Telemetry System in the Irrigation Network

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Abstract: *The irrigation system of Pakistan is the largest integrated network in the world. There are 3 major storage reservoirs, 19 barrages, 12 inter-river link canals, 45 independent irrigation canal commands and over 1,22,268 watercourses. Network of irrigation of the province of Sindh consists of 3 barrages and 14 canal commands.*

The irrigation water is being used for agricultural, industrial and domestic purposes. Owing to mismanagement and inequitable distribution of water, it is necessary to have a fool-proof system where water is supplied to the end-users judiciously. The canal operation is carried out with the help of water levels in the canal. To record water levels, staff gauges have been installed at every head regulators. This enables the canal operation staff to observe and record water levels. Therefore, this system of canal water management based on water level recording is tampered, which ultimately leads to inequitable distribution of water.

Telemetry System has been designed to observe discharge with the help of gate openings and water levels. Since sensors are used to observe these parameters, therefore, it helps in obtaining accurate measurements. The telemetry system is linked to the entire network and can be facilitated at any other place through telephone/radio system, thus information is spread out to every corner simultaneously. Thus it helps enormously the managers in proper regulation and distribution of water while the farmers know about the quantum of water received by them. This system is widely practiced in the developed countries. It has been recently introduced in the irrigation system of Pakistan at Twin Jamrao Head, a major distributary of Nara Canal. The telemetry system is working very efficiently and has opened new vistas; however, it requires willingness and participation of the engineers and farmers.

INTRODUCTION

Irrigation system of Pakistan is the largest integrated network in the world. There are 3 major storage reservoirs, 19 barrages, 12 inter-river link canals, 45 independent irrigation canal commands and over 1,22,268 watercourses. Network of irrigation of the province of Sindh consists of 3 barrages and 14 canal commands.

In Sindh, canal operation is carried out with the help of water levels in the canal. To record water levels, staff gauges have been installed at every head regulator, cross regulator, bridges and along the canal at regular intervals. This enables the canal operation staff to observe and record water levels.

Any abnormal variation in the water level indicates discharge variation in the canal. Abnormal decrease of water level along the canal may indicate abnormal withdrawal of supplies from a canal, which may result in reduced supplies to outlets (karias) downstream. However, an abnormal increase in the water levels may indicate abnormal entry or availability of water in canal, which may be due to sudden closer of outlets by khatedars due to rains as happened during monsoon rains of July 2003. Sudden increase of water level in the canal may result in breaches in the canal bank. Breaches have often resulted in large-scale submergence of land, roads, villages and destruction of standing crops. However, if a canal is running at full supply discharge, then it is presumed that the canal is also carrying full supply discharge, which may not always be correct. Since silting of bed of the canal reduces the area of the canal section and consequently reduces the full supply discharge capacity of the canal, even if the water level in the canal remains at full supply level. Therefore, it is not correct to assume that if the canal is running at full supply level it is also carrying full supply discharge.

Gate Operator/Tandel

The water level data is collected by Beldars and Tandels (gate operators) and is transmitted to higher offices by Canal wires along the canal. Since fudging and wrong reporting of data is a common practice all over the world especially in far off and hazardous places, it should hardly be expected that the gauge heights data of the canal also collected throughout the year and reported by Tandels in Sindh, who can be influenced by khatedars and landlords, would always be correct. Moreover, since a Beldar is required to carryout several more functions daily like maintaining of service roads, banks and canal section etc. He may become too tired to walk or ride cycle to a far off water level gauge twice daily to record water level readings especially when there is no supervisor available to all the time, therefore he may be inclined at times to report fictious data. The system in vague therefore, depends entirely on the honesty, integrity and hard work of Beldars and Tandels. In the prevailing socio-economic conditions it should hardly be expected from a low paid Beldar that he remains honest and hard working while others around him enjoy all sorts of illegal benefits. Therefore, the system of canal water management based on water level recording has many loopholes and cannot be relied upon any more.

Obsolete Gauge Recording

The gauge heights recording instruments were introduced as a state-of-art method in the 19th century when the canals were originally introduced. However, during the last century, tremendous development has taken place in the field of water storage recording, discharge measurements and also in transmission of data. Unfortunately, in Sindh the original method of recording of data is still being used. This method has become obsolete and probably in use only in this part of the world. In view of the above the system of water management based on gauge heights data has lost its credibility altogether.

Water users/Farmers

Farmers at head of channels took more water than due share, whereas, at tail of channels Farmers suffer owing to shortage of water. Ultimately, tail-end farmers have been worried for not receiving their due share in our country and particular in the province Sindh. This situation has led to migration of tail-end farmers and peasants for looking their livelihood in the province of Sindh. This condition creates due to not equitable and judicious distribution of water in irrigation network of Sindh.

Modern Water Technology

Western countries though have much smaller canal systems and supply waters to much smaller land and few number of farmers, have been continuously upgrading their data collection and transmission techniques and have adopted state-of-art methods and technologies during every period. Pakistan is far behind the west in adoption of technology in nearly every field. However, it has the knowledge and capability to upgrades its technologies including water technologies. In nuclear field and in aviation, Pakistan is equal to if not ahead of the west. In IT, it is making very quick strides. The new state-of-art water technology is known as Supervisory Control and Data Acquisition **SCADA/Telemetry System**. This technology is simple, suitable, fool proof and completely automatic. Sindh has surplus electronic engineers who can be employed in large numbers if Sindh adopts the new technology. SCADA/Telemetry system is used extensively all over the world to collect data of canals, tube wells, pipelines, plant etc. it is extremely useful for monitoring and collection and transmission of data from a remote or hazardous location. The new technologies can revolutionalise the irrigation management in Sindh. It will allow supply of design discharges in branches, distributaries, and minors and allow judicious and equitable distribution of water among khatedars especially to those lying at the tail of the canal. The system has many advantages and can point out the location of losses of water from the canal. It can improve the safety of canal structures from breaches and can avoid flood situation as is being created nearly every year. The control of Beldars, Tandels and Sub-engineers will be minimal.

Water Management Strategy:

The water management strategy means, the distribution of water in line with design and available proportion of water. The water distribution strategy cannot be made without actual and proper available data. Therefore, the strategy relies on and takes in account the water availability (water level in reservoir, expected surface flow), the water demand (irrigation, urban/rural supply and industrial). The strategy results in the following major decisions:

- Diversion of water from dams/reservoirs/rivers/canals
- Allocation of water quota to the various stakeholders
- A reservoir/dam strategy (availability water target monthly)

Water Supply:

Water supply is related to delivery of required quantity of water to stakeholders. It might be split in four tasks:

Water Supply Management: Water Supply Management could be applied the results of availability of water on daily basis, taking into account the actual water situation. The objective is to ensure the supply of due share of water to each stakeholder.

Operation of Infrastructure: The task consists in physically adjusting gates, opening and closing valves, and starting pumping stations, according to the of Water Supply situation.

System Monitoring: The objective of this task is to monitor the operation of the system, and to check that daily water management decisions have been correctly implemented in the field. It relies on hydraulic measurements (flow, water level, and water quantity).

Water Supply Control: This task consists in analyzing field measurements in order to establish statistics. The objective is to follow-up and controls the implementation of the water management strategy, and to provide statistics for future water management planning.

Water Distribution

Water Distribution consists in the management of the irrigation network. It involves the operation of the network head structure, and the farm turnouts.

Water Distribution activities may be divided into four tasks:

Organization of Irrigation Schedule: The output of the task is a weekly calendar (or bi-weekly), which schedules the days and hours during which each farmer is entitled to receive water. This schedule takes into account the water quota resulting from the water management strategy, the

crop water requirements, and the irrigation network physical constraints.

Water Delivery to the Farmers: This task consists of opening and closing of farm turnouts in order to provide water according to the irrigation schedule. The schedule may be modified one day prior to irrigation: either according to farmer's requests in case of unexpected events

Water Demand Assessment: This task consists in checking farm crops, in order to establish a Planting Register. The Planting Register is used to compute present and future water needs, and farm quotas.

The Water Management Information System (WMIS): The Water Management Information System (WMIS) is an Information Technology tool developed to assist and achieve optimal water management. WMIS is an integrated system, as it covers all tasks related to water management, from management of water resources, down to water distribution to the farmer.

Since 1960, telemetry has been used to *monitor* the performance of water and sewage pumping stations, and water reservoirs. This telemetry was designed, assembled and installed in-house, and eventually featured a variety of technologies, depending on the era" of installation at each site. The technology *more-than-met* the needs of the distribution until the late 1980's.

Description of Area

The study area is located in the Nara Canal system. The Nara Canal off takes from Sukkur Barrage and splits into five main canals, as *Jamrao*, Mithrao, Khipro, Hiral and Thar. From these main canals, branch canals, minor and outlets and lift machines off take water. There are 163 distributaries, 830 officially sanctioned direct outlets and 328 lift machines exist of which 178 are sanctioned. In 2001 the *twin Jamrao canal* was commissioned, the twin Jamrao system has design discharge 3400 cusecs and its length is 124 miles/203 km, and it consists Branch canals (West branch, Dim branch, Shahu branch and lower Jamrao canal), 16 distributaries,58 minors and161 direct outlets.

SCADA/Telemetry System Installed at Twin Jamrao Head Regulator Nara Canal

The Telemetry System has been installed at Twin Jamrao Head Regulator Nara Canal, the sensors analysis have been installed with measuring scale of gates opening boxes and one sensor has been installed one and half feet above bed level at upstream of Head Regulator. The field instrumentation and control equipment has been installed in the room, which is constructed on the left side of canal. The sensors will transmit data to field instrumentation and control equipment. The remote stations are located NDP office Karachi, SIDA office Hyderabad, NCAWB Mirpurkhas. The telemetry communication network transfers data collected through the field instruments with in the SCADA system. The telemetry system consisted on telephone lines, radio, and cable or satellite terminal. This telemetry system is communicating and supplies data to the mentioned offices regularly. The staff of IPD, NDP, SIDA and stakeholders is receiving data regularly. This system is providing and supplying data accurate and better way. The staff of IPD and SIDA is remaining all time aware about discharge and water position at Head Regulator, on that basis they can make distribution of irrigation water on justifiable and equitable in the command area of canal in line with available quantity water in the canal network. The discharges manipulated by telemetry system have been compared with discharges measured through velocity rod and current meter. There is less difference in comparison among them. Therefore, this system may be installed entire irrigation system of Sindh that the distribution of water can be equitable and right. Through this system all farmers from head to tail of channel can receive their due share of water. Out of this system there is main benefit that all stakeholders can acquire position of available of water in irrigation canals, on that based they can demand of their right and due shares, therefore the irrigation staff can not make exploitation of distribution of water in canal system.

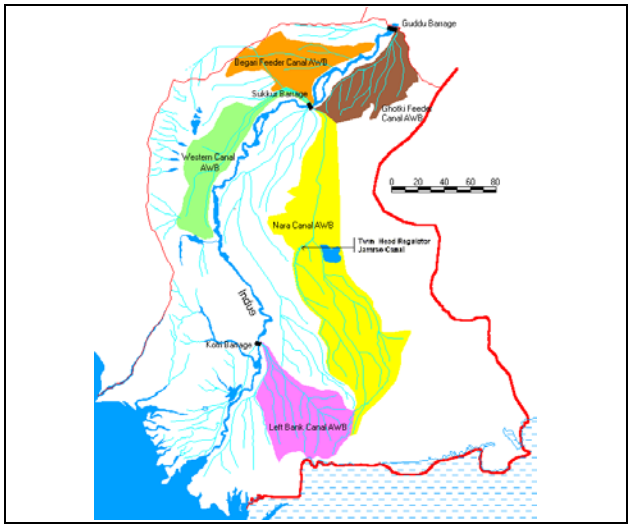

Figure: 1 Shows the Installation of Telemetry System on Head Regulator of Twin Jamrao canal.

Supervisory Control and Data Acquisition SCADA/Telemetry System

At International level, much development and progress has been made in diverse field through modern technologies. Modern technology has been applying for integrated water resources at world level but particularly in developed countries. Modern technologies such as Telemetry system, GIS and MIS are particularly related to irrigated agriculture. These countries have got much benefit from

modern technology (Telemetry System) in equitable and judicious distribution of irrigation system and network. Accordingly, there is dire need of application and utilization of such type of technology to introduce in the irrigation network of Sindh. The objective and purpose of introducing the telemetry system is to make equitable and right distribution or water from head to tail network of the province of Sindh.

SCADA/Telemetry System is a combination of data acquisition and telecommunication system. The SCADA system collects information from the field, transfer it to a central control site or main computer conducts the necessary computation and analyses and then displays the data on computer screen. Control functions are automatic and do not need any operator instructions. The data so collected is transferred by telemetry system with the help of one of the telecommunication system options, which may include satellite communication.

The Main Components of SCADA/ Telemetry System are:

- Filed instrumentation and control equipment
- Remote station
- Communication network, and
- Central monitoring station

The data from the field is collected by field instrumentation and control equipment. These include sensors, meters and or actuators and are directly connected to the canal gates at regulators. It is this equipment, which records data and transfer it to remote stations.

The remote station is located at a suitable location in the canal network like offices of sub divisional officers, etc.

The telemetry communication network transfers the data collected through the field instruments with in the SCADA system. The telemetry system may depend on telephone lines, radio, and cable or satellite terminals.

The data is transferred to the central communication station, which is equipped with computers. At the central communication station the data is processed automatically by computers and very useful information in the form of output is supplied, which can be used by canal managers. The computer output consists of real time water levels and canal discharge. The system can be programmed in such a way that water level computed discharge for even every second can be supplied. Each Executive Engineer and Superintending Engineer may have monitoring system installed in their offices. This helps in proper regulation and management of water resources. The facile and rapid dissemination of information helps in controlling of water theft and canal breaches. The collection of sound data is beneficial in the planning and development of the irrigation system.

Benefits of modern SCADA Telemetry systems

The tangible benefits of SCADA/Telemetry system can, and should, be identified to meet business justification requirements; many unquantifiable or unanticipated benefits have subsequently been demonstrated. These less tangible benefits add considerable value to the investment and help to illustrate that the use of modern SCADA/Telemetry technology is a fundamental strategic tool for operations as the new century approaches.

The Strategic Benefits of modern SCADA systems include:

- Improved operating and stakeholder/ customer service capability
- Opportunities to standardise operating procedures and to better utilise staff
- Reduced costs and risks through standardisation of technology: maintaining SCADA, training operators, etc
- Reduced incident risks through the reduction in the number and severity of operational incidents and improved capability to respond once an incident has occurred (remote monitoring, remote control, and ability to control groups of assets)
- More knowledgeable and capable staff, learning through the power of the technology
- Better ability to negotiate with water managers and stakeholders
- Improved capital and maintenance planning through more integrated, useable information
- Improved ability to integrate with information systems such as financial, customer, maintenance management, planning, geographic, email, etc
- Improved ability to take advantage of any opportunities.
- IPD staff and Stakeholders receive information about distribution of water in their offices

CONCLUSIONS

SCADA/Telemetry systems should be seen for their value as a powerful, integrated information system, linked to distribution of irrigation water, urban / rural supply water, waste water and ground water. Through this modern SCADA/ Telemetry system organizations related with water can manipulate about distribution of water The discharges manipulated by telemetry system at Twin Jamrao Head Regulator have been compared with discharges measured through velocity rod and current meter. There is less difference in comparison among them. Telemetry data is provided in annexure-1. There is no doubt that water is precious and essential for all living flora and fauna, therefore dire step should be taken for saving water. All the stakeholders would receive their due share from head to tail of irrigation network through the installation of this system. Telemetry System will bring a great change and help in ensuring equitable and judicious distribution of irrigation waters. However, it requires

willingness and participation of the stakeholder. All potential users/stakeholders should be extended input to decision making through processes such as Value Management Studies, as SCADA is an expensive tool, which can yield great benefits if the right proposal is formulated and the full potential is harvested. These users include planners, operators, customer service staff, contractors, business strategists, and senior management. Decisions should not be made which limit the use of systems to a single group of users in the organization.

Operation of hydraulic schemes dedicated to irrigation is being analyzed with an increasing acuity, the Operators are being asked to improve their management of water resources. The use of Information Technology tools, is certainly a way to achieve this objective.

The system designer must take into account these practices in order to ensure the integration of the system in the chain of decision-making. The art of the engineer, when designing a Management Information System, is to define the fine line between process logic, and integration to existing practices. If this challenge is successfully tackled, the system may actually help the Operator to improve operational organization procedures, and tend toward optimal water management.

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