MANUAL AND GUIDELINE

EQUITABLE DISTRIBUTION AND NON-REVENUE WATER MANAGEMENT BY USING SCADA

MARCH 2018

DELHI JAL BOARD

MANUAL

EQUITABLE DISTRIBUTION AND NON-REVENUE WATER MANAGEMENT BY USING SCADA

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SCADA Standard Operational Procedure(SOP)

Topics to be Covered

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1. Steps to Start SCADA Server
2. Steps to Start SCADA Client(Locus)
3. Starting PNCS Data Transfer
4. Steps to Monitor SCADA Screens
5. Valve Control Procedure
6. Alarm Monitoring
7. Trends Use
8. History Playback Function
9. Dashboard Function
10. Alarm Set Points
11. Starting DATA Collection Server

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1. Steps to start SCADA Server

Steps to Start SCADA Server

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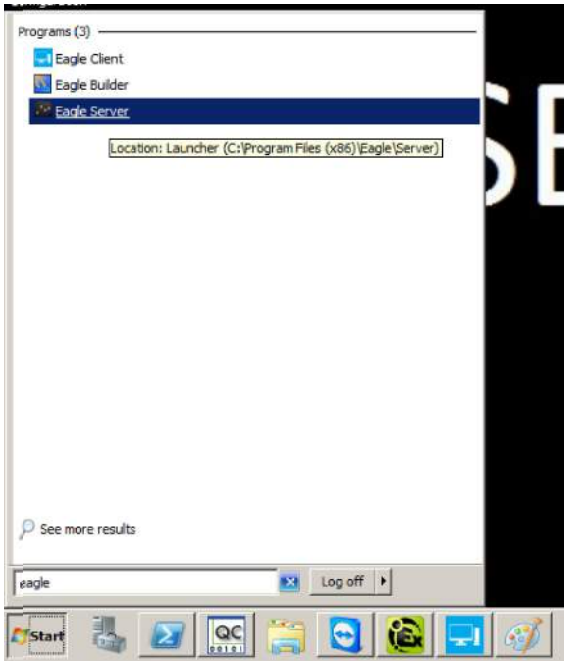
1. Go to Start and type Eagle Server



Steps to Start SCADA Server

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2. Following Window will appear

3. Now Click on Start All to start all the servers

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Steps to Start SCADA Server

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4. Following Screen will appear , when all servers are online

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2. Steps to Start SCADA Client(Locus)

Steps to Start SCADA Client(Locus)

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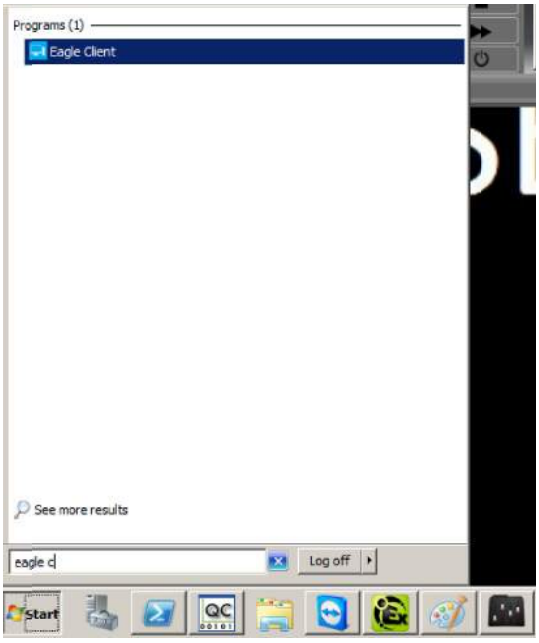
1. Go to Start and type Eagle Locus/Client



Steps to Start SCADA Client(Locus)

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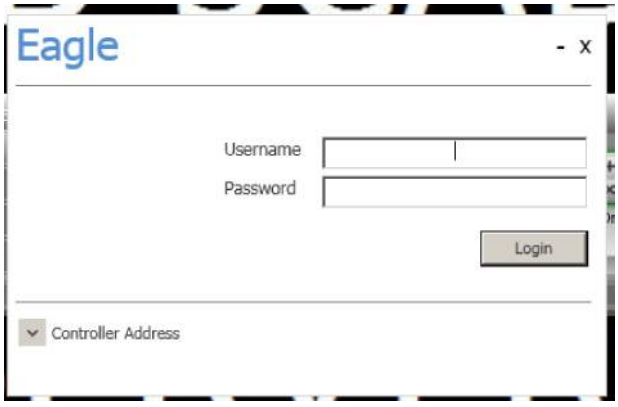
2. Following Window will appear



3. Type User Name and Password, given by Administrator

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Steps to Start SCADA Client(Locus)

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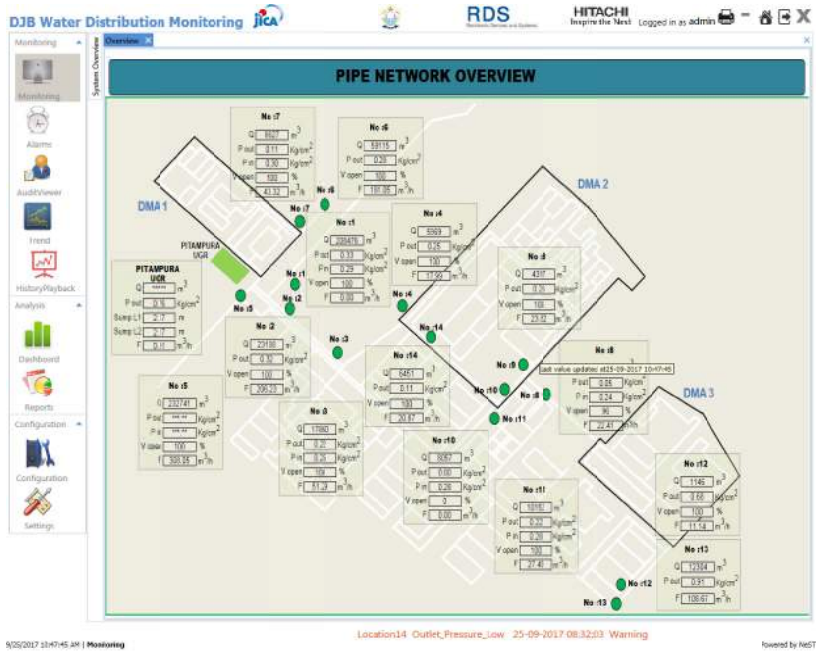
4. Following Monitoring Screen will appear



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3. Starting PNCS Data Transfer

Starting PNCS Data Transfer

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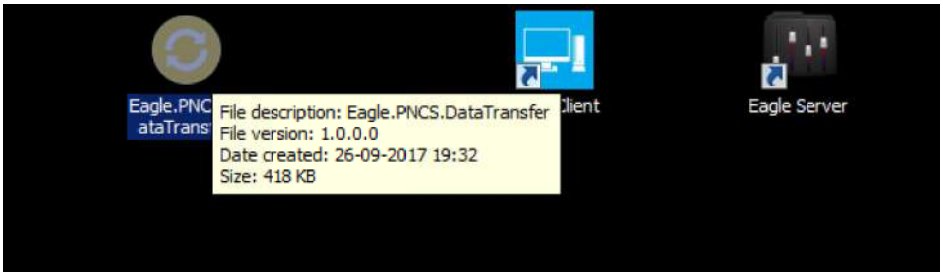
- **In order to Start Data Transfer to PNCS , double click on Eagle.PNCS.Datatransfer Application from the Desktop**



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4. Steps to Monitor SCADA Screens

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Steps to Monitor SCADA Screens

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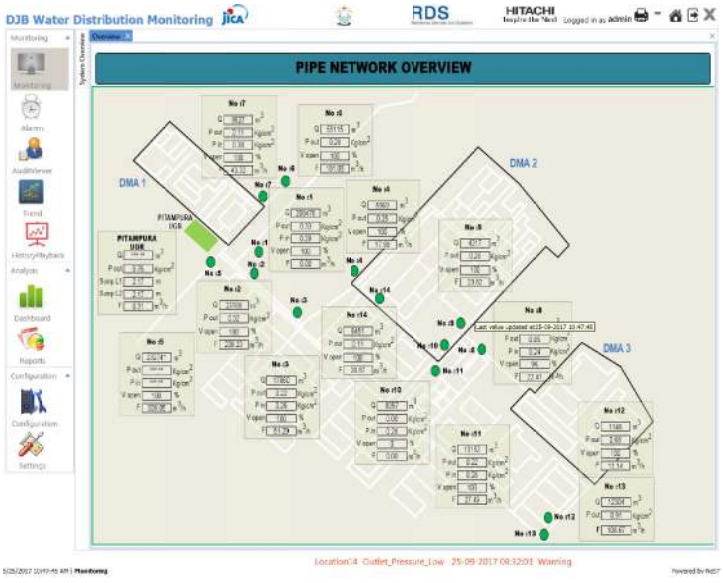
1. By default user will Logged In in Monitoring Mode
2. After Logging In you can go to any Location by clicking on Location no. in Overview Screen or by going in System Overview and Going on Particular Screen



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5. Valve Operation Procedure

Valve Operation Procedure

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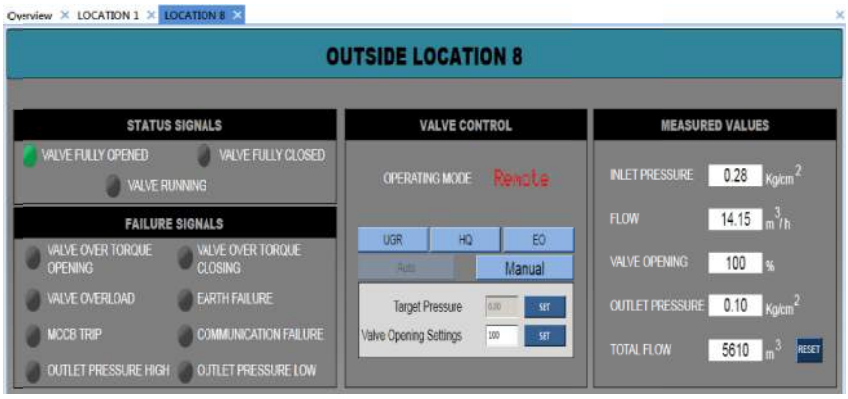
1. **Make Sure that Remote Mode is selected from the PLC Panel and it should be shown in SCADA**



2. **There are Two Modes of Operation from SCADA**
   - **Manual Mode**
   - **Auto Mode**

Valve Operation Procedure

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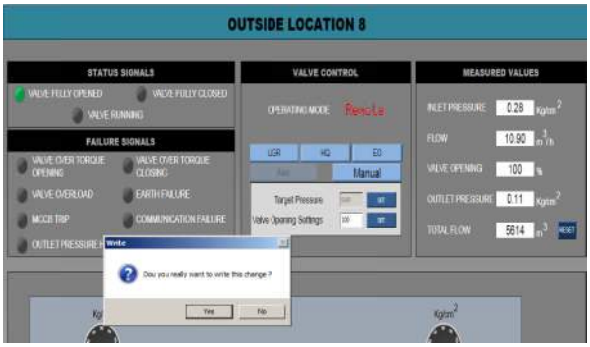
1. Select Manual mode from SCADA screen & Select Yes if you want to give Valve position setting



Dashboard Function

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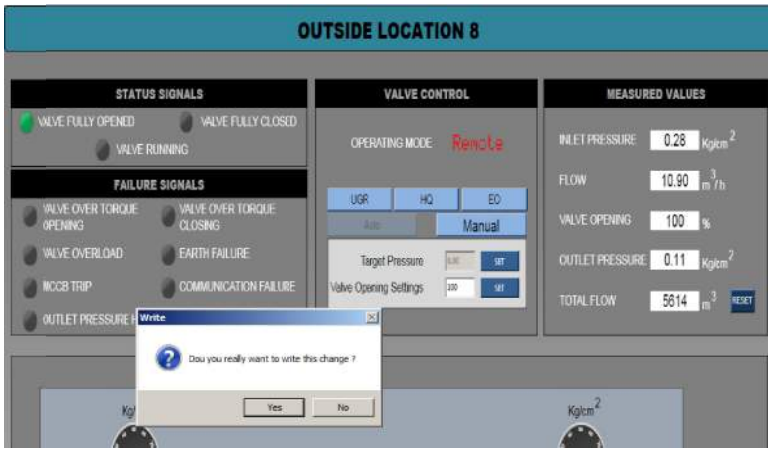
2. Then give Valve Opening Setting from 0 to 100 % & Select Yes.



3. There is a Buffer of 1 Minute in the SCADA, i.e. there should be 1 minute gap before giving next Command.

Dashboard Function

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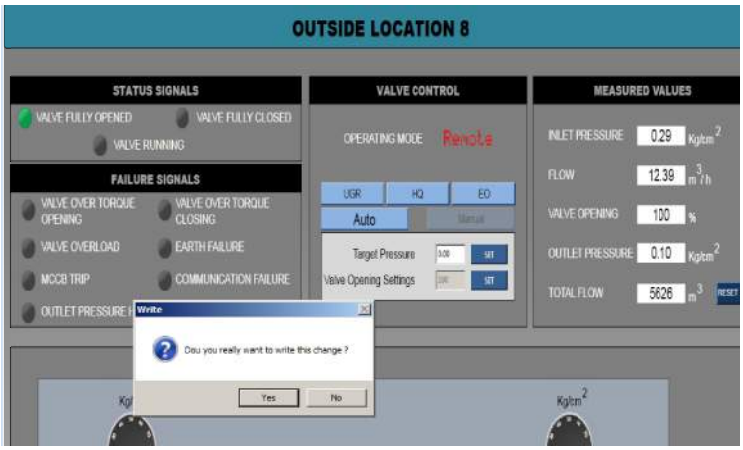
1. Select Auto mode from SCADA screen and then select Yes if you want to Set Target Pressure at the Output of the Valve

2. Then give Target Pressure Setting from 0 to 10 Kg/Cm^2 from the SCADA and Press SET and then Yes.



Valve Operation Procedure

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3. For Target Pressure we have a Accuracy of less +/- 1%

4. It you give Target Pressure of 1.2 Kg/Cm^2 if valve is fully closed then the system will maintain the Pressure of 1.1 to 1.19 Kg/Cm^2 .
Similarly if Valve is Full Open & if Outlet Pressure is 1 Kg/Cm^2 and we Set Pressure of 0.5 Kg/Cm^2 then the System will maintain the Pressure of 0.59 to 0.5 Kg/Cm^2

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6. Alarm Monitoring

Alarm Monitoring

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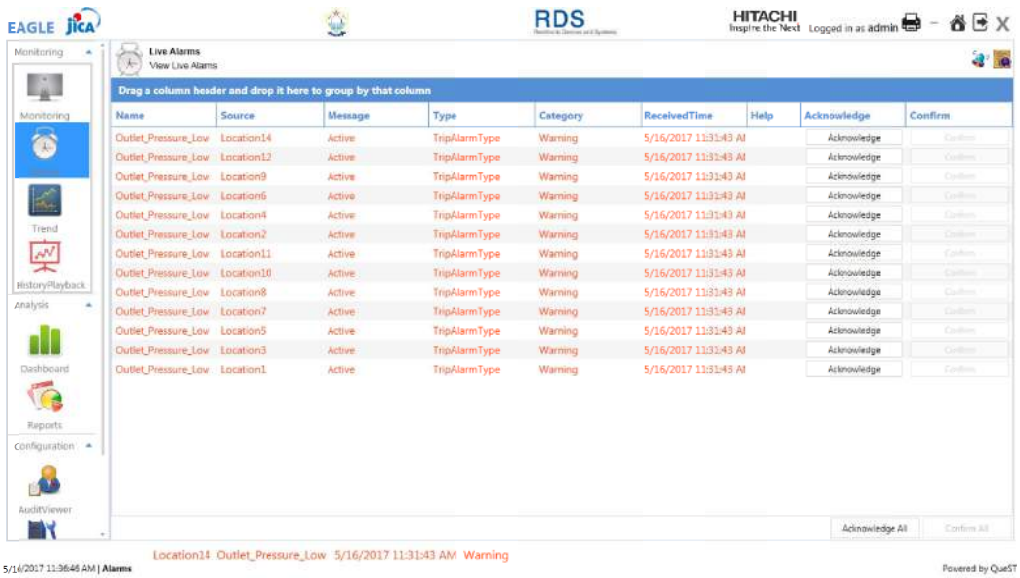
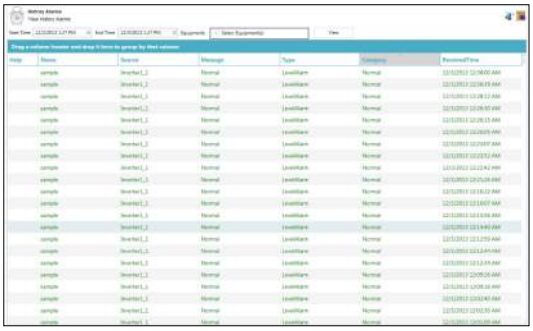
1. To see Alarms at Site click on Alarms & following Screen will appear



2. To see Historical Alarms at Site click on History Alarms & following Screen will appear
3. Select the Time Period and Click on View

4. Following screen will appear



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7. Trends Use

Trends Use

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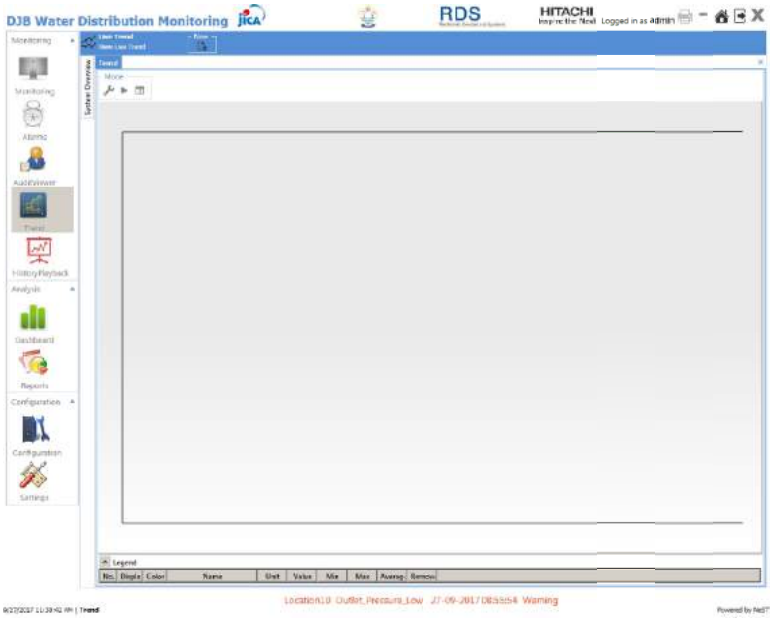
1. Click on Trend following Screen will Appear where a Trend window named as Trend is already added.



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Trends Use

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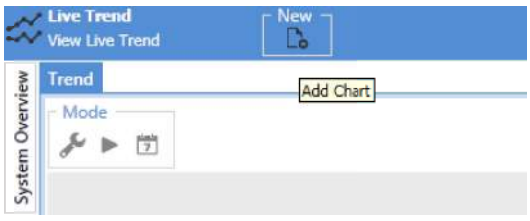
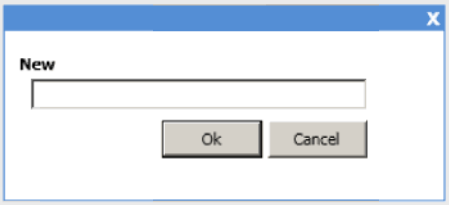
2. Otherwise Click On New , you can add a New Trend Window. As shown below.



3. Give Any Name and Click Ok, new window gets added



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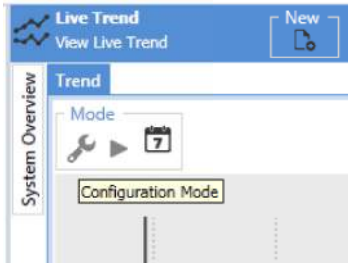
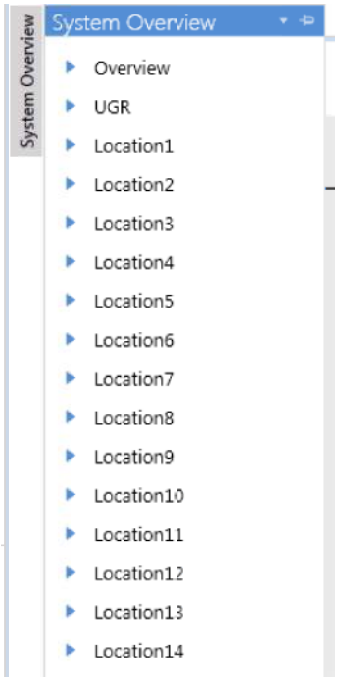
4. Now for Adding any parameter in trend go to Configuration Mode and then go to System Overview.





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Trends Use

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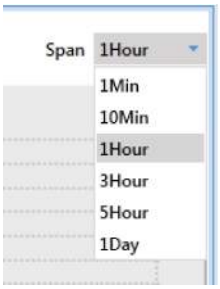
5. Then click on the Particular location

6. Then Select the Particular Parameter you want to see monitor in Trends and then drag and drop that as shown

7. In Order to see the live Value of the parameter select Live Mode and then select Span



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Trends Use

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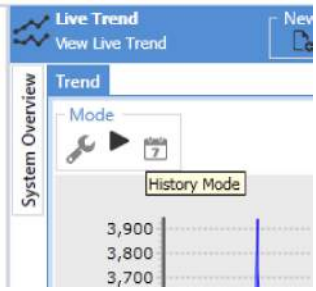
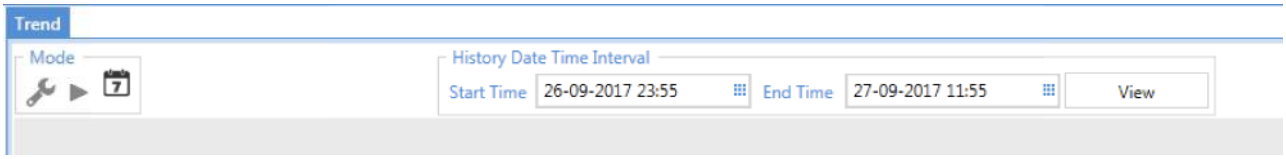
8. In Order to see the Historical Value of the parameter select History Mode and then select Start time and End time and then View

Note:- Always select time duration 6 Hours Earlier than desire. For example you want to see the value from 23rd Sept 8 PM then select time as 23rd Sept 2 PM.





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Trends Use

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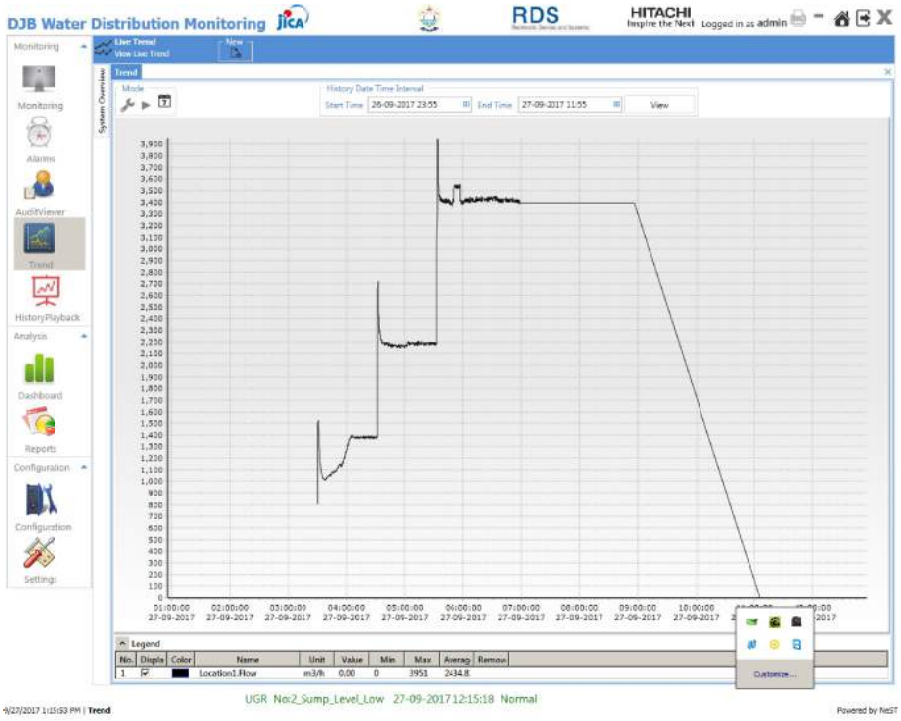

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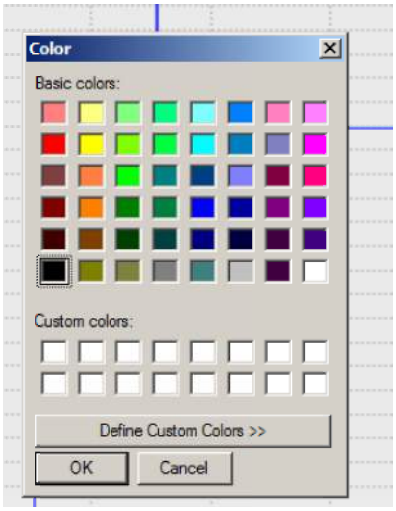
Sept 2017	HECSC	Hitachi India Pvt. Ltd	Sub-Title :– *SCADA SOP*		0	32

8. In order to change the color of the parameter Click on color and change it accordingly.



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8. History Playback Function

History Playback Function

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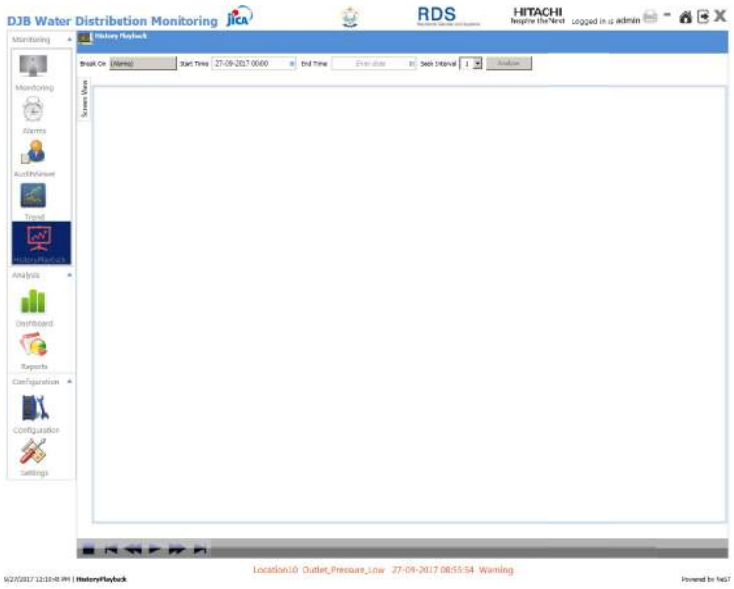
1. In Order to use this function click On HistoryPlayback following screen will appear



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History Playback Function

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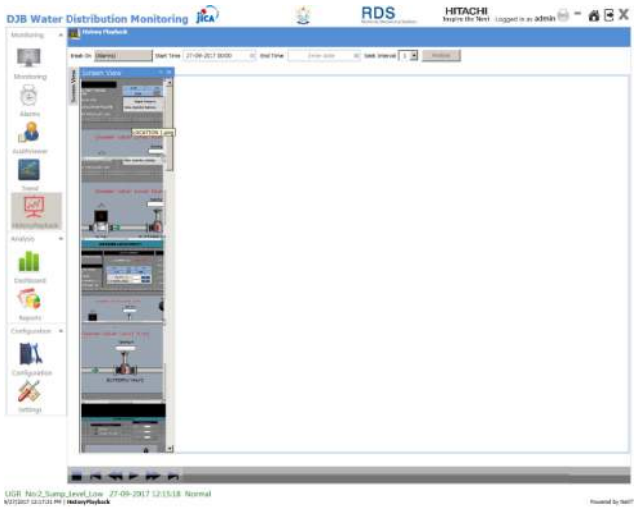
2. Then click on Screen View and drag and drop the Screen you want to Monitor

3. Then click on Start time and End time and then Analyse



History Playback Function

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4. Then click on Start , stop , Fast forward etc. accordingly.

5. If there are any alarms in the system , it will appear as shown. Click on that Alarm and we can find it

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History Playback Function

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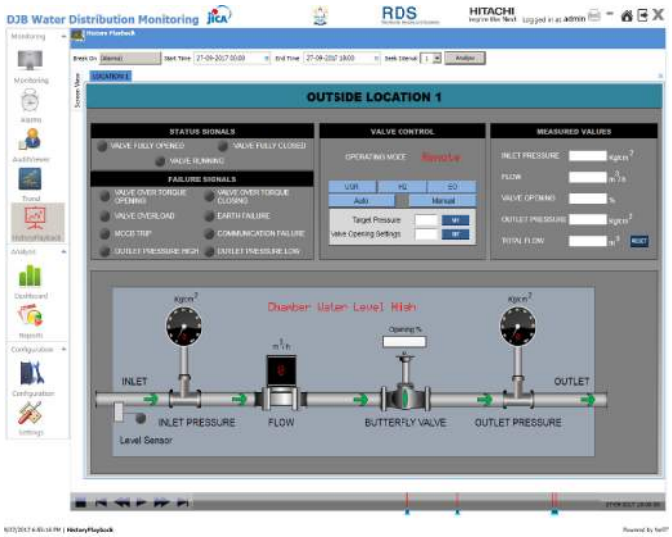

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9. Dashboard Function

Dashboard Function

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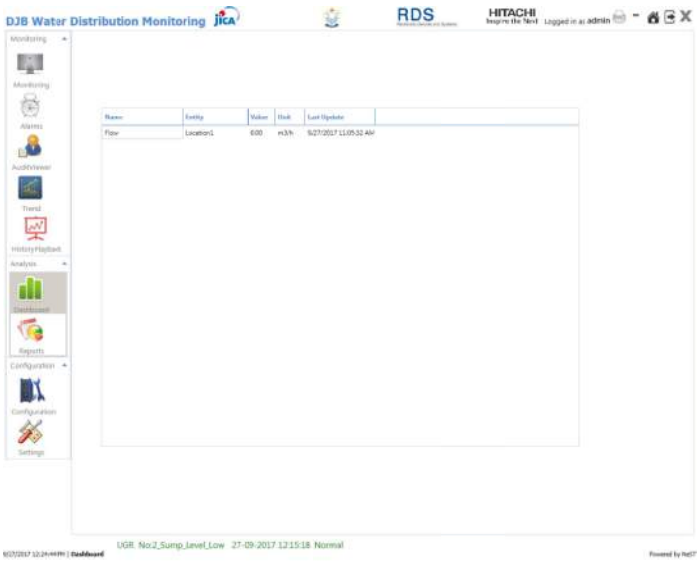
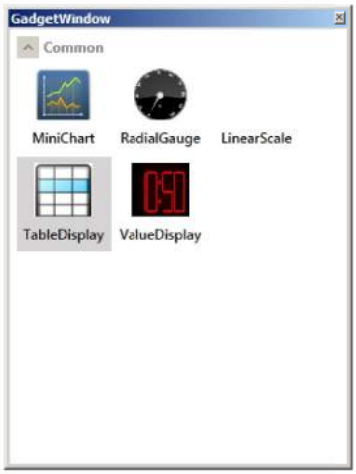
1. In Order to use this function right click and then select Edit
2. Then again right click and select Gadgets





Dashboard Function

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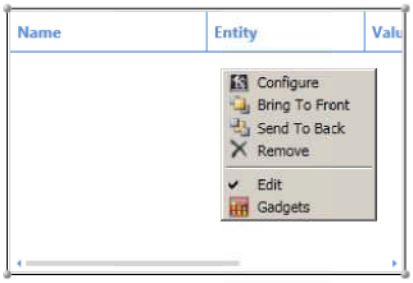
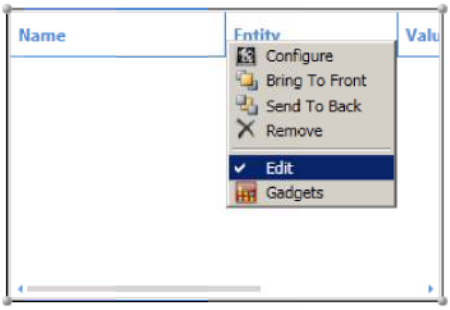
3. Then select the gadget according to your choice by Drag and drop.

Note: 1)Dashboard is used to monitor live values.
2) In a single table we can add maximum eight quantities.

4. For adding a parameter , right click and Configure



5. After completion , right click and then select Edit.



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10. Alarm Set Point

Alarm Set Points

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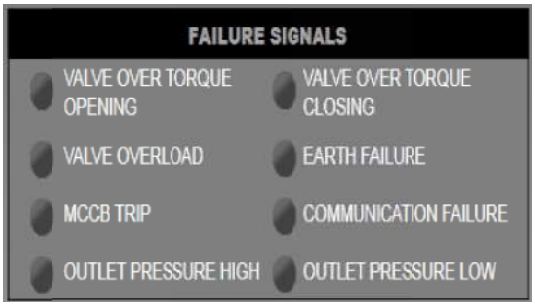
1. For Showing Location Pressure High Alarm
   We have given Set Point As
   Outlet Pressure > 2.5 Kg/Cm^2

2. For Showing Location Pressure Low Alarm
   We have given Set Point As
   Outlet Pressure < 0.01 Kg/Cm^2



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11. Starting DATA Collection Server

Starting DATA Collection Server

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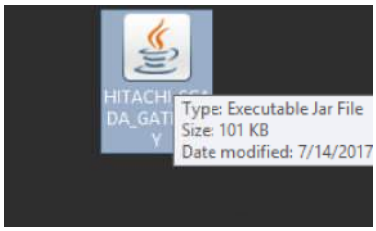
1. DATA Collection Server PC is Collecting Data from all 14 Remote Locations.

2. To Collect Data from all Locations,
   Start Hitachi_SCADA_Gateway application from the Desltop by Double Click as shown below



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Starting DATA Collection Server

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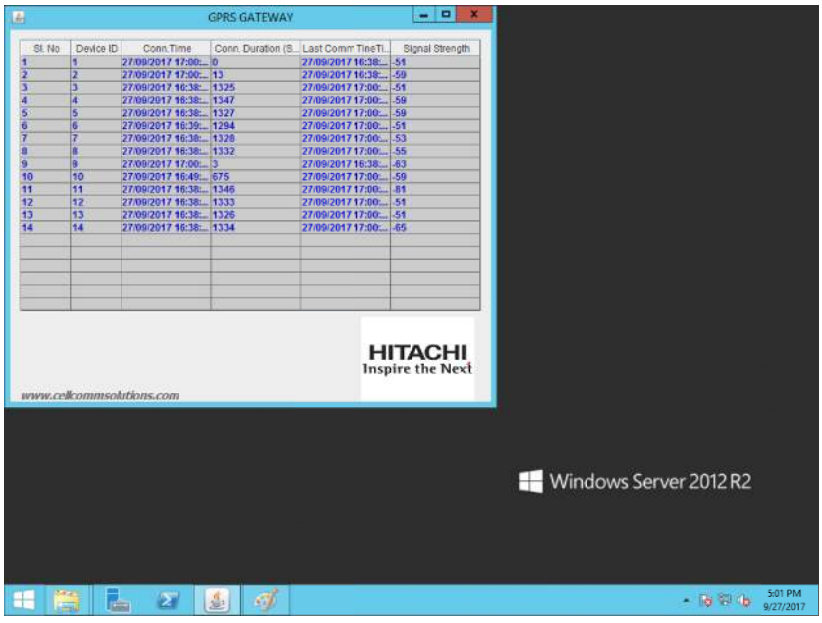
3. Following Screen will appear where all remote locations are showing connected.



Starting DATA Collection Server

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4. If any of the remote location is not connected then follow the steps given in on the SCADA room Guidelines

Note:- Whenever there is '****' is shown for a parameter in the SCADA , it indicates that remote location is not connected , then follow the same steps as given in the SCADA room Guidelines

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System Configuration , Major Devices, Their Use & Troubleshooting

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Topics to be covered

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1. System Configuration
2. View of Outside Location Panels
3. Major Devices Connected in Panel & their Use
4. Troubleshooting Procedure

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1. Overview of System Configuration

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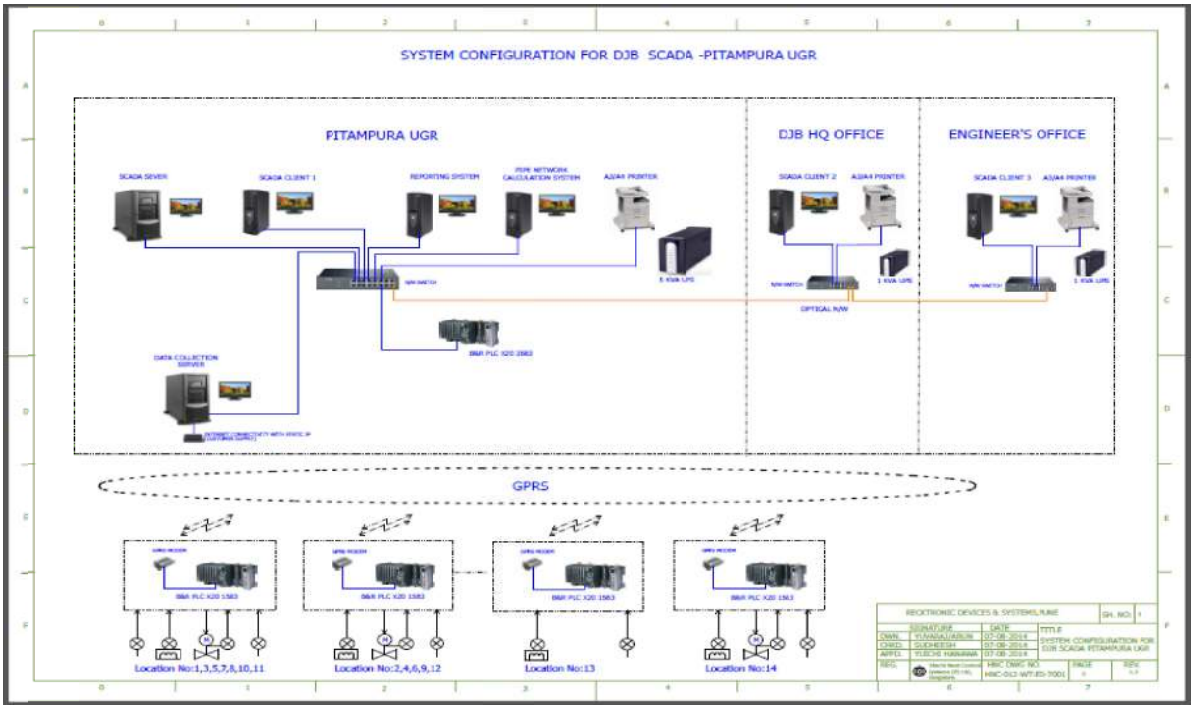

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2. View of Outside Location Panel

View of Outside Location Panel

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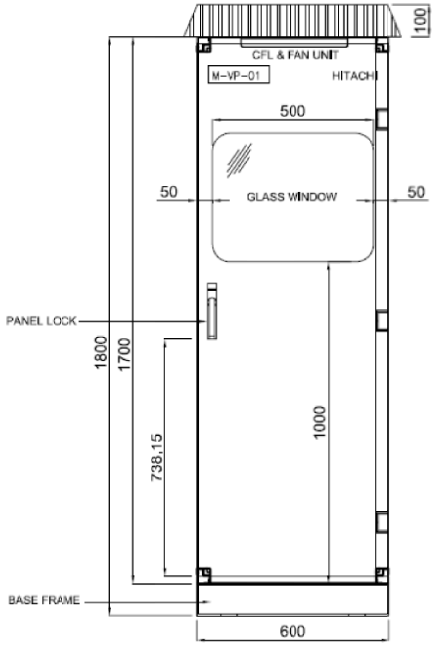
➢ Front View



FRONT VIEW

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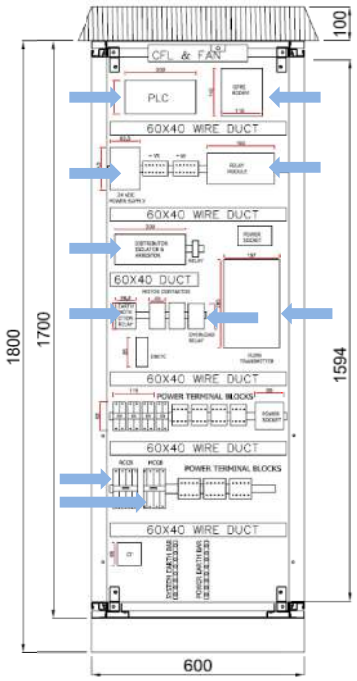
➢ Internal General Arrangement (IGA)



FRONT VIEW INTERNAL

View of Outside Location Panel

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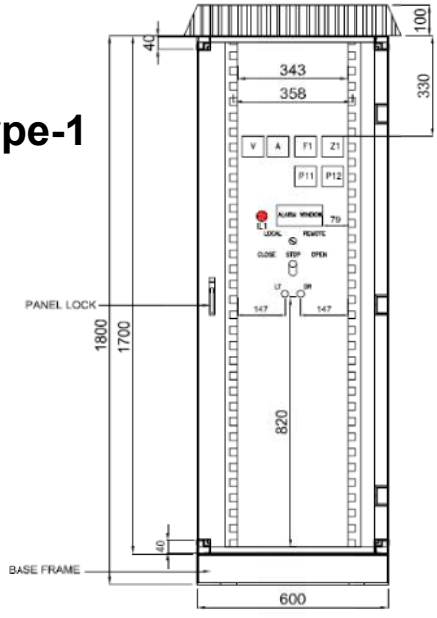
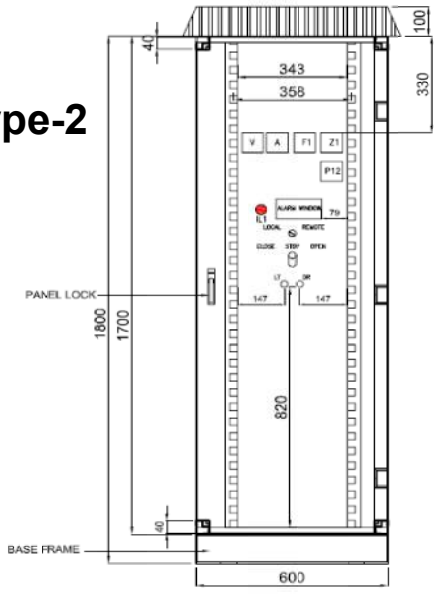
Type-1



FRONT INSIDE VIEW
SWING DOOR

Type-2



FRONT INSIDE VIEW
SWING DOOR

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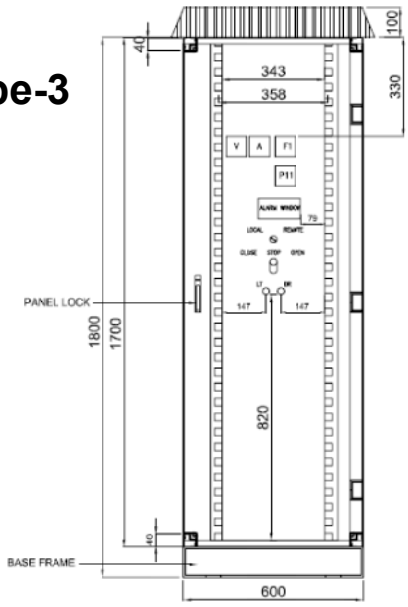
Type-3



FRONT INSIDE VIEW
SWING DOOR

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3. Major Devices Connected in Panel & their Use

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➢ RCCB(Residual Current Circuit Breaker)

Test Button

ON/OFF Switch

Major Devices Connected in Panel & their Use

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➢ Earth Fault Protection Relay(EFR)

Test Button
Earth Fault
Relay Active

Reset Button
ON Indication

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➢ Control Power Supply

Output Terminals

Status LEDs

Input Terminals

Major Devices Connected in Panel & their Use

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➢ MCCB

ON/OFF Switch

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➢ Differential Thermal Overload relays

Test Button

Overload Setting

Trip Detection & Reset

Major Devices Connected in Panel & their Use

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➢ Integrated PLC & Power Supply Module

PLC Status

Power Supply Status

✓ Checking Power Supply Module Status with LEDs

Figure	LED	Color	Status	Description
	r	Green	Off	No power to module
			Single flash	RESET mode
			Blinking	PREOPERATIONAL mode
			On	RUN mode
	e	Red	Off	No power to module or everything OK
			Double flash	LED indicates one of the following states: • The X2X Link supply for the power supply is overloaded • I/O supply too low • Input voltage for X2X Link supply too low
	e + r	Red on / Green single flash		Invalid firmware
	S	Yellow	Off	No RS232 activity
			On	The LED lights up when data is being sent or received via the RS232 interface.
	I	Red	Off	The X2X Link supply is within the valid limits
			On	The X2X Link supply for the power supply is overloaded

Major Devices Connected in Panel & their Use

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✓ Checking PLC Module Status with LEDs

Figure	LED	Color	Status	Description
	R/E	Green	On	Application running
			Blinking	Boot mode system start: CPU initializing the application, all bus systems and I/O modules[1]
		Red	On	SERVICE mode
			Blinking	The "R/E" LED blinks red and the "RDY/F" LED blinks yellow when there is a license violation.
			Double flash	BOOT mode (during firmware update)[1]
	RDY/F	Yellow	On	SERVICE or BOOT mode
			Blinking	The "RDY/F" LED blinks yellow and the "R/E" LED blinks red when there is a license violation.
	S/E	Green/Red		Status/Error LED. The statuses of this LED are described in section 4.12.3.4.1 "S/E" LED".
	PLK	Green	On	A link to the POWERLINK peer station has been established.
			Blinking	A link to the POWERLINK peer station has been established. The LED blinks when Ethernet activity is taking place on the bus.
	ETH	Green	On	A link to the peer station has been established.
			Blinking	A link to the peer station has been established. Indicates Ethernet activity is taking place on the bus.
	CF	Green	On	CompactFlash inserted and detected
		Yellow	On	CompactFlash read/write access
	DC	Yellow	On	CPU power supply OK
		Red	On	Backup battery empty

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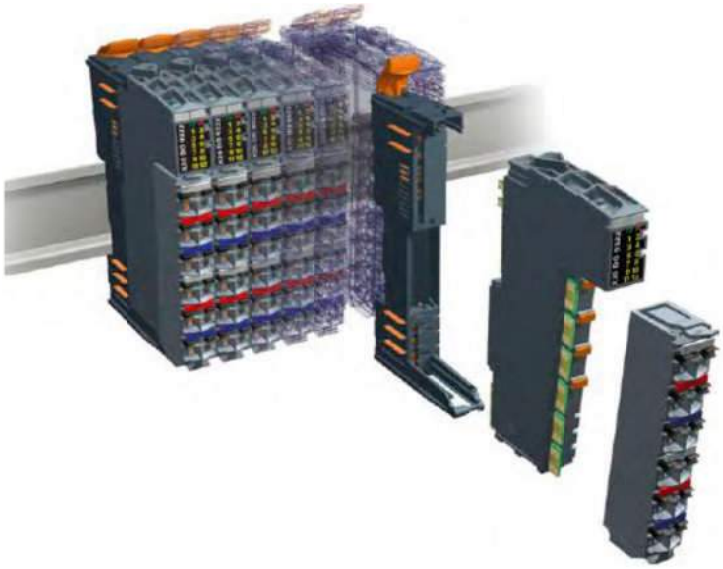
➢ Connecting I/O Modules



Major Devices Connected in Panel & their Use

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Bus Module

I/O Module

Connector

✓ Checking Digital Input Module Status with LEDs

Image	LED	Color	Status	Description
	r	Green	Off	No power to module
			Single flash	RESET mode
			Blinking	PREOPERATIONAL mode
			On	RUN mode
	e	Red	Off	Module supply not connected or everything OK
	e + r	Red on / Green single flash		Invalid firmware
	1 - 12	Green		Input status of the corresponding digital input

Major Devices Connected in Panel & their Use

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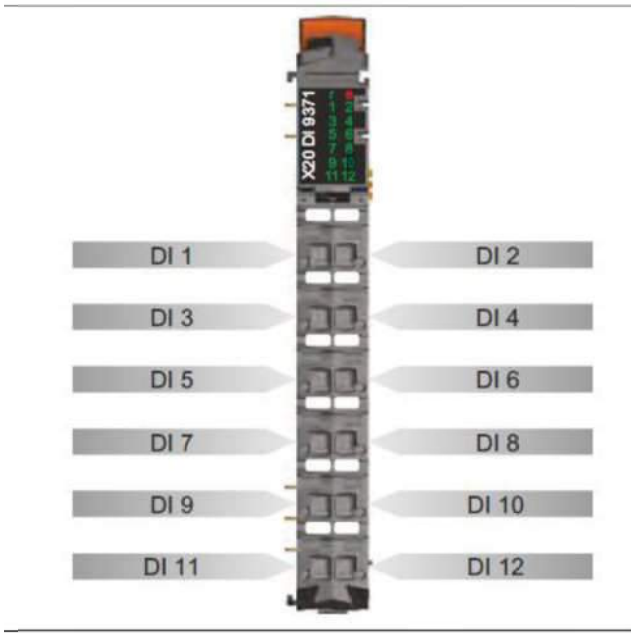
✓ Digital Input Module Pin Diagram



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✓ Checking Digital Output Module Status with LEDs

Figure	LED	Color	Status	Description
	r	Green	Off	Module supply not connected
			Single flash	RESET mode
			Blinking	PREOPERATIONAL mode
			On	RUN mode
	e	Red	Off	Module supply not connected or everything OK
			Single flash	Warning/Error on an I/O channel. Level monitoring for digital outputs has been triggered.
	e + r	Red on / Green single flash		Invalid firmware
	1 - 8	Orange		Output status of the corresponding digital output

Major Devices Connected in Panel & their Use

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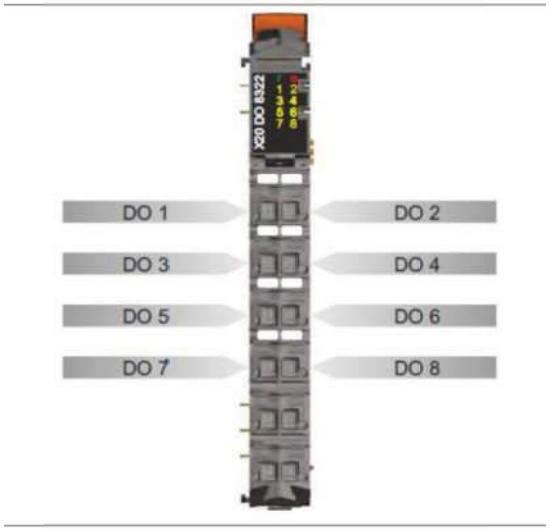
✓ Digital Output Module Pin Diagram



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✓ Checking Analog Input Module Status with LEDs

Figure	LED	Color	Status	Description
	r	Green	Off	No power to module
			Single flash	RESET mode
			Blinking	PREOPERATIONAL mode
			On	RUN mode
	e	Red	Off	No power to module or everything OK
			On	Error or reset status
	e + r	Red on / Green single flash		Invalid firmware
	1 - 4	Green	Blinking	Input signal overflow or underflow
			On	Analog/digital converter running, value OK

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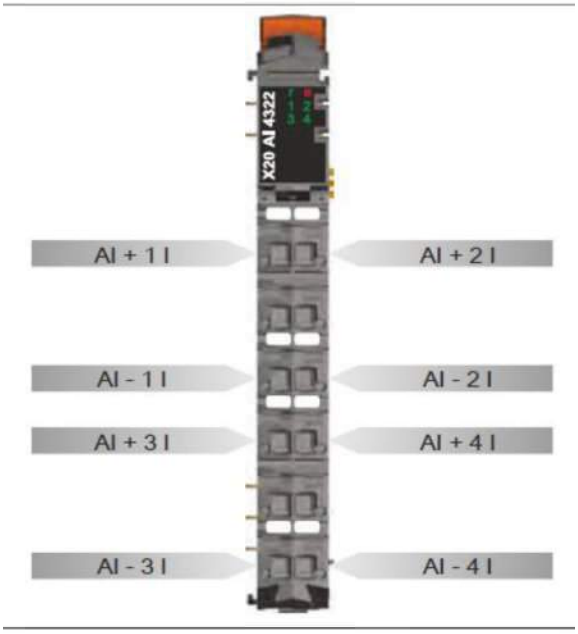
✓ Analog Input Module Pin Diagram



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✓ Checking Counter Module Status with LEDs

Image	LED	Color	Status	Description
	r	Green	Off	No power to module
			Single flash	RESET mode
			Blinking	PREOPERATIONAL mode
			On	RUN mode
	e	Red	Off	Module supply not connected or everything OK
	e + r	Red on / Green single flash		Invalid firmware
	1 - 2	Green		Input status of the corresponding digital input

Major Devices Connected in Panel & their Use

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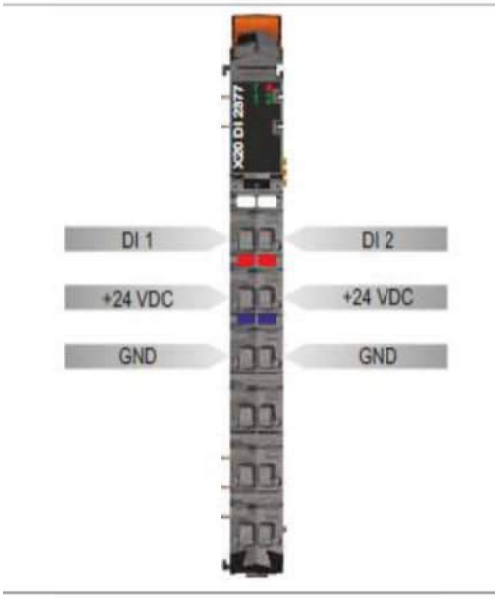
✓ Counter Module Pin Diagram



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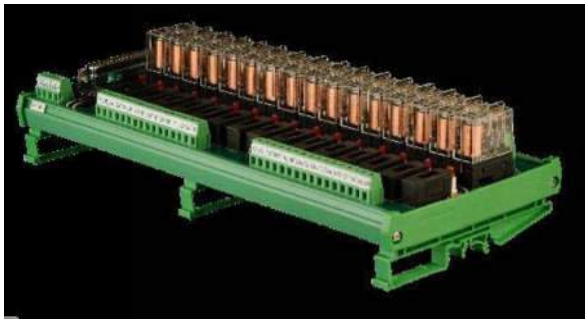
➢ Relay Board



Major Devices Connected in Panel & their Use

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➢ Alarm Annunciator

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➢ GPRS Modem

Power ON Indication

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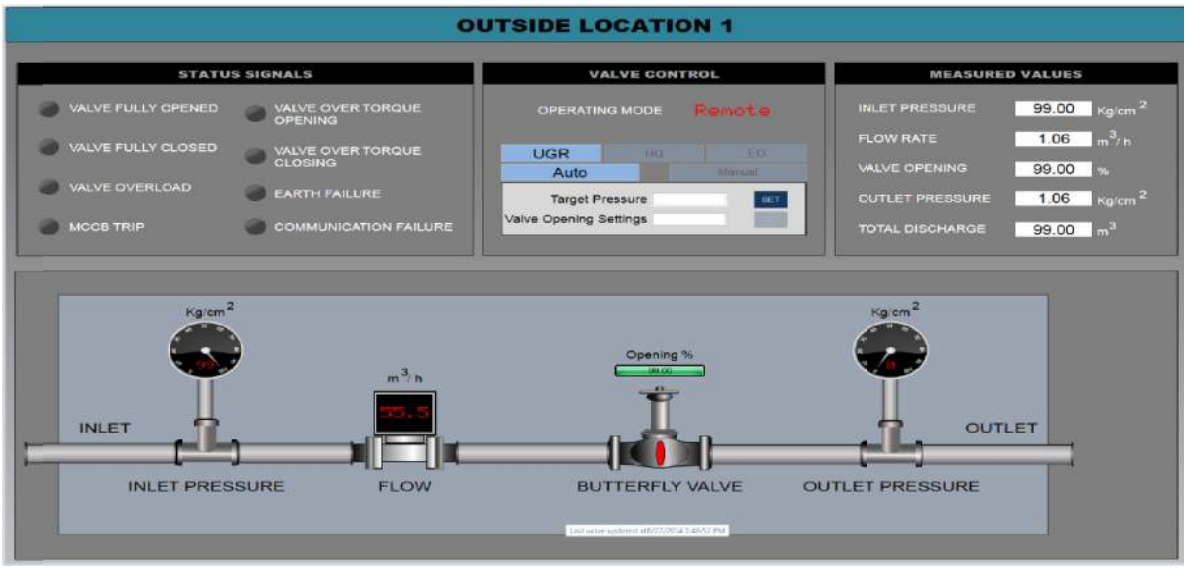
4. Troubleshooting Procedure

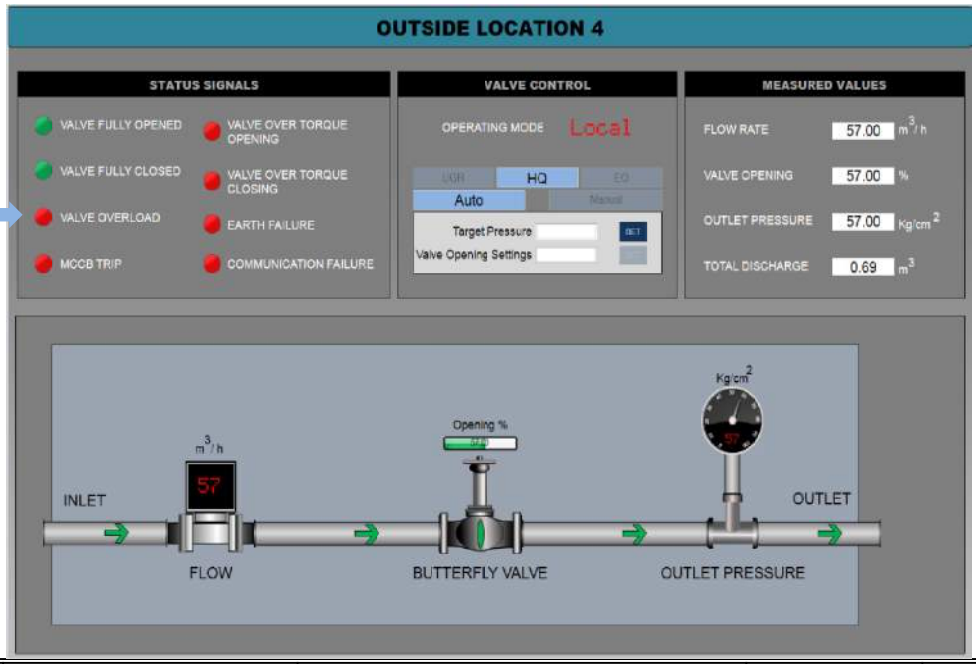
➢ With SCADA

✓ Normal screen without fault



✓ Screen with faults

Checking THIS DI



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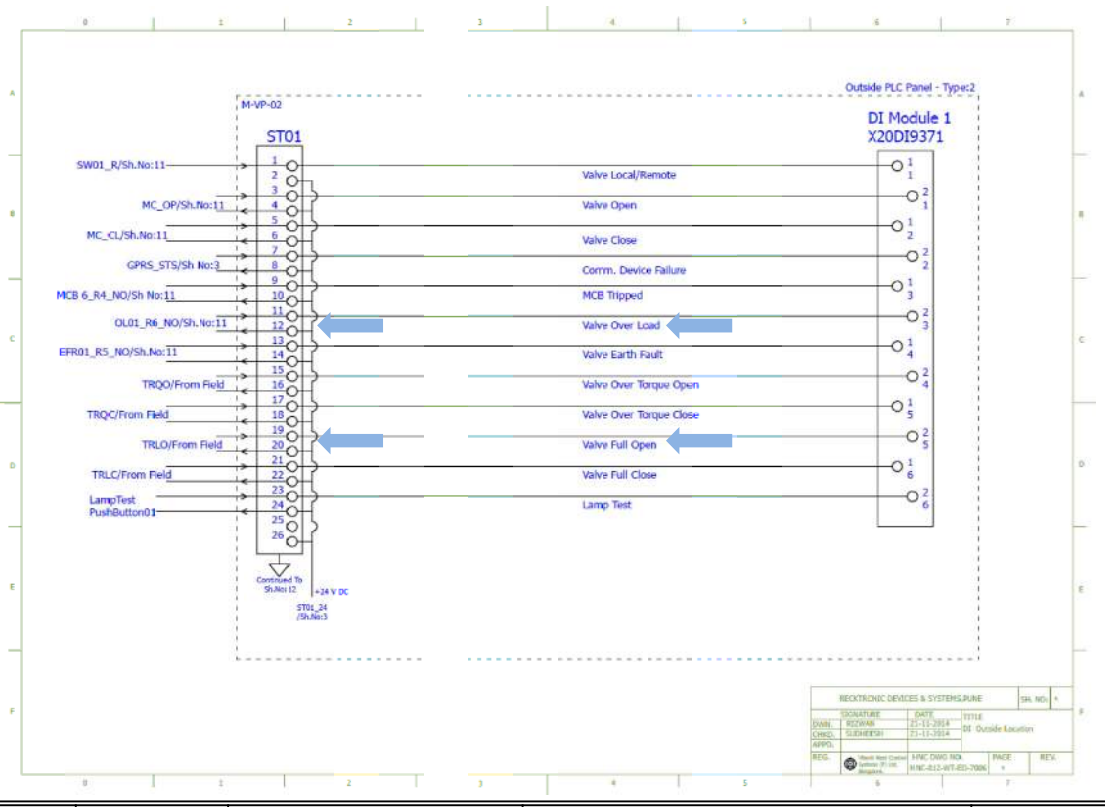

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APRIL 2017	**HECSC**	**Hitachi India Pvt. Ltd**	**Title :– Customer Training Document** **Sub-Title :–** ***D*** ***Troubleshooting***	Document No	Rev **0**	Page 35

REPORTING SYSTEM

Operation Manual

B >REPORTING SYSTEM

The Reporting System is a dotnet based utility that enables the user to create configurable reports as per requirement.

The reporting system shall use the SQL database created by the SCADA software to access the tag values that are required to be reported by the program.

There are two types of Users

A. Administrator (Login: admin, Password: 101010)
B. User (Login: djb, Password: djb123)

A. Administrator

The function of the administrator is to configure the Project for report generation
Configuration to be done by the Administrator
Application Configuration
Project Configuration
Report Configuration

2. Project Configuration

a. Manage Project

Basic Information about the Project to be fed in here

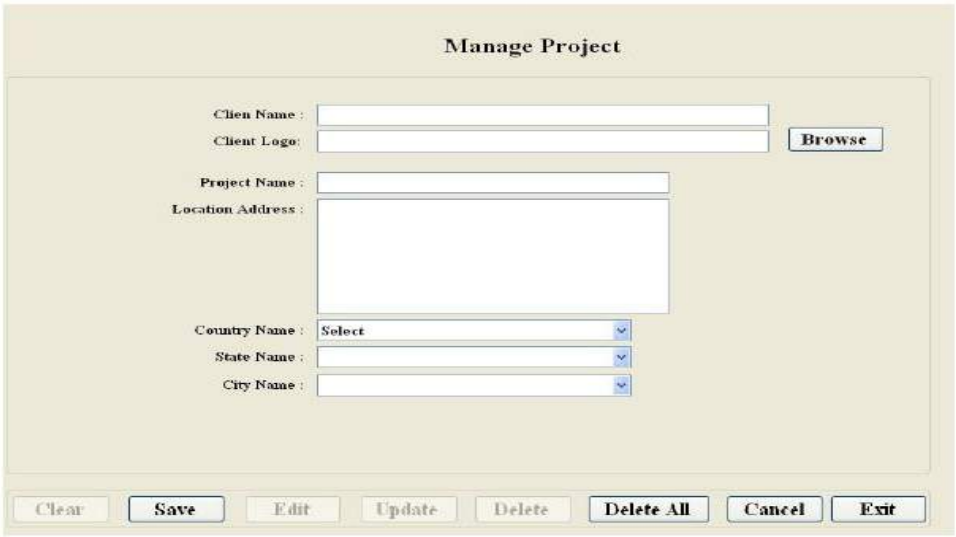
Name of the client

LOGO Of the client

Name of the Project

Address

Country,State, City



c. Manage Database

This is required to link the databases created by the SCADA software with the projects created in the reporting application.

The following features are required for the same

Project Name Selection : from drop down menu

SQL Server Name : from a drop down menu

SQL Authentication user and password

Database Name : from a drop down menu

Database type : select between Parameter type, Event Type and Alarm type

b. Manage Parameters

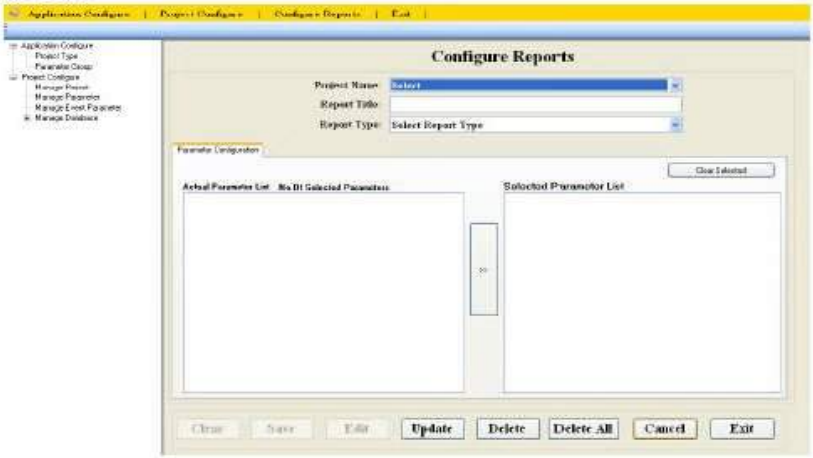
Project Name : to be selected from a drop down menu.
Database Name : to be selected from a drop down menu.
Parameter Type : Any parameter can be defined as any of the three types, viz analog, event, alarm
Analog Parameters :
These are analog values which are recorded by the SCADA software at fixed intervals of time
For analog parameters the following fields are to be provided in the software
Group Name
Tag Name to be selected from a drop down menu
Alias
Min and Max Range permissible for the parameter

3. Report Configuration

This deals with the user configurable reports to be created and assigning reports to specific users of the program

a. Report Creation

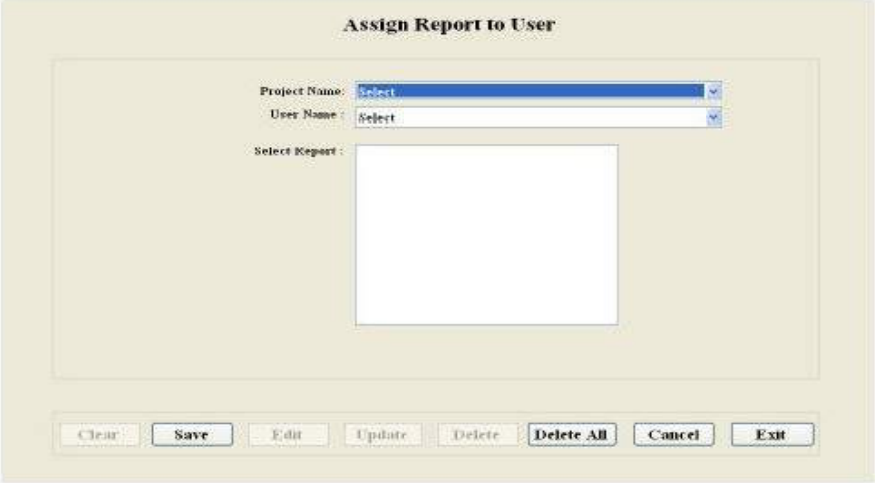
Report Creation screen shall have the following features
Project Name Selection
Title of the Report
Type of Report : from a drop down menu
Parameter Selection : All the parameters depending on the type of report are displayed in the left pane. The parameters required for a report are selected one by one and pushed into the right side pane.



b. Report Assignment

All the reports can not be seen by all the users. Only if a report has been linked/ assigned to a user can he see that report.

The assignment screen shall have the following features
Project Name
User Name
Select Report



HOW TO USE:

For Reporting System to successfully log data, please ensure the following softwares are also running on the system:

•SQL Server.
•FTView (Reporting System monitoring window)

HOW TO USE:

Click on this icon

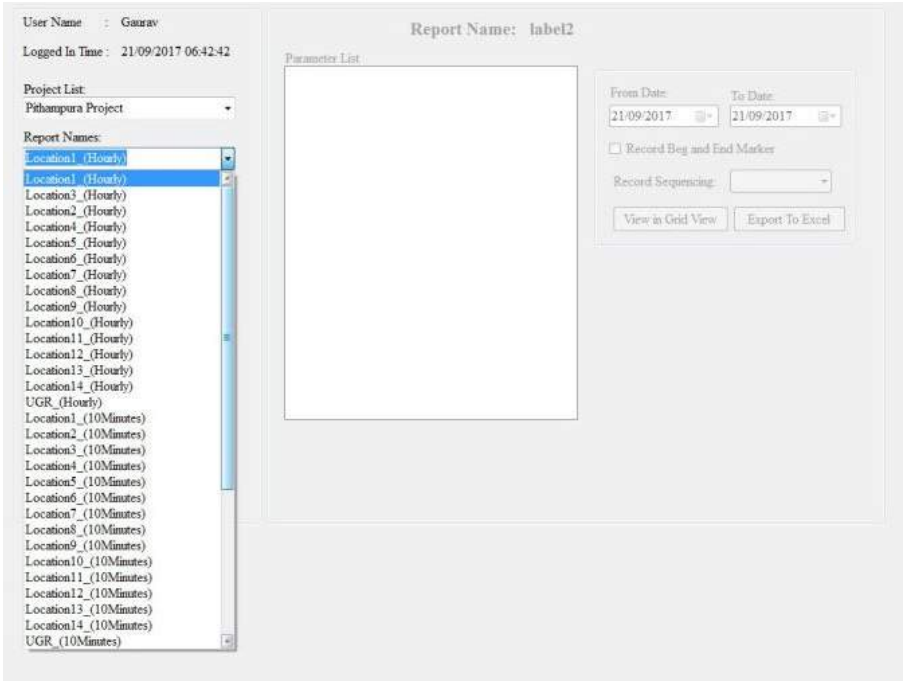
Insert username and Password

For development:
Login: admin
Password: 101010

For User:
Login: djb
Password: djb123

1.Select Project

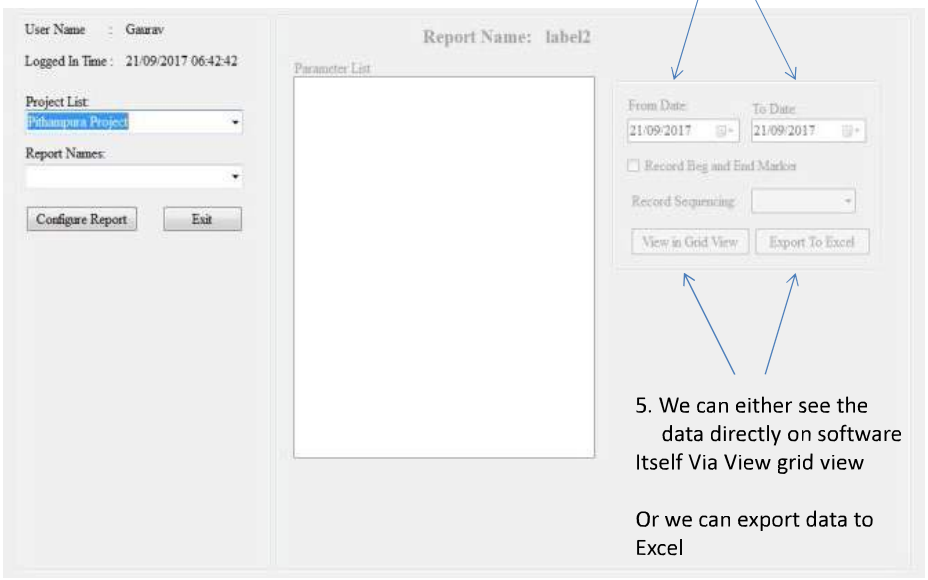
2.Select Report



We have created 3 Types of report.

a. Hourly Report
b. 10 Min Report
c. 1 Min Report
d. DMA 1 Hourly
e. DMA 2 Hourly
f. DMA 3 Hourly
g. Combined Hourly
h. DMA1 10 Min
i. DMA 2 10 Min
j. DMA 3 10 Min
k. Combined 10 Min

4. We can select start and end date



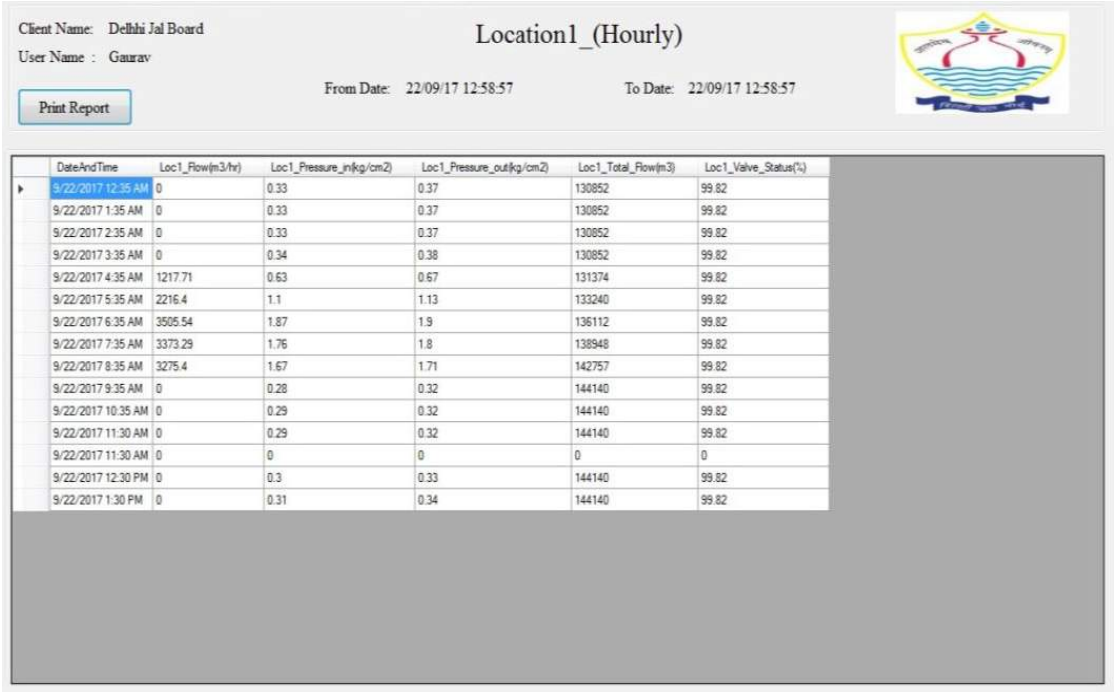
3. Click on Configure Report

5. We can either see the data directly on software Itself Via View grid view

Or we can export data to Excel

Don't touch the PC after starting the report generation till the report is generated.

*Please wait until the report is generated. otherwise the system may hang.



DateAndTime	Loc1_Flow(m3/hr)	Loc1_Pressure_in(kg/cm2)	Loc1_Pressure_out(kg/cm2)	Loc1_Total_Flow(m3)	Loc1_Valve_Status(%)
9/22/2017 12:35 AM	0	0.33	0.37	130852	99.82
9/22/2017 1:35 AM	0	0.33	0.37	130852	99.82
9/22/2017 2:35 AM	0	0.33	0.37	130852	99.82
9/22/2017 3:35 AM	0	0.34	0.38	130852	99.82
9/22/2017 4:35 AM	1217.71	0.63	0.67	131374	99.82
9/22/2017 5:35 AM	2216.4	1.1	1.13	133240	99.82
9/22/2017 6:35 AM	3505.54	1.87	1.9	136112	99.82
9/22/2017 7:35 AM	3373.29	1.76	1.8	138948	99.82
9/22/2017 8:35 AM	3275.4	1.67	1.71	142757	99.82
9/22/2017 9:35 AM	0	0.28	0.32	144140	99.82
9/22/2017 10:35 AM	0	0.29	0.32	144140	99.82
9/22/2017 11:30 AM	0	0.29	0.32	144140	99.82
9/22/2017 11:30 AM	0	0	0	0	0
9/22/2017 12:30 PM	0	0.3	0.33	144140	99.82
9/22/2017 1:30 PM	0	0.31	0.34	144140	99.82

Hourly Report Sample

Client Name: Delhhi Jal Board
User Name : Gaurav

Print Report

Location7_(10Minutes)

From Date: 22/09/17 12:58:57 To Date: 22/09/17 12:58:57

DateAndTime	Loc7_Flow(m3/hr)	Loc7_Pressure_in(kg/cm2)	Loc7_Pressure_out(kg/cm2)	Loc7_Total_Flow(m3)	Loc7_Valve_Status(%)	Loc7_10min
9/22/2017 12:05 AM	29.97	0.37	0.18	4907	100	4
9/22/2017 12:15 AM	30.58	0.36	0.18	4911	100	3
9/22/2017 12:25 AM	30.43	0.36	0.17	4915	100	4
9/22/2017 12:35 AM	30.16	0.37	0.18	4919	100	4
9/22/2017 12:45 AM	28.8	0.37	0.18	4922	100	4
9/22/2017 12:55 AM	30.11	0.37	0.18	4926	100	4
9/22/2017 1:05 AM	29.44	0.37	0.18	4930	100	4
9/22/2017 1:15 AM	29.8	0.37	0.18	4931	100	3
9/22/2017 1:25 AM	29.8	0.37	0.18	4931	100	4
9/22/2017 1:35 AM	29.8	0.37	0.18	4931	100	4
9/22/2017 1:45 AM	29.8	0.37	0.18	4931	100	4
9/22/2017 1:55 AM	29.8	0.37	0.18	4931	100	4
9/22/2017 2:05 AM	29.8	0.37	0.18	4931	100	4
9/22/2017 2:15 AM	29.8	0.37	0.18	4931	100	4
9/22/2017 2:25 AM	29.8	0.37	0.18	4931	100	4
9/22/2017 2:35 AM	29.8	0.37	0.18	4931	100	4
9/22/2017 2:45 AM	29.8	0.37	0.18	4931	100	4
9/22/2017 2:55 AM	28.86	0.37	0.19	4971	100	4
9/22/2017 3:05 AM	29.37	0.37	0.18	4974	100	4
9/22/2017 3:15 AM	28.55	0.37	0.18	4978	100	4
9/22/2017 3:25 AM	28.72	0.37	0.18	4982	100	4
9/22/2017 3:35 AM	29.37	0.37	0.18	4986	100	3
9/22/2017 3:45 AM	29.53	0.38	0.19	4989	100	4

10 Min Report Sample

Client Name: Delhhi Jal Board
User Name : Gaurav

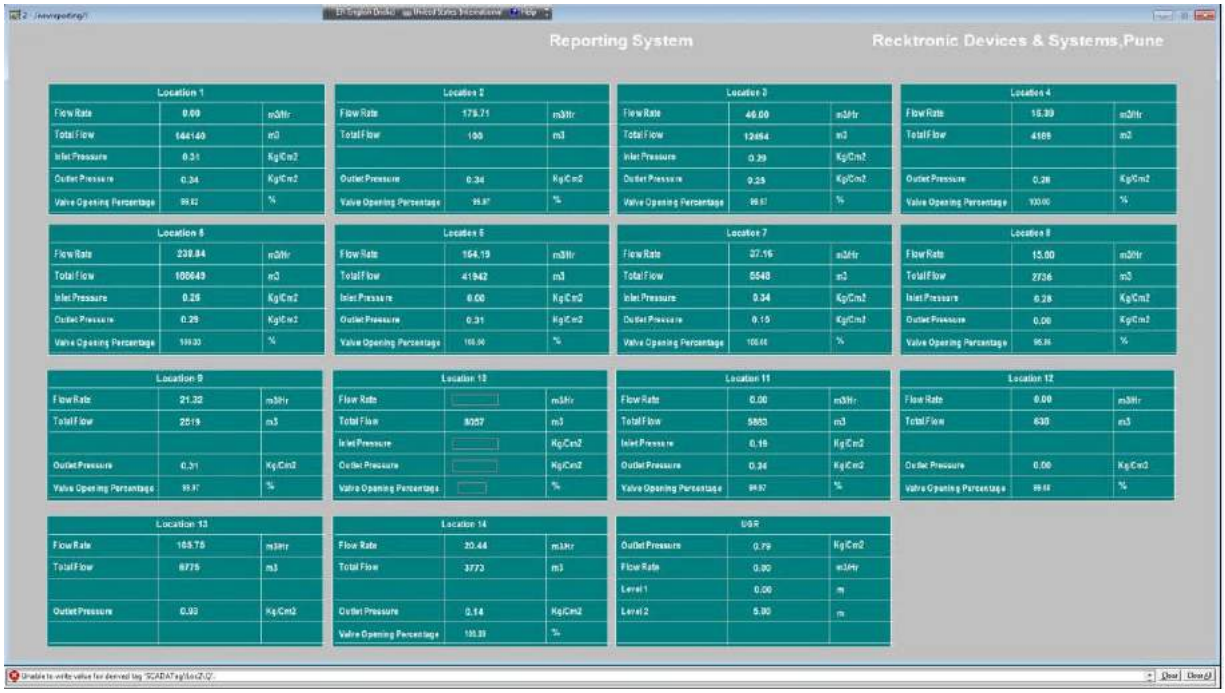
Print Report

Location7_(1Minute)

From Date: 22/09/17 12:58:57 To Date: 22/09/17 12:58:57

DateAndTime	Loc7_Flow(m3/hr)	Loc7_Pressure_in(kg/cm2)	Loc7_Pressure_out(kg/cm2)	Loc7_Total_Flow(m3)
9/22/2017 12:00 AM	30.62	0.36	0.18	4909
9/22/2017 12:01 AM	29.68	0.36	0.17	4909
9/22/2017 12:02 AM	30.49	0.37	0.18	4910
9/22/2017 12:03 AM	30.27	0.37	0.18	4910
9/22/2017 12:04 AM	29.81	0.37	0.18	4910
9/22/2017 12:05 AM	29.57	0.36	0.17	4911
9/22/2017 12:06 AM	30.7	0.37	0.18	4911
9/22/2017 12:07 AM	30.14	0.37	0.18	4911
9/22/2017 12:08 AM	29.87	0.36	0.17	4912
9/22/2017 12:09 AM	29.86	0.36	0.17	4912
9/22/2017 12:10 AM	29.77	0.36	0.18	4913
9/22/2017 12:11 AM	29.57	0.36	0.17	4913
9/22/2017 12:12 AM	29.58	0.37	0.18	4913
9/22/2017 12:13 AM	30.29	0.37	0.18	4914
9/22/2017 12:14 AM	30.16	0.36	0.17	4914
9/22/2017 12:15 AM	31.49	0.36	0.17	4915
9/22/2017 12:16 AM	30.43	0.36	0.17	4915
9/22/2017 12:17 AM	30.35	0.36	0.18	4915
9/22/2017 12:18 AM	30.15	0.36	0.18	4916
9/22/2017 12:19 AM	29.66	0.37	0.18	4916
9/22/2017 12:20 AM	30.43	0.37	0.18	4916
9/22/2017 12:21 AM	30.36	0.36	0.18	4917
9/22/2017 12:22 AM	29.37	0.37	0.18	4917

1 Min Report Sample



Provisional Monitoring Screen

*If this reporting system monitoring window is turned off then no report is generated

*The tentative time taken by reporting system to generate reports are as following
Location wise Hourly report (1 Day)=30 sec
Location wise Hourly report (1 W)=1 Min
Location wise 10 Min report (1 Day)=30 Sec
Location wise 10 Min report (1 Week)=2 Min
Location wise 1 Min report (1 Week)=2 Min
Combined Hourly Report (1 Day)= 30 Sec
Combined Hourly Report (1 Day)= 3 to 4 Min
Combined 10 Min report (1 Day)= 1 to 2 Min

The "Total flow difference" being shown on the Reports may not be accurate.
The Reporting System and the PLC is not time synchronised.
Therefore the Reporting System is unable to procure the desired results .
So it is recommended to do the calculations manually on Excel sheet by applying formula.
eg: =(J2-J1)
where J2 and J1 are the row adresses of the values

Storage capacity of reporting system: Storage capacity is set to Max in the SQL for data logging.
Although the Reporting System cannot be predicted the exact tenure of Historical data being logged.
But the Reporting System can be roughly approx it upto 1 Year.

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Pipe Network Calculation System (PNCS)

Standard Operational Procedure

Contents

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- Starting PNCS Client
- Stopping PNCS Client
- System and Log-in user
- System overview
- System View Screen Menus – user 3 , user 4 view Screen menus
- Pipe Network Management System
- Switching the Edit Mode
- Setting of Analysis Condition
- Run Analysis
- Display of Analysis Result
- Real-Time Monitoring System
- Display Items
- Analysis Results Display
- Cycle of Display update
- PNCS Task Manager
- Feature properties/attributes
- Index Map
- Measurement Function's

Starting PNCS Client

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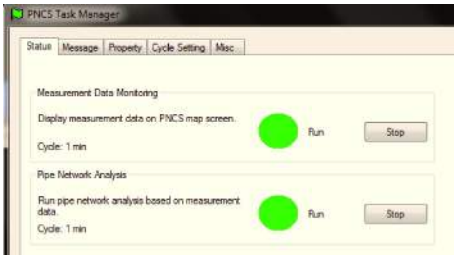
Step1:
(1) Turn on the Client PC.
(2) Log in to the Client OS.
(3) Log in the PNCS Client

Step 2:
Start the PNCS task manager
- PNCS task manager is accessible form Green Icon at Taskbar notification area (task tray)

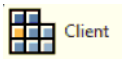
- Status of PNCS task should be on “RUN”

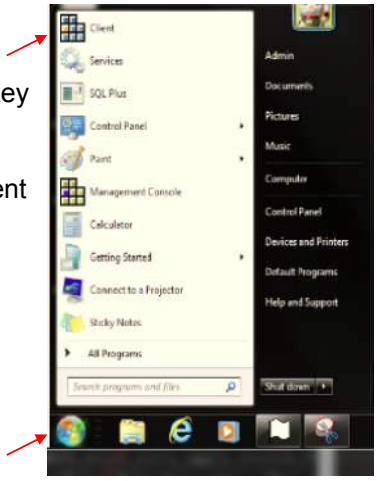


Step 3:
Start PNCS client

From PNCS client start menu
- By Windows start key

- Click on PNCS Client icon





From desktop
- Click on PNCS client Icon on desktop screen

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Stopping PNCS Client

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Stopping PNCS

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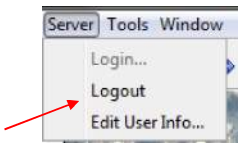
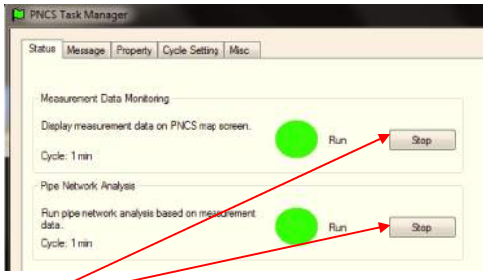
- Logout server using Server > logout tabs

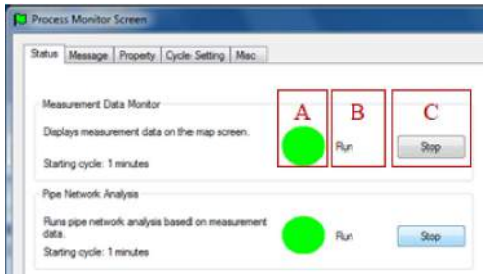




- Exit from PNCS System window

- Stop PNCS task services from PNCS task Manager.

  - Circle colour changes from Green to Yellow to Red



No.	Circle symbol (A)	Task status (B)	String in the button (C)
1	Green	Run	Stop
2	Yellow	Stopping	Run
3	Red	Stopped	Run

- Shut down the Client machine through “windows Key” + “Shutdown button”

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System and Log-in user

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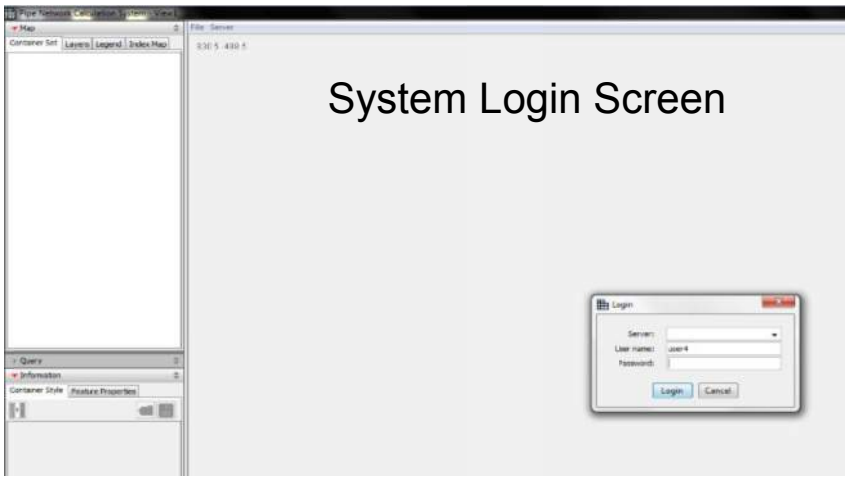
Access to each system is restricted according to the login user authority. Each user belongs to a user group, and can log in to the system according to permission given to the user group. At the installation of this system, default user accounts are provided as shown below.

System	User group	User name	Password
Pipe network management system	NetworkManagement	user3	user3
Real-time monitoring system	AnalysisMonitor	user4	user4

To login to respective user

- Select User name
- Enter Password
- Click on Login



System Overview

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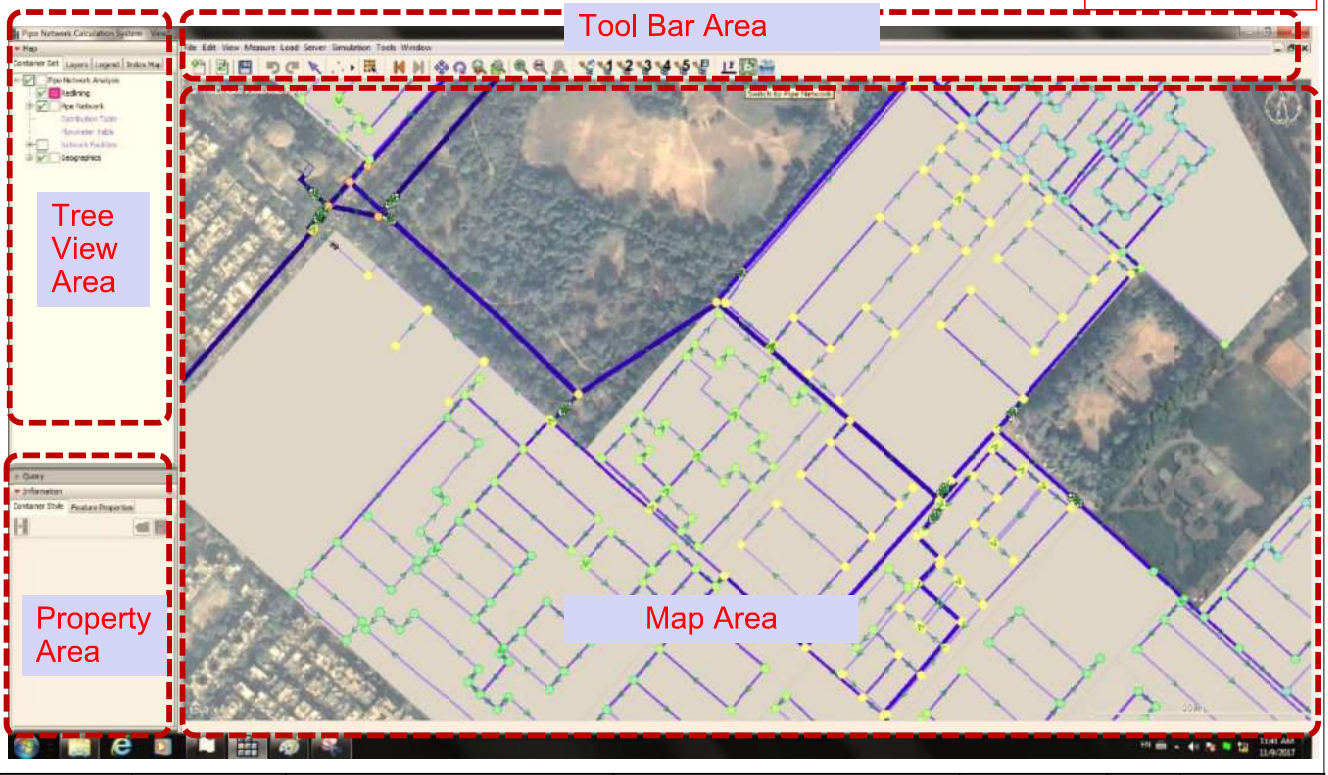

SYSTEM VIEW SCREEN MENUS

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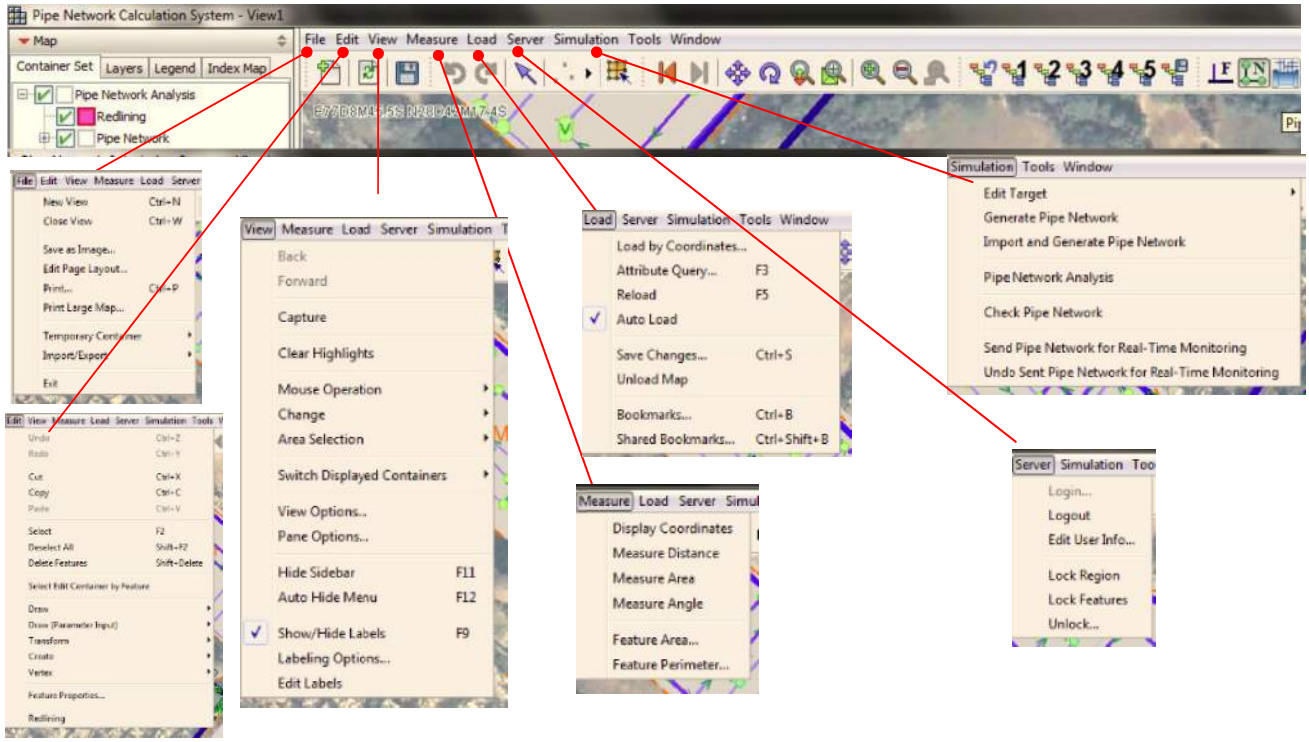
User 3 View : Screen menus



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SYSTEM VIEW SCREEN MENUS

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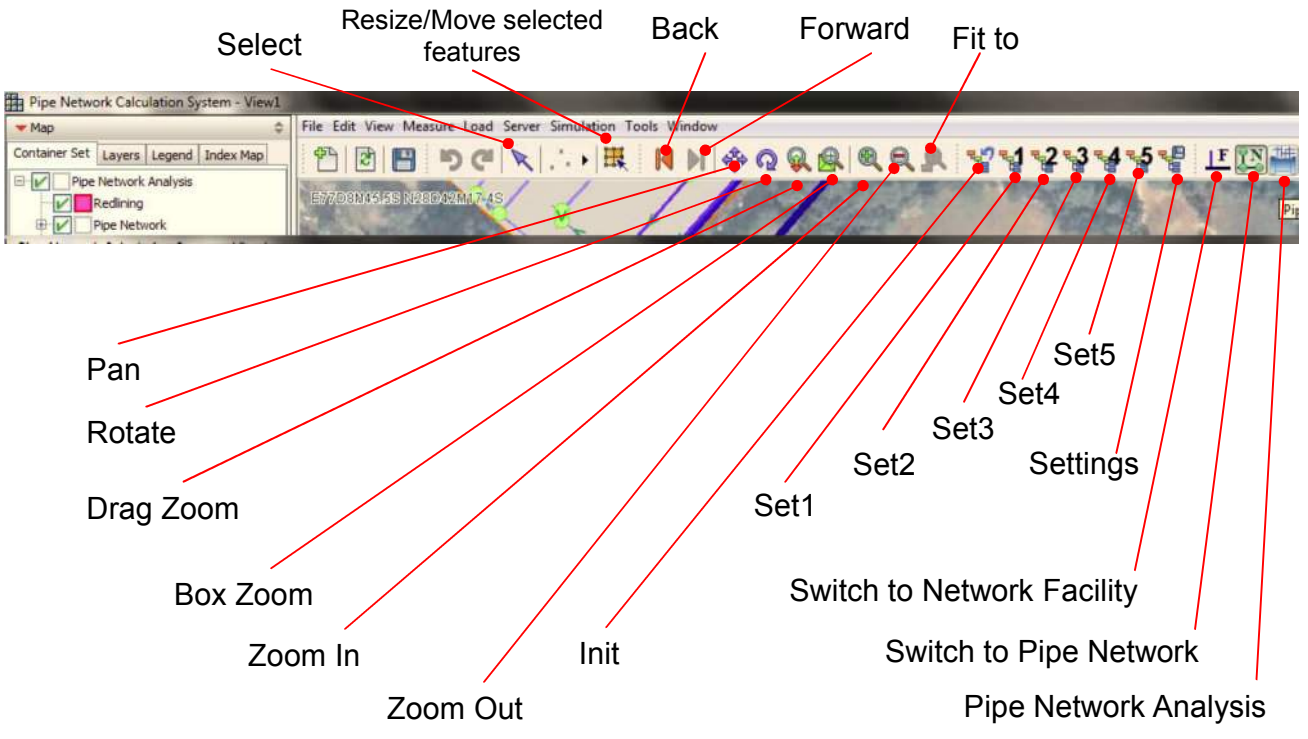
User 3 View: Screen menus



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SYSTEM VIEW SCREEN MENUS

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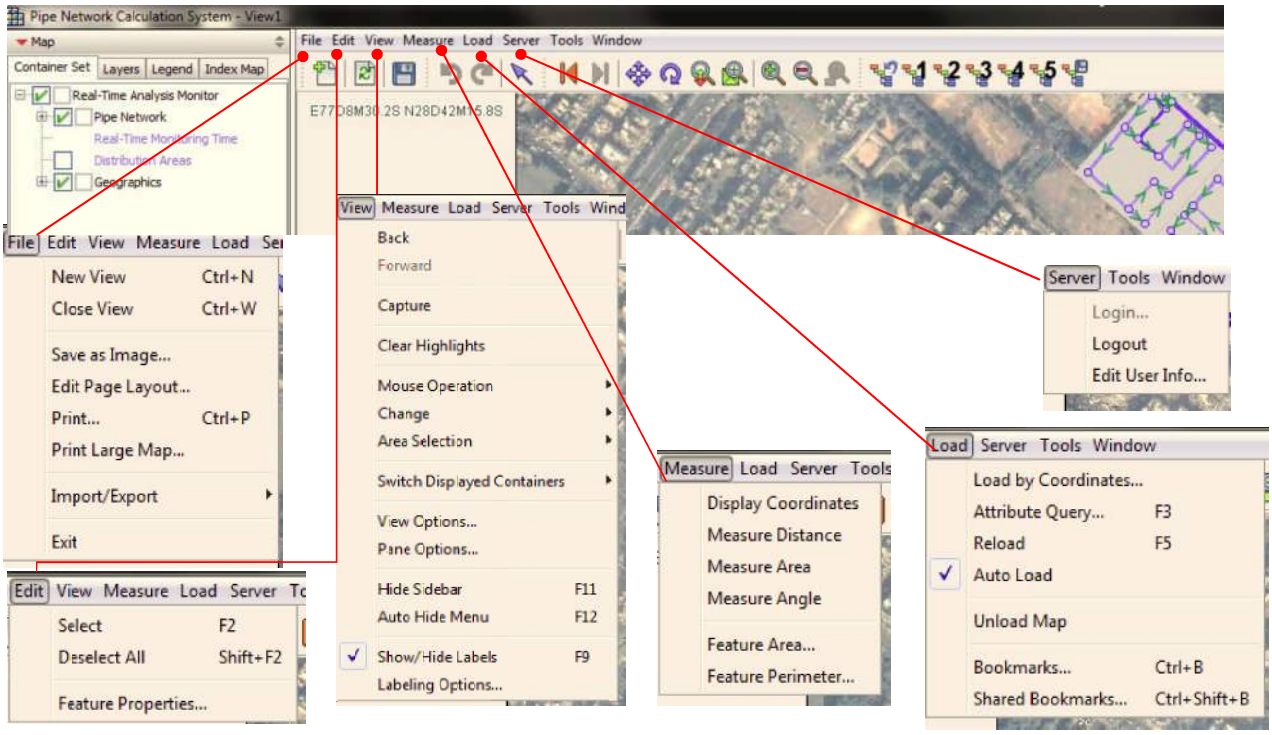
User 4 View : Screen menus



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SYSTEM VIEW SCREEN MENUS

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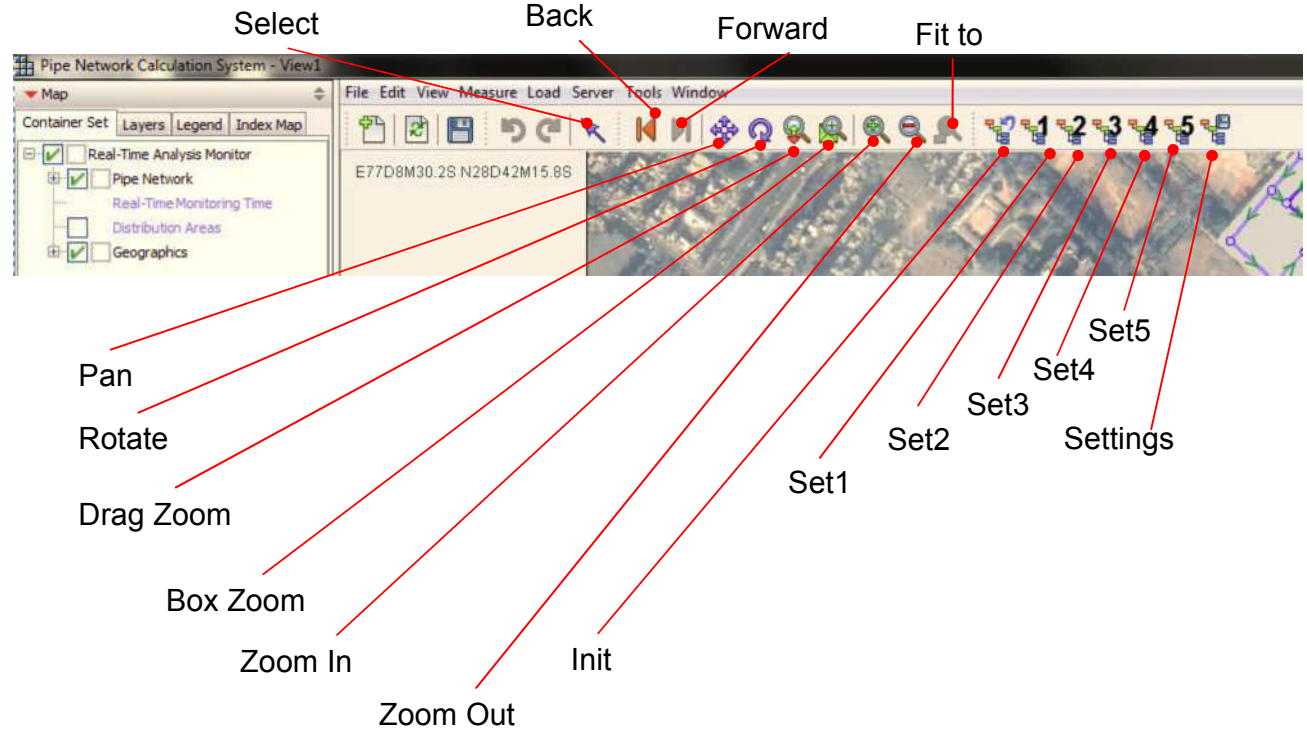
User 4 View : Screen menus



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Pipe Network Management System

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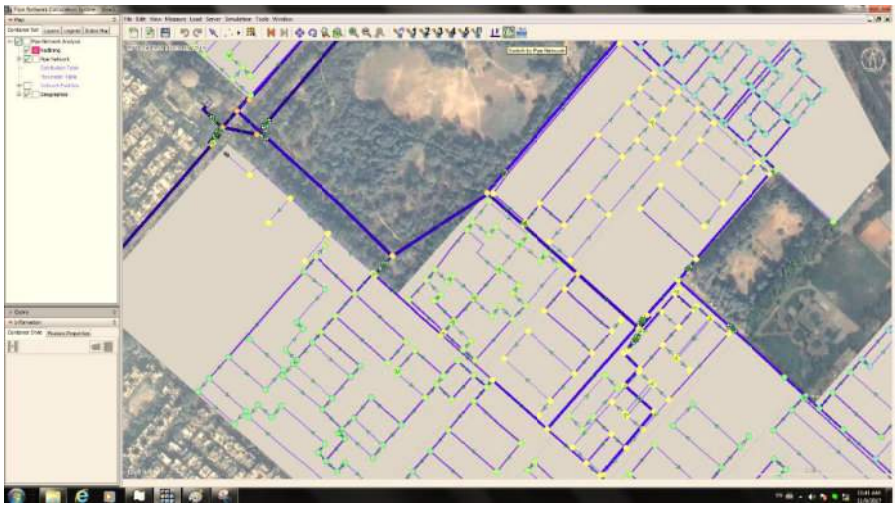
- The pipe network management system performs a pipe network analysis using the network-modelled water facilities called pipe network data.
- The pipe network analysis enables you to determine the flow rate and direction of pipe lines, pressure at junction, etc. You can utilize the analysis results as a index for a development plan of water facilities.
- As a condition for the analysis, water level of the reservoirs, water distribution volume of each distribution area, etc. are required. These measurement data are acquired from SCADA.



This function can be accessed after login as " User 3"

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Pipe Network Management System

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Switching the Edit Mode

The pipe network data and network facility data fully correspond to each other in terms of location when the two types of data are overlaid on display. Therefore, to edit data smoothly, one of them should be shown and the other should be hidden during editing. The [Edit Target] command enables you to switch the containers of the pipe network data and network facility data between shown and hidden status and switch them between editable and non-editable status so as to facilitate the editing of respective data

In pipe network edit mode

In network facility mode

Setting of Analysis Condition

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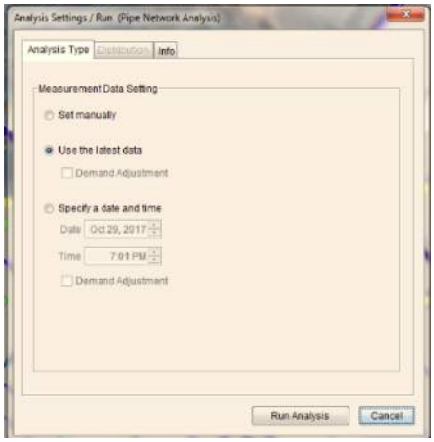
PNCS registers the measurement data acquired from SCADA as the properties of reservoirs, tanks, pressure reducing valves, gate valves and flowmeters that configured as the targets for the measurement data acquisition

Select how to set the measurement data from “Set manually”, “Use the latest data” or “Specify a date and time”.



Options	Description	Notes
Set manually	Input the measured flow for each flowmeter manually on the [Distribution] tab.	The measurement data other than flow need to be input as the property of each symbol before the analysis is executed.
Use the latest data	Apply the latest data acquired from SCADA for the symbols targeted for the measurement data acquisition.	For the symbol not targeted for the measurement data acquisition, the measurement data need to be input as the property of each symbol before the analysis in executed in the same way with “Set manually”.
Specify a date and time *1	Apply the data on the specified date and time from SCADA for the symbols targeted for the measurement data acquisition.	

*1 PNCS holds the measurement data acquired from SCADA at 1-minute interval for 2 years.

Note : User can select Pipe Netw lysis Function by selection “Simulation” then “Pipe Netw lysis” from Tool bar area tabs.

Pipe Network Management System

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Run analysis

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The analysis process runs a pipe network analysis according to the analysis setting condition. The analysis is executed by EPANET.

Display of Analysis Result

There are functions displaying the analysis result with effect, such as the **thematic style** function that colours features according to its properties, and the labelling function that displays the analysis result near features after pipe network analysis.

See Pressure thematic style (legend settings)

Configured Thematic style (legend settings)

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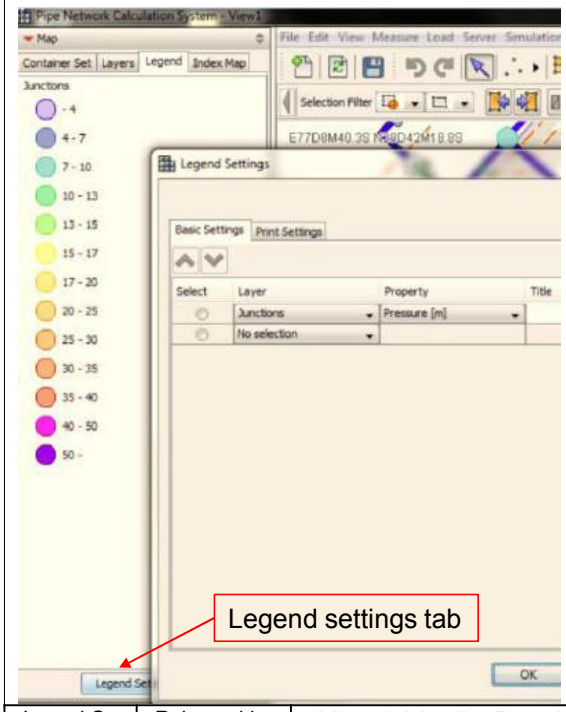
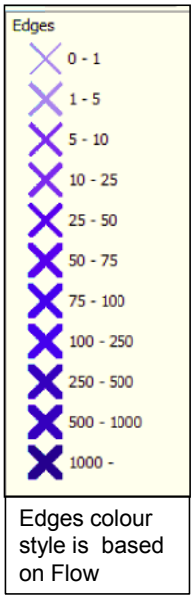
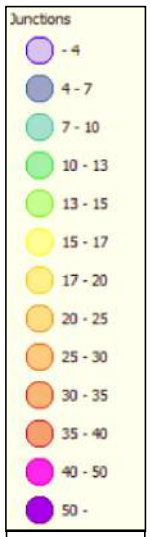
These are visible in tree menu under Legend tab





Edges colour style is based on Flow



Junction colour style is based on Pressure

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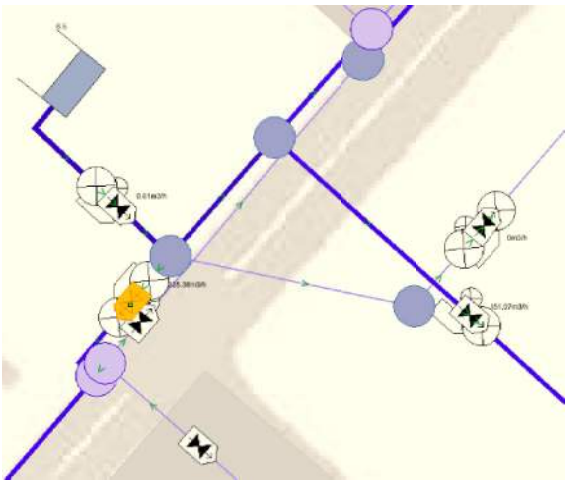
The real-time monitoring system acquires measurement data from SCADA in specified cycles. Acquired data are registered and displayed as properties of a pipe network data, and also used as a condition of a pipe network analysis. Since the display of analysis results is automatically updated, you can monitor the distribution of pressure and flow rates in the pipe network on a real-time base.



The real-time monitoring function consists of the "measurement data monitor function" and "real-time pipe network analysis function" that uses Pressure and Flow measurements data acquired through SCADA system

User should login as "User4" for accessing this function.

This function executes a pipe network analysis at a fixed cycle using the measurement data such as water level of reservoirs and tanks, pressure setting of pressure reducing valves, open status of gate valves, and flow of flowmeter are used as analysis conditions. The results are registered as a property of each feature and updated at a fixed cycle

Display Items

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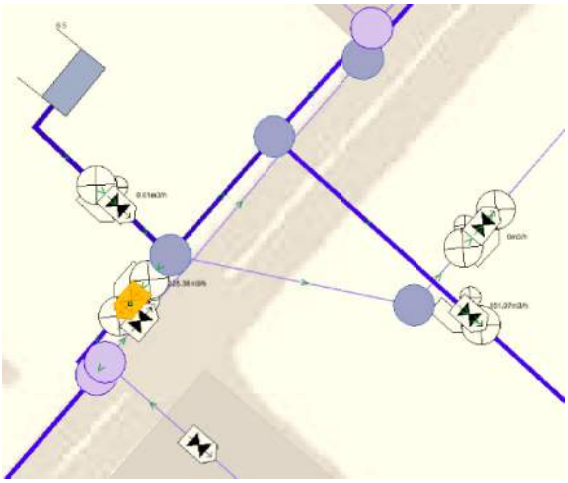
Analysis Results Display

In the real-time monitoring system, the thematic styles of velocity of edges and pressure of junctions.



Junction Pressure ,Total Head, Measured Pressure, Flow are displayed as per thematic style

Refer page 14 for Configured Thematic style (legend settings

REAL-TIME MONITORING SYSTEM

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Cycle of Display Update

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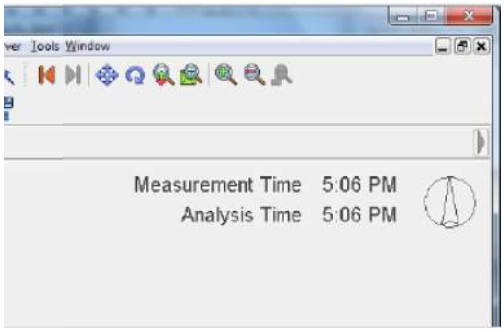
- The display of the real-time monitoring system is reloaded at 1-minute cycle and updated automatically.
- The update timing is non-synchronized with the timing of acquiring the measurement data and the analysis result.
- The display is also updated by the operation loading the latest map information (scroll, zoom in, or out) as well as the automatic update.
- The measurement time of the measurement data (SCADA base) used by the measurement data monitor function and the real-time pipe network analysis function are displayed at the upper right area of the map view.



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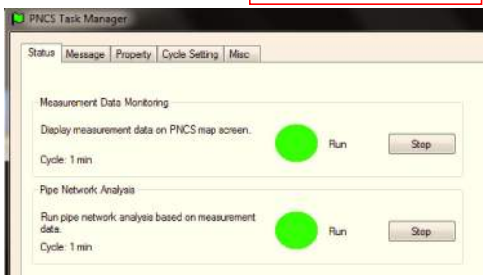
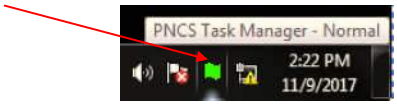
The PNCS Task Manager controls the cycle of executing each process operated by the real-time monitoring system as well as the operational state of each process. It is used to direct each task to run/stop, and update the pipe network monitoring data for real-time monitoring system.



PNCS Task Manager Window

The PNCS Task Manager window is automatically started after the Server OS is started up. The processing of the window continues even after closing the window, and remains in the task tray as a resident process. To display the PNCS Task Manager window, double-click this icon.

The PNCS Task Manager window consists of the following five tabs



No.	Tab name	Description
1	Status	Displays the status of each task (The initial display).
2	Message	Displays log messages of each task.
3	Property	Displays the condition of updating the pipe network management data.
4	Cycle Setting	Sets the cycle setting of each task.
5	Misc	(Unused in PNCS)

PNCS Task Manager

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Task Tray Icon

The icon is displayed on the task tray while the PNCS Task Manager is running. Normal/abnormal state is indicated by its colour, and the presence or absence of pipe network monitoring data updating request is indicated by light/blink. The red-coloured icon indicates that an error has occurred on the task, so confirm the situation on the Message tab. But the colour of the icon will return to green when the task returns to normal state or has not been executed for 60 minutes

No.	Icon	Color	Light/Blink	Status	Data updating request
1		Green	Light	Normal	No
2		Yellow	Blink	Normal	Yes
3		Red	Light	Abnormal	No
4		Red	Blink	Abnormal	Yes

Feature properties/attributes

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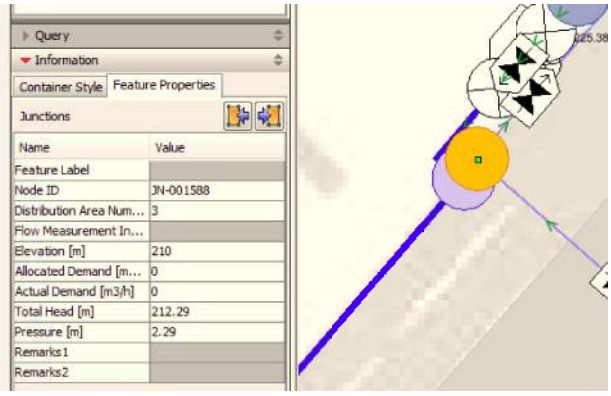
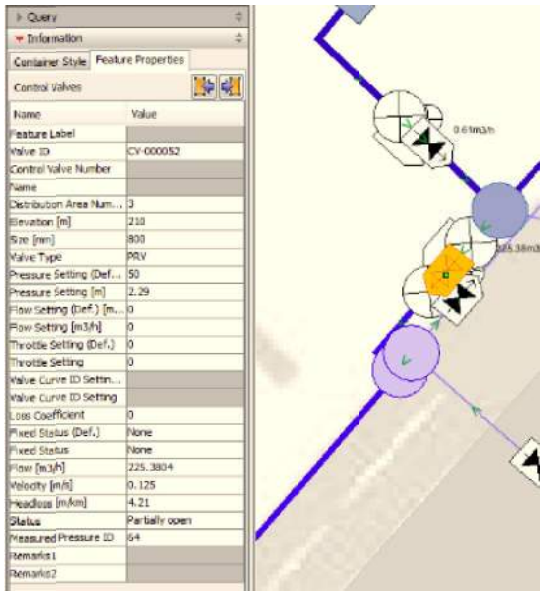
Using select function, user can click on Junction, flowmeter, Valve to check its feature property in "property Area. See below some examples.
Selected item colour is turned to Orange.



Junction



Valve

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Index Map

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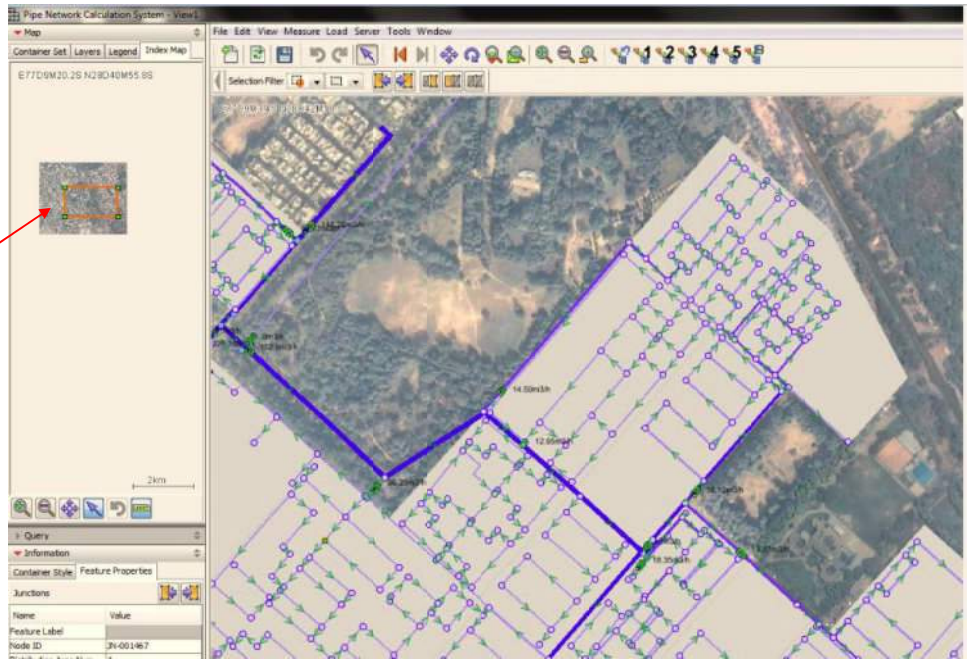
Using Index Map tab in "Tree view" area, user can select the required map area and can Zoom In or Zoom Out the required area on MAP.

Adjust here to Zoom In or Zoom Out the required area on MAP.



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Measurement Function's

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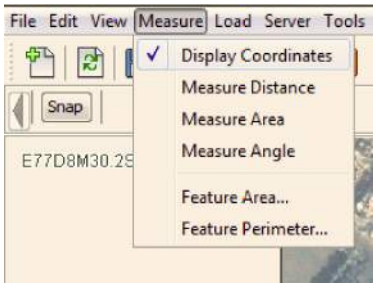
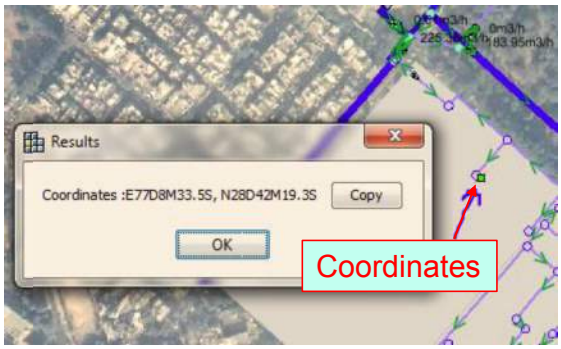
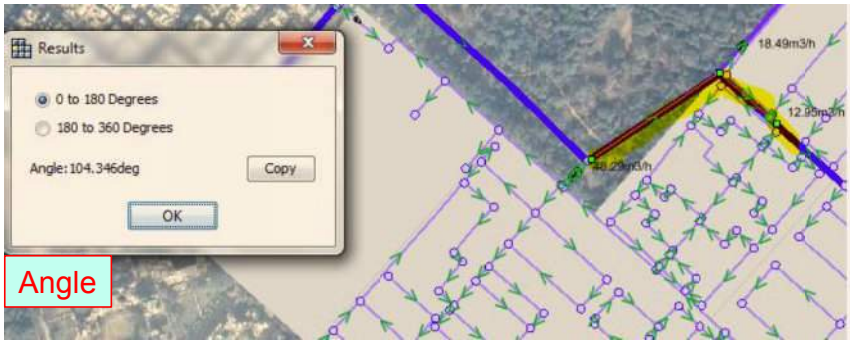
Using “measure” tab in Tool bar area user can view Display Coordinates, measure distances, Area, angle ,perimeter of selected pipe/area.







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Measurement Function's

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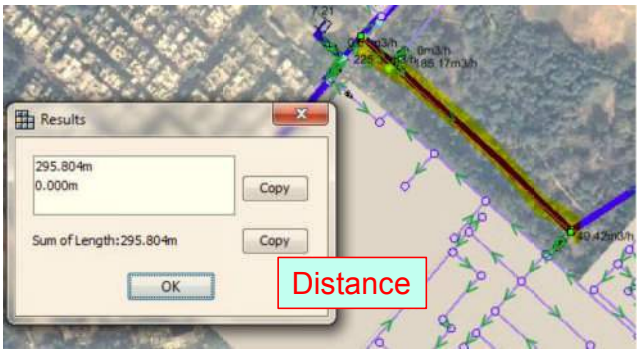
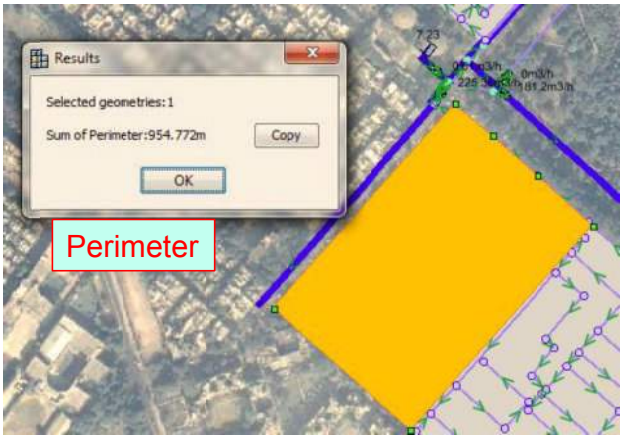
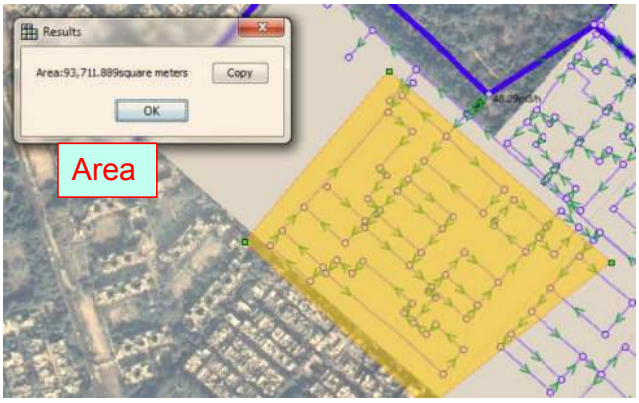
Display of
Distance, Perimeter, Area







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GUIDELINE

EQUITABLE DISTRIBUTION AND NON-REVENUE WATER MANAGEMENT BY USING SCADA

MARCH 2018

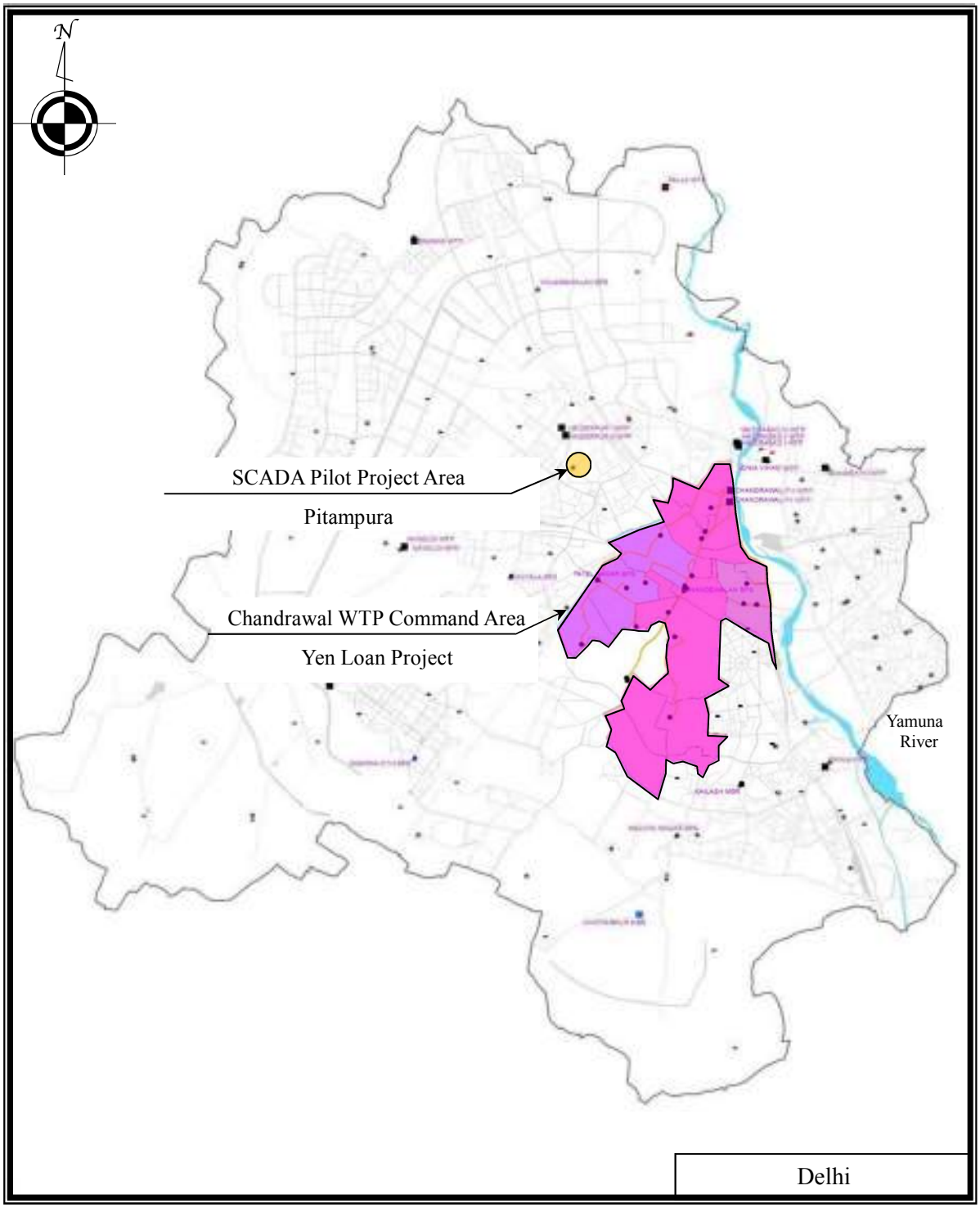
DELHI JAL BOARD

GUIDELINE

EQUITABLE DISTRIBUTION AND NON-REVENUE WATER MANAGEMENT BY USING SCADA

MARCH 2018

DELHI JAL BOARD



Location Map of Pilot Project Area in Pitampura and
Yen Loan Project Ara in Chandrawal WTP Command Ara

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Appendix 2: Sample of Weekly Report

Appendix 3: Sample of Monthly Check List

Appendix 4: Sample of Inspection Sheet of Chamber

Appendix 5: Procedure of "Waterproofing Work"

Appendix 6: Sample of Inspection Sheet of SCADA Room and Clients Room

Appendix 7: Sample of Inspection Sheet of Local Panel

LIST OF ABBREVIATIONS

BAC	Billed Authorized Consumption
BPS	Booster Pumping Station
DMA	District Metered Area
GPRS	General packet radio service
NRW	Non-Revenue Water
PLC	Programmable Logic Controller
PS	Pumping Station
RMS	Revenue Management System
SCADA	Supervisory Control and Data Acquisition
SIV	System Input Volume
UGR	Underground Reservoir
UPS	Uninterruptible Power Supply

CHAPTER 1 Introduction

1.1 Necessity and Objective of Equitable Water Distribution and NRW Management

With water sources drying up, it is essential that the existing water supply and distribution system be run most efficiently and economically in an optimized manner conserving water and energy so that long term sustainable use of the resources is possible.

As for the water distribution system, equal distribution of clear water to the command area isn't accomplished in Delhi because of lack of consistent measured data and means for controlling the demand variation. The booster pumping stations operate for about 6 hours a day with a set time frame operation method in the morning and in the evening without considering the actual water demand of each command area. For the purpose of equal distribution, the adjustment of the pump operation and the control of water volume according to the water demand are essential.

The effective use of the limited raw water and equal distribution of available water among the users in different localities are very vital in water distribution. In addition, the reduction of non-revenue water is equally important for effective use of scarce water resource.

For the purposes of equitable water distribution and NRW reduction mentioned above, it is imperative that the necessary data is collected and stored and the water distribution system is operated and controlled rationally. A SCADA system, in particular a water distribution SCADA system (hereinafter called as the SCADA system) is a very useful tool to achieve this purpose. The SCADA system helps control water volume allocated to the concerned DMAs from each UGR which is important for the equitable water distribution and NRW management. The SCADA system is also a tool of the comprehensive data acquisition through which important decisions can be made.

1.2 Plan of Pilot Project of Pitampura Command Area

High ratio of NRW and inequitable distribution are the two major issues identified by Master Plan in Delhi's water supply system that was formulated by JICA in 2011. Chandrwal WTP command area was one of the priority area recommended by MP and will be implemented under the Yen Loan Project (refer to location map). The Yen-loan project started in November 2014 with a target year of 2023. 18 reservoir zones and 147 DMAs will be created, and there is a plan to achieve equitable water distribution and efficient NRW management by the SCADA system, which will be also installed in the Yen Loan Project.

The Assistance Project started in June 2013 to enhance DJB's capacity to manage the Yen Loan project. One of the 3 outputs under the Assistance Project was "DJB's capacity to monitor and control the

water distribution for equitable distribution and non-revenue water management is upgraded". And the pilot project was carried out using the SCADA system covering three DMAs located in Pitampura UGR command area (refer to location map). The main purposes of the pilot project are to give an opportunity for DJB staff members (i) to learn and understand the SCADA system's structure and equipment operation, and (ii) to learn how to monitor and control water flow and pressure through the SCADA system for enhancing equitable water distribution and NRW monitoring, which will be utilized in the future SCADA system installed in the Yen Loan Project. This is the first attempt of its kind in Delhi.

The particular purposes of the pilot project are to obtain the technical know-how on how to control valves for equitable water distribution and to minimize water pressure difference between three DMAs and the knowledge on how to accurately estimate NRW.

Achievement targets of DJB staff are as follows;

- Understand the basics of the SCADA system
- Operate the SCADA system for equitable distribution and NRW reduction
- Monitor the volume of system input to a DMA
- Monitor the water pressure at the inlet of a DMA
- Monitor the billed water volume within a DMA
- Estimate NRW by comparing the system input and the billed water volume
- Develop a manual on the SCADA operation and NRW estimation

The purpose of this guideline is to provide a quick reference for how to operate and maintain the SCADA system and the related facilities constructed under the pilot project. The guideline also provides guidance for how to achieve equitable distribution by monitoring and controlling water flow and pressure through the SCADA system. The guideline is prepared for DJB staff to understand as above and expected to be used in the internal training of DJB that is scheduled in 2018 and onwards. In addition, the guideline is also intended to be used as a reference for the future application of water distribution SCADA(s) in Yen Loan Project area and other parts of Delhi. This guideline should be updated from time to time based on the feedback obtained during actual operation.

In addition to this guideline, a standard operation procedure (SOP) or manual has also prepared in order to provide instructions on how to operate, maintain, and troubleshoot the SCADA system of the pilot project.

CHAPTER 2 The SCADA System

2.1 What is SCADA?

SCADA: **Supervisory Control And Data Acquisition** is a control system architecture that not only uses computers, networked data communications and graphical user interfaces for high-level process supervisory management, but also uses other peripheral devices such as PLC and discrete PID controllers. The operator interfaces which enable monitoring and issuing of process commands, such as controller set point changes, are handled through the SCADA system supervisory computer system.

The SCADA system is equipped to make immediate corrections in the operational system, which can increase the life-period of equipment and save on the need for costly repairs. It also translates into man-hours saved and enables personnel to focus on tasks that require human involvement. Further, the auto-generated reporting system ensures quick and easy dissemination of information on water distribution.

The SCADA system enables operators to transmit operational instructions to the PLC installed at the site to control pumps, valves and water treatment equipment through analog calculation or sequential logic control. The SCADA system in a water treatment plant enables operators to remotely monitor and operate valves based on the real-time status of water supply condition, and to control water supply volume by adjusting valve aperture, thereby reducing manpower and unifying operation.

2.2 Water Distribution SCADA

The most important issue of water distribution is whether water is distributed equitably to each distribution area. The introduction of the SCADA system enables operators stationed at UGR/BPS to monitor and control the flow/pressure of each distribution area and confirm the water distribution status.

The SCADA system is also a very effective tool for estimating NRW as it can accurately establish the system input volume to a DMA. NRW ratio of each distribution area or DMA can be accurately calculated by comparing the system input volume to the DMA with the billed consumption within it.

2.3 Pilot Project of the SCADA System at Pitampura Command Area

The SCADA system for the pilot project is described as follows.

(1) Monitoring of flow/pressure

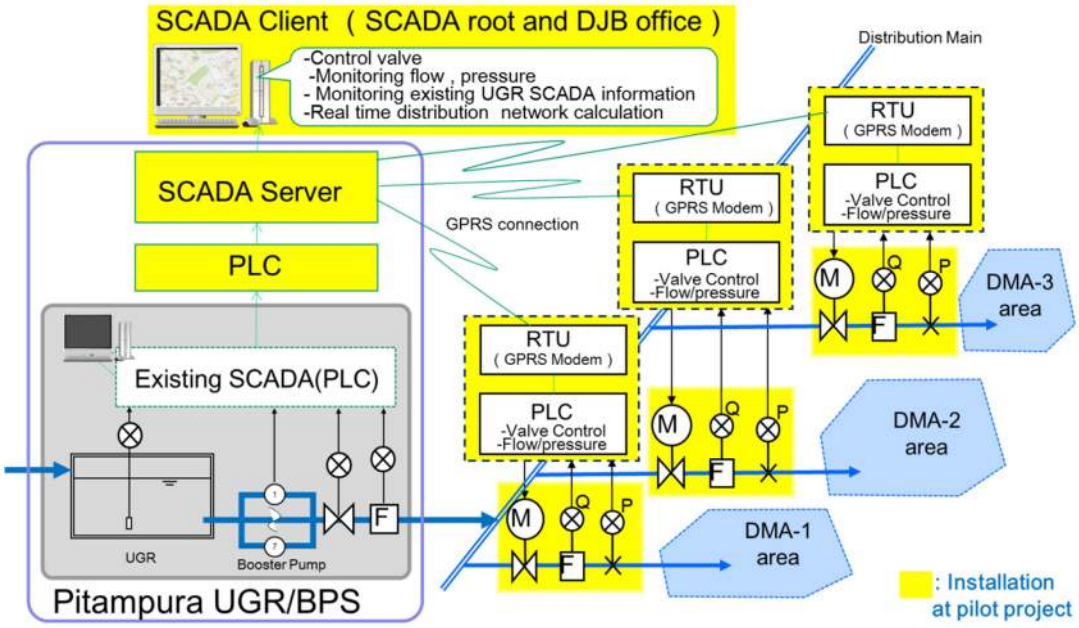
(2) Control of valves through the SCADA system

(3) Transfer of information from the existing UGR SCADA to the SCADA system

(4) GPRS transmission of measured data by installation of local measurement stations

(5) Real time distribution network hydraulic calculation

(6) SOP and Specification of the SCADA system



(1) Monitoring of flow/pressure

The SCADA monitors flow/pressure at each measurement point in real time. The PLC of the local panels send the measurement data of flow meters and pressure gauges of each measurement point into the SCADA system through GPRS transmission in real time, and the status information is displayed on the graphic screen of the SCADA client.

(2) Control of valves through the SCADA system

Electric actuators are installed on the valves which enable operators to control the opening/closing of each valve remotely. Operation instructions through the SCADA system are given to the PLC of local panel at the site in order to control the actuators of the valves.

(3) Transfer of information from the existing UGR SCADA to the SCADA system

The existing SCADA system of the Pitampura BPS monitors information such as UGR water level, pump operation time, and flow/pressure of the water distribution. This information is required in order to achieve equitable distribution among the DMAs. Existing SCADA information is integrated into the SCADA system.

(4) GPRS transmission of measured data by installation of local measurement stations

Local measurement stations are required to monitor flow/pressure and control valves for the pipeline

network. Such stations have never been installed in Delhi because special attention for security is required. The stations in the pilot project are protected with fence and the roof. Contracts with the telecommunications company were required regarding system of GPRS transmission to send and receive information to and from the SCADA center and each local station.

(5) Real time distribution network hydraulic calculation

The real-time distribution network hydraulic calculation function has added to the SCADA system.

During the pilot project, valve operation is performed to realize equitable distribution. While we need to look for optimal control points based on information on the distribution network and demand, actual operation of valve is very limited as water is being provided to homes (for example, it is not acceptable that water pressure is lowered, and water is not supplied). Also, the opening/closing operation of one valve influences the entire water system of the pilot area. In addition, there is a danger of damaging the pipeline due to excessive pressure built-up on some pipe line when closing large valves, so sufficient attention should be paid on valve operation. Therefore, the real-time distribution network function is added to simulate the influence of control on the water supply system in advance. This function is designed to simulate the influence of valve operation without putting a lot of efforts to accurately understand the distribution network information. This distribution network calculation function is secured to have enough accuracy to understand the influence of valve operation by measuring values and calibrating even without detailed data of distribution network. Only measurement data and real-time information are required for this calculation.

(6) SOP and Specification of the SCADA system

The specifications of equipment of the SCADA system are written in SOP that is separately prepared.

CHAPTER 3 Operation and Maintenance Process of the SCADA System in Pitampura

3.1 Reporting and Instruction System for Operation and Maintenance of the SCADA System

For equitable water distribution and NRW management, proper reporting and instruction system for operation and maintenance of SCADA system are required. The detailed flowchart of 'Reporting and instruction management flow of SCADA operation and maintenance' is given in Appendix 1.

3.1.1 Normal Operation Case

(1) EE, SE and JE (Civil) will decide target water pressure or water volume into DMAs for equitable water distribution and will instruct EE (E&M) every month. The method to decide the target is given to Section 4.1.

(2) EE (E&M) will instruct AE, and JE (E&M) will operate the SCADA system to achieve the instructed set values.

(3) AE and JE (E&M) will record data of SCADA operation daily.

(4) AE and JE (E&M) will report the data of the SCADA system to EE (E&M) every week. Refer to Appendix 2 for the sample of weekly reporting format.

(5) EE (E&M) will report the data of above to CE (West) and EE (Civil) every two weeks.

(6) CE (West) will report it to Addl. CEO every 3 months together with calculated NRW (refer to Section 5.5).

3.1.2 Maintenance Case

(1) EE, AE and JE (E&M) will keep monitoring water level alarms in the chambers in the SCADA system.

(2) Monthly checking of the SCADA system

- AE and JE (E&M) will check the SCADA system every month with the monthly check list (Appendix 3) and record it. EE (E&M) will plan repair or replacement of SCADA equipment based on the records of the monthly check list.

(3) Mechanism of inspection and de-watering of chamber in case water level alarm

- AE and JE (E&M) will inform water level alarms to EE (E&M) .
- EE (E&M) will inform water level alarms to EE (Civil) .
- EE, AE and JE (Civil) will inspect chamber and drain water if there is water in it. After de-watering, they will seal manholes to avoid water ingress.

(4) EE, AE and JE (Civil) will inspect chambers using the sample of inspection sheet of chamber (Appendix 4), twice a year, before and after rainy season and record it.

(5) EE, AE and JE (E&M) will entrust inspection of the SCADA system to the specialized firm, which will conduct inspection using the inspection check list, twice a year, before and after rainy season and record it. DJB will plan repair or replacement of SCADA equipment based on the inspection records.

(6) EE, AE and JE (E&M) will immediately repair the SCADA system when it malfunctions, and EE (Civil) or EE (E&M) will record it.

(7) EE (Civil) or EE (E&M) will report it to CE (West)

3.1.3 Emergency Case

- SCADA server down
- Power supply down
- Actuator down

In case of any of the above problems occurs,

- EE (E&M) will instruct AE and JE (E&M) to stop operation of the SCADA system till the problem is resolved.
- EE (Civil) will instruct AE and JE (Civil) to operate the valves manually till the problem is resolved.

3.2 Inspection Methods

3.2.1 Inspection of Chamber

I. Inspection of Chamber

All inspections and emergency response are conducted by EE (NW) III[1] under the management of CE (West).

[1] In areas other than the pilot project area, this position is read as EE (Civil).

(1) Regular Inspection (based on sample of inspection sheet of chamber (refer to Appendix 4))
Twice a year

A. Before rainy season
Appearance inspection of outer wall

B. After rainy season
Appearance inspection of outer and inner walls

(2) Emergency Response

A. After receiving the report of accident warning signal of water level alarm from EE (E&M), inspect water in chamber and drain accumulated water in chambers after rainfall.

B. Analyze causes of water ingress and repair it.

(3) Inspection Sheet of Chamber

Inspection of chambers is conducted when SCADA equipment is inspected. Coordination between EE (Civil) and EE (E&M) is required. Whenever chambers are opened for their inspection and repair, conduct sealing works on manholes and openings immediately after the repair is finished (refer to Appendix 4 "Sample of Inspection Sheet of Chamber" and Appendix 5 Procedure of "Waterproofing Work").

II. Inspection Method/Items

(1) Top Slab (Appearance)

A. Crack and fracture

B. Slippage, rattling, deformation, cracking of manholes and openings including their frames

C. Cracking and peeling-off of joints and caulking compound

D. Parked cars and goods (Garbage, material etc.)

(2) Inside of Chamber

A. Loss of material (peeling, spalling, cracking, deformation, damage) on water-proofing mortar

B. Exposure of I-steel and reinforced bars and their rust

C. Cracking, corrosion, and damage of joints of steps with wall

D. Exposure of bricks

E. Deformation of walls and spalling of water-proofing mortar

F. Trace of water on slab, walls, and floor

G. Water or trace of water

(3) Pipe and Appurtenances

A. Corrosion of pipe, appurtenances, and flange bolts

B. Leakage from joints of pipe and appurtenances.

3.2.2 Inspection of SCADA Equipment

I. Inspection of SCADA Equipment

All inspections and emergency response are conducted by EE (E&M) under the management of CE (West).

II. Frequency of Inspection

(1) Regular Inspection (based on the sample of inspection sheets (refer to Appendix 6 and 7))

Twice a year (According to schedule of chamber inspection)

A. Before rainy season

a. SCADA server, clients:

- Appearance inspection of the exterior of the equipment
- Check the normal operation of each application, check for alarms and errors, and identify the cause and respond if alarms and errors are occurring frequently

b. Local station:

- Appearance inspection of the local panel. Also, operating the switch from the local panel and checking the operation

B. After rainy season

a. In addition to (1), at the timing of opening the chamber

- Visual appearance inspection of the equipment and wiring inside the chamber
- Check the valve opening / closing operation and sound together
- Respond immediately when there is any serious damage

(2) Emergency Response

A. After occurrence of water level alarm and draining of accumulated water in chambers by EE (Civil), checking the equipment inside the chamber.

B. If any equipment in the chamber has failed, identify the cause and respond.

III. Inspection Method

(1) SCADA server, clients

A. Error contents and frequency of the operating system

B. Alarm contents and frequency of SCADA screen

C. Operation and soundness of each application

D. Operation and soundness from the clients

E. GPRS network communication

Refer to Appendix 6, for sample of inspection sheet of SCADA room and clients room.

(2) Local panel

A. Slippage, rattling, deformation, and cracking of panel

B. Indicators and lamps of panel

C. Cracking, corroding, and damaging of parts inside panel

D. Working condition of each equipment such as PLC, modem, relay, etc.

E. Opening / closing operation by electric valve switch

Refer to Appendix 7, for sample of inspection sheet of local panel.

(3) Equipment in the chamber

A. Opening / closing operation from the local panel

B. Slippage, rattling, deformation, cracking of flow meter, pressure gauge and wiring

3.3 Further Enhancement and Sustainable Maintenance

For the SCADA system to be functioned continuously, it is necessary to periodically update the system by analyzing inspection and failure reports in maintenance work. All the maintenance and the enhancement work response are conducted by EE (E&M) under the management of CE (West).

(1) Analysis from monthly checking and twice-a-year inspection records and equipment failure reports.

(2) Plan SCADA equipment update from result of analysis

- Hardware update
- Software update

(3) Carry out SCADA equipment update periodically.

CHAPTER 4 Operation for Equalizing Pressures and Flow to Each DMAs

4.1 Target Pressure Setting at Each Locations and UGR/BPS

For the equitable water distribution, the SCADA system that can set the target value and control water distribution pressure / volume allocated to the concerned DMAs from each UGR is important. The following is the procedure for setting the target value of the equitable water distribution to the DMAs.

(1) In the SCADA system, confirm that the pressure and flow data from all locations are collected and recorded.

(2) Understand the water flow in the command area, and conditions of valves setting (e.g., some valves cannot be controlled due to operational requirement) from SCADA monitor screen at the water supply time, and past flow rate and pressure trend (graph) etc.

(3) Select the location of the control valve to adjust pressure and flow to each DMA.

(4) Use the trend (graph) display function and the report that describes the pressure and flow rate data at intervals of 10 minutes or 1 minute issued from the SCADA system, and understand the range of pressure and flow rate at each selected location in water supply time. Its pressure and flow rate at each selected location set as the baseline pressure and flow rate.

(5) Set the target pressure and flow range where all the selected locations are equalized from the baseline pressure and flow range of each selected location. Also, these target values should be reviewed once a month because the distribution situation will change due to the seasons, pump situation of UGR/BPS and pipeline improvement.

4.2 Controlling to Target Pressure

Use the SCADA system to control degree of valve opening to match the target pressure range for each location. The SCADA system has valve opening setting function or constant target pressure function. Automatic operation (target pressure constant function etc.) has no human errors or omissions.

Trends of water pressure and flow rate are often different in the morning and evening, and trends may also differ on each day of a week. The operator should not rely blindly on the SCADA system, but evaluate pressure and flow rate several times a day. The target values should be changed in some cases.

Since the tendency of pressure and flow rate varies even with the same valve opening depending on the characteristics and diameter of the valve and the number of booster pumps in operation for the DMA, the relationship among the valve opening degree, the flow rate, and the pressure of each location is measured beforehand, to grasp the characteristics. In addition, grasp the valve opening degree that can be operated, and then operate the valve for the equitable water supply.

In addition, if it is not possible to achieve equal water supply with SCADA's valve control, it is necessary to consider installation of additional pipeline and reconstruction of DMA.

CHAPTER 5 Calculation Procedure of NRW Ratio

5.1 Introduction

Calculation of accurate NRW ratio needs accurate values of System Input Volume (SIV) and Billed Authorized Consumption (BAC). In a smaller distribution area such as a DMA, bulk meters at each inlet and outlet can provide accurate SIV while BAC can be calculated from regular meter reading data. NRW is then calculated by subtracting BAC from the SIV.

5.2 Definition of Non-Revenue Water

Table 1 shows “Water Balance Table of IWA (International Water Association)”. This table is widely used in many countries in the world. As shown in this table, NRW consists of (1) Real losses, (2) Apparent losses, and (3) Unbilled authorized consumption.

Table 1 Water Balance Table of IWA

<table>
<tr><td rowspan="10">System Input Volume</td><td rowspan="3">Authorized Consumption</td><td rowspan="2">Billed Authorized Consumption</td><td>Billed Metered Consumption</td><td rowspan="2">Revenue Water</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="7">Non-Revenue Water (NRW)</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="5">Water Losses</td><td rowspan="3">Apparent (Commercial) Losses (Non-physical Losses)</td><td>Unauthorized Consumption</td></tr>
<tr><td>Customer Metering Inaccuracies</td></tr>
<tr><td>Systematic Data Handling Errors</td></tr>
<tr><td rowspan="3">Real Losses (Physical Losses)</td><td>Leakage on Transmission and Distribution Mains</td></tr>
<tr><td>Leakage and Overflows at Utility's Storage Tanks</td></tr>
<tr><td>Leakage on Service Connections up to point of Customer metering</td></tr>
</table>

5.3 Measurement of Water Volume by DMA

DMA is a distribution block, isolated hydraulically from adjoining blocks by isolation valves. The Figure 1 shows the water supply system including DMAs.

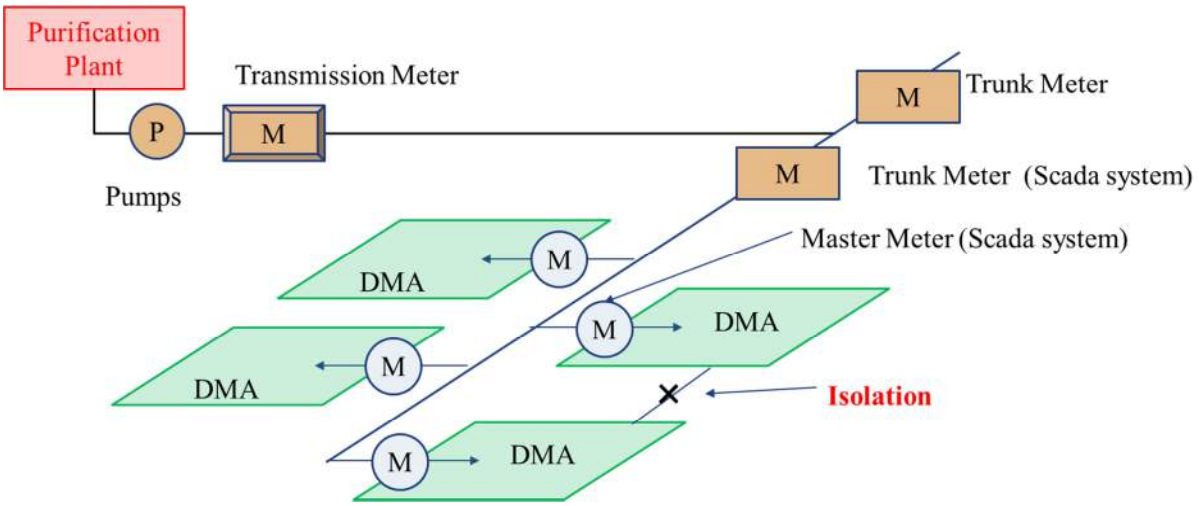


Figure 1 Schematic Figure

5.4 How to Calculate NRW

As shown in IWA Water Balance Table, calculation of NRW requires two main parameters; SIV and BAC. In the pilot project, the SIV will be calculated from the reading of bulk meters at inlet and outlet of each DMA through the SCADA system while the BAC will be calculated from the result of customer billing records obtained through Revenue Management System (RMS).

The BAC consists of two components; Billed Metered Consumption and Billed Unmetered Consumption. Although the customers in the pilot DMAs are all metered there are always be some customers with malfunctioned meters. For those customers it is necessary to analyze the situation and estimate their consumption as accurately as possible. It is important to understand the customer information in each DMA to calculate billed authorized consumption accurately.

(1) Door to door Survey

It is necessary to keep updated record of customers in the DMAs. For this purpose, door to door survey of customer data should be conducted. The table below should be prepared to understand customer information.

BUSN	S.No.	Block	Address	Floor	Name of Consumer	Water Connection YES or NO	Water meter YES or NO	Water Meter DJB ,PVT , or AMR	KNO	G.W. YES or NO	Remark 1 Plus	Remark

(2) RMS data

BAC volume can be extracted from RMS data. For this purpose, the Civil staff requires RMS data that includes the meter reading data from Revenue staff. After getting the RMS data of the DMAs, the Civil staff should check it for the consistency with customer numbers from the customer survey. Any discrepancy between the customer survey and RMS data should be investigated and the error should be rectified.

(3) Calculation of NRW

NRW should be calculated on the basis of the bills issued by DJB and not against the bills paid by the customers.

1) Calculate "Billed Authorized Consumption Volume". (m^3/day)

"Current Billing Record" - "Previous Billing Record" = Consumption Volume (m^3)

"Current Billing Date" -" Previous Billing Date" = Duration (Days)

Consumption Volume (m^3)/ Duration (Days) =

"Billed Authorized Consumption Volume" (m^3/day)

2) Calculate the "System Input Volume" from SCADA data for the same period of time of "Billed Authorized Consumption Volume"

3) Calculate NRW

$$\text{NRW}(\%) = \frac{System\ Input\ Volume\ -\ Billed\ Authorized\ Consumption\ Volume}{System\ Input\ Volume} \times 100$$

Where;

"System input volume" is from the SCADA system.

"Billed Authorized Consumption Volume" is from RMS data.

5.5 Civil Staff's Role

DJB should implement the followings four times per year.

(1) EE (Civil) collects RMS data that includes the meter reading data from Revenue staff.

(2) Calculate "BAC Volume" (m^3/day) from RMS data.

(3) Refer to SCADA data corresponding to BAC Volume.

(4) EE (Civil) will calculate NRW.

(5) EE (Civil) will report the result to CE (West) and Addl CEO.

(6) Based on the results of NRW, Addl. CEO should decide priority measures to reduce NRW.

5.6 Practice

The practice of calculation of NRW is shown in the Figure 2.

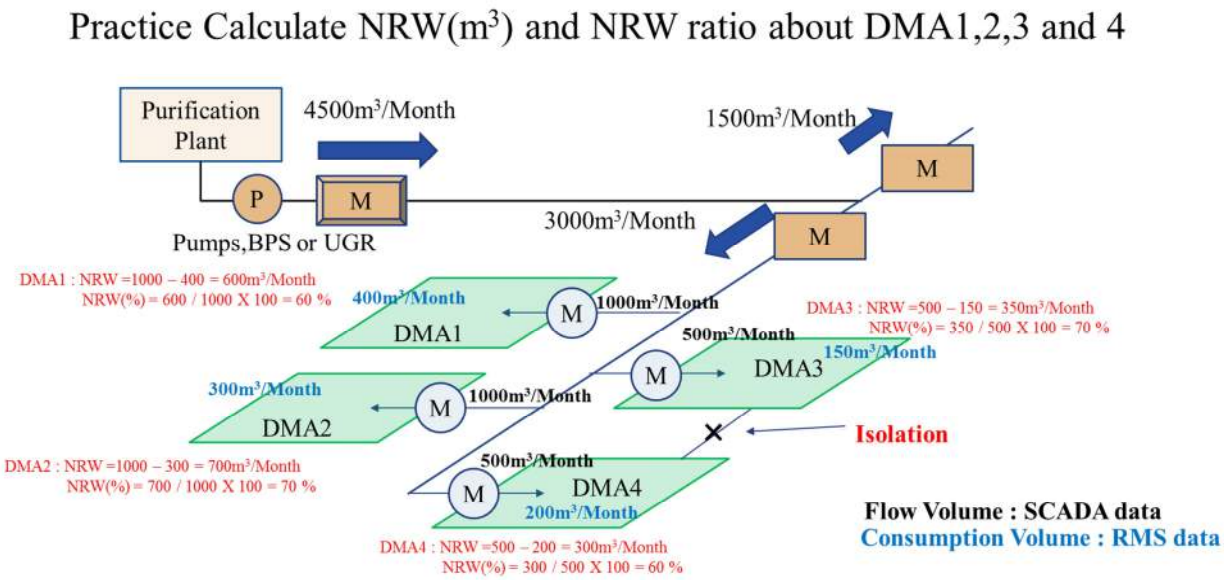


Figure 2 Practice of Calculation of NRW

The procedure of actions of responsible staff in NRW management in case the Civil staff calculates NRW is shown in the Figure 3.

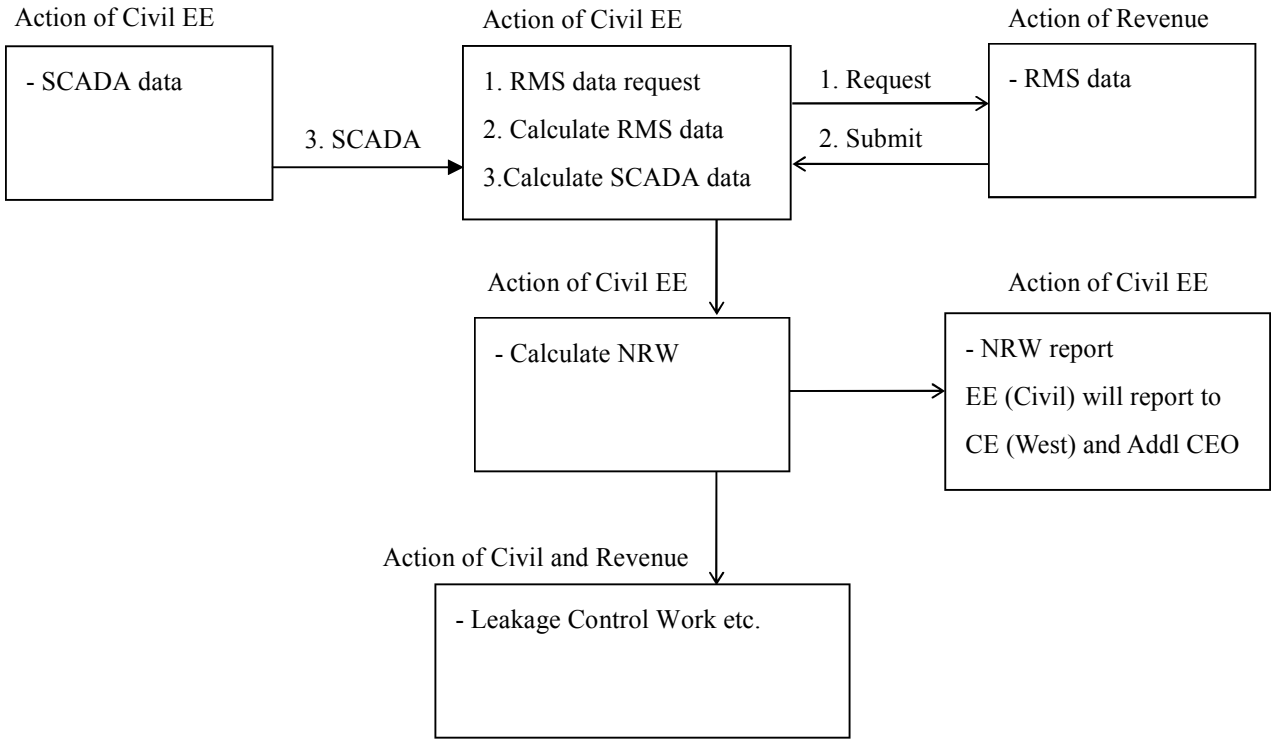


Figure 3 Procedure of Actions of Responsible Staff in Calculation of NRW

5.7 NRW Calculation in Future

NRW is calculated by EE (Civil) in the pilot project as is shown in Section 5.4. However, DJB has decided to calculate NRW in DMA Cell so that EE (E&M) will send the input volume to DMA obtained from the SCADA system to DMA Cell fortnightly. DMA Cell, in turn, calculates NRW using the data of BAC available in DMA Cell. (Figure 4)

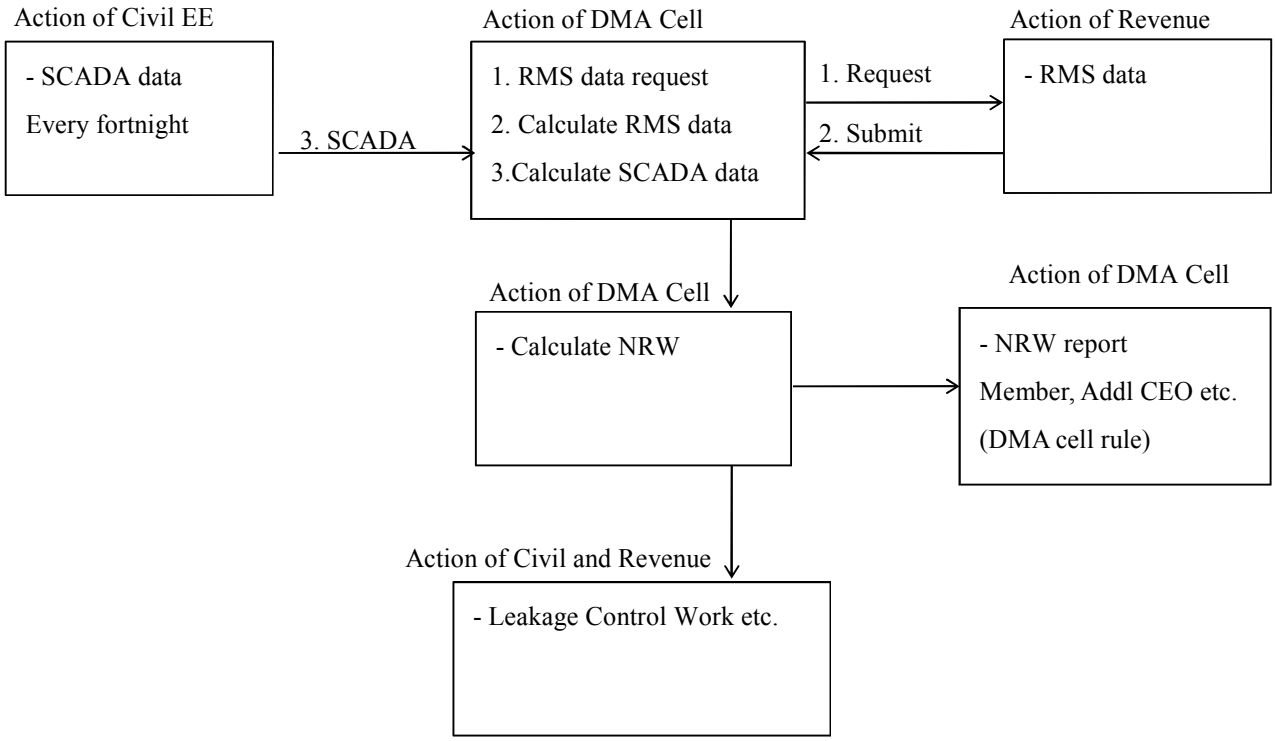


Figure 4 Procedure of Actions of Responsible Staff and DMA Cell in NRW Calculation

CHAPTER 6 Water Proofing for Chambers

6.1 Chambers with RC Structure and Brick

There were gaps between each brick in the chambers constructed in the pilot project at the first stage, and water entered into the chambers through gaps. Water ingress should be avoided because electrically driven valves are stored inside of chambers and electricity leakage might take place when valves are submerged. Therefore, water-proofing measures were taken against the constructed chambers. Measures were taken for walls, top slabs and basements to fill gaps between bricks (refer to Appendix 5).

DJB has decided not to construct brick-made chambers and instead to construct **chambers with reinforced concrete**, so that water ingress can be avoided.

6.2 Water Proofing of Manholes

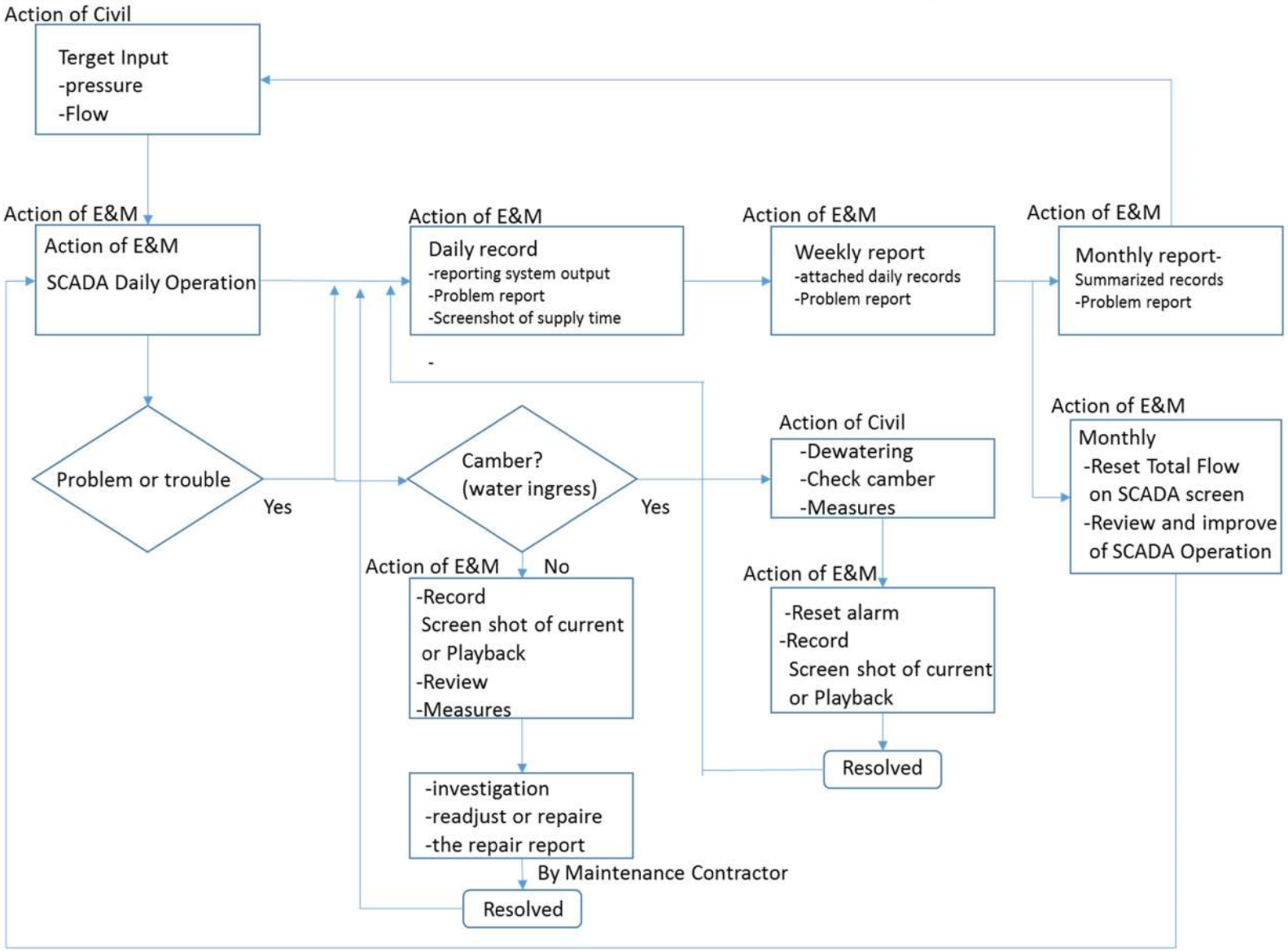
Other measures are taken for gaps of manhole in inspection and maintenance of equipment and openings for carrying-in and out of equipment. These gaps should be small as much as possible. Nonetheless, there are naturally small gaps, particularly in openings and closing of manhole. Therefore, sealing method is recommended every time after they are opened and closed. The method is explained in Appendix 5.

6.3 Water Level Sensor

A water level sensor was provided in every chamber to prevent electrical devices from being submerged. If the water in a chamber rises to a certain pre-set level, an alarm will be set off and transmitted to SCADA center. Then DJB should rush to the site and drain the accumulated water immediately.

APPENDIXES

Appendix 1: Reporting and Instruction Management Flow of SCADA Operation and Maintenance



Appendix 2: Sample of Weekly Report

WEEKLY REPORT for the SCADA System

Reporter's Name:

Cont:-

From:- dd.mm.yyyy To: dd.mm.yyyy

		Screen Shot		
	10 Minute Data	Overview	Location's	Problem (Error or Warning, alarms)
Friday dd.mm.yyyy	Yes · NO	Yes · NO	Yes · NO	1. 2.
Saturday dd.mm.yyyy	Yes · NO	Yes · NO	Yes · NO	1. 2.
Sunday dd.mm.yyyy	Yes · NO	Yes · NO	Yes · NO	1. 2.
Monday dd.mm.yyyy	Yes · NO	Yes · NO	Yes · NO	1. 2.
Tuesday dd.mm.yyyy	Yes · NO	Yes · NO	Yes · NO	1 2
Wednesday dd.mm.yyyy	Yes · NO	Yes · NO	Yes · NO	1. 2.
Thursday dd.mm.yyyy	Yes · NO	Yes · NO	Yes · NO	1. 2.

Remarks

Note: -

1.

2.

3.

Appendix 3: Sample of Monthly Check List

Monthly Check List for the SCADA System

Reporter's Name:

Cont:-

From:- dd.mm.yyyy To: dd.mm.yyyy

Date	WEEKLY RREPORT	Problem (Error or Warning, alarms)
1st week	Yes · NO	
2nd week	Yes · NO	
3rd week	Yes · NO	
4th week	Yes · NO	
5th week	Yes · NO	

Remarks

Note: -

1.

2.

3.

Appendix 4: Sample of Inspection Sheet of Chamber

Inspection Sheet of Chamber

Chamber No.

Date	/ /	Time	: - :	Weather	
Name		Designation			

Classification	Item	Inspection result	
Appearance	Installation position	On-site, roadway, sidewalk, other	
	Top Slab	Car ride	None · Yes ( )
		Crack / Defect	None · Yes ( )
		Other	
	Manhole	Lid opening / closing situation	Opening and Closing
		Cracks / loss of the lid	None · Yes ( )
		Cracks / defects in the lid frame	None · Yes ( )
		Rat rattling	None · Yes ( )
		Sealing loss	None · Yes ( )
		Other	
	Equipment entry port	Lid opening / closing situation	Opening and Closing
		Cracks / loss of the lid	None · Yes ( )
		Cracks / defects in the lid frame	None · Yes ( )
		Rat rattling	None · Yes ( )
		Sealing loss	None · Yes ( )
		Other	
Internal	Dimensions of chamber	Top L = m , W = m , H = m	
		Lower L = m , W = m , H = m	
	Pipe depth	GL – m	
	Ceiling	Mortar damage	None · Yes ( )
		Leakage or leakage trace	None · Yes ( )
		Other	
	Wall surface	Mortar damage	None · Yes ( )
		Leakage or leakage trace	None · Yes ( )
		Other	

	Step	Step breakage/ missing	None · Yes ( )
		Step rust	None · Yes ( )
		Other	
	Floor (base)	Mortar damage	None · Yes ( )
		Leakage or leakage trace	None · Yes ( )
		Other	
	Joint (including all sides)	Mortar damage	None · Yes ( )
		Leakage or leakage trace	None · Yes ( )
		Other	
	Pipe	Is there any corrosion on the pipe	None · Yes ( )
		Water leakage or leakage trace from connection	None · Yes ( )
		Other	
Other equipment	Valve	Corrosion of the main body and flange bolts	None · Yes ( )
		Leakage or leakage trace from the main body and its connection part	None · Yes ( )
		Other	
	Flowmeter	Corrosion of the main body and flange bolts	None · Yes ( )
		Leakage or leakage trace from the main body and its connection part	None · Yes ( )
		Other	
	Pressure gauge	Corrosion of main body and connection part	None · Yes ( )
		Water leakage or leakage trace of main body and connection part	None · Yes ( )
		Other	

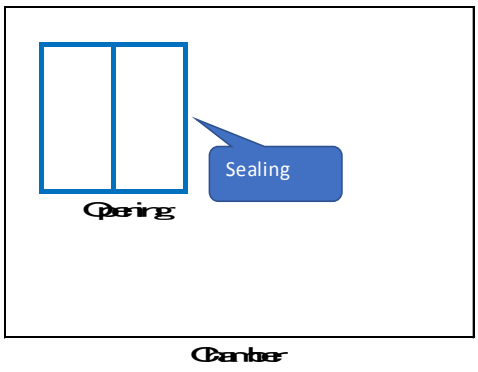
Appendix 5 Procedure of “Waterproofing Work”

Notes

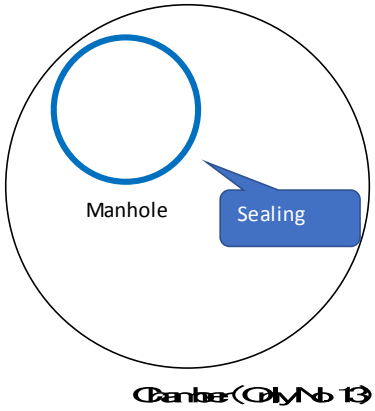
- DJB should make maximum efforts to install a barricade so as not let a car park or passing over on top of the opening.
- Be sure to conduct an internal check before and after the rainy season.
- Conduct external visual inspection once a month.
- When the water level gauge alarm rings on the SCADA side, immediately extract water.
- When constructing a new chamber, positively adopt the RC structure and PC structure rather than brick construction, and also consider iron lids (waterproof type is preferable).

1. Outside chamber

(1) If there is only one Square opening for a chamber, regardless of it being a manhole or not, “Waterproof Silicone Sealant” should be applied to seal it.



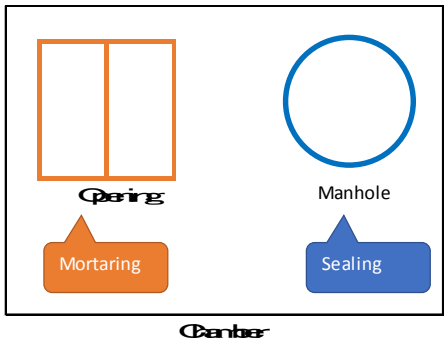
Square type chamber



Circular type chamber

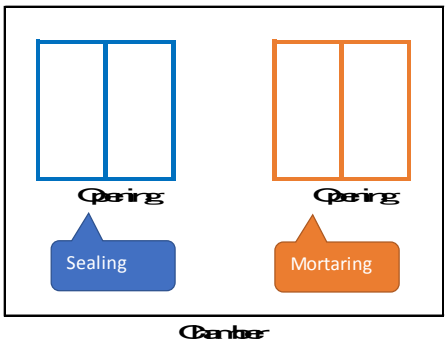
(2) When there are two openings in one chamber

A. Where there is a manhole and one square opening, the manhole should be sealed using “Waterproof Silicone Sealant” and the Square opening should be sealed using “Waterproof Mortar”.



Square type chamber

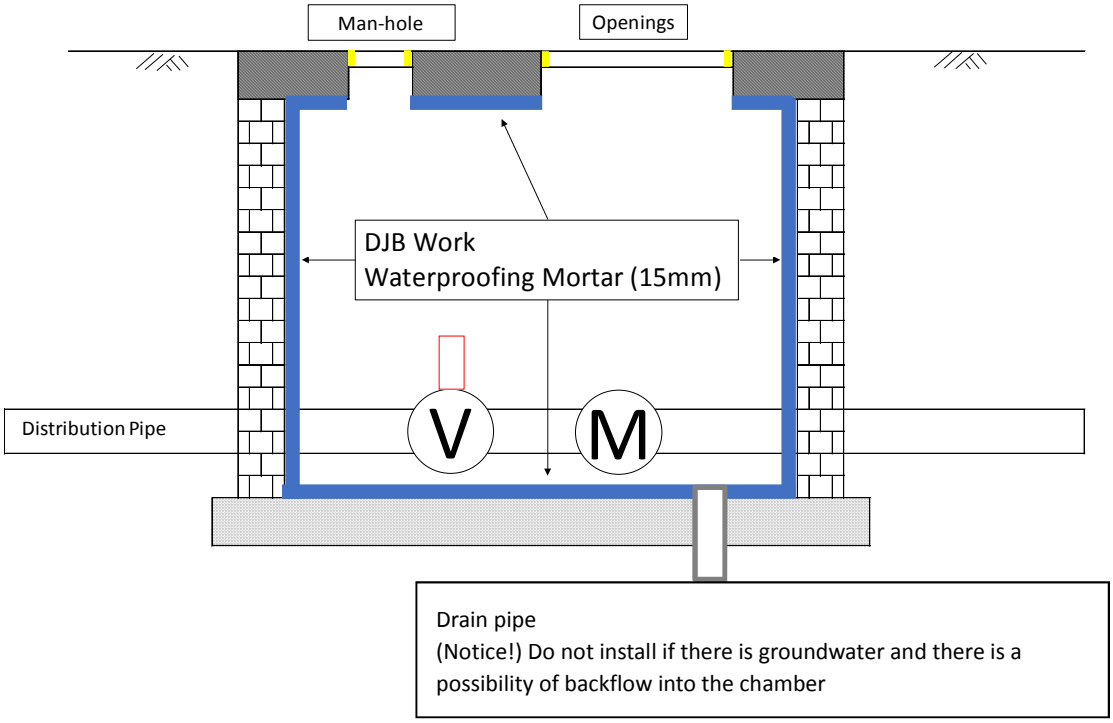
B. Where there are two square openings, one should be sealed watertight using “Waterproof Silicone Sealant” and the other should be sealed off with “Waterproof Mortar”.



Square type chamber

2. Inside chamber

Apply waterproof mortar (preferably 15mm or thicker) to all the sides inside the chamber (base slab, bottom, top slab). However, if it is difficult to apply 15mm at one time, apply it in multiple times. Also, if there is no groundwater in the vicinity, consider setting a drain pipe for draining water from the base slab. (Do not install if there is groundwater and there is a possibility of backflow into the chamber)



Inside chamber

Sealing of the Square Opening using “Waterproof Mortar”		
1		After cleaning the frame, temporarily place the iron plate and confirm the size. If the iron plate is too big, cut it on site accordingly
2		Remove the iron plate and seal using “Waterproof Silicone Sealant” all four sides of the frame.
3		Set the steel plate again, and further seal using “Waterproof Silicone Sealant” the gap between the frame and the iron plate
4		Put “Jute Rope” fully in the gap between the lid and the frame

5		Set the concrete lid and fill “Waterproof Mortar” in the gap between the frame and the lid, and the gap between the two lids. When all the work is finished, further apply mortar over the entire surface of the lid from above.

Sealing of the Square Opening using “Waterproof Silicone Sealant”.		
1-4	Same as 1 to 4 from above "Sealing of Square Opening by Waterproof Mortar"	
5		Set the concrete lid, fill the gap between the frame and the lid, and the gap between the two lids with “Waterproof Silicon Sealant.

Sealing of the manhole using ”Waterproof silicon sealant”		
1		After cleaning the frame, apply “Waterproof Silicone Sealant” as shown in the picture
2		Attach “Bond Breaker Tape” to the frame. It is also possible to use the rubber packing (ϕ 600) used for connecting ductile pipes for water supply.
3		Set the lid, and firmly put “Jute Rope” into the gap.
4		Seal the gap between the lid and the frame with “Waterproof Silicone Sealant” after placing “Jute Rope” sufficiently.

”Waterproofing work” for inside Chambers		
1		After cleaning inside chamber, as for the adhesion of the waterproof mortar to be improved, slightly scrape the surface as shown in this picture.
2		As waterproof mortar falls down during work, start work from Top slab. It is difficult to apply 15 mm at a single time, so apply it a couple of times.
3		Next, apply waterproof mortar to the Side walls. Here as well, if it is difficult to apply 15 mm at once, apply it a couple of times.
4		Finally, apply waterproof mortar to Base Slab. After sufficiently drying, move on to the opening sealing work.

Materials for “Waterproofing Work”	
	Cement
	Sand
	Waterproof additive

	Bond breaker tape
	Waterproof silicone sealant
	Steel plate (3 mm)
	Jute rope

Appendix 6: Sample of Inspection Sheet of SCADA Room and Clients Room

Inspection sheet of SCADA room and clients room

Chamber No.

Date	/ /	Time	: - :	Weather	
Name		Designation			

Classification	Item	Inspection result	
Appearance (Defective)	SCADA room	SCADA Server PC	None · Yes ( )
		SCADA Client PC	None · Yes ( )
		Reporting System PC	None · Yes ( )
		Pipe Network Calculation System PC	None · Yes ( )
		Printer & Toner	None · Yes ( )
		Power Branch panel	None · Yes ( )
		PLC Panel	None · Yes ( )
		UPS	None · Yes ( )
		Router, Ethernet Switch, Any other equipment	None · Yes ( )
		Other	
	SCADA Client-1	SCADA Client PC	
		Printer & Toner	
		Power Branch panel	
		UPS	
		Router, Ethernet Switch, Any other equipment	
		Other	
	SCADA Client-2	SCADA Client PC	
		Printer & Toner	
		Power Branch panel	
		UPS	
		Router, Ethernet Switch, Any other equipment	
		Other	

SCADA Function	SCADA system	Error, No Functional	None · Yes ( )
		Other	
	Reporting System	Error, No Functional	None · Yes ( )
		Other	
	Pipe Network Calculation System	Error, No Functional	None · Yes ( )
		Other	

Appendix 7: Sample of Inspection Sheet of Local Panel

Inspection sheet of local panel

Location No.

Date	/ /	Time	: - :	Weather	
Name		Designation			

Classification	Item	Inspection result	
Appearance (Defective)	Roof, Fence, Key lock	Defective Panel	None · Yes ( )
		Other	None · Yes ( )
	Power Supply Meter	Outside, Wiring	None · Yes ( )
		other	
	Panel	Door handle	Opening and Closing
		Name Plate	None · Yes ( )
		Outside of Panel	None · Yes ( )
		Outside wiring	None · Yes ( )
		Other	
Internal (Defective)	Inside Panel Door	Door, handle	Opening and Closing
		Signal lamps	None · Yes ( )
		Indication Meters	None · Yes ( )
		Switches	None · Yes ( )
		Other	None · Yes ( )
	Inside Panel	Internal Lamp	None · Yes ( )
		FAN	None · Yes ( )
		PLC Unit	None · Yes ( )
		GPRS Modem	None · Yes ( )
		Relay Module, Distributor, Isolator, Arrestor(Sockets)	None · Yes ( )
		24V DC Power Supply Unit	None · Yes ( )
		Earth Protection Relay, ECCB, MCCB	None · Yes ( )

		Flow Transmitter	None · Yes ( )
		Power Terminal Blocks, CT	None · Yes ( )
		Inside Wiring	None · Yes ( )
		Other	