

**MAYENNE RIVER  
CASE STUDY**



NUMBER OF POWER PLANTS	16 in cascade
NET HEAD	1.6 m up to 2.4 m (5.25 ft up to 8 ft)
NOMINAL FLOW	13.5 m <sup>3</sup> /s (476 cfs)
NOMINAL OUTPUT VLH (at grid level)	200 kW & 260 kW
AVG ANNUAL PRODUCTION	16 GWh/year equivalent to 1.6 M €/year
OVERALL INVESTMENT COST	16 M € for the complete HPP
SIMPLE PAYBACK	10 years

The Mayenne River has been used for navigation and commercial purposes since 1860 when numerous navigation locks and dams were constructed. In the 1960's the 40 km (25 mi) long reach of the river between Mayenne city and Laval, which has 16 dams and locks was developed by EDF utilizing siphon type, fix blade Kaplan turbines. Developed heads vary between 1.5 and 2.76 m (5 and 9 ft).

In 2007, 50 years after the initial installation of generation, SHEMA (a subsidiary of EDF), undertook the redevelopment of the hydropower scheme, starting with the Moulin Laroche site – Phase 1. This was followed by further refinement of the concept at l'Ame – Phase 2, then a commitment to the remaining 14 sites between 2013 and 2015 – Phase 3. This process of refinement and co-operation with MJ2 is described below.



Typical layout of an existing Mayenne HPP with a Siphon Kaplan installed in parallel with a navigation lock

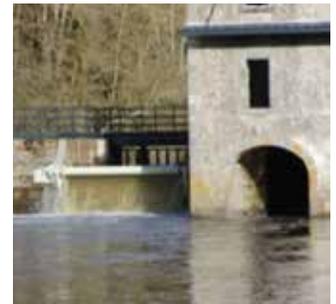
**Phase 1: Upgrading of the Moulin Laroche Dam Site**

In 2007, SHEMA, decided to install a VLH turbine at the Moulin Laroche site. SHEMA's intent was to verify that the new turbine concept would meet the expectations of the different stakeholders involved in the management of the river, fisheries, existing residents, tourist activities, and navigation authorities, while improving the electricity production at the site.

The power plant was commissioned in December 2008, and since then it has operated beyond expectations.



Upstream view of the renewed ancient Mill



VLH in working position almost invisible

**Phase 2: Upgrading of l'Ame Site with MJ2 Gate System**

With the success at Moulin Laroche, SHEMA, in continued collaboration with MJ2, modified the application for the redevelopment of the l'Ame lock and dam site. The modifications included the addition of a set of hydraulic gates upstream of the VLH.

These gates were specifically designed by MJ2 to easily dewater the VLH turbine water passage while preserving the visual integrity of the valley. The gates are completely submerged and when coupled with the VLH the result is a completely submerged generating facility, which eliminates any visual impact.

The l'Ame modifications demonstrated the viability of the concept to SHEMA and the environmental stakeholders, which resulted in SHEMA's decision to redevelop the remaining 14 sites with similar equipment.



Upstream Gates Closed



Upstream Gates Opened



### Phase 3: The Completion of VLH Installations on the Mayenne River

In 2010, SHEMA received a 40-year water authorisation for the purpose of power production at the remaining 14 Locks and Dams. With the water rights in place SHEMA went to MJ2 and civil work firm EIFFAGE for a proposal to undertake the redevelopment of the remaining sites. The investment decision was made in 2010 and a contract was signed for a staged redevelopment of the remaining sites between 2013 and 2015.

### Improvements and New Benefits through Redevelopment

For many years, the Mayenne River was identified as a place where the installed hydropower schemes were a potential source of mortality for downstream migrating silver eels. Installing VLH turbines, with the third and fourth generation fish friendly hydraulic profile allows downstream migration of fish without impact.

As part of the project, SHEMA constructed 16 fish ladders, which

will allow upstream migration. These fish ladders were installed under the approval of the fisheries administration (ONEMA). The result is the safe upstream and downstream migration of silver eels due to the redevelopment of this reach of the Mayenne River 16 small HPP.

The VLH technology will eliminate visual impacts and annoying noise through use of submerged equipment (turbines and gates). The result will be a river system that will almost look like it did in the 19th Century, when the locks and dams were built.

The previous turbines, which were installed in the 1960's, had an all or nothing unregulated water management scheme utilizing the outdated siphon turbines. This resulted in water level control issues for navigation, flooding and fish habitat. The new water level regulated VLH installations will maintain stable river levels. This will result in a considerable improvement of fish habitat and it will eliminate recreational navigation issues on the River.

Finally, replacement of obsolete equipment with new higher efficiency machines, will double the energy production of the river scheme.

In conclusion, the sustainable development of the Mayenne River utilizing VLH turbines considers the environment (fish, flow regulation, visual impact), social aspects of human activity along the banks of the Mayenne River (navigation, walking and sporting activities, tourism, fishing activities) and economic redevelopment of fully renewable energy (hydropower).

