

**HYDROMATRIX®**  
Nussdorf - Austria



# HYDROMATRIX®

## Hydropower plant Nussdorf - Austria

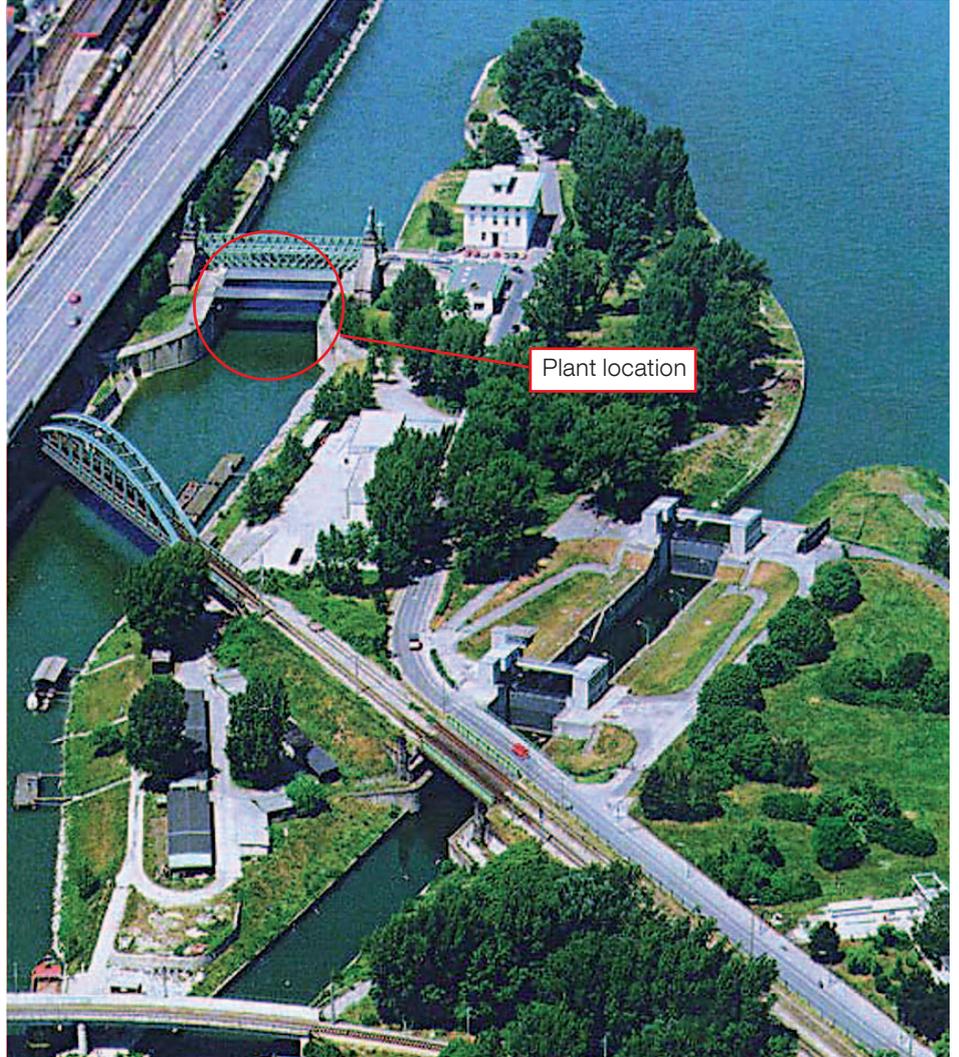


### The Schemerl weir

Two main events took place from 1870 - 1875: the extensive regulation of the Danube and a re-development of the intake to the Danube Canal in Nussdorf.

In 1872 the so called „Swimming Gate“ was designed by Wilhelm von Engerth, a member of the Danube Regulating Commission, to control the inflow to the Danube Canal and for ice defence.

In 1898 the “Swimming Gate” was replaced by a movable weir (“Schemerl weir”) with a width of 30 m together with a ship lock. The architectural design of the weir and the administration buildings was accomplished by the well known architect Otto Wagner. Because of the high creative quality the ensemble is preserved as a historical site. Due to the improved flood control a reconstruction of the ship lock was achieved in 1964 – 1966 and in the years 1971 – 1975 the original needle weir was replaced by two radial gates. By doing this, the total flood control scheme for Vienna was taken into account which allows to softly discharge up to 14,000 m<sup>3</sup>/s.



### The weir operating scheme

The regulation of the Danube Canal is accomplished by the weir and in winter operation by the ship lock. The discharge values are regulated in the valid operating scheme for the Nussdorf weir and ship lock.

Basically it is differentiated between summer (April through November) and winter operation (December through March). The current operation scheme provides a continuous flow of 70 m<sup>3</sup>/s during winter and a flow of up to 225 m<sup>3</sup>/s during summer, depending on the water discharge of the Danube river.

During the winter months a uniform discharge range of the Danube Canal of approx. 70 m<sup>3</sup>/s is ensured by the upper gate of the ship lock (weir closed). During summer operation the discharge is ensured by the Schemerl weir, depending on the flow of the Danube (70 – 225 m<sup>3</sup>/s). In the case of flooding the flow is reduced until a complete stop of the dotation occurs, which depends on the water level of the Danube. Due to design reasons the flow through the ship lock is limited to 70 m<sup>3</sup>/s. In the forebay of the hydropower plant Freudenuau the water level in Nussdorf was raised by approx. 4 meters.

**The new Concept**

In the course of the implementation of the Danube power station Freudenau (1993 – 1997) it was envisioned to build a power station at Nussdorf to utilize the head resulting from the banked-up waters at the Schemerl weir for power generation.

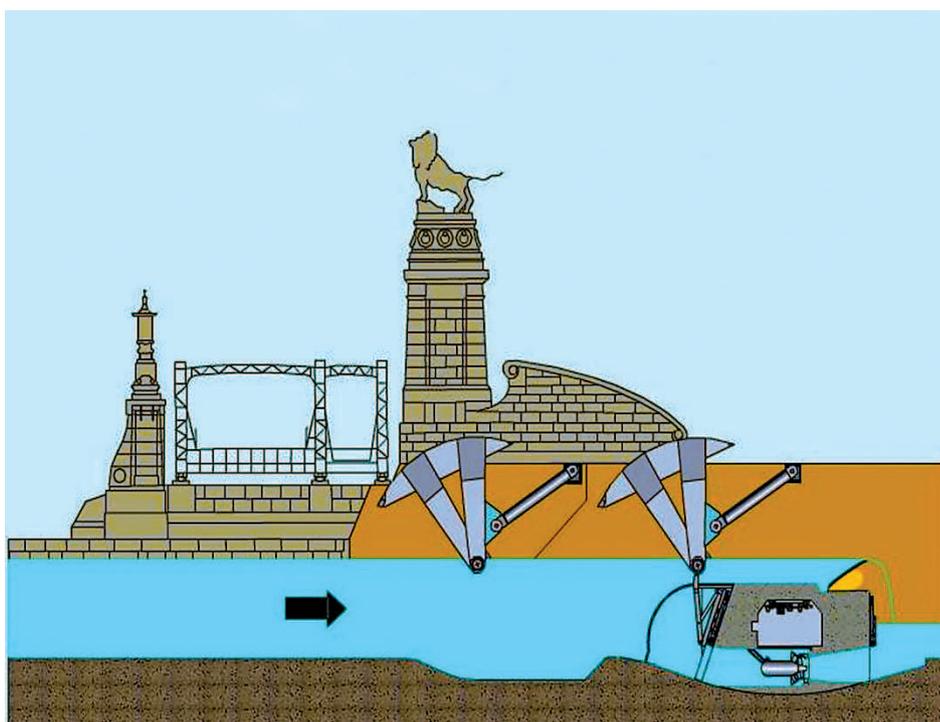
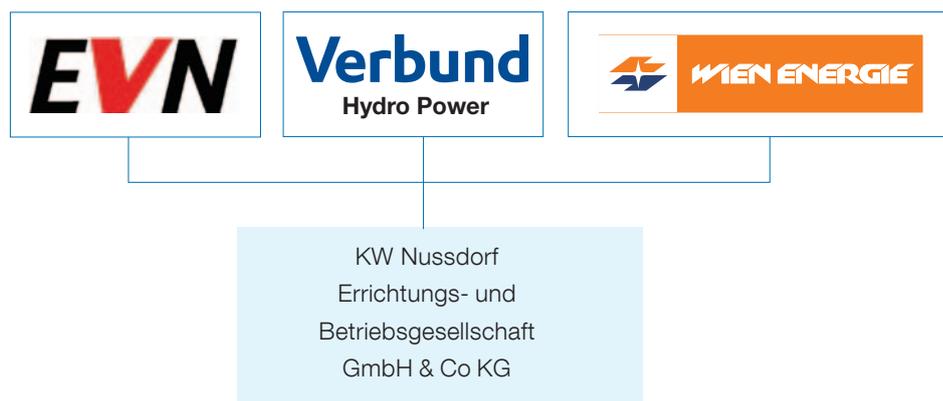
However, this project was not pursued for three reasons:

1. Due to the low power rates the projected investment costs were too high to assure an adequate economic feasibility.
2. The originally proposed alternative downstream of the weir was rejected for aesthetic reasons.
3. At that time there was no sufficiently developed technology available to implement turbines close to the weir.

The realization of the „Nussdorf hydro-power plant” project became economically viable only after the new „green power” legislation had been passed and the new HYDROMATRIX® technology became available.

VERBUND Hydro Power AG subsequently relaunched an initiative together with EVN Naturkraft and WIEN ENERGIE WIENSTROM to build a hydropower plant.

A major feature of the project was its careful integration into the existing Nussdorf weir building complex designed by the famous Jugendstil architect, Otto Wagner.



# HYDROMATRIX®

## The optimal solution



The new hydropower plant is located downstream of the existing Schemerl weir in the stilling basin of the lower radial gate.

The hydropower plant consists of a 30 m long, approx. 12 m wide and 7 m high overflow hollow body weir with attached spillway gates, twelve HYDROMATRIX® turbine generator units (TG-units) and an operation building.

For installation purposes an access pit is integrated in the operation building at the left weir bank. For this case the roof of the building can be partially opened.

The twelve HYDROMATRIX® TG-units can be switched on and off individually. The concreted draft tubes are equipped with gates. In order to enable the dewatering of each individual turbine chamber, each TG-unit has its own intake gate. The turbine chambers are closed with removable pressure covers.

The interior space of the overflow structure is equipped with a lifting gear on two rails. With this lifting gear the TG-units can be hoisted and laterally moved to the vertical access pit.

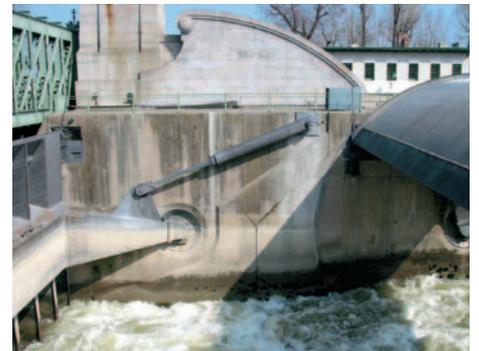
Cables run from the generators to the switch-gear which is located on the left bank in the operation building.

The building also houses all transformers and medium voltage cubicles, from where the distribution to the utility switchyard in Heiligenstadt takes place.

Each TG-unit is supported by guiding rails which are located at the intake of the draft tube.

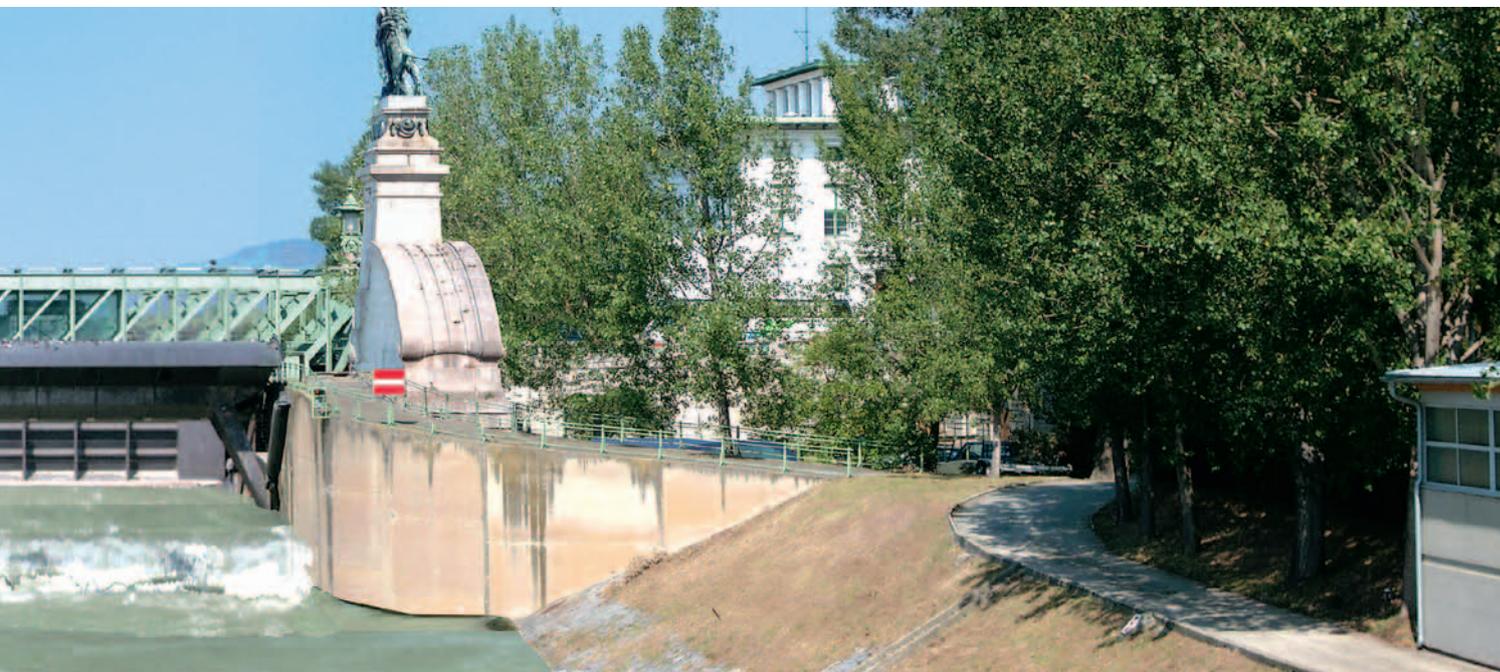
This arrangement allows easy installation and dismantling. In order to be able to adhere to the weir operating scheme at any given time, a spillway flap gate is installed on top of the overflow structure.

The spillway gate in combination with the flow through the turbine chambers ensures that the discharge per weir which is required by the operating regulation is released.



# HYDROMATRIX®

## TG-Units



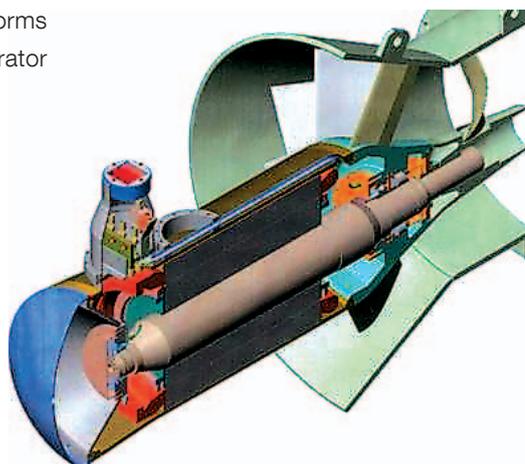
The TG-units consist of asynchronous generators, which are directly connected to the runner.

The stator has a watertight housing and bolted to the distributor. The guide bearing as well as the combined guide thrust bearings at the Tailwater side are designed as oil lubricated roller type bearings. For the regular oil change the turbine chamber can remain filled and the TG-unit does not have to be lifted.

The distributor with fixed guide vanes forms an integral part of the watertight generator

housing. The unregulated runner with its hub is cast in one piece made of aluminium bronze. The shaft seal is situated at the tail-water side and is designed as a maintenance free face type seal. It can withstand all operating conditions.

To ensure high efficiency, the hydraulic contour of the runner, the distributor and the draft tube have been developed and tested at the hydraulic lab of ANDRITZ HYDRO in Linz, Austria.



# HYDROMATRIX®

## The trashrack concept

In front of the intake of the TG-units a six-piece, circular arc-shaped rack is located.

The individual racks are fixated at the existing weir bottom and at the crest of the weir.

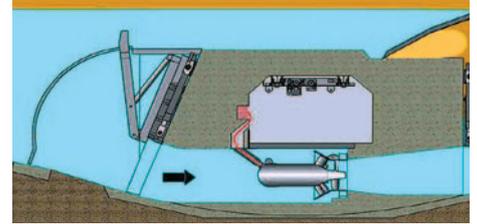
The debris drawn to the intake of the Danube Canal can be disposed or passed on in different ways depending whether the debris is accumulating in front of:

- one of the lowered radial gates
- the turbine trashrack
- the spillway gate

In the first case the upstream radial gate

is used as an immersing wall. Therefore the situation regarding debris in the area of the weir is similar to the original situation. The debris collected before the radial gate can be collected with a crane and truck as it has been done prior to plant construction.

Debris which is pressed below the existing radial gate either resurfaces or collects in front of the arc-shaped trashrack. Six integral trashrack cleaning machines are located on the downstream side of the rack and are therefore well protected. Floating debris will be discharged over the spillway gate. This corresponds to the original situation where trash was continuously discharged. Debris collecting at the spill-



way gate has to be removed in a procedure similar to the radial gate, by means of a crane and a truck. However this only affects a small quantity of debris since the majority is either collected in front of the radial gate or continuously flushed over the spillway gate. Therefore the expenses for trash retrieval are relatively low. Debris which is pulled to the surface by the cleaning machines is continuously flushed.



### Shut-off devices

The intake gates can be individually operated via hydraulic cylinders and allow complete isolation of the turbine chambers.

Dewatering of each turbine chamber without affecting the operation of the other TG-units can be accomplished by simultaneously closing the associated draft tube gates. The turbine chambers are separated from the manipulation room via pressure covers.

After lowering the intake and draft tube gate and dewatering the turbine chamber the pressure cover can be opened for maintenance work on the TG-unit. It is also possible to close the pressure cover without the TG-unit in place and to control the flow through the turbine chamber and the draft tube with the up- and downstream gate. Furthermore a pneumatically operated spillway gate is installed. The spillway gate consists of fabricated steel plates with stiffening ribs. The plates are supported by several fiber-reinforced rubber bladders which are actuated by using compressed air.

The position of the spillway gate can be changed by altering the pressure inside the bladders. The spillway gate is laterally sealed against abutment plates located at each side of the weir.



The sealing surfaces of the abutment plates are made of stainless steel and can be heated, which in conjunction with an air bubbling system upstream of the spillway gate prevents icing.

The design discharge of the spillway gate was set at 225 m<sup>3</sup>/s which allows compensating the shut down of three TG-units.

### The project structure

The contract was carried out by a consortium of ANDRITZ HYDRO, Porr Technobau and Verbundplan as consortium leader. Die HYDROMATRIX® plant started operation in summer of 2005.



### Technical data:

<b>Unit Output:</b>	545.7 kW
<b>Voltage:</b>	690 V
<b>Head:</b>	5.6 m
<b>Speed:</b>	336.7 rpm
<b>Runner diameter:</b>	1,320 mm
<b>Number of units:</b>	12
<b>Average yearly prod.:</b>	24.7 GWh

