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INTRODUCTION

This report is meant to enlighten the environmental impact on Deep River’s installation of riverine power plants in the Nemunas River in Lithuania. The report gives an overview of the project, the technical solutions, environmental impacts during installations, environmental impacts when the plant is running, and other factors regarding the river, government and third parties interests.

The installation is considered a pilot project, and unforeseen events may occur. It is in Deep River’s greatest interest to minimize the impact of unforeseen events. We are always working to prevent environmental hazard spills and to ensure the safety of people, animals and fish in the proximity of the installation.

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THE NEMUNAS RIVER

**Facts:**
The Nemanus/Neman is a 914 km long river stretching from Belarus, through Russia, Poland and Lithuania before it reaches the Baltic Sea at Klaipeda. The river's depth varies from 1 to 5 meters.

**Biological communities:**
The following fish have been found in the Nemunas/Neman River: perch, pike, zander, roach, tench, bream, rudd, ruffe, and bleak. Its tributaries also contain stone loach, the three-spined stickleback, minnows, trout, sculpins, gudgeon, dace and chub (Source: http://en.wikipedia.org/wiki/Neman_(river))

**Area of influence:**

Nemanus River near Kaunas.
TECHNICAL DESIGN AND INSTALLATION

Description of power plant technology:

Deep River’s power station consists of two containers: a land-based container and an underwater container.

1. The turbines are mounted to an underwater container. The container is fitted with two floating tanks; one at the bottom and one above. The unit is anchored to the riverbed and produce power (energy) from currents. The entire unit is located under the surface of the river. An axle connects the turbines to a hydraulic pump. On the axle, we have mounted three bearings built in a waterproof box. Hydraulic liquid is pumped to an onshore generator room. The liquid oil in the hydraulic pump and pipes are environmental friendly. The generator room contains control systems and converters, and is located on land.

2. The turbine is designed as a flow-through turbine. Spinning at low speed (15-60 rpm), the turbine does not pose a likely risk to the river’s ecosystem.

3. The system does not involve encroachment on the riverbed beyond mooring or anchor.

4. The power plant is coated with non-toxic protective paint, designed for ships and underwater installations.

5. All technical installations are fitted with watertight bulkheads.

6. Everything is standard systems, based on conventional technology.

Mechanical constructions and buoyancy:

Buoyancy items are ballast tanks whose mission is to level the structure at a certain depth and balance the structure at a right angle. This is achieved by running air or water into the ballast tanks. The estimated total weight of the offshore power plant is
12.000 kg i.e. the container turbine is approximately 9.000 kg, and the ballast tanks are about 3,000 kg.

**Installations in Nemanus River:**

The plant uses conventional mooring systems and principles depending on bottom conditions and loads. **Lithuania Inland Waterways Authority** (LIW) will coordinate the selection of analysis and methods.

**Foundations and Anchoring System:**

The foundation is estimated to require six anchor points under water. This may be adjusted between four and eight points depending on the currents' strength and the riverbed conditions. The anchors are made of concrete, which are linked to chains. The other ends of the chains are connected to the turbine-container. The weight of the anchors is about 3500kg per unit. This weight is calculated from the water current pressure around the site. Lithuanian Inland Waterways Authority approves the construction of the foundations and anchor system. It is not envisaged any special challenges related to the installation. Installation contractor will plan and implement all marine operations. We will choose a carrier that has considerable expertise and knowledge of the river and its soil conditions. Deep River will fulfill all requirements related to quality, safety and implementation of the installation.

**Connection to Grid:**

Connection to the Grid will happen in cooperation with the local authorities, energy companies and the owner of the project. The electricity from the power plant will be of the right quality i.e. 50Hz or national standard.

**Certification:**

There are currently no comprehensive certification requirements for such facilities. We will deal with claims from parts of the plant where such may exist and industry
standards where applicable. In addition, the Norwegian VERITAS will help with security issues.

**Infrastructure:**

Existing quays are ideal for the installation process, and we will therefore deal with the owners about the use of these in conjunction with the launching of components for the installation of the plant. We will use the existing road for the upgrade of onshore facilities.

**Schedule:**

1. Mapping local conditions / license  
2. Design / engineering / planning  
3. Pilot production  
4. Installation / infrastructure  
5. Test Period / experimental activities

**Operation of the full-scale demonstration plant:**

Remote control and video surveillance will be installed. Inspection of river installations shall be on an annual basis and subject to guidelines developed by Deep River AS in cooperation with technology suppliers. The supplier provides robust and maintenance-free bearings without oil or polluting lubricants.
THE POWERPLANT WILL HAVE THE FOLLOWING ESSENTIAL REQUIREMENTS:

**Turbine**
Deep River flow-through turbine technology test will show the production of energy with approximately 2.3 m/s.

**Generator**
Permanent magnet generators size and production capacity will be determined after the test. ABB Company will supply these generators. The size of the generator is depending on the water speed and measured power generated by the hydraulic pump. The generators will be located in the onshore technical container, and will be easily accessible for periodic maintenance.

**Control**
The entire system will be fitted with sensors and monitoring devices that can communicate via the internet and mobile network, and the main parameters is transmitted and stored periodically. An alert-notice will be sent automatically if a problem or error occurs.

**Cable from Offshore to Onshore.**
All cables from the turbine to the onshore container are placed in pipes in order to protect them. The pipes have an anchoring system to keep them in a good position.
We have three types of cables inside a pipe, namely liquid, electric/data, and air cables. The liquid cables will be installed with safety pressure valves, to secure minimum spillage in case of a fracture on the pipeline. The distance from the turbines to the onshore installation will vary from place to place, but always be kept to a minimum.
Landowners:

The project activities will primarily be located in the river and under the surface, and therefore landowners will be minimally affected.
The power station does not require new docks, roads, etc.

Relationship with other public or private plans:

Based on the information we possess, the measure does not conflict with other plans, and we are neither aware that the proposed development would conflict with other private or public plans or conservation interests.

Location:

When choosing a deployment location for riverine power plant, several aspects must be considered. The most important are:

- **Current conditions**: stable and relatively strong current is the most important prerequisite for establishment of a riverine power plant.
- **Infrastructure**: proximity to existing roads and power lines GRID
- **Protected areas**: we will avoid the interference of areas protected by local government
- **Cultural heritage**: we will avoid the interference of heritage conservation areas that are protected under the Cultural Heritage Act
- **Hunting and outdoor activities**: we will locate the power station in such a way that possible conflicts with outdoor interests are not excessive
- **Competing businesses**: we want to avoid conflict with fisheries interests and shipping to the greatest extent possible
Why Nemanus?

- It fulfills the basic flow-condition requirements
- Deep River has already done preliminary work with measurements and analysis
- Flow conditions in Nemanus are favorable for Deep River’s technology
- Due to the existing infrastructure in the area, there will be no need to build a road, pier or similar.
- It has been confirmed that the onshore grid has the capacity to accommodate Energy from the power plant. In other words, the grid will not have problems taking in the energy from the power plant, which is 1-1.5 MW per unit.

This deployment area:

The power plant will be located in the Nemanus River, Lithuania, east of the Kaunas city.
The deployment location is indicated on the map. There is no ship traffic in the river.
The installation will be located outside the fairway. This will not prevent or restrict traffic.

Turbine Location:

The turbines are located close to the riverbed in a relatively smooth way - without producing too much turbulence that could otherwise endanger riverine plants and animals.

Riverbed Conditions:

These data are available on the map showing riverbed conditions.
**Current Conditions:**

We conducted surveys of flow conditions. Polls from 2013 show that the currents are satisfactory for production of Deep River’s energy.

**Series connection of turbines:**

The turbines can be connected in series with multiple units on both sides, and lengthwise.

**ENVIRONMENTAL MATTERS:**

**Disturbance to local ecosystem:**

Turbine elements move at the same speed as the flowrates of the river. The turbine blades have rounded edges with a radius of approx. 2.20 meters x 6.00 meters. The distance between each turbine blade is 0.5 meters. A wire-rack with 45 degrees corners will be fitted in front of the turbine, and the distance between each lattice is 10 cm.

Only fishes that are less than 10 cm can enter the turbine through the bars, but will pass through the turbine without getting pinched since all moving parts and construction have distances greater than 10 cm. Currents will pass through the turbine at the same speed as the river flow speed. This will cause only small turbulences in the water. Small-scale tests show that this water turbulences are eliminated naturally after 80-100 meters. The turbulences should not affect river speed or direction noticeably.
**Biodiversity:**

In terms of vegetation, there is a minimal physical intervention on the riverbed. Only mooring will affect the riverbed, but the area utilized is considerably small.

**Ship traffic and fishing:**

Boat traffic in the fairway will not be hindered in the operational phase. However, fishing, diving, anchoring, etc. in the safety zone should be prohibited. The safety zone is 50 meters in front of the turbines and supplies water to the turbines. This zone will be adjusted in consultation with the Lithuanian Inland Waterways Authority.

During installation, there may be temporary restrictions on vessel traffic, but the relevant authorities and stakeholders should be able to coordinate this.

As stated earlier, the plant will occupy a small area, and thus should not be an obstacle to both fishing and ship traffic.

**Effect on water flow conditions:**

As the turbine moves linearly due to water inflow, pressure is generated around the turbine blades. The result is a more even distribution of power transmission to the hydraulic pump and moderate local turbulence in the water. This turbulence will be interrupted by the mounted grid and will go back to the normal current quickly. The output of energy is low overall and thus the river’s water flowrate and temperature will not be affected noticeably.
**Outdoors:**

The area is believed to be used for fishing and outdoor activities. The installation will however be placed far enough from shore so that it will not conflict with fishing from shore. Due to signage and labeling there is not expected to be any problems with mooring or fishing from boats. For security reasons, diving is prohibited in a safety zone around the plant.

**Onshore container:**

Onshore container should be covered with wood so that it looks like a small cottage or a boat garage/housing.

**Pollution and Waste:**

Deep River’s flow-through turbine is supplied with a hydraulic transmission system for power transmission. The hydraulic pumps are built inside watertight bulkheads. Hydraulic oil is replaced with glycol as pressure liquid. Glycol or similar non-toxic oils are used in underwater structures to minimize pollution in case of a leak. Security pressure-valves will minimize the amount of liquid spilled. All bearings in construction are water-lubricated ceramic or composite bearings. This is to prevent small oil spills, which is common under any marine operation.

**Noise:**

With the exception of marine operations, the plant will not cause any noise during operation.

**Conditions on land:**

The installation process does not require new docks, roads, etc. Consequently, the installation has little or no impact on local infrastructure.
**Cultural Heritage:**

The cultural heritage of the area is currently unknown. This will be investigated further and any finds will be taken into account before installing the plant.

**Marking of the unit:**

The plant will be marked in consultation with and subject to the LITHUANIAN INLAND WATERWAYS AUTHORITY’s requirements.

The area will be marked with signs with warnings such as "**high voltage danger**," "**diving forbidden**" and "**anchoring prohibited**". The location of the turbine will be reported to local authorities, ensuring clear mapping of installations. The turbine will be marked with four red buoys.

**INTERESTED PROPERTY AND COPYRIGHT HOLDERS:**

Because the plant will be placed close to the riverbed, at about five meters depth, landowners along the riverbank may, to a small extent, be affected by the installation. If this happens, there shall be a negotiation between interested parties before installations take place.
ATTACHMENTS

Attachment A
2-as profilis

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Pavadinimas ledenelio pobūdžio žemės vandens lygis 1993 m. -57 cm

Žemės vandens lygis susidariusis šie skirtingai 2009 m. -72 cm

Žemės vandens lygis 1993 m. -120 cm

$KK_2$

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