DOWNSTREAM FISH MIGRATION ALONG THE LOW MEUSE RIVER

Action C1

Operation report of the electrical barrier and the exhaust path during 2021 migration periods

Deliverable – Operation report during 2021 migration periods

Révision				
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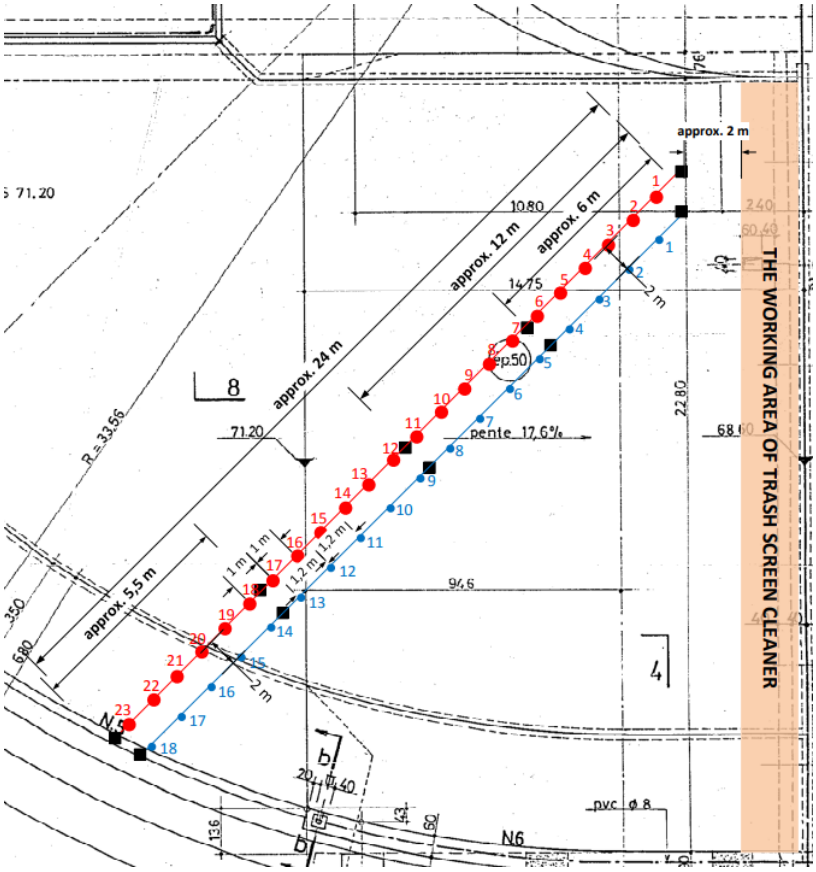
I. Introduction

Following the selection of the electrical barrier solution at the Grands-Malades pilot site, the commissioning of the solution took place in October 2020 for the smolts barrier.



Positioning of the smolts barrier

Two submerged chains formed a parallel linear line and on this line electrical to which an electric cable and electrodes are attached. It's used to control the movements of fish and direct them away from hydropower plant. The barrier comprises two verticals rows of positives and negatives electrodes in order to create an electrical field. The objective of the barrier was to redirect the fish to the dam. This first electrical barrier was designed to influence eels behavior and is placed at the entry of the channel.

II. Smolts migration

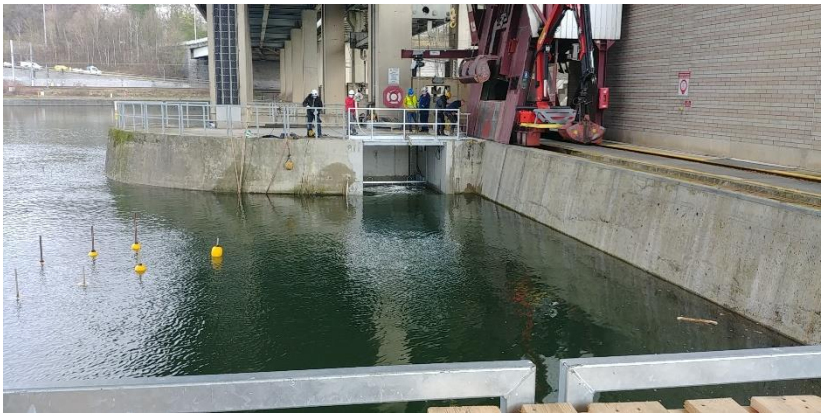
During the spring 2021, the salmon smolts begin their migration to the north see through the Meuse river. The main biologic parameter is the increase of temperature in the river. Therefore, the smolts have to pass the obstacles in their way such like dam, lock and hydropower plant.

As the smolts follow the water flow and swim close to the surface, they can be attracted by our turbines. The objective of the barrier was to create an electrical field in front of our turbines and direct them to an exhaust path construct in 2021. It's why we had to combine the electrical barrier and the outlet, a sort of a big pipe, to allow the smolts to go around our installations without any arm.

The system is powered by an electrical cabinet on the river bank.

The two rows of electrodes

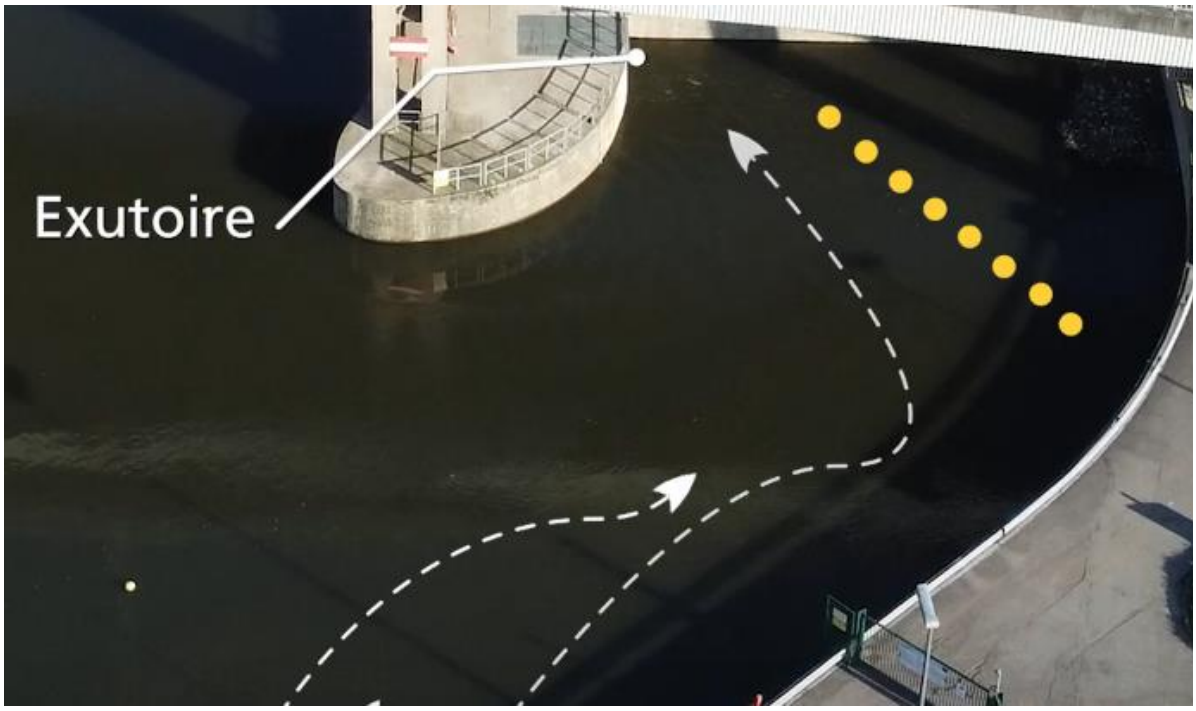
The electrical cabinet



Entry of exhaust path

Exit of exhaust path

During the migration period of the smolts we switched on the system. The monitoring was made by Profish and is the object of another report.



Smolts are redirected by the barrier to the exhaust path

III. Trashes issue

Due to the high flow rate of the Meuse and the positioning of the outlet in the flow line, we catch all the debris. This confirms the good functioning of the outlet but unfortunately creates a major waste management problem.

The grid into the entry of the exhaust path was blocked quickly. The water flow was weak and the amount of trash could create passage problem for the smolts. In less than 12 hours we have recorded decrease of 50% of the water flow.

Grid full of trash

The trash decrease the water flow

Regular water flow

Water flow reduce by trash

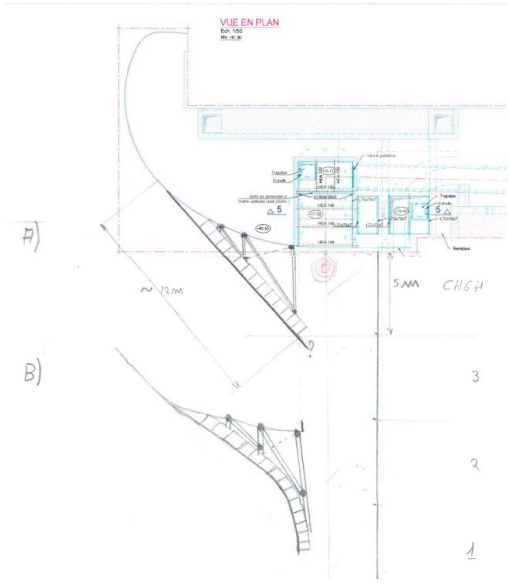
Nevertheless, the system once again proved its effectiveness as the largest floating trashes passed over the barrier without damaging it. To reduce this problem, the partners thought about many options.

III.1 A floating drome

A) Straight blade solution

B) Curved solution

- Advantage of the drome, it adapts to the height of the river automatically.
- Disadvantage, being long, floating and fixed in the banks, it could easily be destroyed by the biggest floating trashes and get caught in the power plant installations.



Sketch with 2 variants (A & B).

III.2 Metalic blade

We decided to install a blade of 20cm during the downstream migration at the entry of the outlet to block the trashes in the water flow in front of the turbine. This solution was design with the help of ULiège and Profish to allow the passage of smolts.

Metallic blade at the entry of the outlet

During the entire smolts period our agent and the employees of Profish had to clean the grid at least two time per day, day and night. Nevertheless, the system hold during the monitoring and didn't block the smolts.

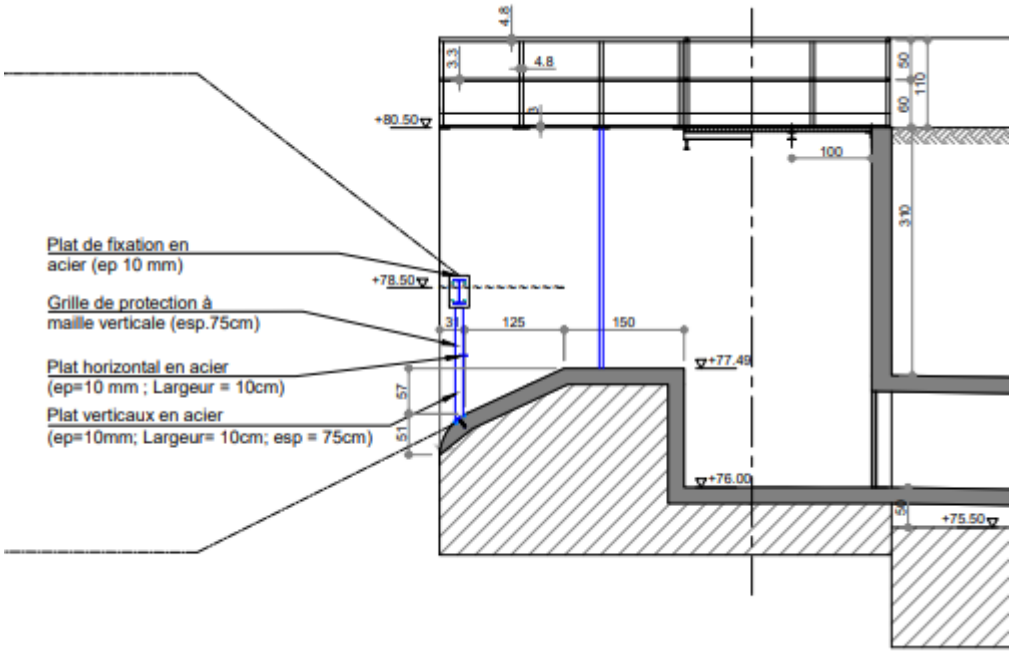
Unfortunately, with the important water flow and the actions of the turbines a whirlpool was created in front of the outlet and the waste went under the blade. Moreover large trunks have damaged the blade and sometimes lifted it. The blade didn't resist after the migration period. The electrical barrier was also damage because, a float from on the second line of electrode has been detached due to the trashes and water flow.

The blade couldn't resist to trunks

Yellow float from the electrode

With the partners we worked on a new system of grid and blade more resistant and it will be installed in 2022 in order to reduce the problem without any impact on the smolts migration. The cost of this solution will be in charge of Luminus and not put on the Life. This shows that we want to make the investment sustainable.

This grid shall consist of vertical bars 10 cm wide and 10 mm thick spaced at 75 cm intervals. These vertical bars are completed halfway along the length by a horizontal bar 10 cm wide and 10 mm thick.



Schematic of the grid

III.3 Damage during the monitoring

Moreover, the trashes caused many troubles during the monitoring made by Profish during spring migration. They placed a net at the exit of the outlet to capture smolts after their passage into the pipe. Unfortunately many trashes did the same and after few days, Profish had to repair the net many times. We had to stop the groups for an hour to secure the equipment and the Profish team.

Net and platform

Profish's team working on the plateform

IV. Issue regarding the valve

In order to control the activation period of the outlet and allow maintenance operation, a valve has been installed at the entry of the pipe. It is also useful to cut off the flow and allow the operators to clean the trashes screen at entrance. This valve is manual and requires an operator to open and close it. Luminus has decide to motorized this valve. The cost will be fully supported by Luminus.

The section of the valve was smaller than the diameter of 1.20m and the hoist was too weak (500 kgs) to close it. We had to use a crane (1.5 t) to close and open it. Due to the supply of material, the gate was managed during the 2021 migration without impacting the results of the downstream migration.

Hoist of the valve

In addition, the valve could not close all the way. The gasket had to be replaced because it was not positioned correctly and was letting water through. It could be replaced by the subcontractor before the start of the downstream migration.

Valve at the outlet entrance

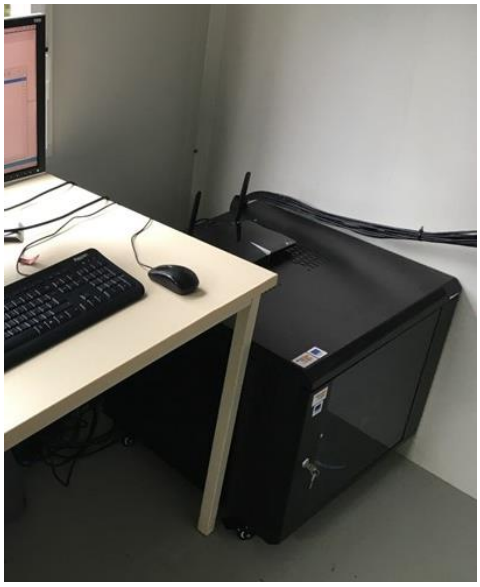
Valve gasket is not positioned correctly view 1

Valve gasket is not positioned correctly view 2 **Valve gasket is not positioned correctly view 3**

V. Fish counting system

To facilitate the monitoring of individuals passing through the outlet, the partners wanted to test a prototype system used by EDF R&D. This prototype consists of five elements.

1. The acoustic barrier (here 6 cords which can go up to 8, that is to say 16 sensors in emissions/receptions)
2. A camera and its associated infrared lighting
3. The 19' rack of acquisition and acoustic detection (it records the acoustic data and a video sequence for each acoustic detection)
4. The workstation: it saves the detections, the videos and does the processing in real time
5. A 4G modem that allows to control the system remotely and to watch the detections in progress



The acoustic barrier and cameras on a site in France **Control and analysis system**

This system had obtained good results during laboratory tests and a preparation had been initiated in the outlet of the plant.
However, the strong disturbances caused by the water flow and trashes in the outlet did not allow the EDF R&D teams to guarantee a successful test. The costs for men and equipment and the risks made that the meter was abandoned.

We finally used two RFID antennas to detect fish, one at the entry and one at the exit. The idea was to install it for a long period but the water flow and the presence of many trashes didn't allowed to let it in place.

VI. Water blades

As the smolts swim close to the surface, the partners tested a water blade on the dam. In collaboration with publics authorities, we tested to open the upper part of the dam gate closest to the site of Ivoz-Ramet, Monsin et Lixhe. Four methodology were tested : 20 cm, 50 cm, 90 cm and 90 cm offset. No problem occurred and it's the subject of another report.

VII. Damage on the smolts barrier

Few weeks after the end of the smolts migration we had the sent the divers inspect the second row of the barrier due to a signalment of the operators of the powerplants. The pipe of 7 meters was twisted on the 2.5 meters. The trashes probably laid down the electrode until the trashes cleaner and during the cleaning of the powerplants grides the crane damaged the electrode. Diver team finally replaced it.

Electrode number 5 twisted probably by the trash cleaner

VIII. Communication Neptun System

To pilot the barrier remotely, PROCOM created an application that we can use on our computer, the NeptunTool system. Unlike the eel barrier, the smolt barrier has only one section.

Luminus' security requirements force us to use an external network. That's why a router has been installed in the cabin to allow us to have a signal linking the barrier, Procom and Luminus.

During the test before the migration, we had some communication problems between the barrier and the application which were promptly corrected by PROCOM.

NeptunTool System

Error on the electrical cabinet

IX. Eel barrier inspection

During the preparation of the spring monitoring, we also organized an inspection of the eel barrier. Indeed, from the river bank, we could see that some electrodes were no longer visible. Some were stuck by rolling trashes in the bottom of the river.

The last electrode, the closest from the mole, was damaged by trashes or waterflow. It was only maintained by the blue electric cable and not any more by the white ertalon part. The diver team removed the broken piece and replaced it by a new one. After this incident we asked to Procom to send us more spare parts.

Ertalon intact before installation

Ertalon breaked

X. Conclusion

Due to trash issue in Meuse, the outlet needed a daily attention to maintain the water flow in the outlet and follow the status of the barrier. Nevertheless, quick reactions of the teams on site allowed us to conduct the test for the period.

In consequences, we had many troubles and the maintenance during the operations took a lot of time and resources. We will take actions the reduce the issue by the installation of a new grids at the entry of the outlet without any impacts on the migration. Furthermore, during the floods of July 2021, despite the extreme flows, the system held. On the river we recorded 1900 m^3/s.

Despite all this issues, we had good results of the monitoring for the electrical barrier, the outlet and the water blades.