DOWNSTREAM FISH MIGRATION ALONG THE LOW MEUSE RIVER

Action C2

Installation of a pilot behavioral barrier and downstream fish pass at pilot site 1

Deliverable – On site installation report

Révision				
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I. Introduction

Based on the extensive experimental findings available in the scientific literature and operational testing in the field and in the lab, the solution chosen for the LIFE4FISH project is a bubble curtain.

Submerged air bubble curtains form a linear barrier used to control the movements of fish and direct them away from hydropower plant. The barrier comprises a pipe pierced with holes and positioned on the bottom of the channel. Compressed air is forced into the pipe, creating a bubble curtain that discourages fish from crossing. By installing the bubble curtain in a strategic location at intake channel, it is possible to redirect the fish to the dam.

The effectiveness of this technology, if demonstrated at the Meuse pilot site, could be harnessed for diverting fishes from the water intake channels at hydropower plants and any other waterways that have an impact on the migratory movements of the species in question (canals, industrial water intake channels, etc.).

The behavioral barrier will be placed upstream of the power plant at the entrance to the water supply channel in order to divert the fish toward a properly calibrated pass.

II. SITE PREPARATION

II.1 Supplier selection

The supplier selection was done on February 2019 according to several requirements:

- **Biotechnological criteria :** barrier efficiency / barrier location / project compatibility.
- **Price criteria :** purchasing price / purchasing conditions.
- **Technical aspect :** specific design adapted to the site.
- **Project management :** Site preparation and site follow-up.
- **Security aspect :** Risk analysis / Material choice.

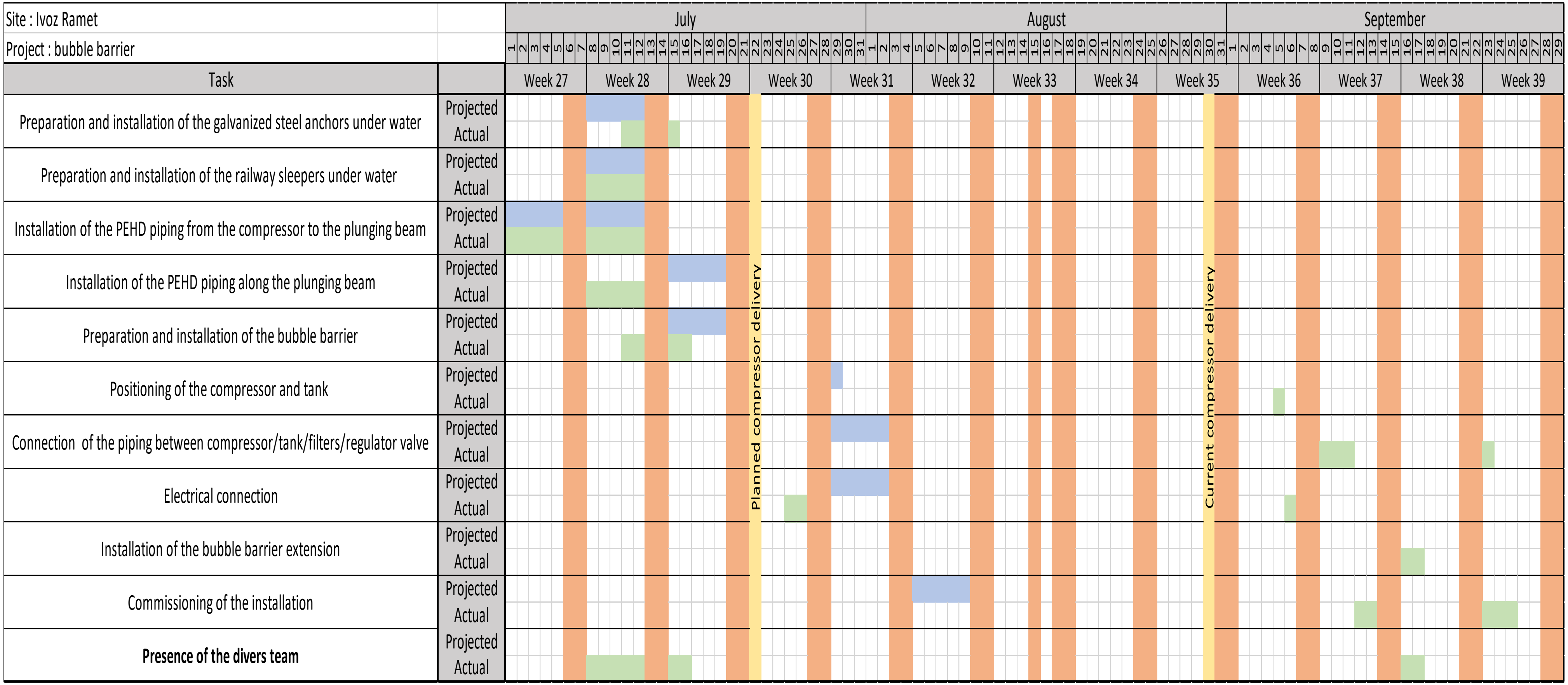
APUMAS had an overall score of 6.81/10. Despite non-existent barrier efficiency in literature, we decided to test this technology with bubble curtains. With the configuration of the Ivoz Ramet site, the bubble barrier seemed the most appropriate. In terms of purchasing price, APUMAS was the cheapest and was the only one to offer a bubble curtain deterring fish from swimming past the bubble wall. The price includes only the supply of the equipment, no human services are provided.

II.2 Supplier scope

Three suppliers worked for the bubble barrier project.

- Apumas: In charge of supplying the equipment: Compressor 55kW (3*220V) – Steel tank – Filters – Torpedo hose 51m – Bubble pipe 199m – Connection and accessory.
- Meca fluid: In charge of the supply and the installation of piping: PEHD 90mm (160m) – PEHD 50mm (100m) – exhaust valve – 2 isolation valves –2 control valves. Connection between compressor, steel tank and filters.
- Hydroscaph: In charge of underwater work: preparation and installation of anchorages (concrete bloc) – preparation and installation of the bubble barrier.

II.3 Projected scheduled and actual scheduled



II.4 Financial aspect

Total costs	**TOTAL (HTVA) € : 160 513,75**

III. PROJECT REALIZATION

III.1 Security aspect

At Luminus, security is the most important. The safety rules must be applied by employees, suppliers, subcontractors. To ensure the safety of the site, the worksite manager provided the necessary documentation for the good progress of the works: work permit and risk analysis. The risk analysis is written by the company performing work. This document is approved or completed by the worksite manager, the work permit is written afterwards.

The main risks are related to the fall of a person into the water. Several solutions were implemented to make the workers as safe as possible. First at all, we placed a lifeline on the plunging wall to secure the area. Along the bank we used a temporary lifeline connected to two vehicles. All work areas are marked out. Wearing the lifejacket is mandatory close to the water if the lifeline is not used.

Every morning, the site manager gives the safety instruction and signs the work permits. To ensure maximum safety, the Ivoz Ramet's hydropower plant is shut down during the works.

We have provided railings for the maintenance of valves and the exhaust valve. The use of a duckboard facilitates the maintenance of the exhaust valve.

The installation of the bubble barrier requires the intervention of the divers. Diving work involves stopping the turbines. We were used to working with divers, our operators are aware of the risk associated with diving.

Figure 1 : Lifeline on plunging wall

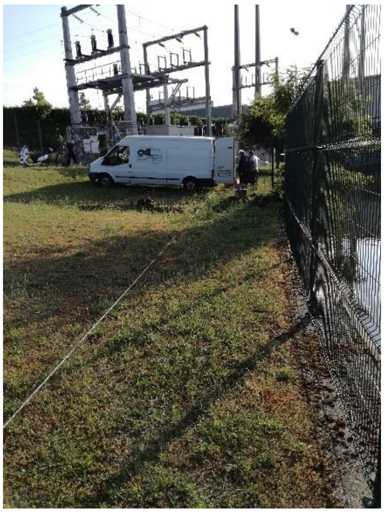


Figure 2 : Lifeline connected to vehicles

Figure 3 : Work areas

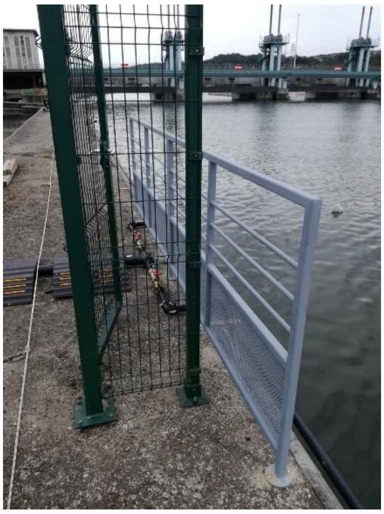


Figure 4 : Railings

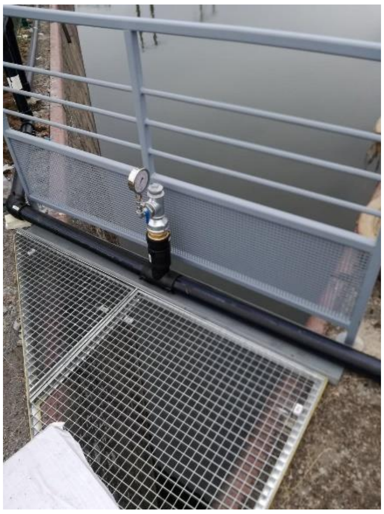


Figure 5 : Duckboard

Figure 6 : Piping passage

III.2 Power supply

The power supply works are insured by New elec. They set up a circuit breaker and a cable with 100m length (3*220V). They do the connection between the compressor and the cable 4*220V. They use existing cable trays and they put a new one next to the compressor. The power supply area is secured by a steel protection.

Figure 7 : Circuit breaker

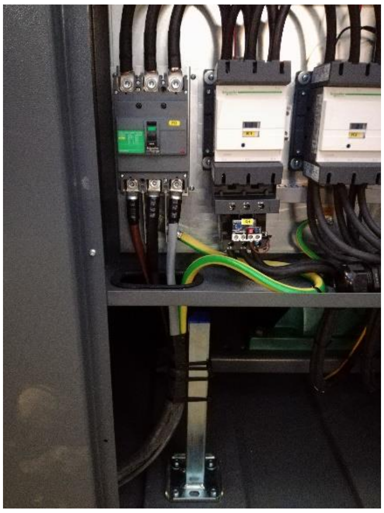


Figure 8 : Compressor electrical connection

Figure 9 : Power supply protection

III.3 Receipt and connection of equipment (compressor, tank and filters)

Unfortunately, there has been a delay in delivery in particular for the compressor delivery. The compressor was delivered on august 30th. The HPP 's bridge crane was nonfunctional so we ordered a truck crane to move the compressor and the steel tank. Equipment were unloaded to the ground with the truck crane and were put in place with a pallet truck. The elements (compressor, steel tank and filters) are positioned to facilitate maintenance. All the elements of the compressor are reachable. The assembly is supported by Mecafluid. PEHD and hose pipe are used to perform connections. An automatic purge is placed under the tank because the steel tank will be filled with water daily. The purge is powered by the 24V output from the compressor. The evacuation of dirty water is rejected on the stairs to the Meuse. A safety valve and a manometer are set up on the steel tank for maintaining the security.

Figure 10 : Equipment location

Figure 11 : Automatic purge

Figure 12 : purge discharge

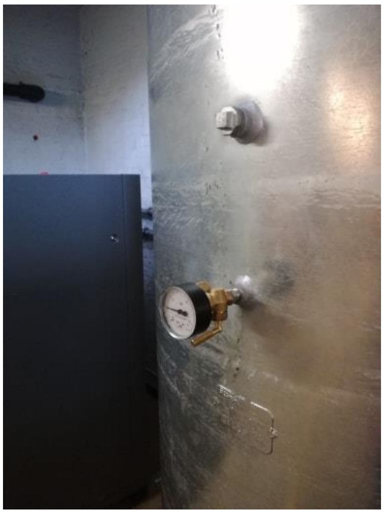


Figure 13 : Manometer

Figure 14 : Filters

Figure 15 : tank connection

III.4 Piping connection

Meca fluid is in charge of the supply and the installation of piping. We use HDPE pipe with electro-welded connections. We chose this type of material because it is easy and quick to set up.
If the effectiveness of the bubble barrier is proven we will invest on a way to protect the pipe especially against UV. The HDPE pipe has been raised for the passage of UV protection. Aluminum clamping rings used are not tight to allow the pipe to move in the hose clamps.

Due to the length of the pipe, we noticed a strong dilation. Expansion loops is recommended to compensate for thermal expansion and contraction. With a length of 160 meters, three expansion loops are used.

The compressor being inside the hydropower plant, two drilling cores were made for the passage of the pipe. The main difficulty of the drilling is the presence of electric cable behind the concrete wall. Mecafluid used a company specialized in coring in order to avoid an accident.

One part of the pipe is fixed on the bridge, we used a basked to secure the personnel.

The installation includes several accessories (total clean-up, exhaust valve, control valve). The map details the position of the accessories.

The bubble curtain under the water is composed of two curtains. One fed by the upstream and the second by the downstream.

Metal legs have been fixed along the plunging wall to support the pipe feeding the downstream of the bubble curtain. Compensators are installed along the HDPE pipe to limit expansion. Blocks valves are located at the upstream and the downstream ends of the plunging wall.

Figure 16 : HEPD pipe 90mm 50mm

Figure 17 : Expansion loop

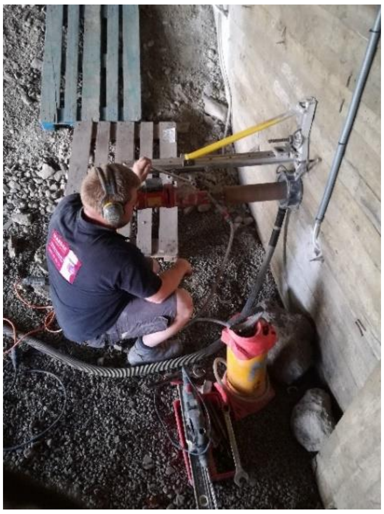


Figure 18 : Drilling equipment

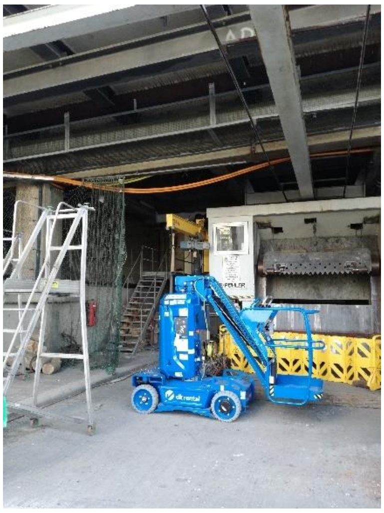


Figure 19 : Basket

Figure 20 : Metal legs

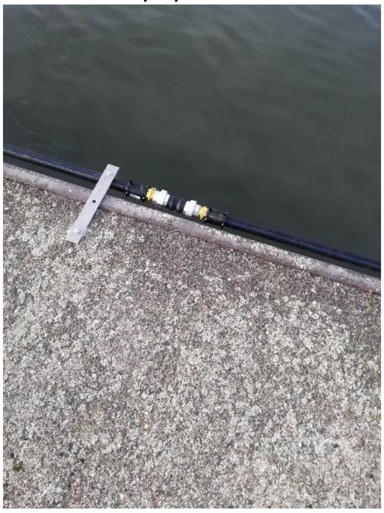


Figure 21 : Compensators

III.5 Anchor preparation

We used railway sleepers as anchors. Prefer company provided us these concrete blocks. We made the mounting part to connect the bubble barrier to the concrete blocks.

Hydroscaph was in charge of the assembly. They drilled the railway sleepers and they fixed the mounting parts. In total, 6 railway sleepers were used. The removal of concrete blocks is provided by a truck crane.

Figure 22 : Railway sleepers

Figure 23 : Mounting part

Figure 24 : Truck crane

III.6 Aquatic works

The first job did by the divers was the positioning of the railway sleepers. Based on the layout plan provided by Luminus. To lift and move the concrete blocks into the water, divers use parachute. They use referenced strings for positioning. We decided to set up the bubble pipe at 5 meters from the plunging wall. We thought that at this distance the bubbles would not pass under the wall. We were wrong.

Divers fixed 4 metal parts on the concrete wall. They are used to attach the torpedo hose. The 2 metal parts closest to the bottom are used as anchor points for the bubble barrier. One of the metal parts (downstream) is welded on the sheet piling.

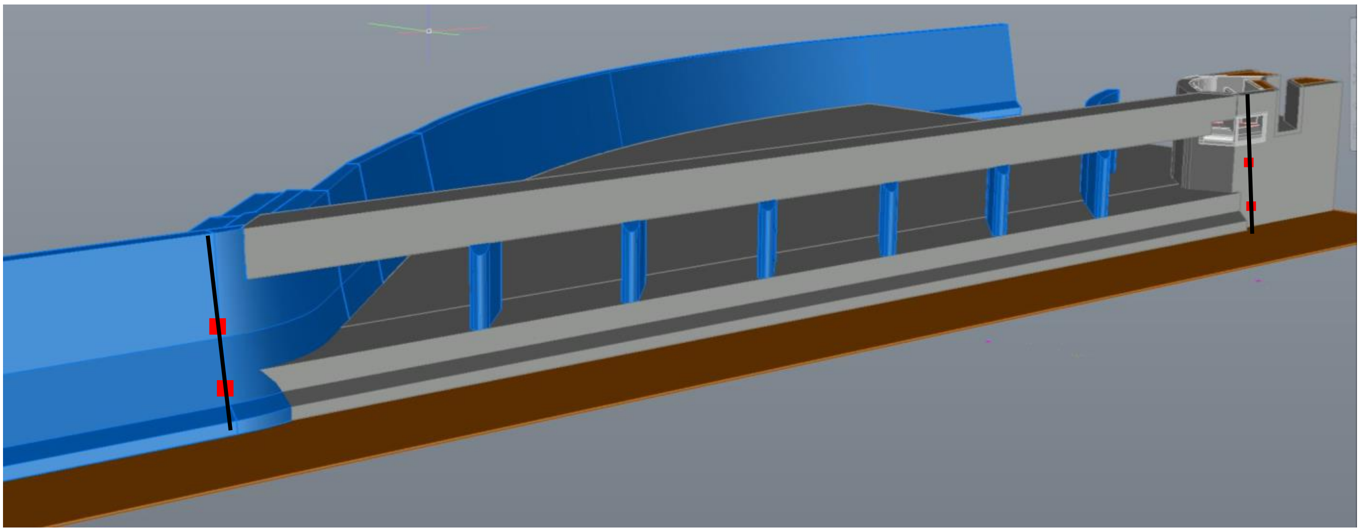


Figure 25: Four metal parts and Torpedo

Outside the water, we prepared all the connections (2 connections between Torpedo and the bubble pipe and a connection welding between bubble barriers).

Divers used a cord to mark the exact position of anchors on concrete blocks.

We uncoiled the bubble pipe on the quay. We extracted the steel cable at the landmarks' cord used by the divers before. To prevent slipping of the steel cable into the rubber, we made a loop with the steel cable and a cable clamp. Then the bubble barrier is carefully and slowly lowered into the water to avoid a tear. All connections are made under water by the divers. During the test pressure, we have detected a leak on the bubble curtain, divers plugged it with a steel pipe.

After the first phase of commissioning we noticed that the bubbles rise to the surface near the plunging wall. Only one turbine was operating. We decided to change the positioning of the barrier from 5m to 10m. We ordered an additional distance (30m) of bubble hose from Apumas. After discussion with the divers, the best solution was to place the addition upstream of the barrier. For the connection between the new and the old hose, we used galvanized cylinders and clamps. Moving the barrier in place was difficult for divers (concrete blocks and bubble barrier). The downstream part of the barrier is the most prone to fouling. We believe that over time this part will be the most difficult to release from waste. Divers noticed leaks at the fittings. They have been changed or tightened.

Figure 26 : Concrete block positioning

Figure 27 : Parachute

Figure 28 : Metal part

Figure 29 : Torpedo and bubble pipe connection

Figure 30 : Bubble barriers connection

Figure 31 : Bubble pipe cutting

Figure 32 : Extract the steel cable

Figure 33 : loop and cable clamp

Figure 34 : Bubble barrier ready to go down

III.7 Commissioning

Commissioning took place on September 12th.

After checking the whole installation (purge, manometer, safety valve, filters) we put the circuit breaker down and we started up the compressor. No leaks were detected in the pipping system, the purge solenoid valve works) .

Two parameters are calibrated in the compressor (Low pressure: 6.4 bar – High pressure: 7.5 bar). However, the bubble tube can only support 4.8 bar. We asked to Mecafluid for a quote to add a pressure regulator to obtain a maximum pressure of 4.8 bar. The price indicated in the quotation is around 500€. The pressure regulator was added on September 23th.

During the first test, a connection did not hold under the pressure provided by the compressor. We called on the divers to repair the connection. We think that the connections between all the elements will be the most constraining on the durability of the installation.