FERGANA VALLEY AUTOMATION PROJECT

October 11 to 26 Mission

REPORT FROM INTERNATIONAL EXPERTS

GENERAL PRESENTATION OF THE MISSION

This is the report of the second mission of International Experts recruited by SDC to provide technical assistance for the Fergana valley canal Automation project SDC. The team of SDC International Experts was composed of:

- Mr. Hervé Plusquellec, team leader and expert in the field of automation
- Mr. Pierre Rousset, senior technical expert in hydraulics
- Mr. Georges Favreau, expert in control equipment and hydraulic control

The team arrived in Tashkent on October 11, 2006 and travelled to Andijan on October 13 to visit the works under the responsibility of the BVO Syr Darya Organization and test the automation equipment installed by the Contractor SIGMA. A preliminary debriefing meeting was held with Mr. Krahuenbuhl and representatives from SIC-ICWC, SIGMA and BVO Syr Darya.

On October 18, Mr Favreau left the mission, and MM Plusquellec and Rousset started visiting the three irrigation canals which are part of the project: South Fergana Canal (SFC) in Uzbekistan on October 18 and 19, 2006; Aravan Akbura Canal (AAC) in Kyrgyzstan on October 20 and 21.

The purpose of the visits to these canals was to assess the progress of repair works of the existing mechanical equipment and the readiness of the works for the installation of the automation and communications equipment.

Because of visa problems in Tajikistan and Uzbekistan, the team could not visit Khaji Bakirgan in Tajikistan and could not go to Khudjant for a final wrap up meeting as it was scheduled. The team travelled by air to Bishkek on October 25 and to France on October 27.

Overall progress since the October 2005 mission of International Consultants

During the 12-month period, SIGMA has installed the automation and communication equipment for the works of BVO Syr Darya.

The contract for the AAB canal between SIGMA and Osh Basin Organization has been signed and SIGMA has prepared the project documents.

The contracts for the last two canals SFC and KBC canals have not yet been signed because of delay in executing repair works on the structures and irrigation outlets and no compliance with the registration of the Union of SFC Association.

Pilot canals

The three pilot canals are presently operated under upstream control with a minimum of regulators. This control logic will not be changed. The main purpose of the SDC project is the automatic monitoring of the flow released at key structures and the flows passing the hydro-posts to enable water accounting in each "balancing site". Automatic control will be limited to the flow releases at the major intake structures and water levels at cross regulators. The relevant organizations are in the process of completing the rehabilitation of the water control structures and where necessary the motorization of the control gates. The equipment inspected during the mission, although functional, is old and has been poorly maintained for many years. Under these conditions, there is a certain risk of interruption of the automatic control. This observation justifies the prudent approach adopted by SIC for the design of the SDC project with a main focus on automatic monitoring.

PART A
BWO/SYR DARIA

1. Visits and inspections

During their October mission, the experts have inspected the following structures:
Big Fergana Canal head works and gauging station
Head regulator of Feeder Canal
Hakulabad divider at DP15 on Feeder Canal
Divider at DP66 on Feeder Canal (head structure of Big Andijan Canal, Unifier canal and continuation of Feeder Canal).
Head regulator and discharge structure on Akhunbabayev canal
The equipment installed by SIGMA in the framework of the project was reviewed. The various components of the automation system are analyzed from the point of view of their selection and their installation.
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2. Review of project hardware

2.1 General comment

As a general remark, it may be pointed out that the selection of the equipment by SIGMA is satisfactory and the feature of the various devices fit with the requirements. Equipment is well corresponding to detailed design.
It is important to point out that SIGMA has reproduced the same system architecture over the various structures, which is important for future maintenance and troubleshooting.
The cabling of the sensors and remote devices to the PLC’s is adequately performed and the cables are well protected from vandalism outside of the technical cabinets and buildings. In

some cabinets and buildings, the cable laying could be strengthened (e.g. gauging station on BFC 3, 5 km downstream head works). More generally, cables should be equipped with tags allowing identifying them for further maintenance.
No surge protection device was installed in the system. The PLC I/O modules provide for galvanic insulation (4 kV), which may be sufficient for some small problems from sensor cables. However, the power supplies being not protected damage to the PLC and other equipment may occur in case of lightning strike.
At present, diesel generators are located only at Uchkurgan barrage, BFC head works, Hakulabad divider and DP66. Use of diesel generators is encouraged by the experts at the other localities where regulation is performed. These generators should have enough fuel supply to cope with emergency situations. The autonomy of PC's is not sufficient (less than one hour), and the autonomy of the PLC's is sufficient (6 hours). The figures were provided by SIGMA and could not be tested. It would be recommended to increase the autonomy of the PC's up to 6 hours; for that, it is only necessary to add batteries.

2.2 Level sensors

The level sensors are of Endress & Hauser brand (Prosonic model). These sensors are well known for their reliability and excellent features. The water protection level IP66 is correct for this type of use.
The test of change of discharge or level in the various structures has resulted in observations of incorrect sensor behaviour, especially in the following:

- Hakulabad head structure: the reading of the sensor downstream the structure has shown erratic results during change of discharge. It was observed that the sensor is installed at a location where small standing waves can be observed at the canal surface and the position of this wave may vary randomly and with variation of discharge. For this structure, the experts recommend to change the location of the sensor, possibly upstream where the gauging station is installed.
- BFC head works: the two sensors located respectively at the upstream and downstream ends of the first reach have given inconsistent measurements with sometimes H upstream > H downstream, and sometimes the opposite. SIGMA explains that this may be a problem of reference of the sensors, some of them only being adjusted to Baltic Sea Level, but in this case, the difference would be constant. It will also be checked that the distance between the sensors and the stilling well they are attached on is sufficient.
- The level sensor downstream the Akhunbabayev headwork is placed close to reeds and other vegetation. The surface of water is not very smooth at this location. It is recommended to move it slightly upwards in the lined section.

For these sensors, and also all level sensors of the project on the BFC, Feeder and rivers, it is requested to perform a general topographical survey, not only inside a structure, but also between structures. This survey will be made using the closed loop technique.

2.2 Gate position sensors

The gate position sensors are of German brand. The inspected sensors were properly installed in sealed cabinets and did not show reading problems during the testing (errors in reading these sensors are reported to the supervisory software and were not observed).

2.3 End switches

The end switches are sensors testing the proximity of a fix part, located on the frame holding the drives, and a mobile part fixed on the axis of the gate.
This system can allow BWO to limit the movement of some gates, by changing the position of the mobile part of the sensor along the axis, but this mobile part must be carefully tightened, which may have to be verified.

2.4 Programmable logic controllers (PLC) and gate command

The PLC's are of model DECONT 182 and are installed in tight cabinets close to the gates. The cabinets were cabled and tested in Tashkent, then connected on site to the various sensors, actuators, power supplies and communication lines. This two-stage operation is a good way to guarantee proper functioning after site installation.
As a general principle, one PLC controls four gates. The good temperature specifications of the PLC's correspond to this type of installation (-40°C +70°C). The equipment is very modular and provides for separate I/O modules (analog or digital inputs, digital outputs) and also connection blocks that can allow easy replacement of faulty PLCs.
The PLC's were programmed to send the following 6 alarms to the supervisory software:

- Torque overload (closure or current relay in control panel)
- Error or no reading from gate position sensor
- Reading of erroneous value from gate position sensor (e.g. off-limits values, such as height greater than gate dimensions)
- Gate movement opposite to the requested movement, mostly in the early testing phases in case of inversion of cables. As the cables are generally not equipped with tags, this can occur. The experts recommend the addition of tags on cables where removal of the connected element can lead to wrong re-cabling.
- .One last alarm occurs when a PLC sends a command which cannot be executed by the gate. This can have several origins, including electrical and mechanical problems.

During the tests on the structures (more often on the regulating structures than on the canal intakes), the use of the gates often raised the last alarm. This occurred randomly and no explanation could be found. As the reliable command of the gates is the cornerstone for efficient canal control, this problem must be further investigated and solved. As a conclusion of the discussion between SDC, BWO, the experts, SIC and SIGMA, it was agreed that the problem will be addressed in three successive steps:

- BVO will make their own survey, and will correct the known and found problems (e.g. wearing out of some mechanical parts, as observed in the Uchkurgan barrage or errors while manipulating the lever allowing disconnecting the engine from the gate and enabling manual operation).
- A joint inspection is made by BWO, SIC and SIGMA to find the reasons of the alarms. As it was observed that problems were more frequent on gates operated seldom, it is recommended to move all gates time to time and to permute gates under automatic mode.
- If the joint inspection is not successful, then SIGMA will propose to SDC an update to their contract for installation of additional diagnosis equipment (to be defined by them) on selected gates. This may help to detect if the problem is of electrical or mechanical nature. Re-use of this equipment over the selected gates will be considered.

The cabling of the PLC's and their modules is described in a drawing that will be available in the control room of the structures.

3. Review of project software and communications

3.1 Supervisory software

It was recommended by the experts to make use of a commercially available supervisory package. This allows easier customization, maintenance and avoids specific developments. SIGMA has chosen an intermediate solution between a readily available program and a totally custom-made application. The supervisory application was built using libraries (e.g. for operator interface and archives) supplied by the provider of the PLC's. In the opinion of the experts, this is also a good choice.
The supervisory system provides good interface to the operator, but can be improved by providing feedback to the operator after entering a command:

- Signalling that the new set point in discharge or level has been taken into account and is being processed
- Signalling that a gate is in movement (e.g. blinking indicator)

Manual input of gate opening was requested (e.g. on failure of a level sensor, the operator can input gauge reading), but SIGMA says this can cause problems to the regulation. The supervisory software must be corrected to allow manual input of sensor values without problems in the regulation.
Development of the supervisory software is not finished, and the levels and discharge of the safety spillway downstream .Akhunbabayev head work still cannot be transmitted to the main station.
The User Manual of the supervisory software has been transmitted to BVO in July 2006 but training to operators has not been performed yet (only training on PLC's and hardware to maintenance people has been carried out). This is very important to facilitate the use of the automatic regulation mode by BVO.

3.2 Communication system

SIGMA has chosen to use GPRS for the communication between sites (except between Kuyganyar and Uchkurgan dispatchers, where conventional radio is used). This is a good choice, allowing better quality of service, for the following reasons:
The maintenance of the communication network will be performed by a specialized communication company,
No authorization to use frequencies has to be obtained from the authorities
This allow extensibility (e.g. link to Tashkent is possible with no additional hardware)
Today the service provider (MTC) is installing the GSM+GPRS network in the Fergana valley (a GPRS network is already operating in the Tashkent region) and installation should be completed by the end of the year. Currently some communications are possible, but not in a reliable manner, and the transfer of commands and information to/from the structures could not be tested. This is an important component of the system to be checked prior to system commissioning. SIGMA will work closely with MTC to ensure that the system is timely installed;

4. Tests on structures and canal regulation or control

4.1. General presentation

The principles of the control to be installed on the BVO canals have been discussed in detail during the previous mission of the experts in October 2005 and accepted by all parties as summarized bellow:

- BFC Head Work: this structure comprises two parts. The first one allows to divert water from the Naryn River and the 2d one located a few hundreds meters downstream, shares the water between the BFC itself and the Uchkurgan canal. In the upstream structure, it was decided to adopt a downstream regulation (i.e. maintaining a constant water level in the pool the two structures) and two discharge controls on the second structure to supply a constant discharge to the BFC and to the Uchkurgan canal. This solution has been effectively implemented by SIGMA.
- Kakhulabad Divider on Feeder canal: this is only one structure with two functions supplying water to the Kakhulabad canal and to the 2d pool of the Feeder canal. In October 2006 it was decided to have discharge control for Kakhulabad canal and to install a downstream control on the Feeder canal. AS a consequence a downstream control must also be installed on the Feeder canal Head Work. This solution was not implemented and replaced by an upstream control which cannot work satisfactorily. At the meeting with SDC on October 16, SIGMA admitted to have made a mistake and agreed to make the necessary corrections. As a matter of fact, the downstream control could not be tested.
- Water Work at DP 66 of Feeder Canal: constant discharge control at the head of each downstream canals, BFC, BAC and Unifier. Automation of DP 66 has been implemented according to this principle.
- Ahunbabaev Head Work and Outfall: discharge control at the Head Work and Upstream level control at the Outfall (i.e. opening of the spillway when the level in the Ahunbabaev canal exceeds a target level in order to avoid spillage and overtopping of the banks). Automation of Ahunbabaev canal has been implemented according to this principle.

Practically speaking, adjustments of gates are made each ten minutes. Water level control utilizes a loop of automation following a specific algorithm of SIGMA taking place in the controller (or PLC). Discharge control consist in computing the gates opening according to the theoretical law of the gate and includes a readjustment of the coefficient of discharge at each step of time by comparison between the computed discharge and the discharge given by the hydro post (gauging station located downstream the structure).Experts think that readjustment of gate coefficient at each step of time is too much and may introduce an instability in the control. It would be sufficient to do this readjustment once a day and when there is a big change in discharge. The discharge control is also programmed in the PLC's.
Taking into account the relative complexity of the automatic controls of the structures the experts decided to implement experiments and tests at each control point in order to check that the results meet the objective and allow an efficient adjustment of levels and discharges in terms of accuracy and stability.

4.2. Tests on BFC Head Work

These tests were implemented on October 14, in the afternoon.
At 13 H 00, all gates were put in automatic mode; the water level in the pool between the two structures was 499.50 and the discharge supplied to BFC at the 2d structure was 34 m3/s. As GPRS was not functioning, the water level at the hydro post located 3.5 km downstream was not available and the flow was computed by the gate formula without readjustment of the discharge coefficient.
At 13 H 15 the target flow was changed from 34 to 50 m3/s and the target level was kept at the previous value.
It was impossible to obtain the target flow because the water level in the pool was insufficient and in addition gates were often and randomly faulty.

At 14 H 00 the target level was increased to 499.85, and this value was obtained at 14 H 30. Half an hour later the target discharge of 50 m3/s was also obtained and remained stable.
At 15 H 30 the target flow was again increased from 50 to 70 m3/s and the new value was obtained at 16 H 00 with +/- 5% fluctuation.
During this period of time many gates were randomly faulty, but at 16 H 00 the number of manageable gates was not enough to maintain the level in the pool and the level and the controlled flow started to decrease.
At 16 H 30 the target flow was decreased from 70 to 35 m3/s and this value was obtained at 17 H 15.
At the end of the test it was observed that the water level measurement downstream of the pool was not consistent with the upstream measurement (1m more which is physically impossible). It I impossible to know which one is incorrect, may be both, and this shows a shift in the level measurement devices which must be corrected.

Conclusion:

The tests seem to be positive but, due to the problem of the water level measurement, there is a doubt on its validity because the value of the adjusted flow and/or level could be erroneous.
For this reason it would be recommended to implement new tests after correction of this failure.
Gates become too often and randomly faulty; most of the times the reasons of these failures were not found.
When a gate which was in automatic mode becomes again manageable after a transitory and random failure, it is no longer under the automatic mode but returns to the manual mode. The operator has to intervene in order to put again this gate under the automatic mode. In the absence of the operator this gate remains non automatic. It I recommended to correct this drawback.

4.3. Tests on Hakhulabad divider (DP 15)

Tests were implemented on October 15. The control of level was not tested because it is under upstream control in place of downstream control and in addition, too many gates were not manageable.
Only tests on flow control on Hakhulabad canal were implemented:
The set point was initially 12 m3/s and was changed to 22 m3/s.
The new value was obtained 15 minutes latter and remained during 30 minutes with fluctuations of +/- 2 m3/s.
The set point was then changed to 10 m3/s and the new value was obtained 15 minutes latter, but the fluctuations remained at +/- 2 m3/s
The fluctuation of discharge is due to fluctuation of the surface of water provoked by a standing wave located just under the measuring device.

Conclusion:

Too many gates failures which make the control unreliable.
Stability of the flow control satisfactory but insufficient accuracy due to the problem of location of the water measurement device.
Level control to be corrected.

4.4. Tests at DP 66

Tests were implemented on October 15 on KDP (Feeder Canal) and BAC but not on Unifier canal. All gates could be controlled and the hydro point on KDP was linked with the control structure. Tests started at 15 H 10 and they are summarized in the table below.

Time	Water level on KDP Upstream (m)	Discharge on KDP Downstream (m3/s)	Discharge on BAC (m3/s)
15 10	480.20	37	61
	All gates put on automatic mode with KDP=62 and BAC=61		
15 20	479.94	51	59
15 30	479.91	52.3	61
	As there was not enough water arriving from KDP Upstream, target were changed: KDP=62 and BAC=37		
15 40	479.98	54.9	36.9
16 00	480 01	57.6	37
	The target discharge on KDP Downstream could not be reached due to insufficient flow coming from upstream; the target discharge on BAC was obtained and remained stable. The targets were changed again: KDP=37 and BAC=61		
16 10	480.02	42.7	58.8
16 15	480.09	37.6	57.5
	The new target on KDP was obtained and remained stable but the new target on BAC was also reached but with only 5% accuracy; this is due to the insufficient flow from upstream		

Note: in red are the input set points and the adjusted value when the accuracy is better than 5%.

Conclusion:
Test were satisfactory and the adjusted discharges were stable and accurate except when the total discharges supplied downstream exceeded the upstream discharge
Test show the advantage of installing downstream control on the two 1st pools of KDP. This would have avoided the shortage of upstream flow which prevented to reach the target discharges in some tests. It is pointed out that to points are to be modified (1) at feeder canal head work, (2) at DP 15.
Except few exceptions, gates remained under control continuously.

4.5. Test at Ahunbabaev Head Work

The test was performed on October 17 at the head work but could not be done at the Outfall because the installation of equipments was not completed.
At 11 00 flow from Naryn River was 33 m3/s, water level upstream was 391.69. Gates were put in the automatic mode with a new set point of 38 m3/s. 10 minutes latter, 2 gates out of6 were faulty but the adjustment continued without problem with the4other gates.
The adjusted value of 38 was reached at 11 50 and remained stable until the end of the test 14 30 although the level rose by 20 cm.

The reading have been taken from the computer and put on the graphs in annex 1: opening of gates, Water level and discharge. On these graphs it can be seen that local staff has operated the gates manually at 7 00 and 9 00 giving picks of discharge.
Concerning level, it must be pointed out that values in the different points are not consistent:
At the end of the test they were: Upstream 391.85, Downstream 390.80, Hydro post 388.20and at the Outfall 394.65. Level measurement devices have to be adjusted and tuned.
Conclusion:
This test is satisfactory although 2 gates remained permanently faulty.

Level sensors must be tuned and adjusted.

3. Conclusions and recommendations

- Commissioning should only occur when the following work has been done and properly documented:
  - Diagnosis (and repair of any faulty component provided by SIGMA) on the operation of gates
  - Alarm on gate failure: when the alarm disappear the gate must return in automatic mode
  - Readjustment of gate coefficient done only once a day and when there is a large change in discharge
  - Corrections in level sensors installation or calibration
  - Correction of discharge and level management on the feeder canal
  - Successful test of GRPS data links

- Maintenance is an important issue. After the two-year guarantee period on PLC's, it is essential to ensure that an organization is set up for system maintenance (both preventive and corrective). The experts are in favour of the current solution of having SIGMA perform the maintenance in the framework of a contract renewed every year.

- Training of operator is also important: in some point, operators did not know how to use the automatic system and did not use it at all.

- Relation with SIGMA: some questions had been raised by the experts on equipment and software at BFC head work in August 2005 concerning design documents. No reply was received before the mission and some mission time has to be devoted to the discussion of these questions. Unitary tests had been performed by SIGMA on sensors and gate control, but here also no result was provided to the experts. For a better efficiency of the missions, it is requested to obtain some information from SIGMA on the progress of the project. More generally, some comments were made to SIGMA about the presentation of documents (general maps showing the structures, general schemes explaining the roles and relations of components, etc.) and SIGMA answered that they will upgrade translation and presentation of project document.

PART B
SOUTH FERGANA CANAL

The mission spent three full days visiting the South Fergana Canal from October 18 to 20, 2006. As recommended during the last mission, the management of the Shakhrihkansay has been transferred to the SFC Management Organization. Automation of this structure and of

the intakes for the two other canals Savay and Andijansay has been included in the SIGMA contract. [1]

The following observations have been made during the inspection of the water works on the SFC:

The mission spent three full days visiting the South Fergana Canal from October 18 to 20, 2006. As recommended during the last mission, the management of the Shakhrihkansay has been transferred to the SFC Management Organization. Automation of this structure and of the intakes for the two other canals Savay and Andijansay has been included in the SIGMA contract. [2]

The following observations have been made during the inspection of the water works on the SFC:

1. **Intake of Shakhrihkansay-Andijansay and Savay**

All the gates are motorized. The gates are equipped of only one drive shaft by contrast with the gates of BVO Syr Darya, which are equipped of two shafts.
There is no compensation reservoir at the tail of the Andijan power plant.
The Andijan power plant is operated on the basis of irrigation requirements on a continuous basis. i.e. there is no production of peak energy.
The present operation consists in controlling the discharges in the three irrigation canals through hydro-posts (Q=f(H)). The power plant management organization checks the releases to irrigation canals on a hydro-post located about one-km upstream from the trifurcating structure. Minor adjustments are done if necessary to balance the flow released from the reservoir and the flows released to the irrigation canals.

2. **Intake of SFC**

The intake of the SFC consists of a weir without any control gate. The Shakhrihkansay intake is equipped of three gates to be used for flow control. The mission could not test their functioning because of failure of power.

3. **Akbura Water works at DP 36: Crossing of Akbura River**

The two siphons under the river are not gated. The aqueduct over the river drains into a very short pool with two gates supplying a small irrigation canal and two other gates connecting with SFC. These four gates are still under repairs (no motors and bent shaft)

4. **Aravansai Water Works at DP 261: Crossing of Aravan river**

The three siphons under the river bed are not gated. The only gate at that site is an escape with will be equipped with a level emergency device. The gate was tested manually because of a problem with the switch board.

5. **Khamza Water works at DP 360: Diversion of Karkidon Canal:**

[1] Automation of the structures fro the diversion of the Akbura and Aravan rivers to the SFC has been downgraded to monitoring saving some funds for the automation of the trifurcation structure.
[2] Automation of the structures fro the diversion of the Akbura and Aravan rivers to the SFC has been downgraded to monitoring saving some funds for the automation of the trifurcation structure.

That structure is the most important one of the SFC, as it controls the diversion of water to the Karkidon reservoir. The three gates controlling the flow to SFC were tested. The head gate of the Karkidon canal was also successfully tested. That structure is ready for automation.

6. **Karkidon reservoir:**

The 70 m high Karkidon dam was built between 1962 and 1967 before construction of Andijan dam. The 212 million me reservoir was playing a key role in operation of the SFC Canal for storage of the unregulated water diverted from Akbura and Aravan rivers. The reservoir released water to a short link canal with SFC through two hollow jet gates. The reservoir still plays an important role for the operation of the 120-km long SFC canal as a compensation reservoir. The target flow in the downstream section of SFC is controlled both at Khamza structure and at Karkidon reservoir. The hollow jet gates were tested during the visit.

7. **Palvantash Water works at DP 570:**

That structure is located at the upper section of two high chute structures, one equipped of 14 drops and the other one with a steep uniform slope. Only the later is equipped of three gates. Electric motors have not been installed. Motors of the three gates at the head of the Mayarik canal have not been installed.

8. **Tolmazar Water Works at DP 670:**

This structure diverts water to the Kuasi canal through a radial gate. The regulator on the SFC consists of two bays, with only one equipped of a radial gate. Motors have not been installed yet.

9. **Beshalishai Water works (DP 950**):

That structure located at the crossing of the SFC with the Yozovansai River through 3 siphons is the most complicated one on the SFC. It makes possible to transfer water between SFC and the river and the reverse. A diversion dam on the river consisting of 8 flat gates is located just downstream of the crossing with SFC to supply water to a left and right bank canals. All the 18 motorized gates of this complex are in working conditions. **The mission suggests not automating the eight gates of the diversion dam, which are kept close during the entire irrigation season.**

10. **Margilansai Water Works (DP 1034)**

That simple structure consists of a 3-bay regulator of which only two are equipped of motorized gates, and one-gate head works of the Margilansai canal. The two gates of the cross regulator are not in operating conditions and apparently rarely operated**. The mission recommends not to automate these two gates.**

11. **Faizabad Water Works (DP 1121).**

The water level control structure at DP 1121 consists of a long crested weir combined with an undershot gate controlling water level in the fore bay of a 10-unit pumping station (lift of 180 and 90 m).

This structure provides an excellent example of the design and advantages of long crested weirs. This structure could be replicated in many locations in the Fergana, at the levels of main or secondary canals, to make the operation of the systems easier and more reliable.

The design of the structure controlling the water level for the pumping station at DP 1193 is based on the same concept although with some differences in application. The weir section only consists of two small weirs perpendicular to the canal on both sides of a central overshot gate. This structure provides a sufficient level control for a pumping station.

SDC project is limited to the automatic monitoring of these two structures.

In summary the following structures are presently ready for installation of the SIGMA equipment: Water works at head of Sharihkansai canal, SFC head works, Aravansai water works, Khamza water works, and Karkidon reservoir. Few of the 170 irrigation outlets have been repaired.

PART C
ARAVAN AKBURA CANAL

1. Visit of Aravan Akbura Canal

The mission visited this canal on October 21, 2006 and was accompanied by the Chief Officer of Osh Basin Organization and by the Chief Officer of AAC Organization.
The 4 structures included in the project have been inspected and it was found that:

- All gates have been repaired, painted and lubricated; the gate of the head work of Yangi Canal has to be removed and re installed.
- The two Bachkariov radial gates (automatic safety gates) have been repaired and work. One of them has been tried by raising the upstream level; it opens automatically when the water reaches a certain level and works smoothly.
- Electric motors have been installed at each gate and are ready to be automated
- Power is available at each structure.
- Canals have been cleaned and look in good condition.
- Irrigation outlets have not been inspected, but the Chief Officer of Osh Basin Organisation guaranteed that most of them have been repaired and that the remaining will be repaired before the end of the installation of the automatic system.

Conclusion:
Aravan Akbura canal is ready for the installation of the automatic data transmission and control system.

2. Detailed Design

The experts have received four reports before the start of the mission and one fifth concerning data and voice communication has been handed over in Tashkent. These documents have been reviewed and then discussed with Osh Organisations, with SIC and with Sigma:

- The general organisation of the system and the definition of the discharge and water level controls are absolutely correct.
- The last mission in October 2005 recommended to build a long crested weir at DP 135 and to mix in this point electronic and classical hydraulic controls This solution was agreed by Osh Organisation and SIC but farmers did not accept the construction of a weir across Kayirma canal. They feared that Yangi canal would receive more water and more sediment. Osh Organisation could not convince the m that it was not really true and they took the decision to come back to the electronic control which was agreed without problem.
- The mission well understands the reasons of this change. Experts think that electronic control is also convenient but they regret that this solution which is very interesting for small structures could not be applied as a demonstrative example.
- As regards electrical and electronic circuit as well measuring equipment, PLC's, PC's and all other electronic devices, SIGMA has applied the same principle as for BVO Syr Darya. The mission agrees on this proposal provided mall adaptations request for BVO Syr Darya are incorporated.
- As regards radio communication, SIGMA proposes a two levels network: one sub network using only one UHF frequency for data transmission and a second sub network using 2 VHF frequencies for voice communication.
- The voice communication sub system utilizes one repeater set at D P 135 which makes it possible to cover the whole area. This is a classical design for radio communication.
- The solution proposed for data transmission with only one frequency is less classical. At DP 135 there are two radio sets equipped with directional antennas and connected through a PLC's. The PLC's manage radio emissions of the two radio sets in order to avoid any risk of interference.
- SIGMA should give a formal guaranty of good operation of this one frequency sub system. In case it is not functioning satisfactorily, SIGMA would be obliged to use two frequencies and to install a repeater. Presently only three frequencies are available and it would be necessary to apply for a forth one.
- SIGMA has not completed a full radio wave propagation study. They think that the study they have already done is sufficient because they have a sub contractor for radio who is specialized in this domain and know very well the local situation. In addition, distance between the various points is not important.
- There again, SIGMA should give a formal guaranty.

Conclusion

The design of data transmission and control system proposed by SIGMA is satisfactory. Improvements done on BVO system should be applied on AAC system.

SIGMA should guaranty the satisfactory functioning of the radio and in case of unexpected problem should modify and adapt the radio system, for example addition of a forth frequency.

CONCLUSIONS AND RECOMMENDATIONS

Nearly one year before the completion date of the Fergana Valley canal Automation project, only the equipment for the BVO works has been installed. If the contracts for the implementation of the projects in the three pilot canal projects are not signed in the coming weeks it is unlikely that the equipment could be installed and tested before the closing date of the project in December 2006.

Training of the operation staff is essential for the success of the project. SIGMA should be responsible for this training. However SIC-ICWC should be responsible for training the high level and field staff on the overall concept of the automation project, particularly the adopted control strategy for the Feeder canal, which is not yet fully understood by all parties involved.

The experts would also like to stress the importance of the maintenance of the control equipment. They support the project of contracting the maintenance to SIGMA through annual contracts.

BVO Works:

The experts recommend that commissioning of the data transmission and control system be only accepted when the following work has been done and properly documented:

- Diagnosis (and repair of any faulty component provided by SIGMA) on the operation of gates
- Alarm on gate failure: when the alarm disappear the gate must return in automatic mode
- Readjustment of gate coefficient done only once a day and when there is a large change in discharge
- Corrections in level sensors installation or calibration
- Correction of discharge and level management on the feeder canal
- Successful test of GRPS data link.

Maintenance and training are two important issues particularly for the BVO Water Works. Adequate solutions must be found for training before the system is handed over to BVO. Maintenance must also be well organized before the end of one year guaranty by SIGMA.

Pilot Irrigation canals:

The team suggests that the contracts with SIGMA for the implementation of the three pilot canals be signed since the focus of the project is automatic monitoring of the flows and analyses of volumes allocated to each balancing site. However the experts are concerned that most of the outlet gates have not been repaired. The purpose of the project is to monitor the allocation of water and to re-adjust the gate to achieve equitable allocation. If the outlet gates cannot be adjusted, the purpose of the project is defeated.

1. **Aravan Akbura canal**:

The mission recommends that SIGMA be ordered to install the equipment of the Aravan-Akbura canal. The mission found that the repair works have been completed. The design of the telecommunication and control system is appropriate.

The mission recommends that SIGMA gives a formal guaranty of satisfactory functioning of the radio communication system using three frequencies and be obliged to modify and adapt the system in case of problem (utilization of a forth frequency).

The team understands the objections of the user associations to the construction of a long crested weir, which was proposed for demonstration.

2. **South Fergana Canal**:

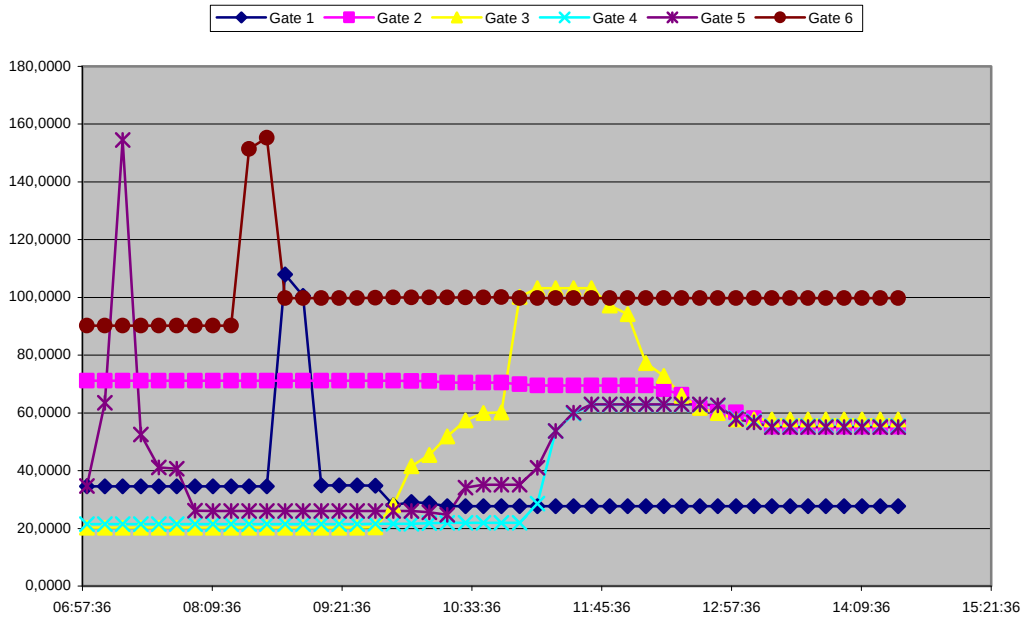
Although the installation of electrical motors has not been completed and maintenance works of the gates is not yet satisfactory, the mission recommends that the contract with SIGMA be signed. However the SFC Canal Organization should be strongly requested to improve the maintenance program of the gates (repairs, painting and greasing).

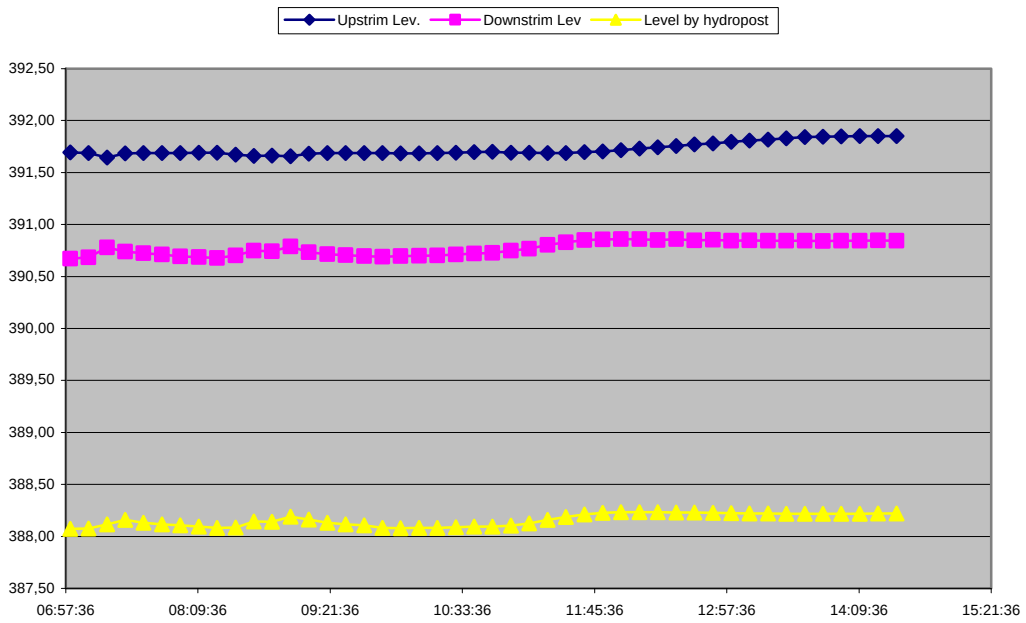
The mission recommends to limit the implementation of water level controls where it is strictly necessary, for example at the diversion dam of Beshalishai water work, and to focus on measurement and data transmission.

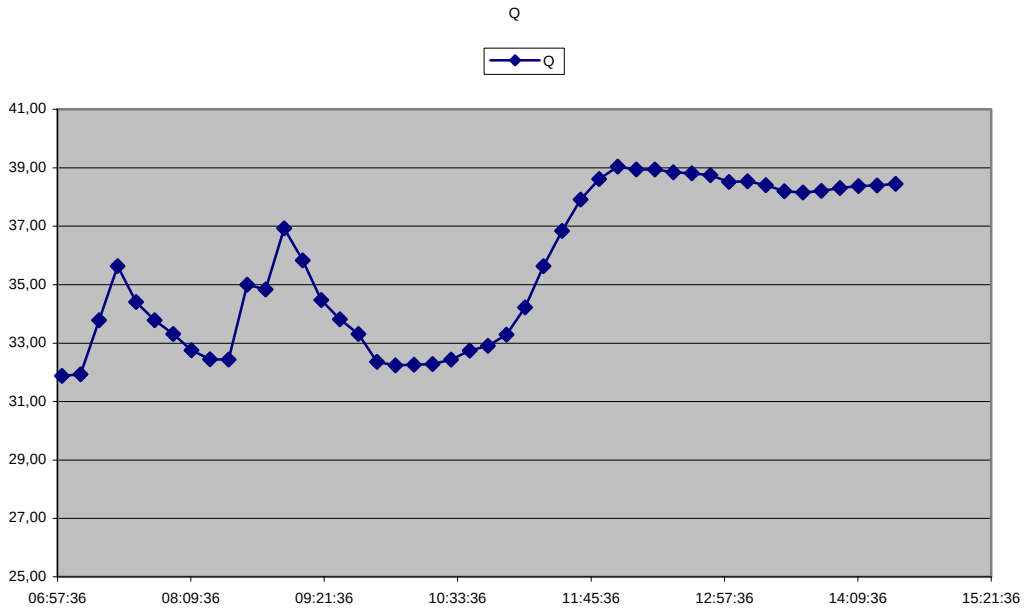
3. **Khoji Bakirgan Canal:**

The mission was not able to visit the project area. A combined SIC-ICWC and SDC mission should be organized and a report submitted to the expert team on the progress with the repair works and the rehabilitation works to be carried out under ADB assistance. The report should provide detailed information on the works where SIC-ICWC is considering the construction of long-crested weirs.

ANNEX 1
AHUNBABAEV TEST



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ANNEX 2

DETAILED AGENDA OF THE OCTOBER 200 MISSION OF INTERNATIONAL CONSULTANTS

October 11, 2006: Arrival in Tashkent
Meeting with Dr. Dukhovny at SIC-ICWC to discuss the overall agenda of the mission

October 12, 2006:

Meeting with SIC-ICWC staff and SIGMA to discuss the Aravan-Akbura project

October 13, 2006

Travel from Tashkent to Andijan
Visit of Kuygunar dispatcher near Andijan

October 14, 2006

Travel to BFC head works at DP 15; inspection and testing of the BFC regulator and Uchkurgan canal regulator

October 15, 2006

Travel to Hakulabad regulator. Inspection and testing of the intake;
Inspection and travel of the Big Andijan regulator at DP 66

October 16, 2006

Preliminary debriefing with Messrs. Krahenbuel and Jalalov with attendance of SIC, SIGMA and BVO Syr Darya staff.
Visit of the Uchkurgan dispatcher and the Uchkurgan hydro-complex structure.

October 17, 2006

Visit of the Akhunbabayev canal regulator; inspection and testing of the intake; visit of the escape at DP 140;
End of the visit of BVO works.

October 18,2006

Start visit and inspection of the South Fergana canal (SFC)
Visit of the head works of Sharihansai canal near Andijan dam,
Visit of the SFC head works
Visit of the SFC water works at crossing the Akbura river;
Visit of the SFC water works at crossing the Aravan river

October 19, 2006

Transfer to Fergana city.
Visit of the central section of the SFC:

October 20, 2006

Continuation of the visit of SFC

October 21, 2006

Travel to Osh
Visit of the AAB canal

October 22, 2006

Day off

October 23, 2006

Travel from Osh to Tajikistan Border and return to Osh during the night.

October 24 , 2006

Organization of the return travel to France via Bishkek. Drafting of the mission report

October 25, 2006

Flight to Bishkek. Contact to SDC Regional Office
Continuation of report drafting

October 26, 2006

Continuation of report drafting

October 27, 2006

Flight from Bishkek to Paris via Itambul

ANNEX 3

PERSONS MET DURING THE MISSION:

SDC:

Juerg Krahuenbuhl: Water sector Adviser
Sandjar Jalalov; Water Sector Manager

SIC-ICWC

Dr. V. Dukhovny Director
I.Begimov: Automation Expert
Felix Einhor: Water Allocation expert

SIGMA

S.N Vasilenko Director
Michael Tolstunov Technical Director
Yuri Smetanin, Program Engineer

BVO Syr Darya

Ilhomjon Manajanov: Head of BVO Naryn-Karadarya
Niyzov Nizomali Head of Naryn Syr-Darya Section
Ulchyev Atham head of Communications and Automation

South Fergana canal Organization

Roustam Roustamov: Head of SFC Organisation

Aravan-Akbura canal Organization

B. Matraimov: Head of Osh Basin Organisation
Mavlan Alimov: Head of Aravan Akbura Canal