Control- and Information System for wastewater pumping and distribution in Berlin

(LISA = Leit- und Informationssystem Abwasser)

Berliner Wasserbetriebe (BWB) Division sewage-works Cicerostraße 24 10709 Berlin

Table of contents

1.	History		3
2.	Sewage-system of the BWB before LISA		4
	2.1	System and operations	4
	2.2	Existing operations-optimum	5
3.	Central control of the sewage-system		6
	3.1	Operations-concept	6
	3.2	Advantages	7

1. History

The service and supervision of the Berlin wastewater pumping system has experienced diverse changes in the last 40 years.

Since the 1960's, a pumping-station-renewal-program was implemented in the western part of the city, that intended to automate 55 pumping stations until then operated mainly by hand and to concentrate the control and operations in main pumping stations.

With the start of operations of the renewed pumping stations Bln IX in 1998 and Wilmersdorf in 1999 the completion of the program and with it the concentration on seven main pumping stations occupied by personnel (Zhl, Stg, Chb, Wil, Spa, Wit and Krb) was reached.

The high stand of the automation-technology (programmable logic controller) as well as the control- and supervision-technology (LSX) allowed for a continuously personnelminimization in the operation of the pumping stations, which was realized in 1996 with the introduction of the new operation- and personnel-structure in the western part of the city.

Parallel to this the wastewater pumping system as it was applied in the western part of the city was introduced also in the eastern part of the city after the consolidation of the VEB WAB Berlin with the BWB. The pumping stations of the eastern part were in extremely bad structural and technical conditions and were operated also mainly by hand. Differently to the western part of the city only a few pumping stations were fully renewed and the operation concept changed to inflow operation with deep set intakes and pumps with little astringencies.

In order to reduce nevertheless the high costs for personnel a number of pumping stations (e.g. Ros, Buh, Fhg, Hdf, Kht I) have been automated and equipped with telecontrol using the existing buildings and pumps, knowing that this would mean a higher rate of faults and failures.

In the eastern part of the city six main pumping stations with their associated pumping stations (Bri, Köp, Lbg, Mit, Mar and Pan) were formed. The mounting of the controland supervision-technology into the main pumping stations was finished with the realisation of the main pumping station Mitte (completion 2000). This included the supervision and telecontrolling of the affiliated automatically working pumping stations. Analogously to the western part of the city a new operations- and personnel-structure was introduced in the eastern part by 01.04.01, which led to a reduction of workplaces.

Seven pumping stations (Bln IV, XI, XII, Grü, Joh at, Hgt, Hsch) were left for operation by hand until the renewal, still equipped with old pumping systems.

The age-structure of the employees in connection with early retirement plans and partial retirement led to the problem that necessary positions could not be reoccupied with regard to the remaining staff. Unforeseen departures still reinforced this problem.

2. Sewage-system of the BWB before LISA

The operation of the sewage-system was as follows:

Under "sewage-system "the entire system for the sewage disposal is understood. It includes the following components:

Sewage-system = Sewage-system = Sewage-system = Sewer-network incl. storm water tanks Wastewater pumping stations Pressure mains system Wastewater treatment plants Discharge system of wastewater treatment plants

2.1 System and operations

The present operations and the current plans can be described as follows:

- Sewer-network

A management of the sewer-network doesn't take place normally for lack of available controls that can be operated. In addition to the existing weir Seestraße it is planned however to build more control-appliances.

Because of the lacking sewer management, the sewer-maintenance can be enforced largely independently of the operation of pumping stations, sewer mains network or wastewater treatment plants.

Controls of storm water tanks, mainly for emptying and cleaning, are realized by the pumping station personnel.

- Wastewater pumping stations and pressure mains system

Basis of the sewage-distribution through the pumping stations are the controllable, maximum sewage-streams, which are following the demands of the wastewater treatment plants regarding the technical conditions and the treatment limits. For each wastewater treatment plant exists a so called "coordinating main pumping station", which ensures the wastewater streams for the treatment plant by close adjustment with the other main pumping stations and the possibilities of the pressure mains system.

The fulfilling of the wastewater treatment plant demands is largely guaranteed by the fact, that many pumping stations are able to reach several destinations using different pressure mains.

The control of the pumps, that means turn on and turn off of the pumps as well as adjusting the flow of the bigger pumps where possible through speed-control, takes place essentially only as "long-distance-hand-control" from the responsible main pumping station, provided an intervention is necessary into the normally leveldependent automatic control.

For control and supervision are all pumping stations assigned to one of the 13 main pumping stations run by personnel.

In addition data are made available also for the coordinating main pumping stations, so that these can fulfil their tasks of wastewater delivery to the wastewater treatment plants. A comprehensive central control does not take place here, with exception of the assigned pumping stations.

Some pumping stations, seven before the beginning of LISA, could be operated only by hand in the station and were therefore, as already mentioned, still occupied.

The redistribution of the wastewater-streams partially takes place through valve changes initialized by the personnel of the main pumping station, partially however also through personnel of the pressure mains system on the spot in the streets.

To the operation-tasks belong beside the control and supervision (operation) also following tasks:

- Inspection of the installations
- Recording of operation data, which are not yet transferred to the main pumping station
- Fault-elimination in the continuous shift work
- Cleaning of the suction-areas
- Maintenance-tasks that are closely connected with pumping
- Preparation of material
- Inducement of maintenance of the equipment

For this, altogether 544 employees including running of the pressure mains system and personnel of the headquarters were necessary after the alteration of the structure of the subdivision had taken place.

Wastewater treatment plants

Concerning the treatment of wastewater, the wastewater treatment plants are operated independently of each other in accordance with the inflowing wastewater. The operations are supported by automation-technology and control-systems, which are differently in the plants.

- Discharge system of wastewater treatment plants

Control-systems in the discharge system are normally not in the responsibility of the BWB, so that the operational activities include mainly the controls of the perfect condition of the discharge system.

2.2 Existing operations-optimum

With the existing applied information- and control-strategy in the sewage-system could be reached the following:

- Sewage-distribution in accordance with the flow with restricted possibility of consideration of the current cleaning-capacity of the wastewater treatment plants.
- Optimization of the operation efficiency of the single wastewater treatment plant and the single main pumping station group.

• Observance of the critical values, especially of the wastewater quality, and optimization of the technical operation of the single wastewater treatment plant.

3. Central control of the sewage-system

A system that further minimizes the expenditure for operation, control and supervision through automation must be found, in view of the decreasing financial resources.

In the past mainly the different, historically grown automation-systems prevented a wide-range automation of the sewage-system. With the nowadays available systems including the possibility of creating networks it became significantly easier to realize such a project.

3.1 Operations-concept

The central control of the sewage-system means that the operational processes of the system are observed, supervised and operated by personnel in a central control room. With a complex system as given, this can only be achieved for sure by using a process control system, which communicates with the decentralized automation units. Then, presumably such a system is installed; the tasks of the central control room consist essentially of the input of setpoint values for the central or local automation system, the input of control settings and the handling of failure or disruption information.

Because of the complexity of the pumping system as well as the necessity to control hundreds of measuring points (e.g. levels, flows, pressure) simultaneously it is not possible to gain synergy effects only by centralisation of controlling and supervising. Furthermore the changing requirements for the system due to reconstruction or damages of mains, maintenance of the sewers or only weather conditions are a challenge for the central system. Therefore new process control schemes and functionalities of the control system for the general survey must be developed using only a limited number of monitors.

An integral approach of the sewage-system and the following premises form the basics of the drafted operational concept:

- The control of the sewage-system takes place comprehensively regarding the treatment-capacities of the various wastewater treatment plants.
- The central control remains limited at first to the sewer and pumping system.

The supervision and control of the sewage drainage and pumping system takes place in a central control room. This way the operational dependences of the single operationareas can be taken into account. The technical and operational structure of this central control room depends on the available technical possibilities at present.

For the environmentally sound and economical operation of the entire sewage-system the information of the current treatment capacities has to be available also. Within the complete wastewater system the treatment plants are viewed as almost independent plants however and, like now, will be controlled by means of a local automation system. Following principles exist regarding the control of the sewage-system:

- Superior control- and operation tasks for management of the sewage-system are executed without exception only in the central control room. The reason for this is that all important data for the management of the sewage-system are available for evaluation and assessment.
- Local automation-tasks are executed decentralized. This is absolutely necessary for time or security-relevant processes. To the conditions of the outstations adapted, decentralized automation systems must be therefore present.
- Remote plant control by the central control room of the local automation system of a wastewater treatment plant is to be ruled out.
- The availability of the control- and automation-system must be defined; it is to be viewed in context with the personnel-allocation.
- For the handling of the control-tasks suitable displays must be created for the pumping procedures, which minimize the previous diverse actions, relieve and shorten the decision making, so that personnel-reduction is possible.
- Changes of the pressure mains, which are necessary for a save sewage-disposal, pumping and –distribution should become telecontrolled from the central control room also.

Another important task of the central control system is the qualified treatment of malfunctions with a ranked alarm-concept respecting the single installations and the central control room. The fault clearing groups and maintenance workers are working in the single installation of any given pumping station directly. Accordingly, elaborate information of the current conditions of the single installation must be available or accessible on the spot.

Advisably the personnel of the central control room prepare the information for reporting, documentation, archiving as well as administration and accounting of the sewage-system altogether also. In addition the exchange of information with the supervising authority may be necessary. The availability of current weather-data (precipitation-heights, weather-radar-pictures) on the other hand admits improved prognoses respecting the forthcoming sewage-flows and enables interventions in the sewer- and pressure-network in advance, especially with locally restricted precipitation-events.

Because of the complexity of the sewage-system, the staff should be supported in his decisions for the sewage-distribution by a model-supported prognosis-system, on the one hand in a technical sense, but on the other hand also concerning the economical operation of the system. This model-supported prognosis-system should only be realized in the second step, however.

3.2 Advantages

After the implementation of this program, the following advantages are anticipated:

• The sewage discharge and wastewater pumping can be operated in an economical optimum.

- Savings regarding energy-use are to be expected.
- Decrease of mixed sewage outlets of the sewer system into surface-waters through comprehensive control of the sewage-system and optimal utilization of the existing capacities as well as through extensive and readily available data like e.g. radar-weather-pictures and levels in the sewer-network.
- Diminution of the investment-expenses for spare capacities through flexible usage of plants and refined control-systems.
- Improvement of the information-preparation.
- Essential reduction of the personnel costs.













