Energy Recovery in Drinking Water Systems by Wiegert & Bähr turbine technology

(summary of the essay from our German website: Energierückgewinnung in Trinkwasseranlagen mit WuB Turbinentechnik)

In many drinking water supply systems the residual pressure at the pipe end is too high to feed directly into the storage tank. In the past mainly dissipation valves were used for pressure reduction. By these valves, safe operation of the systems was achieved, but the dissipated energy was lost.

With energy recovery turbines, the surplus pressure energy can be transformed into electric energy, and can be sold back to the grid. The benefit is a significant reduction of the total operating cost of the water supply plant. Reduction of operating cost is one point but on the other hand also the option to keep the water supply running even in case of a grid breakdown, becomes more and more important.

Independent from the kind of recovery the focus must be on a most reliable system for the safe supply of drinking water. An accurate investigation of the total system, mainly in terms of water hammer effects, is essential in the planning phase of each energy recovery project to chose the best suited turbine solution.

The following types of turbines and equipment are mainly used for energy recovery systems in drinking water supply plants:

- **Reverse Running Pumps** can be used for very small systems. They offer rather low efficiency only and their flow range is limited, but the profitability might be given due to the low investment cost by the series-produced pumps.

- **Crossflow turbines** are rather simple but reliable turbines. They are often used for energy production in systems of lower head, e.g. in raw water systems between storage pond and water treatment facility. They offer reasonable efficiency over a wide flow range but they need free discharge into the storage tank and cannot be installed into a closed loop pipe system with back pressure.

- **Pelton turbines** offer very high efficiency and they are first choice for high pressure applications. Pelton turbines cover the full range of power output from smallest installations of a couple of kW only, up to megawatt power stations. They need free discharge into a storage tank and can not be installed within a closed-loop pipe system. They do not cause water hammer and therefore they are preferred for very long pipe systems.

- **Francis turbines** offer highest efficiency (up to 93% and more) and they are suitable for the largest applications. They can be installed into closed-loop piping systems with back pressure at the turbine outlet. Due to their strict flow dependency from the turbine speed, installation with Francis turbines must be accurately designed especially in terms of speed and flow variations. Quick speed changes e.g. in case of grid breakdown could cause water hammer effects. To prevent from water hammer danger to the system, several precautions can be

taken, such as a flywheel to reduce the acceleration speed, or bypass valves to keep constant the total flow in the system.