# Flow And Pressure Calibrations In The Kabini Command Area's Bulk Flow Water System– A Means To Accomplish 24x7 Water Supply

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***Abstract-*** *Calibration is a process wherein the results of a model are compared with field observations [1]. This paper focussed on Calibration of the Kabini bulk water supply system from which the water is supplied to several District Metered Areas (DMAs) of Mysore city. Kabini bulk supply system supplies water to totally 16 DMA's of Mysore and regions of Dattagalli, MUDA Layout and Bank Colony. On an average 62 MLD of water is delivered from this bulk system. Calibration was done considering mainly two parameters; flow and pressure. The field observations were compared with the original design and the factors causing the fluctuations in flow and pressure were identified and studied.*

***Keywords***- Flow calibration, Pressure calibration, Bulk flow meter, Pressure gauge, Flow pattern, Kabini Bulk supply system, 24 x 7 water supply

## I. INTRODUCTION

Generally, divergence between the output of the model application and the field observations carried out for the calibration purposes are caused by factors such as incorrect model parameters (pipe roughness values and nodal demand distribution), incorrect network data (pipe diameters, lengths, and so on), erroneous network geometry (pipes connected to the wrong nodes), erroneous pressure zone boundary definitions, faults in boundary conditions (i.e., incorrect pressure regulating valve settings, tank water levels, pump curves),error in past operating records (i.e., pumps starting and stopping at incorrect times), faults in measuring equipment (i.e., pressure gauges not properly calibrated) and errors in measurements (i.e., reading the wrong values from measurement instruments). In general, a network model calibration effort includes seven essential stages:

- Identifying the anticipated use of the model
- Determine preliminary estimates of the model parameters
- Assemble calibration data
- Assess the model results
- Carry out macro level calibration
- Perform the sensitivity analysis
- Carry out micro level calibration [1]

In this thesis work, Kabini command areas bulk system's calibration studies were carried out. The process of calibration of the Kabini command areas bulk flow system aimed in classically modifying system demands, and validating the field values of flow and pressure parameters with that of designed values.

### 1.2. DESCRIPTION OF STUDY AREA

The water that is being supplied to several District Metered Areas (DMA) of Mysore is drawn from Kabiniriver that flows through Bidaragudu village, Nanjanguduthalluk, Mysore district. This intake point is nearly 25kms away from the Mysore city. The intake is situated at an elevation of 663m above the sea level. The water is being pumped from the river intake to the treatment plant that is situated at a distance of 1.5km from the river intake. Once the treatment is done, the water is pumped to the Intermediate Booster Pumping Station junction (Pinjarapole) which is located at a distance of 11.5kms from the treatment plant. Tapping of this pipeline is done at Thallur junction in order to supply 3.45 MLD of water for nearly 30 villages of Nanjungudthalluk. The water from the IBPS is once again pumped to the city where in the pipeline splits into two at ParasayyanaHundi(Ring road junction).From this junction, one pipeline is connected to Kuvempunagar while the other connects J.P Nagar. On an average 62 MLD of water is being supplied to the city every day. Considering the design period as 30 years, the design was done in the year 2009. The demand was calculated by considering water requirement at a rate of 167 lpcd (135 + 15% transmission loss + 6% floating population demand + 2% fire demand) and the water requirement for villages was taken as 55 lpcd. This project was launched on 22nd October,2012 and since 1st November,2012 the project has been successful in supplying Kabini water to the areas of Mysore that includes Kuvempunagar, Jaynagar, Ashokpuram, Dattagalli,

Ramakrishnanagar, J.P.Nagar, Nanjumalige, Aravinda Nagar and Srirampura. It is designed to supply water to the regions of Vijaynagar 3rd and 4th stage, Hootagalli, K.S.B Colony in the coming future.

## II. METHODOLOGY

### 2.1 Flow Calibration Of Bulk Water Supply System-Source To Treatment Plant, And Treatment Plant To The Distribution Reservoir

The fig.1 shows the flow pattern from the source to the distribution unit. For flow calibrations, bulk flow meters were set up mainly at four junctions; at the Jackwell outlet, at WTP outlet, at IBPS outlet and at Kuvempunagar inlet. The flow readings at all these stations were monitored and recorded daily for a period of three months from 14-12-2015 to 14-03-2016.

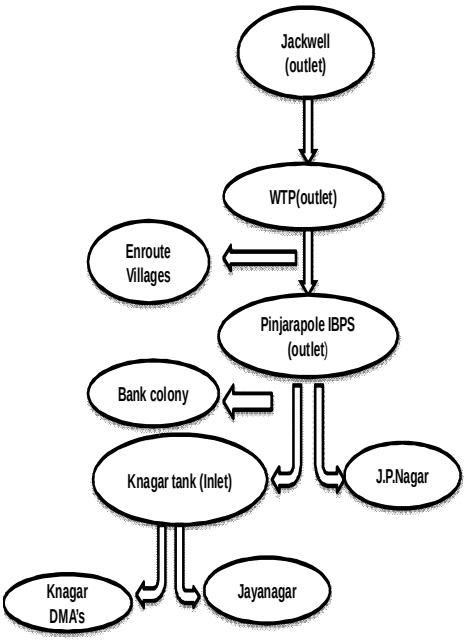


Fig 1: Positions of Flow meter

The fig.2 below represents the Bulk Flow Meter which shows the flow in m3/hr and also reads the total forward flow.

Fig 2: Bulk flow meter readings

Once the calibration of flow by considering these 4 junctions were completed, field survey and data were studied to know the exact flow of water into each of the DMA's. Bulk flow meters installed at various DMA's of Kuvempunagar were not in working condition and there were no BFM to account the flow to Bank colony areas and Jaynagar. Thus under this scenario, the population data of those areas were considered and demand flow was calculated at a rate of 200lpcd. From this it was known that on an average 3 MLD of water is being supplied to bank colony, MUDA employees layout and railway colony and also 18.69 MLD of water is being supplied to Jaynagar and neighboring DMA's. As BFM's installed at J.P.Nagar inlet were not in working conditions, the flow to J.P.Nagar was considered as the difference between the flow at IBPS and the flow at Kuvempunagar inlet and this reading obtained almost matched the reading obtained from calculating the demand for that area. Thus the flow was calibrated only for the bulk supply system and for the distribution networks the flow pattern were just studied based on population data.

### 2.2 Pressure Calibration of bulk water supply system

As this bulk supply system operates under pumping system, the pressure showed a greater values and this pressure was required in order to cater large amount of water to a greater distance. Thus, for the purpose of calibrating pressure, pressure gauges were installed at all the three pumping mains s shown in fig.3 and the readings were recorded at 1 hr interval for a period of 1 week (7 days).

Fig 3: Pressure meters

## III. RESULTS

### 3.1. Flow calibration

After calibrating the flow, it was known that there were fluctuations in the designed flow and the actual flow which is represented in table 1.

Table 1: Flow Calibration Results

| Pipelines | Average Flow of 3 months (MLD) | Designed Flow (MLD) | Difference (MLD) |
|---|---|---|---|
| Jackwell to WTP | 83.2625 | 63.09 | 20.1725 |
| WTP to thallur junction (enroute villages) | 66.832 | 63.09 | 3.742 |
| Enroute Villages | 4.059 | 3.45 | 0.609 |
| Thallur junction to IBPS to P.Hundi | 62.873 | 59.64 | 3.233 |
| P.Hindi to Ring road junction (KEB circle) = KNagar+Bank Colony | 53.766 | 30.64 | 23.126 |
| Ring road junction (KEB circle) to Bank Colony | 3 | 3 | 0 |
| Ring road junction (KEB circle) to Vijaynagar (Basavanahalli,3rd stage ,4thstage,KHB colony) | 0 | 14.23 | |
| Ring road junction(KEB circle) to KNagar inlet | 50.54 | 27.64 | 23.13 |
| Knagar inlet to Knagar DMA'S | 31.85 | 27.64 | 4.21 |
| Knagar inlet to Jaynagar | 18.69 | 0 | 18.69 |
| P.Hundi to JPNagar(DMA 1112 and 1200) | 9.10 | 7.4 | 1.7 |

As per the design, 14.23 MLD of water had to be supplied o the region of Vijaynagar. But in real situation, Vijaynagar regions are not given any supply. Instead Jaynagar and its surrounding DMA's are given a supply of 18.69 MLD. Also on an average, 0.6 MLD of water is being supplied in excess to enroute villages (Thallur) and 1.7 MLD of water in excess is supplied to J.P.Nagar. And in actual scenario, the J.P.Nagar line is extended and connected to the line coming from Jaynagar creating a loop. On the whole, approximately 3.742 MLD of water is supplied in excess from the Kabini command area. This increase can be attributed mainly to the increase in the population when compared to 2009 (designed year). Also, the major issue was at the source. As per the BFM readings recorded at the intake point, on an average daily 83 MLD of water is being extracted from the source but only 63 MLD of water is reaches the WTP and is being supplied. Nearly 20 MLD of water is being unaccounted and the reason behind this was left unstudied.

### 3.2 Pressure Calibration

Pressure variations were recorded at every 1 hour interval for a period of 1 week at all the three pumping mains and also the time at which highest value and lowest value was read has been given in the tables below.

Table 2: Highest and lowest pressure recorded at the Jackwell

| Jack well | Highest reading recorded | | | | Lowest reading recorded |
|---|---|---|---|---|---|
| Date | 25th | 21st | 23rd | 22nd | 21st |
| Time | 7:00 am | 11:00 am | 3.00 pm | 4.00 pm | 3:00am5:00am and 11:00pm |
| Pressure (m) | 42.50 | | | | 39.0097 |

Table 3: Highest and lowest Pressure recorded at WTP

| WTP | Highest reading recorded | Lowest reading recorded | |
|---|---|---|---|
| Date | All days | 21st | 23rd |
| Time | Varied time and repeating | 11:00 am | 9:00pm |
| Pressure (m) | 80.0025 | 75 | |

Table 4: Highest and lowest pressure recorded at WTP

| IBPS | Highest reading recorded | Lowest reading recorded |
|---|---|---|
| Date | 23.5.2016 | 21.5.2016 |
| Time | 4:00am | 9:00am |
| Pressure (m) | 79 | 72.5 |

The pressure readings were recorded for a period of 7 days. Daily average was calculated and compared with the pressure as per the design. Table 5 below shows the comparison of average pressure recorded at all the three junctions for the period of 7 days with the pressure as per design.

Table 5: Pressure calibration results

| Location | Avg pressure(m) | Pressure as per design(m) | Diff(m) |
|---|---|---|---|
| Jackwell | 40.69 | 36.52 | 4.17 (10.64%) |
| WTP | 78.44 | 77.99 | 0.45 (0.55%) |
| IBPS | 76.09 | 80.37 | 4.28 (5.32%) |

In case of the Jackwell, the field average pressure was 4.17m greater than that of the design pressure. This was because 20MLD of water in excess were being pumped from the jackwell that added an extra load on the pumping mains and thus to deliver this amount of water the pressure were on a higher ranges than that of the design.At WTP, the recorded field pressure and the designed pressures did not show any significant differences. While in IBPS, a difference of 4.28m was noted. This difference can be attributed to the changing heads. The pipeline from IBPS splits into two where one supplies to Kuvempunagar while the other to J.P.Nagar as discussed in the study area. As both these junctions have varying head and the supply timings are also varying, this causes the pressure fluctuations and thus the values are different from that of the designed pressure values.

## IV.CONCLUSIONS

For the kabini bulk supply system, from where the water is being supplied to several parts of Mysore city flow and pressure calibration were done. Bulk flow meters were used for flow monitoring while pressure gauges were installed for reading pressures. The results showed how there were fluctuations in the flow and changes in the flow pattern. This changes cause variations in the head, velocities and pressure in the pipelines. Also pressure was monitored and calibrated well and the reasons for variations in pressure were studied and identified. Surge tanks and Pressure Relief Valves were installed at suitable locations in the bulk supply, in order to withstand the high pressure and its fluctuations. As there were changes in the flow pattern and the amount of water being delivered, this necessitated redesign of the hydraulic network as the future scope.

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