SMR constructions. The third deck will carry the diesel gen sets. The STFTe may be built in Korea, building time 3 years. The STFTe will be constructed of two steel pontoons, each 400 x 109 x 32 m, fully welded together afloat. It will hold large accommodation. Facilities for education, training, school. More pages will follow, including new Double Power machineries, MDO dual fuel gen sets/SMS nuclear reactors . About 150.000 ton steel weight. Building cost about 1USDB. Construction method like the floating container terminal, STFT. Other sizes possible.

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### **ACCOMMODATION in two strong steel superstructures placed on the Terminal Deck.**

The Terminal will have a length of 400 meters and a beam of 220 meters. The depth of the construction will be 22 meters. The Terminal will have one main administration superstructure and one machinery side superstructure. All accommodation and living quarters of highest class, fully air conditioned for hot and cold climates, well insulated. Living quarters for 300 special crew located in single cabins of high standard with private bath, plus six 3-room apartments, mess rooms, day rooms, kitchens, pantries, food stores, cold stores, offices, hospitals, laboratories, recreational spaces, gyms and pools. One separate school department for education and training of new crews for serving SMR reactors. A full width communication center on top with all around views. One helicopter deck on top with refueling arrangements. Main building base area of 60 x 60 meters. 8 - 10 stories high. Six large size elevators located in safe staircases communicating all decks. Machinery side building, base area 30 x 60, will be 5 stories high, holding large stores and well and suitably equipped workshops. And will support

all high funnel uptakes. The Terminal will be built to the requirements of recognized Classification Societies, such as DNV-GL, Lloyd's Register, ABS. Others as required. Fully certified and tested. The Terminal will fly the flag of a chosen Flag State. Requirements of the Flag State to be fulfilled. IAEA safety standards and security guidance documents will be followed, IMO rules fulfilled as required. Korean rules, KINS, as required. The STFTe is not a ship. It is a large pontoon for production of clean electric power. Requirements and Protocols of AIEA, IMO/Marpol to be fulfilled, as applicable. Changes of position possible, will be made using tug boats. The superstructures may be built of stainless steel considering the very long life time. Safe illumination of all internal and external areas.

### **Main Structure.**

The structure of the STFT will incorporate a 3 m wide double hull, safety and barrier system for protection at collisions with other vessels or quays. Built all around the Terminal. As a protection at heavy weathers or fires. Used for nuclear shielding materials and/or Ballast Water. The structure will include 20 transversal bulkheads and 15 longitudinal bulkheads plus bulkheads for the double hull barriers. The STFT will have four decks plus double bottom and flat bottom. The very strong Terminal Deck is located 32 m above Baseline, 2nd Deck 22 m above BL allowing 10 m free height for SMR installations, 3rd Deck 13 m above BL, allowing 9 m free height for diesel engine installations, 4th deck 8 m above BL. Height of double bottom tank constructions will be 8 meters. And a flat bottom. The Bottom will be built of 40 mm plating. Bottom is flat. Longitudinal framing between strong girders. The Terminal deck will be very strong, 50 mm thick, well stiffened to take heavy deck loads and for safety. The STFTe can carry a total load of one million tons. Four (4) cargo hatches with hydraulic steel covers, 6 x 16 meters. Two 400 m long quays for large vessels with two moving 50 tons cranes arranged alongside if the STFTe is moored to a quay. If the STFTe is anchored, four pillar mounted 50 tons cranes will be arranged at each corner of the deck. Near the hatches. Ten (10) Free fall type life boats, five on each short side, for together the whole crew of - 600 persons will be installed. Two speed boats for personnel movements will be arranged with mooring. A strong road type barrier 1,5 m high will be built all around the STFTe for security and safety. The Terminal Deck will be built with a camber, An effective scupper system will be built avoiding stormy rain water flushing over the external decks. Heavy wind protections and safe closing of large ventilators and large windows. Cranes will be provided with clamping down wire systems. Low positioned piers, 3 m above water line, will be built on the short sides of the Terminal, between the anchoring extensions, with ladders and lifts up to the Terminal Deck for tug boats and other smaller ships.

### **Ballast Water. Fresh, large quantities produced and exported using barges.**

An extensive Ballast Water System, consisting of a large number of tanks and a pumping system will be installed, positioned in the double bottom and double hull tanks and aimed for safe stability and for keeping the STFTe at the operational draft of 22 meters and at even keel. High quality pipe/valves and pump materials. Stainless steel, bronze or glass fiber epoxy system. The STFT will be kept at a constant draft of 22 meters and with a freeboard/quay height of 10 meters. The ballast system will have self-priming centrifugal pumps. Remote control system of content Ballast capacity will be 800.000 tons, located in double bottom tanks. The STFTe, may be de-ballasted for service works, towages and relocations, services of bottom valves, cleaning and painting. The tanks, ladders and hatches of stainless steel. Draft at de-ballasted condition will be 3 meters. The Ballast water system will be handled and controlled from the Communication Center. All ballast and fresh water tanks to be accessible with hatches and sloping ladders. Pump rooms will be installed. Fresh water deliveries to large barges. Large production of Fresh Water with shipments using barges as being agreed.

Production of Fresh Water will start from day one based on diesel gen sets capacities. About 50000 tons per day will be produced. Later, with SMS power, the production will increase to 200000 tons per day or more. Alfa-Laval systems.

**Positioning. Anchoring. Mooring. Model testing.**

The STFT is a free floating large unit, it will be located in fairly protected areas with limited exposure to heavy weather, waves, swell, tides and currents. Normal tides and currents will be acceptable. One starting/service location followed by a permanent location. The STFT will be secured in position by heavy 4 (four) anchors and chains in each corner, total 16 anchors. Or will be moored to a safe port. The STFT will be towed, in a light condition, 3 meters draft, from the building site to the operation site. Repositioning will be possible using tug/anchoring boats. Can be arranged in short time. Changes considered for new cooling waters and for reducing problems of shadowing of sea bottoms, changes which may be needed for keeping good conditions of the flora and fauna of the sea bottoms. Sea keeping model tests shall be carried out by yard to assess the STFT's performance in various weather and sea conditions. Wind and wave and Sea Bottom conditions will be investigated and an anchoring analysis will be made. Seasonal weather changes considered.

**Mooring of visiting cargo/service vessels. Mooring of large fresh water transport barges.**

The sides of the STFT will generally be protected with a suitable hard rubber fender system. The low positioned decks of the Terminal, at the short sides, will be used for Life Boats, Tug boats, Service and Guard Vessels and other types of vessels. Also, strong bollards, automatic mooring winches to be provided. Special arrangements will be provided for good mooring of 400 m long container vessels with nuclear machineries. This will be combined with special technical services including nuclear works. Pneumatic big fenders, ladders and gangways will be arranged. Waste incinerators will be installed for cleaning of all wastes from toilets, wash rooms, laundries, kitchens, residual oils, plastics, bottles etc. in order to provide total cleaning of all outlets from the STFT. Visiting vessels may deliver black water for cleaning. Membrane systems with suitable tanks will be arranged for cleaning of all dirty black waters. The anchored STFT will be keeping a 24/7 guard crew with equipments. Including patrol vessels.

**Corrosion protection and maintenance.**

The structure of the Terminal will be made of shipbuilding type steel. All steel will be sand blasted and given shop primers before delivery from steel factory. The Terminal deck will be coated with a special anti-slip, heated if winter conditions, suitable compound with el heating will be added. Barriers and all other deck equipment will be painted with thick epoxy systems. After construction all internal areas in dry compartments below the Terminal Deck will be painted with a thick epoxy paint system of light shade.

All ballast tanks will be sand blasted again at yard and painted with a special epoxy paint priming system followed by several layers of paint for a 5 years life time. Zinc anodes will be fitted in all ballast water tanks. Fresh water tanks to be constructed of stainless steel and will be epoxy painted in white colour. Fuel tanks will not be painted. Fresh water tanks will be made of stainless steel and will be epoxy painted in white color.

The tanks will be accessible for cleaning and coating. All outside side areas of the STFT Terminal will be painted with a thick epoxy paint system. Under water parts will be painted with special salt water resistant epoxy system with very long life time and will be fitted with zinc anodes. The submerged underwater parts will be cleaned by divers as required. A divers' station will be provided, complete with compressors. The outside of the complete superstructures will be painted with epoxy paints. The bottom, which will always be submerged will be sandblasted again and preserved with a special long lasting epoxy compound. At services these parts will be cleaned by divers and bare areas will be protected with a rich zinc spraying and zinc anode system. Two separate usual type bottom valve intakes will be built.

The STFTE will undergo periodical inspections and services, as for large ships. IMO and IAEA inspections with renewals of certificates. As will be internationally and locally nationally required. Every five years a major inspection and overhaul will be carried out. Every two and a half year a minor inspection and overhaul will be made. At service occasions, the STFT can be de-ballasted and tilted so exposing all the bottom structures. All the external bottom plating and sea chests with valves can be exposed to the air for cleaning and coating works. Divers services will be provided for external cleaning and painting of the STFTE and visiting vessels. This STFTE will entail education schools, certifying and testing facilities for marine SMR nuclear reactors and steam turbine machineries. And laboratories and expert facilities will be provided. Storage of used nuclear fuels will be arranged with cooling tanks and other means as required.

**The STFTE will be built including the double power machinery Systems.**

**1. First power system will be a complete diesel gen sets system for starting up and back up, 440 volt AC, during services and refueling of nuclear batteries. Total power to be 100/200 MW, electricity of 220 V 60 Hz. It will stay in operation for the full life time of the STFTE. This system will be arranged working as a strong emergency power. Ready 2027/8.**

**2. Second power system will be a Nuclear SMR power system to be installed when IAEA rules and all other regulations allow. Total power to be up to 1 GW. Shipyard works will be prepared and carried out. Barriers and radiation protection according to AIEA regulations. This system will take over normal power of the STFTE. To be of 220/440 V, 50/60 HZ, same as shore receiving grid. Ready 2032.**

**3. In cases of operation close down for services, installations and other difficulties and emergencies the First power system will deliver electricity to all usual and emergency systems including cooling systems, fire pumps, illumination, doors, communication systems, life boats, winches and cranes. All AIEA safety requirements will be fulfilled.**

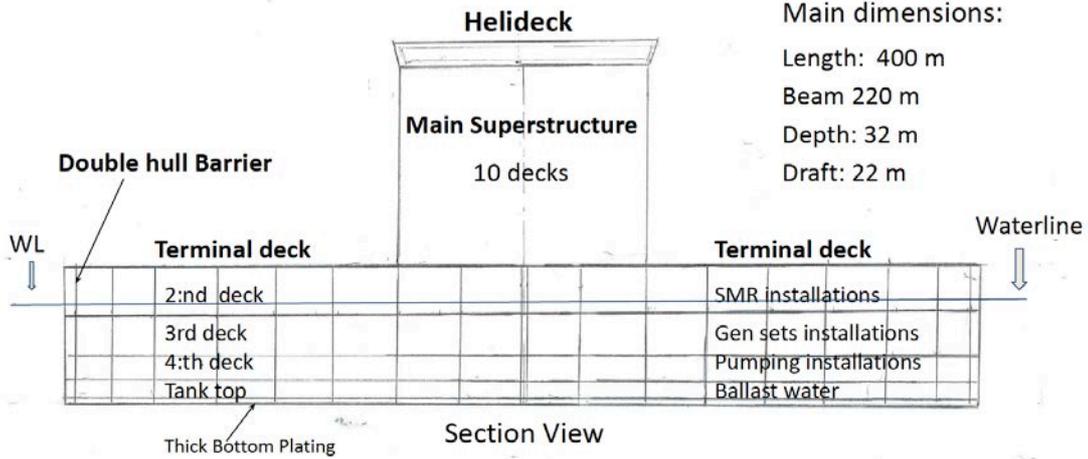
When the ship building type works are completed, and the STFTE anchored and deployed at its first location, anchored or moored to a port quay, the STFTE will start using the first step of double powering production, This will be based on 4 stroke diesel engine gen sets with a total power of 200 MW. With water centralized cooling systems, complete with all conventional machinery systems alike in the STFT Terminal. V-type diesel engines of license makers. This machinery will be mounted on 3rd deck. Fire and noise protected. High Funnel uptakes built at Machinery side. Clean Diesel Oil fuel systems, complete with all usual equipment and tanks. LNG as alternative, dual fuel.

The nuclear power installations will start operation, after a period of 3 to 5 years at prepared, safe position. The electrical power will be generated from the SMR reactors complete with Steam Turbine machinery systems. One complete set for each SMR of 250 MW. Siemens manufacture from Swedish Finspång is possible. The "First power machinery" of diesel gen sets type will be installed with a power of up to 100 - 200 MW. Diesel gen sets power to be used as power for all operational electrical systems during towage and at installation operations. The temporary installations works may stay as a backup as long as needed. This system will be effective as a safety system in case of mal function of the nuclear system needing a shut down. Two large air cooled emergency generators of diesel gen sets type will be installed by the shipyard and will stay operational on board for the life time of this STFTE. An emergency electrical net will be provided for emergency services of vital systems like opening/closing of emergency doors, illumination, communication systems, fire pumps, ventilation and all other required uses, served by two ship type large air-cooled emergency gen sets placed at an enclosed space in the accommodation. Ventilators of machinery space for forced ventilation of all machinery compartments. Inlets will be installed with closing means. Fixed fire alarm and

extinguishing systems for all machinery and living quarters will be provided. A high capacity deck wash line for and deck cleaning piping system to be provided, with piping reaching all areas of the STFTe.

### SEA TECHNOLOGY AB Floating Terminal, STFTe.

A Floating Nuclear Power Package. FNPP. SMR Power up to 1 Gigawatt.  
 Earthquake and tsunami safe. Movable. Unsinkable. Long Life time. Anchored with 16 anchors.  
 Production of large quantities of fresh water.

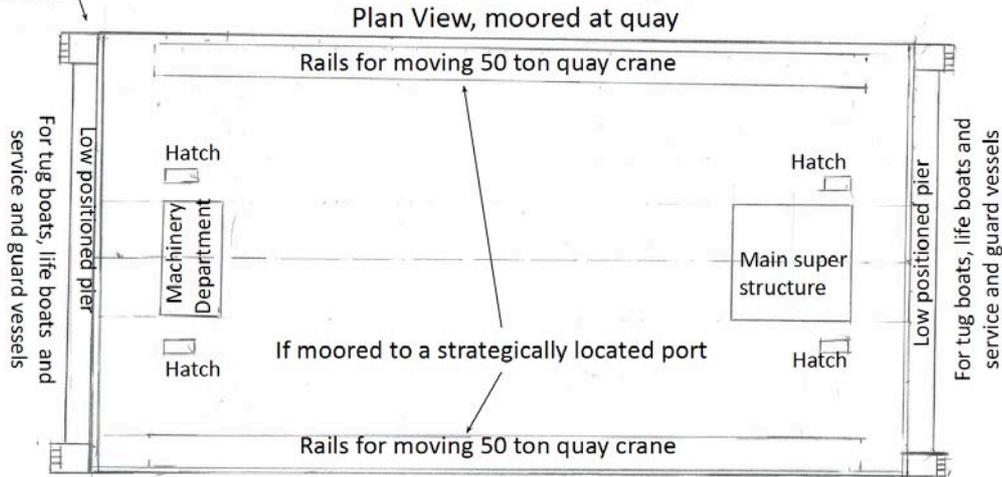


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### SEA TECHNOLOGY AB Floating Terminal, STFTe.

A Floating Nuclear Power Package. FNPP. SMR Power up to 1 Gigawatt.  
 Earthquake and tsunami safe. Movable. Long life time.

Anchoring deck 15 x 15 m  
 with 4 winlasses



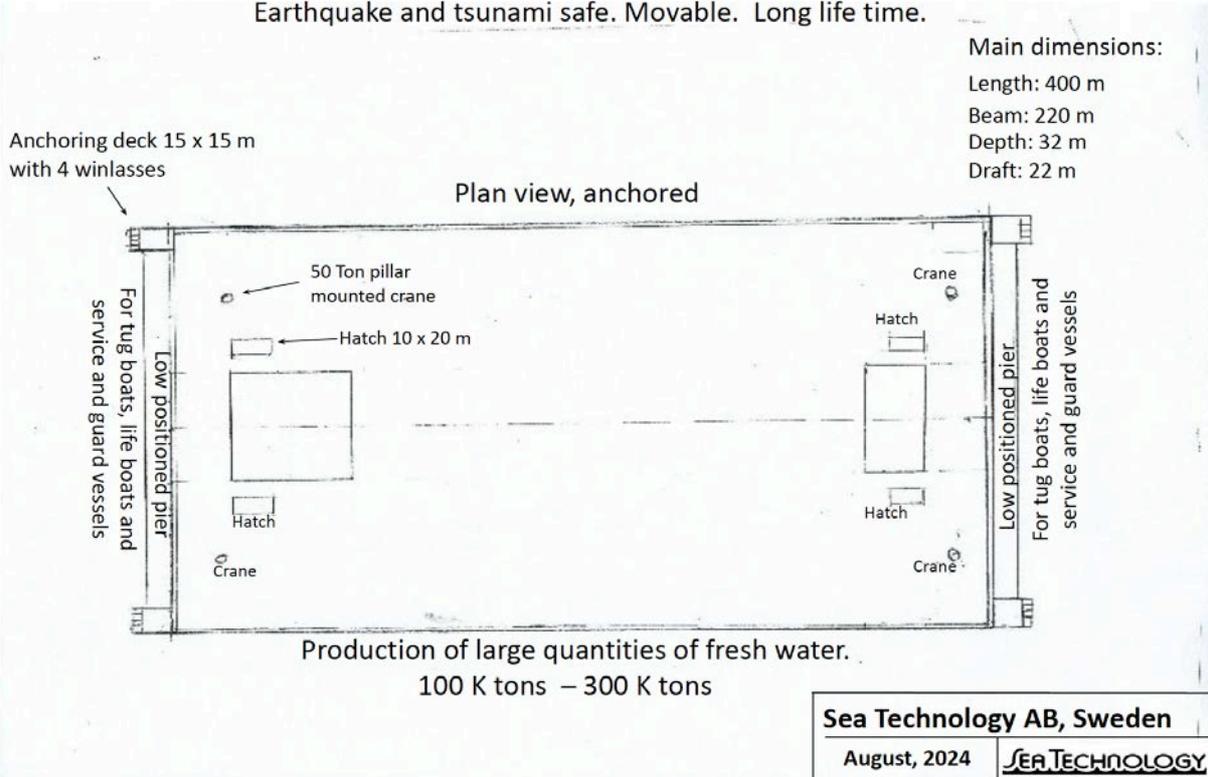
**Main dimensions:**  
 Length: 400 m  
 Beam: 220m  
 Depth: 32 m  
 Draft: 22 m

Production of large quantities of fresh water.  
 100 K tons – 300 K tons

**Sea Technology AB, Sweden**  
 August, 2024 **SEA TECHNOLOGY**

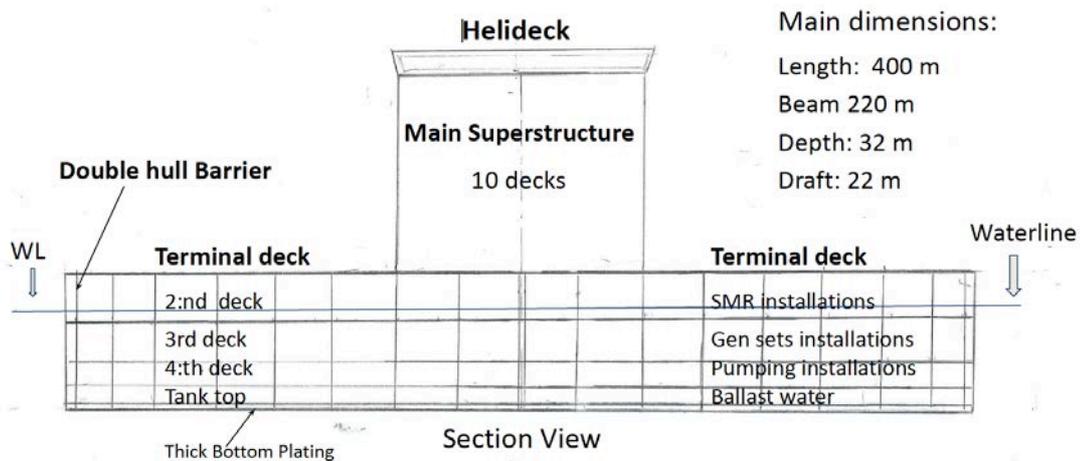
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## SEA TECHNOLOGY AB Floating Terminal



Sea Technology AB, Sweden

August, 2024

SEA TECHNOLOGY

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### **Enclosure B**

Questions for interviews of managers of large scale wind- and solar panels

- 1) How have you agreed with the military about the disturbances?
- 2) How have all the environmental permits turned out. How much work?
- 3) Why does everything stand still? How can we push the build-up
- 4) Where do the wind turbines come from? China?
- 5) What voltage comes from individual turbines in OX2
- 6) Who supplies the hubs with transformers?
- 7) What does the land cable look like. Is it direct current? What excitement?'
- 8) What do you think about a large floating platform as a node, which in addition to transformers can contain future SMRs and also Electrolysers as well as hydrogen storage

### **Enclosure C**

Questions to sea farers

Martti Simojoki (Swedish Club) and  
Johan Gahnström (CompetenSEA)

Introduction to question:

Sea Technology Floating Terminal is a transshipment platform that provides reloading between ULCV and feeder boats. The size is 600x400x35 m with draft approx. 15 meters... to be location outside large ports, which today have reached and passed the capacity limits. The platform is ready for production as there are quotes from three Korean shipyards. Now working on finding customers. Writes a report for the Swedish Transport Administration about any location in Kattegat.

My question:

How much free water may be needed around the platform?

There are going to be many wind farms now in the same sea areas!

Answers: minimum one nautical mile...then depending on distance to fairways and the general traffic in the area.