Serbia

Ex-Post Evaluation of Japanese Grant Aid Project
"The Project for the Improvement of Water Supply System in Belgrade City"

External Evaluator: Hisamitsu Shimoyama, IC Net Limited

0. Summary

In this project, Belgrade Waterworks and Sewerage (Beogradski Vodovod i Kanalizacija, BVK) in the Republic of Serbia was provided with a supervisory control and data acquisition (SCADA) system[1], distribution pumps, control equipment, and water quality testing equipment. The project aimed to provide Belgrade with a safe and stable drinking water supply by these procured system and equipment. This would help Belgrade properly operate and maintain existing city water and sewer facilities while also improving the water supply in regions experiencing water shortages in the city. This project conformed with Belgrade development policy and needs, as well as Japanese ODA policy, and its relevance is high. During the planning phase, Belgrade had issues with citywide droughts in summertime and water shortages due to inefficient water supply in zones 3 and 4[2] where are at higher altitudes than zone 1 and 2. Because of the contributions from the project, along with those of other donors and BVK itself, issues are now solved and its effectiveness is high. The project efficiency is fair; although both project cost and period of Japanese side were within the plan, Serbia side did not complete its project component, and the project period significantly exceed the plan. BVK is generally good on the technical front and be able to develop the SCADA system themselves; however, due to Belgrade's inability to install the pumps within the planned budget and its financial vulnerabilities, sustainability of the project effect is fair.

Considering all the elements above, the project is evaluated to be satisfactory.

1. Project Description

Project Location

The pump installed in PS 15 by the project

[1] In Japan, SCADA (Supervisory Control and Data Acquisition) systems are generally referred to as monitoring control systems. For this cooperation project, the system monitors Belgrade city water service operations and allows remote operation of some facilities from a central control room.

[2] BVK defines each zone according to differences of altitudes.

Zone	1	2	3	4
Altitude (m)	75-125	125-175	175-225	225-310

1.1 Background

The project region is Belgrade, the capital of Serbia[3]. The Belgrade population at the time of the planning was 1.32 million, with 84% of them receiving water supply. BVK manages the city water and sewer services. The existing water supply facilities showed extensive signs of deterioration and malfunctioned frequently. Coupled with less groundwater being drawn, this resulted in water shortages, particularly in summertime. Water was not being appropriately distributed due to the large number of facilities involved in water supply management, keeping facility water supplies away from working together as one system. Thus, many regions were plagued with chronic water shortages. Furthermore, much of the water quality analysis equipment was unusable, hindering smooth water quality management.

1.2 Project Outline

The project aimed to provide Belgrade with a safe and stable drinking water supply. It would accomplish this by building a SCADA system and updating the distribution pumps and water quality analysis equipment. This would help Belgrade properly operate and maintain existing city water and sewer facilities while also improving the water supply in city regions experiencing water shortages.

Grant Limit/Actual Grant Amount		754 million yen / 661.97 million yen (I/II) 454 million yen / 370.82 million yen (II/II)
Exchange of Notes Signed (/Grant Agreement Signed)		July, 2005 (I/II) October, 2006 (II/II)
Implementing Agency		Belgrade Waterworks and Sewerage (BVK)
Project Completion		February, 2008
Project Contractors	Work Contractors	Ebara Corporation
	Consultant	Tokyo Engineering Consultants Co., Ltd.
Basic Design Study		March, 2005
Related Projects (if any)		Other agencies: 1) Kreditanstalt für Wiederaufbau (KfW): Water meters and piping upgrade for non-revenue earning water (8.909 million EUR) 2) European Bank for Reconstruction and Development (EBRD): Expansion Project for Makis 2 Water Treatment Plant (20 million EUR)

2. Outline of the Evaluation Study

2.1 External Evaluator

Hisamitsu Shimoyama, IC Net Limited

2.2 Duration of the Evaluation Study

Ex-post evaluation studies of the project were conducted as follows:
Duration of the Study: September 2011 – November 2012
Duration of the Field Study: March 13-27 and June 17-25, 2012

[3] Serbia was Republic of Serbia and Montenegro in 2004 during the planning phase.

2.3 Constraints during the Evaluation Study

In terms of evaluating the project effectiveness, a vague project objective of "improving water supplies in regions with water supply shortages" limited quantitative evaluation of operational indicators. Specifically, it was unclear if the objective was to be achieved by improving water distribution amounts or distribution efficiency. Therefore, judgment on the project effectiveness is restricted.

3. Results of the Evaluation (Overall Rating: B[4])

3.1 Relevance (Rating: ③[5])

3.1.1 Relevance to the Development Plan of Serbia

In 1995, the Republic of Serbia in the Federal Republic of Yugoslavia formulated the "Master Water Plan for the Republic of Serbia", which specifies the need to ensure and protect water resources, as well as maintain and develop integrated water management. At the time of planning the Basic Design study was conducted, Belgrade had written the "General Urban Plan of Belgrade 2021". The plan stated that the city would implement plans within its power to solve water problems, such as with water resources or water supply and sewerage management. Even at the time of ex-post evaluation, this plan was still an integral part of water supply policy for the city. Moreover, the "Urgent Improvement Plan" formulated in 2001 designed to reduce a rate of leakage from 33% to 28% and to increase quantity of water intake and water distribution by renovating pumps. The "Prospective Development Program for Water Supply System for Belgrade", formulated according to the Master Water Plan, set forth objectives in line with demand for safe drinking water and stable supply. As the project was to help give Belgrade a stable water supply by renovating pumps and building efficient water supply system to monitor all the relevant water facilities in the city, it has been consistent with the development plan of Serbia.

3.1.2 Relevance to the Development Needs of Serbia

In the planning phase, Belgrade had problems with summer droughts and frequent water outages. Zone 3 and 4 where are at higher altitudes than zone 1 and 2 always face water outages not only in summer but all the time. The reasons for the problems were mostly due to the frequent failure of its aging facilities and overall management issues, which was caused because there was no measure to get the operational situation of the citywide water supply system. The Development Plan of Water Supply Facilities, which was formulated in a previous year of the project planning, estimated to increase demand of water supply per day in Belgrade from 950,400 cubic meters (2005-2010) to 1,209,600 cubic meters (2010-2020). As the city expanded, the water-supplied population increased from 1,319,188 in 2003 to 1,583,857 in 2011, in particular, the population in the zone 4[6] where is located in the suburb increased from 17,092 to 36,429. It was highly necessary to appropriately supply water in each zone with efficient management of water supply in order to adjust such a rapid growth of water demand. It follows that water supply needs are still high in the ex-post evaluation. The project aimed to improve the water supply situation and it has been consistent with the development needs.

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4 A: Highly satisfactory; B: Satisfactory; C: Partially satisfactory; D: Unsatisfactory

5 ③: High; ②: Fair; ①: Low

6 All regions of Belgrade expansion into the suburbs are included in zone 4. Specifically, zone 4 is classified into four districts. Note that the district originally set as zone 4 takes the generic name Zone 4 District. Districts: Zone 4 District, Southern District, Avala District, and Vinca District.

3.1.3 Relevance to Japan's ODA Policy

During the planning phase, infrastructural reconstruction assistance, including that for water and sewerage, was an important objective in Japan's ODA policy for Serbia. Infrastructural development in Belgrade, Serbia's most populous city, has great significance as a rehabilitation after economic sanction led by the Balkan conflict. By installing a SCADA system, a system used in Japanese water departments with a reputation for being easy to use, the project built the latest water management system. This is highly relevant in terms of Belgrade independently developing the system after the project completion. Thus the project is highly consistent with Japan's ODA policy.

From the above, the project has been highly relevant with Serbia's development plan, development needs and Japan's ODA policy.

3.2 Effectiveness[7] (Rating: ③)

At the planning phase, supply amounts of water, distribution amounts of water, operational conditions of facilities, and operation and maintenance for facilities and equipment were set as indicators. Since the project objective was an improvement of water supply in water shortage areas, the evaluator initially defined that the project objective is to improve efficiency of water supply, and to eliminate the gaps of water supply in terms of regions as well as seasons. Thus, population of water supply in each zone and flow of annual water demand were set as the indicators to evaluate effectiveness. However, since the implementing agency did not record these indicators, the original indicators were replaced to following ones; estimated populations of water supply in each zone, supply amount of water, and planned value for leakage rate.

3.2.1 Quantitative Effects (Operation and Effect Indicators)

(1) Improvement of water supply volume in Belgrade

The Belgrade water-supplied population in 2011 was 1,583,857, or 120.1% of the 2003 figure of 1,319,188. As of an amount of water supply, in 2008, the maximum daily supply volume for all four zones was 105.7% that of the 2004 level. The water supply volume in zone 1 was 116.6% of the 2004 level in 2008, and 110.5% in zone 2. While the water supply volume is increased in a whole city, zone 3 and zone 4 were respectively 72.4% and 79.7% of the 2004 levels in 2008. This showed the regional gaps were available. However, SCADA system was introduced in 2007 and distribution pumps were mounted in 2008. If comparing maximum daily supply volumes in 2011, which is the year that the water supply system became fully operational, for all four zones to 2004 levels, levels decreased to 97.9% in 2011 and the gaps among four zones became shrunk. This is because improvements in distribution efficiency have enabled to provide for a greater water-supplied population with less water by volume.

Table 1: Maximum Water Supply Volume by Zone

Water supply volume: m^3/day

Zone	2004 (Baseline Year)	2008	2008 vs. Baseline Year (%)	2011	2011 vs. Baseline Year (%)
1	381,165	444,532	116.6	397,804	104.4
2	240,332	265,603	110.5	248,128	103.2

7 This rating for effectiveness also takes impact into account.

3	143,697	104,052	72.4	104,975	73.1
4	20,499	16,337	79.7	17,916	87.4
Total	785,693	830,524	105.7	768,823	97.9

Source: Created by the external evaluator based on data provided by BVK

As mentioned above, the Belgrade water-supplied population increased 121.7% from the levels of 2003 to 2011. The largest population growth in volume was 178,874 in zone 1 from 2003 to 2011, and the growth in rate was the highest in zone 4 and became 213.3% over the reference year of 2003. In proportion to the expansion of Belgrade into its suburbs, this is mainly due to expansion of the water-supplied population of zone 4. BVK explained as follow that the maximum water supply volume decreased to 87.4% over the reference year of 2004 despite the fact that the water supply population became double.

At the planning stage, BVK needed to supply more water per person in zone 4 where is the highest altitudes in all four zones, because BVK added water pressures to deliver the water in zone 4. For example, in 2003, BVK supplied 0.59 cubic meters per day in zone 1 while 0.83 cubic meters per day in zone 4. However, BVK installed booster pumps to add water pressures at reply points by itself after the project, BVK no longer needed to supply excessive amount of water with additional water pressures from pump stations. As a result, at the time of ex-post evaluation, amount of water supply per person in zone 4 decreased to 0.49 cubic meters per day.

Table 2: Water Supply Population by Zone

Zone	2003 (Baseline Year, ppl)	2011*	Increase (%)
1	639,980	818,854	127.9
2	403,520	513,169	127.1
3	241,269	215,405	89.2
4	17,082	36,429	213.3
Total	1,301,851	1,583,857	121.7

Source: Created by the external evaluator based on data provided by BVK.
Note: In order for BVK to get a grasp on the exact numbers, the water-supplied populations of each zone for 2011 were assumed from the percentage of total 2011 water supply volume by zone.

Beneficiaries have also given testimonies that there have been very few water outages even in summertime since 2009. As shown in Table 3 below, 92.1% of the residents in zone 3 and 77%[8] in zone 4 who experienced problems of water shortages in the planning phase responded that they have had a continuous supply of tap water.

Table 3: State of Water Supply in Zones 3 and 4 (%)

Beneficiary Response	Zone 3	Zone 4
Have stable water supply	92.1	77
Do not have stable water supply	7.9	23

Source: Survey of beneficiaries by the External Evaluator in the ex-post evaluation.
Note: Figures are given as percentages of 76 respondents in zone 3 and 53 in zone 4.

Excluding temporary outages from burst water pipes and frozen pipes in winter, water

[8] While 23% of residents in zone 4 reported experience with water outages, the External Evaluator found that water pressure was extremely low in this responding region due to illegal water connections.

limitations due to shortages have decreased. This is because the levels of water in reservoir were stable, and water limitations in zone 3 and 4, where outages were problem at the planning phase, were more or less eliminated according to the beneficiary survey. Thus, it can be said that most regions have a 24-hour water supply in a real sense.

(2) Seasonal differences in amount of water supply

Summer in Belgrade starts in July and water consumption starts increasing, with overall city water consumption peaking in August at 12.6 million cubic meters. The water supply system in the city corresponds to 135% of the annual minimum of 9.3 million cubic meters consumed. August is also the peak for water consumption in zone 1 at 6.2 million cubic meters, or 167.6% of the lowest consumption month (November) at 3.7 million cubic meters.

When the external evaluator checked the monthly average water levels in reservoirs in 2011 provided by BVK, it is found that no reservoirs registering close to empty in any zone and confirmed that there were no water shortages for an entire year[9]. A survey of beneficiaries in zones 3 and 4, those hit hardest with droughts during the planning period, revealed that they noticed no water shortages. Given this, it is fair to say that water supply in Belgrade is sufficient.

Table 4 Average water levels in reservoirs in 2011 (%)

	Month											
Zone	1	2	3	4	5	6	7	8	9	10	11	12
1	61	64	59	60	62	63	56	63	59	60	54	55
2	70	70	69	68	69	68	57	55	54	56	65	67
3	60	61	59	56	59	52	50	52	52	55	52	52
4	71	71	67	67	68	66	63	66	65	64	64	68

Source: Created by the external evaluator based on data provided by BVK

(3) Improvement of water supply efficiency and effects by related projects

While a total amount of water supply was decreased, BVK even supplies sufficient amounts of water to the larger populations in Belgrade city. In addition to the project, there is a compound effect here; KfW replaced distribution pipes and it is planned that water leakage reduce by 5% from 33% to 28%, and BVK also worked to reduce its own leakage rates. In zone 4, while water-supplied population increased to 213.3% from 2003 to 2011, the maximum amount of water supply decreased to 87.4% of the level in 2004.

Although no data was available on designed capacity of water treatment plants, it is considered that there have been no closed plants since the planning phase or changes in design water supply capacity. At the time of ex-post evaluation, the Makis 2 water treatment plant was under construction. The French Development Agency and European Bank for Reconstruction and Development are working on a project aiming to start its operation by the end of 2012. Once Makis 2 is completed, the older Bele Vode and Vinca plants are scheduled to be closed. However, as the water supply volume and regions to be supplied are highly expected to continue increasing as Belgrade continues to expand, the closure of these water treatment plants will

[9] With water supply work in neighboring Petlovo Brdo, zone 2 had a planned service outage from July to October 2011, reducing reservoir levels. BVK explained that this was not indicative of the regional drought situation.

likely be postponed for now.

Pump upgrades by BVK and the US Agency for International Development have prevented declines in the water volumes drawn from the wells dug along the Sava River, which was an issue in the time of planning. BVK monitors that the water intake from these wells is slowly decreasing annually, and plans to have sufficient water supply through Makis 1, which draws surface water from the Sava River, and the Makis 2 currently being expanded.

(4) Changes in water safety from improved water quality inspections

According to the BVK water quality control manager, the quality of water continues to be inspected as stipulated according to the Official Gazette of FRY 42/98 at the time of ex-post evaluation as it was in the planning phase. It was confirmed that the water met all criteria at the time of ex-post evaluation. This includes criteria for turbidity, residual chlorine, ratio of included minerals and bacteria, which are prescribed in 23 physical science items and seven biochemical items.

While there is no visible proof that water quality has improved with the introduction of the new equipment compared to before, it can be said that water quality inspections are more efficient and refined, and its accuracy has improved. Thus water quality is stably inspected now.

3.2.2 Qualitative Effects

The qualitative indicators of “enabling accurate understanding of operational status of the facility and water distribution status, and appropriate facility operation and maintenance” were achieved by installing the SCADA system. More specifically, instances of low water pressure have been reduced by monitoring Belgrade's complex water supply network, understanding the overall water pressure situation throughout the city and prompting the system to pressurize low pressure areas. Also, the Maintenance Department can foresee the measures necessary for equipment maintenance from pump operational data, meaning that the department can replace parts before they fail. For instance, if the system confirms a fixed water pressure for pumps at a pump station and water distribution by pumps falls below normal levels, it points to a possibility of motor irregularity. This allows staffs to inspect and repair pumps before the system halts due to a failure. Further, a system that checks residual chlorine in each header tank in real-time was established. This allows it to adjust the appropriate chlorine levels at water treatment plants with more details than before[10].

3.3 Impact

3.3.1 Intended Impacts

(1) Achievement of Overall Goal

The overall goal was to sufficiently supply safe drinking water to Belgrade. The following gives the extent to which the indicators for this overall goal were achieved. While the Project Design Matrix (PDM) had a reference indicator of 240 liters of water supplied per day per capita, the supplied water reached to 304 liters per day per capita[11] in 2011. Furthermore,

[10] The reagent for the instrument which checks residual chlorine levels in each reservoir may be depleted if procurement process is lengthened. If this happens, staff will have to inspect the tanks manually.

[11] As previously mentioned that water leakage rate was set at 28% at the time of ex-post evaluation, an average water supplied per capita from water treatment plant, 423 liter per day, is multiplied by the rate of water to be supplied

water-supplied population has grown significantly to 1.58 million while the target was 1.32 million.

(2) Improvements of Living Environment

As shown in table 3, from a result of beneficiary survey of 129 households in zones 3 and 4, which both had problems with summertime droughts, it is confirmed high rates of continuous water supply in both zones. As water supply has improved and residents can avoid the impacts of outages and droughts, it can be said that their living environments have improved. In concrete terms, these residents can now obtain a continuous access to tap water even during summertime, and thus they have less trouble with water outage at the time of washing clothes and preparing meals.

(3) Promotion of water supply projects across Serbia

In the basic design study, the project's indirect effect was expected to "promote projects for safe and adequate water supply within Serbia." However, there were no facts showing any link between the project and promotion of other water supply projects in Serbia at the time of ex-post evaluation. Novi Sad, which has the second largest population in Serbia, and Nis have expressed interest in installing SCADA systems and came for visits. According to BVK, Novi Sad did not end up installing a system due to lack of funding, but Nis did install a small-scale water supply monitoring system with its own funds.

3.3.2 Other Impacts

There were no environmental impact and indirectly negative effects of resettlement and land acquisition as assumed during the basic design study. This is because the project rehabilitated existing facilities and did not acquire new lands to construct facilities.

As seen above, the project has achieved its objectives; therefore, its effectiveness is high.

3.4 Efficiency (Rating: ②)

3.4.1 Project Outputs

The outputs of the Japanese side were produced mostly as planned, but Serbia had not yet completed a part of the required installation of procured equipment at the time of the ex-post evaluation. Beside these installations, the Serbian side supplied other required equipment, such as, transformers, communication equipment, and etc. They were provided as planned, and please refer the details in Table 5.

3.4.1.1 Output List and Summary of Differences

(1) Distribution pump station equipment

Installation of equipment scheduled for Pump Station 23 in the Studentski Grad region (hereinafter PS 23) had not been completed at the time of ex-post evaluation. This equipment included five pumps, two rotation speed controllers, three soft starters and five flap gates.

Installation of equipment was put in Serbia's scope at the time of planning. While BVK recognized the need to replace aging pumps, it explained that the equipment could not be

(100% - water leakage rate 28% = 72%).

installed due to lack of funding from the Belgrade city government. In particular, since the world-wide economic crisis negatively affecting the Serbian economy in 2008 when the project was completed, the Belgrade city government also severely curtailed its expenditure. As a result, BVK has not received sufficient budget to install those remaining equipment. In fiscal year 2012, BVK appropriated 100 million dinars (approx. 89 million yen[12]) needed for whole renovation of PS 23, but did not decide a specific work plan to install. In order for zone 1 and 4, which show rapid population growth, to match water needs, it is necessary to install these pumps, to improve efficiency of water distribution, and to strengthen capacity of water supply.

a. Pumps

(No. of pumps)

Pump Station Name	Units Upgraded (During Project)	Units Upgraded (Completed)	Installed Units
PS 1a Bele Vode	3	3	3
PS 1b Bele Vode	4	4	4
PS 18 Tansmajan	4	4	4
PS 19 Bezania	3	3	3
PS 23 Studentski Grad	5	5	0 (not installed)
PS 17 Zvezdara	3	3	3
PS 20 Zeleznik	2	2	2
Total	24	24	19

Source: The number of renewal equipments is confirmed with the materials provided by JICA, and the external evaluator confirmed the number of installed units at sites.

b. Pump station ancillary equipment

Equipment	Units Upgraded (During Project)	Units Upgraded (Completed)	Installed Units
Rotation Speed Controller	8	8	6[2)]
Soft Starters	16	16	12[3)]
Control Panels	7	0[1)]	-
Flap Gates	23	23	18[4)]
Pressure Transmitter	75	75	75

Source: The number of renewal equipment is confirmed with the materials provided by JICA, and the external evaluator confirmed the number of installed units at sites.

Notes:

1) Control panels are built into the soft starters and rotation speed controllers, and are not counted as lost output.

2) Installation is incomplete for two rotation speed controllers at PS 23.

3) Installation is incomplete for three units at PS 23, and one unit at PS 1a is removed after installation.

4) Installation is incomplete for five flap gates at PS 23.

All equipment was provided as planned, but installation of two rotation speed controllers out of eight and three soft starters out of 16 remains incomplete. This is because these equipments are supposed to be installed with the pumps in PS 23, which are not installed yet. Also, another one soft starter has been removed and is currently not in use. In 2010, BVK removed one of the

12 Calculated using local exchange rates for June 20, 2012: 1 Dinar = 0.89 Yen.

two soft starters installed at the pump station and replaced it with a rotation speed controller they purchased with their own budget. Their reasoning was that rotation speed controllers served more practical use than soft starters and the one planned by the project was not enough, so they bought an additional one. Soft starters only contribute to reduce damage to pumps caused by high pressure at the beginning of pump operation while rotation speed controllers can freely control water flow and adjust the amount of water distribution, which contribute the efficiency.

The removed soft starter could technically be diverted to another pump station, but there were no such prospects at the time of ex-post evaluation.

Flap gates are installed along with pumps. Since five pumps in PS 23 remain incomplete, five flap gates also have not been installed yet.

c. Residual chlorine analyzers for distribution reservoir
As planned.

(No. of units)

Equipment	Qty During Project	Qty Completed	Installed Units
Residual chlorine analyzers	20	20	20

Source: The number of procured equipments is confirmed with the materials provided by JICA, and the external evaluator confirmed the number of installed units at sites.

(2) SCADA system

There were some changes, but overall function of the SCADA system was not affected. Thus the entire unit is deemed to have installed according to the plan[13].

(3) Water quality testing equipment

(No. of units)

Equipment Name	Qty (During Planning)	Qty (Completed)
Scientific Analyzers		
Atomic Absorption Spectrometer	1	1
Total Organic Carbon Analyzer	1	cancelled
Ultraviolet-Visible Absorption Spectrometer	1	cancelled
Ion Chromatograph	-	1
Microbial Analyzers		
Autoclave	1	1
Microscope	1	1

Source: Created by the external evaluator based on data provided by JICA

[13] Due to the large number of components in the SCADA system and limited pages in the report, this chart has been omitted.

During the planning phase, the water quality laboratory was in urgent need of a total organic carbon analyzer and ultraviolet-visible absorption spectrometer, making BVK decide to purchase the equipment with its own budget before the project implementation. As such, the next most urgent piece of equipment after these two, an ion chromatograph, was purchased instead.

3.4.2 Project Inputs

3.4.2.1 Project Cost

As shown in Table 5 below, Japanese project cost was kept to 88% of those planned. Data was unavailable for the Serbian expenses[14].

Table 5: Variance Analysis of Project Costs

1) Costs borne by the Japanese side	Planned Cost	Actual Cost	Vs. Plan
Equipment: Distribution pumps, motors, inverters, SCADA system, water quality analyzing equipment, etc.	1,094 million yen	952 million yen	87%
Detail design, construction management	83 million yen	81 million yen	98%
Total	1,177 million yen	1,033 million yen	88%
2) Expenses borne by Serbia side			
Transformers (14)	250,000 EUR	Unknown[2)]	
Communication facility, dedicated radio line and antenna (1 set)	40,000 EUR	Unknown	
Installation materials, cable materials, ladders, racks	200,000 EUR	Unknown	
Total	490,000 EUR	Unknown	
Total cost in yen[1)]	66 million yen		

Source: Documents provided by JICA
Note:
1) Exchange rate: 1 EUR = 134.62 Yen (July 2004)
2) BVK could not provide data of expenditure in these items due to complexity of accounting system.

3.4.2.2 Project Period

The Japanese side finished its portion of the project as totally planned (100% of planned time). On the contrary, the Serbia side greatly exceeded its plan, not having completed its portion of the work as of the ex-post evaluation[15].

Table 6: Planned Work Duration and Actual Work Time

Phase	Planned Duration	Actual Duration	Vs. Plan
Phase I: SCADA system procurement and installation	17.5 months[1)]: Sept. 2005 – Feb. 2007	16 months: Nov. 5, 2005[2)] – Feb. 28, 2007	91%

[14] As a sub-rating for the project cost in the Japanese side, which completed within the planned period, is evaluated as ③ while it was impossible to judge the one of the Serbian side due to a lack of relevant information.

[15] As sub-rating of the project period, Japanese side, which completed its portion as planned, was evaluated as ③. On the contrary, the Serbian side was evaluated as ① due to its portion is on-going, and thus the total evaluation became ②.

Phase II: Procurement of distribution pumps and water quality analyzing equipment	17.5 months: Jun. 2006 – Dec. 2007	14 months: Dec. 28, 2006[2)] – Feb. 28, 2008	80%
Total	28 months (2 years, 4 mos.)	28 months (2 years, 4 mos.)	100%

Notes:
1) In the basic design, Phase I construction was expected to take 20 months. As Phase I start time was shifted, the phase period was shorted to 17.5 months in the project feasibility study conducted after the basic design in August 2005. The major change from the initial plan was that equipment needed for SCADA system construction was procured in Phase I.
2) Signing day for construction consulting contract.

As seen above, while the cost and period of Japanese side were within the plan, the period of Serbia side greatly exceeded its plan. Thus efficiency of the project is fair.

3.5 Sustainability (Rating: ②)

3.5.1 Structural Aspects of Operation and Maintenance

BVK changed its organizational structure in 2010. From the planning phase to 2011, it reduced personnel by 531 to 2,594. Most of the reductions were basically natural attrition from retirement and curbing of new hires. In interviews, BVK said there are no noticeable staff shortages from the reductions as being a corporation, its personnel numbers were high in the first place. The External Evaluator also asked for opinions on sufficiency of management quality and personnel numbers with the consulting company entrusted with SCADA system maintenance, and the company replied that there were no problems of significance.

The Central Information Technology Unit, which is placed in Makis Water Treatment Plant and was intimately related to the project, employs 16 staff. They manage the SCADA system 24 hours a day in shifts from the SCADA system central control room. Similarly, each of the four regional control centers has their five employees managing the center 24 hours in shifts. The External Evaluator asked those staff if they felt understaffed, and they responded that staff numbers were sufficient in the current operation.

The External Evaluator also inquired about the sufficiency of staff numbers at the seven pump stations that the project centered around, and it is found that no one felt that they were understaffed or had any staffing problems.

3.5.2 Technical Aspects of Operation and Maintenance

(1) In interviews, BVK and the contracted management and maintenance company reported that no SCADA system administrators in any of the central or regional control centers have resigned since the systems were installed. All the administrators were well trained in the technology when it was installed. Since SCADA system installation, center personnel have incrementally increased their skills through trainings and routine activities in necessary system operation and maintenance, and are deemed to have sufficient skills to this point. This is backed by the fact that they have yet to experience a SCADA system outage due to a system failure.

According to BVK, future personnel will be trained on the job by veteran staff within the organization. Additionally, there is the contingency plan of training by technicians from contracting company for maintenance of the SCADA system if necessary.

(2) The External Evaluator interviewed some of the administrators for the seven pump stations which the project focused on about utilization of the administrator's manual. They all confirmed that they had a manual on site and refer to it when necessary. However, they did express that they rarely have to check the manual in their daily tasks as administrative work has been so simplified.

Meanwhile, the administrators also said that the development engineers frequently referred to technical manuals on topics such as SCADA system programming and electric circuits due to the constant development of the system. The manuals have been updated as necessary with additional features.

(3) Preventive maintenance became easier as it can monitor the operational status for each pump in detail by the SCADA system. However, it has only been four years since the project completion, and there have been no noticeable pump failures yet. As of the ex-post evaluation, no failures requiring extensive repair have occurred.

Regarding older pumps outside the project scope, pump station personnel will switch them over to spare pumps when a failure occurs or there is a possibility of failure. Even this level of response capability is sufficient. Pump components are easily procured, and their technical capabilities do not pose any major problems.

3.5.3 Financial Aspects of Operation and Maintenance

(1) BVK Finances

Table 7: BVK Finances

1999 to 2003

Million dinars

Year	Total Expenditures	Total Revenue	Balance
1999	895	565	-330
2000	1,841	664	-1,177
2001	2,386	1,855	-531
2002	3,409	2,909	-500
2003	4,909	4,170	-739

2007 to 2010[1)]

Million dinars

Year	Total Expenditures	Total Revenue	Balance
2007	11,163	6,813	-4,350
2008	10,287	6,267	-4,020
2009	6,840	7,012	172
2010	7,181	7,226	45

Source: The data from 1999 to 2003 is based on the documents JICA provided while the data from 2007 to 2010 is based on the information in BVK website.
Note: 1) BVK does not disclose financial data from 2004 to 2006

As seen in Table 7, BVK balance sheets were chronically in debt before the project. In the ex-post evaluation, however, BVK cleared its accrued interest-bearing debt in 2007 and 2008, and improved finances enough to turn a profit from 2009 onward. BVK has not disclosed information for 2011 and later, but when interviewed said that it turned a small profit.

A number of elements factor into the financial improvement of BVK. One reason is reduced labor costs. BVK reduced 275 employees from 2869 in 2007 to 2594 in 2012. BVK has also reduced maintenance costs with efficient water supply due to the installation of the SCADA system and updating to pumps with lower power consumption. Further, it has expanded its supply area and reduced their non-revenue water rate.

(2) At the time of the ex-post evaluation, BVK allotted 100 million dinars (approx. 89 million yen) for PS 23 installation expenses in its 2012 budget. It has not, however, made any restrictions in the use of those 100 million dinars, meaning that the budget may not be implemented as recorded. If BVK has a project it wants to give priority, it could divert the budget. Installation will wind up costing this much because it will also involve incidental work, such as improvements to the pump station electrical and piping systems. While the budget for installation work was allocated for fiscal year 2012, the Belgrade city government has not yet granted permission for the expenditure. According to BVK, no installation plans are currently set.

While BVK's financial situation has improved, it has some issues with budget shortfalls when the Belgrade city government has not allocated the needed budget. This includes the pumps and control equipment procured for PS 23 not being installed. There are several factors contributing to the Belgrade budget shortfalls. While all of Serbia has been impacted by the world-wide economic crisis since 2008, Belgrade has also been unable to allocate budget to install existing equipment procured for the past four years. The likelihood is thus high that similar issues will arise for future equipment upgrades.

3.5.4 Current Status of Operation and Maintenance

(1) The External Evaluator has confirmed that the equipment procured is maintained according to ISO9001 international standards[16]. More specifically, in line with standards accepted by the International Organization for Standardization (ISO), it improves transfer of water quality control skills by creating manuals and other documentation, and project continuity by using a PDCA cycle[17] in water utility monitoring.

BVK explains that its maintenance program also monitors facility updates and repairs according to ISO9001. However, some pumps have not been replaced despite exceeding their service life due to budgetary issues, as in the case of PS 23.

(2) BVK has continued developing its SCADA system independently. It has expanded both the number of facilities the system controls and the area it monitors. Particularly impressive is that

[16] ISO9001 is the standard to manage the system delivering services. International Organization for Standardization defines ISO standards.

[17] PDCA cycle is an abbreviation for a cycle of Planning, Doing, Checking and taking Action. It is a method for making production management, quality control and other management work progress smoothly.

the system can monitor 234 facilities as of the ex-post evaluation, up dramatically from the 159 at the project completion. This is a good example of how BVK is actively utilizing the basic system procured and expanded things in a proactive fashion.

(3) The only piece of equipment that could pose problems with maintenance is the autoclave for water quality inspection equipment. Although the manufacturer has a local distributor, spare parts are quite difficult to obtain. This is because this distributor takes a plenty of time to deliver even a small part. At the time of ex-post evaluation, some parts were seen failing, but stuck together with bond as an emergency measure. Administrators said there were no maintenance problems with other equipment as other local distributors can easily deliver any spare parts to BVK.

A measuring agent is used for measuring the residual chlorine concentration for reservoirs. This agent is a consumable which must be replenished on a regular basis. However, even as domestic procuring process takes time, the stations occasionally run out of the agent. During the ex-post evaluation, they were out of the agent and the equipment was stopped. When the measuring equipment is stopped, station staff members have to visit the reservoir and measure manually. It is a problem stations have to stop due to difficulty to obtain consumables or parts for repairs. This should be taken into consideration in the planning phase.

Monitor of SCADA System

Autoclave with a tentative treatment

From the above, the project maintenance has some light financial issues; therefore, the sustainability of the project effect is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

In this project, BVK in the Republic of Serbia was provided with a SCADA system, distribution pumps, control equipment, and water quality testing equipment. The project aimed to provide Belgrade with a safe and stable drinking water supply by these procured system and equipment. This would help Belgrade properly operate and maintain existing city water and sewer facilities while also improving the water supply in regions experiencing water shortages in the city. This project conformed with Belgrade development policy and needs, as well as Japanese ODA policy, and its relevance is high. During the planning phase, Belgrade had issues with citywide droughts in summertime and water shortages due to inefficient water supply in zones 3 and 4 where are at higher altitudes than zone 1 and 2. Because of the contributions from the project, along with those of other donors and BVK itself, issues are now solved and its effectiveness is high. The project efficiency is fair; although both project cost and period of Japanese side were within the plan, Serbia side did not complete its project component, and the project period significantly exceed the plan. BVK is generally good on the technical front and be able to develop the SCADA system themselves; however, due to Belgrade's inability to install the pumps within the planned budget and its financial vulnerabilities, sustainability of the project effect is fair.

Considering all the elements above, the project is evaluated to be satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Implementing Agency

(1) BVK removed the soft starter procured in the project for PS 1a in order to replace with the rotation speed controller BVK purchased with its own budget. At the time of ex-post evaluation, the removed soft starter was being stored in a warehouse and was not in use. Soft starters are effective equipment which buffer pump damage from rapid pressurization when the pump is started up. Technically, the removed soft starter can be diverted to other pump. There are pump stations in Belgrade still using older pumps, and the soft starters could reduce the load put on pumps at startup if installed. As such, BVK should identify a pump where it can be used and install it as soon as possible.

(2) In PS 23, five pumps, two rotation speed controllers, and three soft starters remain uninstalled yet. If these equipments are installed, it is expected that it enables BVK to monitor water supply in the area around PS 23, and to efficiently supply water to zone 1 and 4 where show a rapid population growth. Moreover, the maintenance become easier than the old modeled pumps currently being used. Due to the continuous discussion of budget implementation between the Belgrade city government and BVK, the government remains undisbursed the allotted budget. Also, mechanical failure may be occurred if the equipment remains unused for a long time. These failures may cause necessity to allocate an additional budget for repair when being installed. BVK should seriously recognize that this project will not be completed unless these equipments are installed. Furthermore, it should be installed as soon as possible to avoid additional cost for repair.

4.2.2 Recommendations to JICA

It should continue to follow up with the equipment that has yet to be completely installed at PS 23. It is expected that completing installation reduce costs by efficiently distributing water, reducing power consumption and decreasing the frequency of failures.

4.3 Lessons Learned

(1) In grant aid projects, the Japanese government and counterpart government divide up the work. However, if the counterpart's capacities are overestimated, the counterpart may not be able to complete its work as scheduled. In the case of this project, the Serbian government was tasked with installing some equipment, but the required budget for installation at PS 23 comes to 100 million dinars (89 million yen) with electrical system improvements, pipe replacements and other ancillary work. Establishing the counterpart's scope of responsibility should be a suitable approach to increasing their ownership for the projects, but JICA should review carefully whether the counterpart is financially and technically capable of handling that scope

during the planning phase. Further, JICA should discuss a system maintaining the posture that it will complete the project together with the counterpart. This may involve attempting to occasionally check on progress on the counterpart's obligations throughout the project and sequentially delivering portions of the project as they are completed.

(2) Although “improving water supplies in regions with water supply shortage” was set as the project purpose, this purpose was vague. Improving efficiency of water distribution by applying procured equipment contributed to eliminating regional and seasonal gaps in terms of water distribution. Thus, it is considered that the project purpose was achieved. On the contrary, the implementing agency was rather aware of reducing maintenance cost and electrical consumption by renewing pumps instead of improving the efficiency of water distributions. As a result, the agency did not record relevant indicators being originally set, and thus this constrained to evaluate this project.

When implementing and donor agencies keep the gaps in terms of interpretation of a project purpose, an implementing agency tends to miss the indicators, which a donor agency expects, and it would be an obstacle for evaluations. It is commonly phenomenal that stakeholders have different interpretations on a project purpose. Also, it is significant for an implementing agency to hold indicators to fairly validate project effects. In the future, a project should be implemented with sharing a common understanding of a project purpose among all the stakeholders from a planning phase.