Sewage Signaling System

For CUHK pump station

User's Manual

Contract No. DC/2009/14

19/11/2011

Revision history

Revision	Date	Description
V0.1	19/11/2011	Original by York M. Hwe
V1.0	6/1/2012	Added "Maintenance" section

1 Introduction

This document specifies the signaling system for the Temporary Sewage Pump Facility (TSPF) project. The TSPT a sewage water pump station located at Chinese University. The TSPT is remotely monitored at Sha Tin Sewage Treatment Works (STSTW). As part of the pump station system, signaling system is the key component that makes remotely monitoring possible. The signaling system provides the following functions:

1. Monitor and display devices and operation status of the pump station
2. Send real time operation status to the remote location
3. Generates and store operation records
4. Create reports/summary in digital file format for analysis
5. Send critical data and alert messages to mobile phone through GSM network

The system is partition in to two parts or subsystems, which are in different locations. They are digitally connected with wire and wireless link. The diagram below shows locations of and the link between.
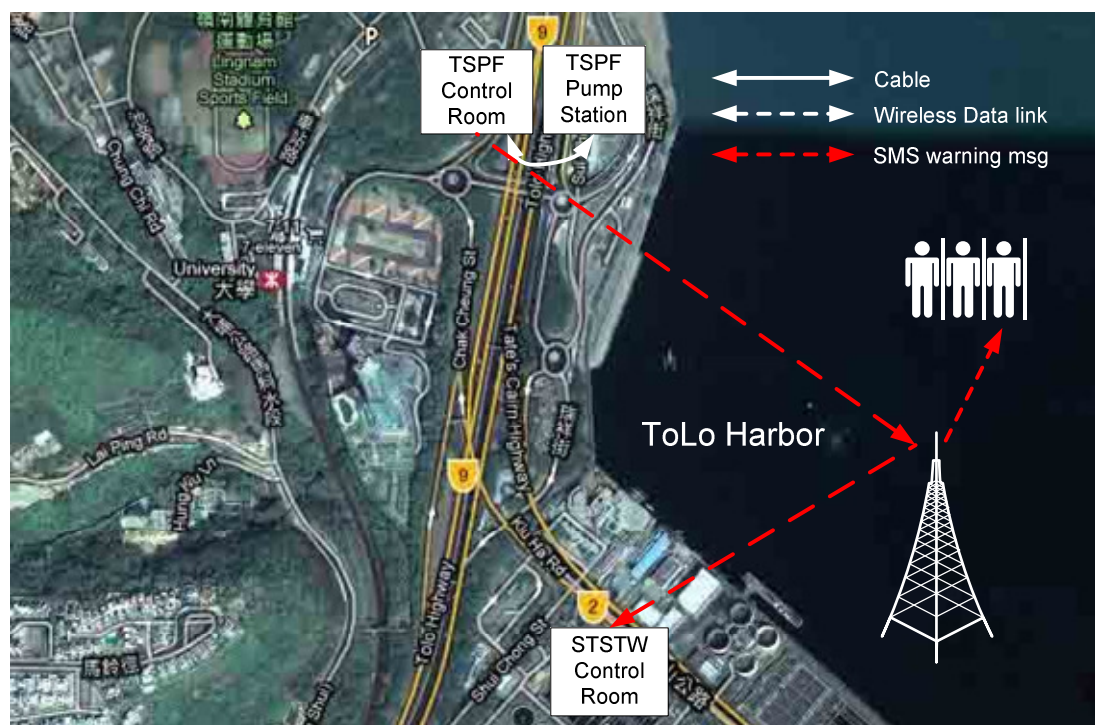
The signaling system is located at both the TSPF (server panel) control room and STSTW (client panel) control room.

Devices and operation status of the pump station are monitored by the signaling system. The data, along with other status information are packaged and send to STSTW Control Room

periodically. The operation status of the pump station are displayed on the remote monitor panel installed in the STSTW control room

In an event system failure, device failure or alarm conditions are reached, the system will send SMS message to the predefined mobile phones.

Chapter two of the document defines the scope of the document. Chapter three will have a general description of the system. The system configurations, interface between components will also be defined in the chapter. The chapter will also describe the inter system communication, system hardware and the system performance.

Chapter four will have detail description system operation and how to use the system.

2 Scope

This document is the user manual of the signaling system for the TSPF. The connection and interface to the other system and/or devices will be described. The function of the signaling system will be enlisted, along with the performance of the signaling system. The document will also cover where the status and data being display and how to use the functions.

The implementation of the function is beyond the scope of this document. More over, the daily operation procedures (i.e. when the report should be generated) belong to a higher level of document and will not be covered in this document. The installation of the system is also outside the scope of this document.

3 System

The signaling system is part of the pump station system. Through hardware connection the signaling system monitors the operation status devices in real time The operation status will be recorded in a format easy to understand (i.e. report in Excel format), as well as SMS message to mobile phone. In an event of abnormal operation, the signaling system will send SMS to alert to the group of predefined user.

This chapter will describe the system. The first section will provides the configuration of the signaling system from the system point of view. The second section will describe the features of the signaling system. The first section covers the partition and the configuration of the system. The second section will descript the functions of each subsystem and the interface between. The first section is the system configuration. The third chapter will describe the general features of the system.

3.1 Configuration

The system block diagram shows the system and the interface between signaling system and other subsystem. The block diagram also shows partition of the signaling system.

The system interface defines the signal and connection between the signaling system and the other part of the system.

3.1.1 System block diagram
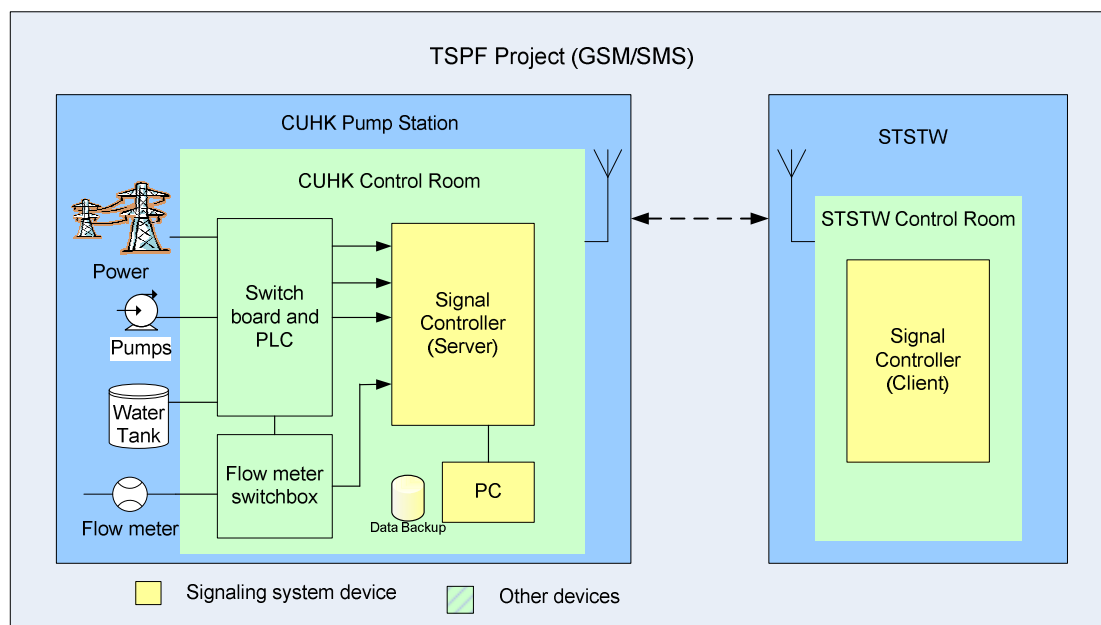
3.1.2 System interface

The signaling system interface defines the connection to the other part of the system. Signaling system process the input signal, and output the processed signals. The following sections will specify the interface, signals and direction of the interface. The connector will be specified in the chapter with hardware description, while the pin and cable assignment will be specified in the appendix A.
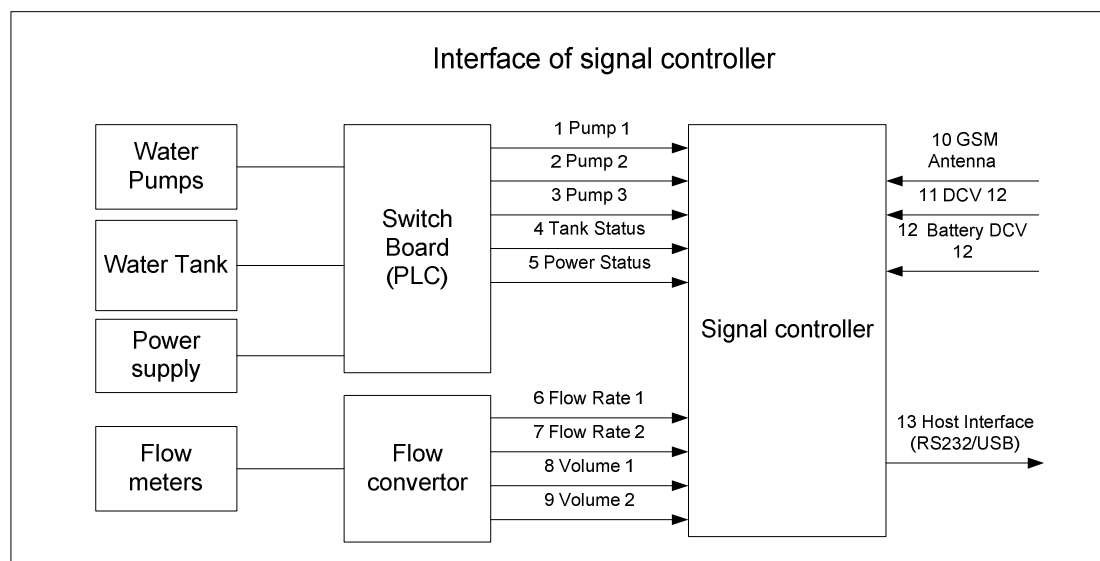
3.2 System features

The system is a distributed system with two subsystems installed in different locations, which is geographically disconnected. The following is an outline of the system features:

1. Monitor and data collection
2. Display
3. Communication
4. Host interface
5. Host application

3.2.1 Monitor and data collection

The status outputs from the external device are connected to the signaling system through the switch board. The signal system will sample the inputs periodically, and filter the noise. The following devices are monitor by the signaling system:

1. Water pumps
2. Power supply
3. Water tank
4. Flow meters

3.2.1.1 Water pump

The CUHK station has three water pumps. The signaling system monitors the following status of each water pump:

1. On/Off
2. Fault (trip)
3. Emergency stop

4. Power failure

As by design, the power failure will also trigger the emergency stop and the fault status.

3.2.1.2 Power supplies

The power for the pump station may come from three different sources:

1. CLP
2. Emergency power
3. UPS

Under normal operation, power is provided by CLP. In an event CLP failure, Emergency power will kick in. UPS will be final power source. The signaling system monitors the status of all three power sources. In additional, the signaling system has its own build-in battery with enough power to issue SMS alert even all other power source failed.

3.2.1.3 Water tank

The status of the water tank is monitored by the signaling system. The signaling system monitors the following (abnormal) status of the water tank:

1. High level
2. Over flow

3.2.1.4 Flow meters

Flow meter provides real time information of the water flow rate, and accumulated volume flowed through the pipe. There are two flow meter installed at the site, and the signaling system collect both the flow rate and volume of two flow meters.

3.2.2 Display

The signaling system displays the operation status of the pump station on the devices appropriate for the message being delivered. The following are list of devices/methods:

1. LED light on the signal controller (both the server and client)
2. LCD display on the signal controller (both the server and client)
3. SMS message to the mobile phone

The display function of the signaling system will be described in detail in user interface chapter.

3.2.3 Communication

The communication channel for signaling system is GSM in SMS format. The signal system use SMS for communication between server and client, as well as with human being.

3.2.3.1 Data link

For communication between server and client, the signaling system will package the information into a message and deliver periodically. The message includes the information as follow:

1. Message start indicator

2. Message type

3. Port number (term for internal component intended to deliver)

4. Information (i.e. the current status information)

5. Check sum

6. Message end indicator

3.2.3.2 Alert SMS messages

Alert SMS messages are delivered to mobile phone for user. The alert messages informed the user a predefined alert has happened. The conditions of user receiving the alert SMS message are:

1. Mobile phone number is entered into the system

2. Subscripted to the event

3.2.4 Host interface

The host interface is design for host device (i.e. PC) connect to the system. The signaling system defined a set of interface command, enable the host to collect data and make configuration change the signaling system.

3.2.5 Host Application

The PC application provides a graphic user interface for use to monitor and manage the system through the host interface.

1. Collect data from the signaling system

2. Store data for statistic analysis

3. Setup signaling system

4. Manage/change system configuration

5. Create reports

3.3 System Hardware

The main hardware for the signaling system is the Signal Controller Board (SCB), one for the server and one for the client. A block diagram of the SCB shows the components and connection of the SCB, follow by a brief description of the components and connections.

A picture of the SCB shows the layout and physical location of the components and

connectors.

3.3.1 SCB Hardware block diagram

Hardware block diagram for controller board

Signal switch box → Opto Isolator & I/O Extender — 1

GSM modem — 3

USB — 5 → PC

Flow meter convertor → Analog Input — 2

MCU

LCD — 6 → Display

Buttons → Digital I/O — 8

UART — 4

I/O Extender — 7 → LED

1. Optical Isolated inputs
2. Digital inputs
3. UART 0

4. UART 1
5. USB
6. SPI

7. Output Extender
8. Analog Inputs

Hardware, connectors   32 bit MCU (Cortex M0)
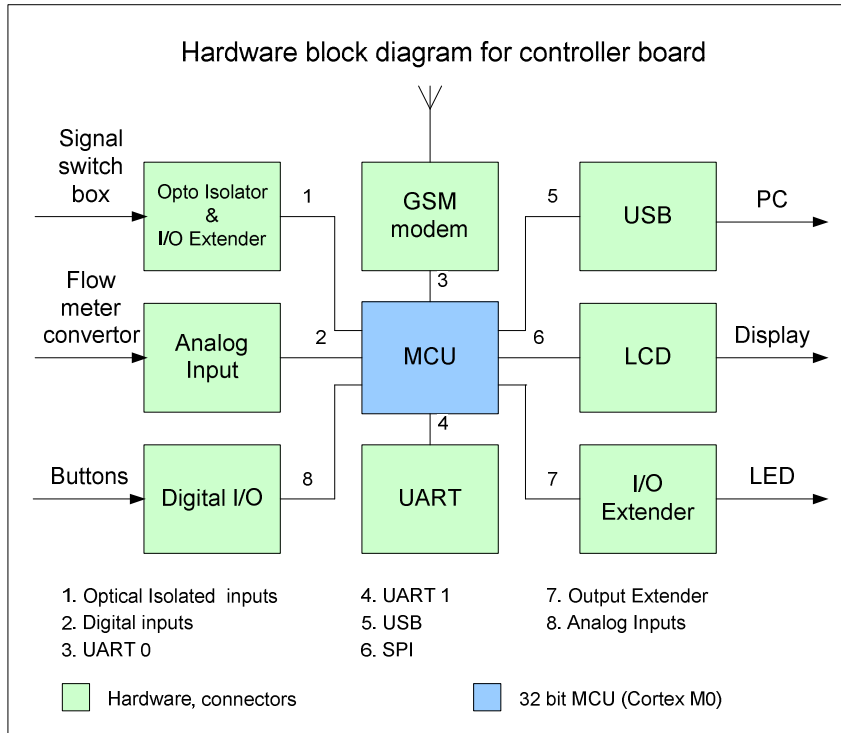
3.3.1.1 Optical Isolator and I/O extender

The optical isolator isolates the signaling system from the other part of the system. The isolator interfaces with the external devices with the industrial standard of 24 DCV. Since the SCB handles a large amount of I/O signals, an input extender circuitry is designed to expand the digital inputs, and an output extender circuitry is designed to expand the output signals.

3.3.1.2 MCU

The MCU is the central component of the SCB. The 32 bit MCU is running at 36 MHz clock speed with internal peripheral controller to control the other functional blocks of the SCB. In additional, an internal real time clock keep a system time and provides a accurate time base to time stamped the sample

3.3.1.3 Analog inputs

The flow meter use current to indicate the flow rate. The SCB use two internal ADC (one for each flow meter) to acquire data from the flow meter. The operational amplifiers are used to as pre-condition the analog signal inputs.

3.3.1.4 UARTS

The MCU has two internal UARTS. UART 0 is assigned to the GSM modem, while UART 1 is used for the host interface;

3.3.1.5 SPI and I2C

The SPI interface is used to control the LCD display. The I2C is assigned to access the on board EEPROM.

3.3.1.6 USB

USB is used for the system development.

3.3.1.7 GSM modem

The GSM modem is the bridge between the signaling system and the GSM network.

3.3.2 SCB physical layout
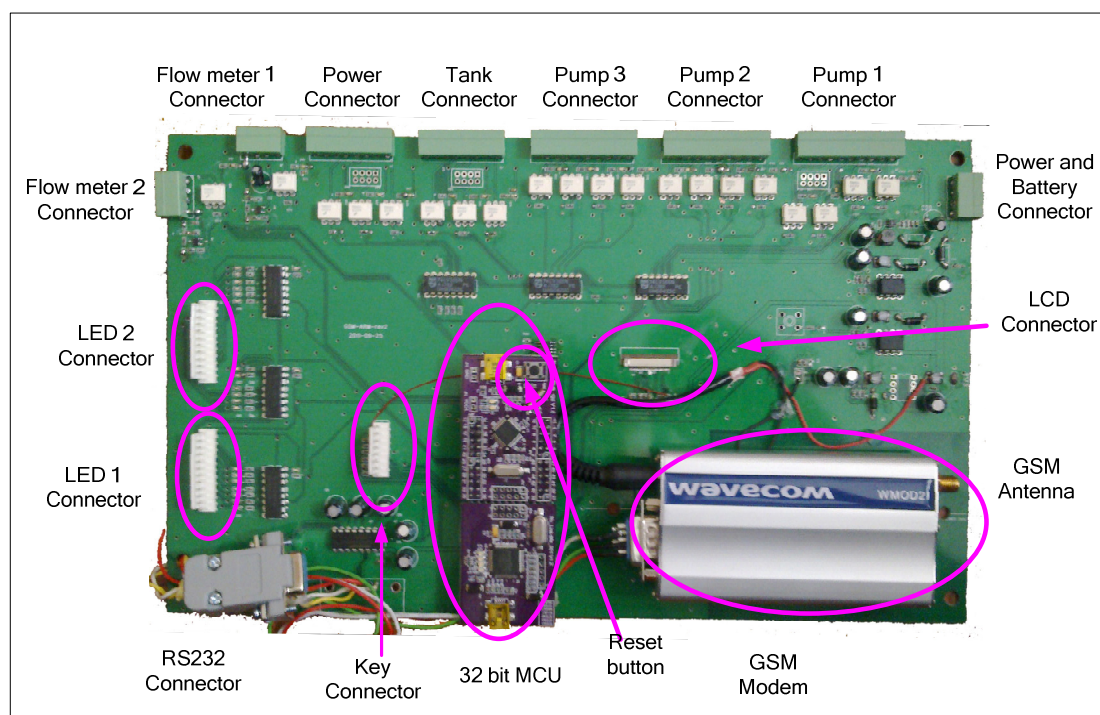
While the SCB is installed inside the box, the signals are passed to the LED and LCD through cables from the box. Appendix B defines the cables and pin assignments.

3.4 Signaling system performance

The signaling system performance is measured by the time delay of the system input and the output. The signaling system outputs are listed below:

1. Client
2. Display
3. SMS message
4. Host interface

The table below enlisted the timing parameters of the signaling system.

Measure	Period	Unit	Remark
Data sample	0.5	Sec.	External inputs are sampled every 0.1 sec.
Display refresh (LED, LCD)	0.1	Sec.	
Data link	30	Sec.	Send data sample to client in every 30 second
Data link (pump on)	20	Sec.	Increate send sample rate to 20 second
Data link (event on)	1	Sec.	
Query by PC	5	Sec.	Host interface application query the data every 5 sec.
Sample stored (internal)	60	Sec.	Samples are stored no data query received from host
Sample saved (on PC)	60	Sec.	host application sample data into data file
Volume accumulation	24	hour	Volume is reset to zero at 00:00:00 am every day
SMS message (day end event)	24	hour	Total volume is send to SMS subscriber
Data log file	24	hour	A data log file is create every day

3.4.1 Sample rate

A valid sample is created every 0.5 second in the system. The sample is stamped with date
and time according to the real time clock.
The internal sample clock is running at 100 ms, and the filter length is set to 5. In other word,
sample is validated if signal is stable for 0.5 second.

3.4.2 Display

The signaling system displays the operation using LED and LCD on the panel. The panel on
the server side update the according to the valid sample. The panel on the client side will
display the status according to the time stamp of the sample.

3.4.3 Data link

When all the pumps are "off", the server send status update message to client every 30 second.
The server will accelerate and send message to client in every 20 second.
The delay from server send out message to client receive the message is network dependent.

3.4.4 SMS message

The SMS message is delivered through GSM network. The delay time is depending on the GSM network condition.

3.4.5 Host interface data

The signaling system responds to the request from host interface with up to date sample. The current host application requests status update in every 5 second.

3.5 Events and SMS message

Event is a change of state in the system, i.e. the water pump start/stop, or water reached high level. Some of the event must be notified by other part of the system, while other may be the interest of a user or a group of user. A user will receive the SMS for the specific event by subscription. Appendix will enlist all the events and the SMS text for the event. The chapter for operation will describe the host application and how to manage user and subscription.

4 Operation

This chapter will focus on the operation of signaling system. The first section specifies the components, which may connected by wire, or wireless network. The second section will describe the host application and how to use it to manage the user and generate reports. The block diagram below shows the system components of the signaling system and the linkage between.
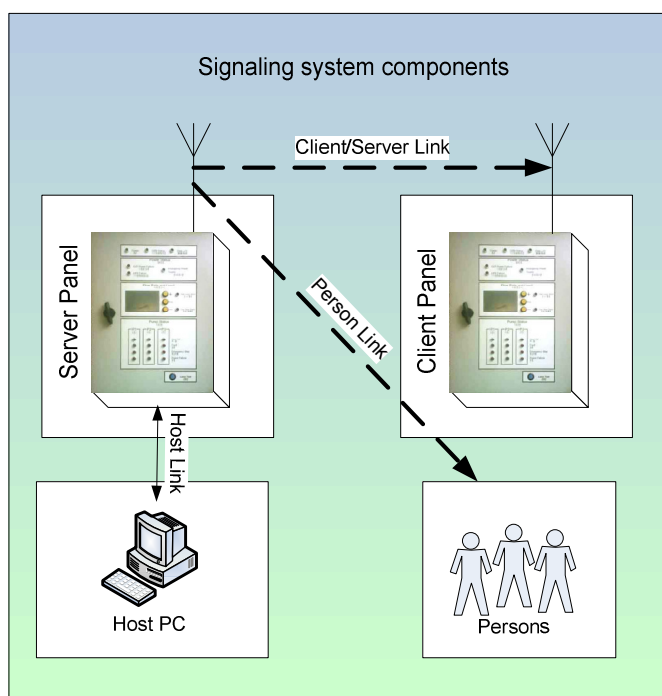
4.1 System components

The signaling system has the following components:

5. Server panel

6. Client panel

7. Host PC

8. SMS subscribers.

4.1.1 Server and client panel

The panels are use to collect and display the operation status. The server panel connects the external devices through wire. While the client panel is connect to the system wirelessly. The panel is powered by AC power with internal battery enable uninterrupted operation during power outage.

The panels are layout according to the devices it monitored, and the LEDs and LCD are direct indication of the status.

The server panel is located in the pump station with connection to the other devices external to the signaling system.
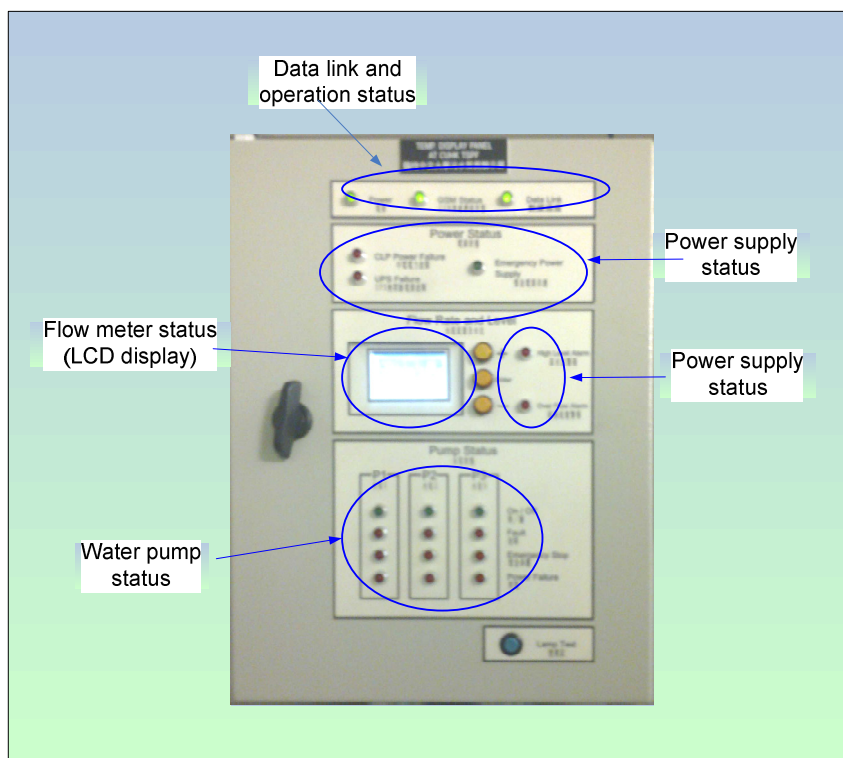
The client panel may be located in any place with GSM network cover for the service provider. When the system is in operation, the client panel will be a mirror image of the server panel (with a delay as specified in the performance section).

4.1.1.1 Data link and operation indicator

There are three LED indicates the operation and data link: Power, GSM status and data link. The power LED is on when the panel is powered. The LED will not distinguish whether the panel is powered by battery or the power supply.

The GSM status indicates the activities of the GSM network. The LED will brink once with it a message is received, and twice with it send out a message.

The data link LED indicates on the client panel indicates the linkage between the client and the server: the LED will be off if the client did not receive a message for 1.5 minute.

4.1.1.2 LCD display

The LCD display on the panel indicates the status as follow:

1. GSM signal strength

2. Real time clock/sample time stamp

3. Host interface

4. Total volume reading

5. Current flow rate
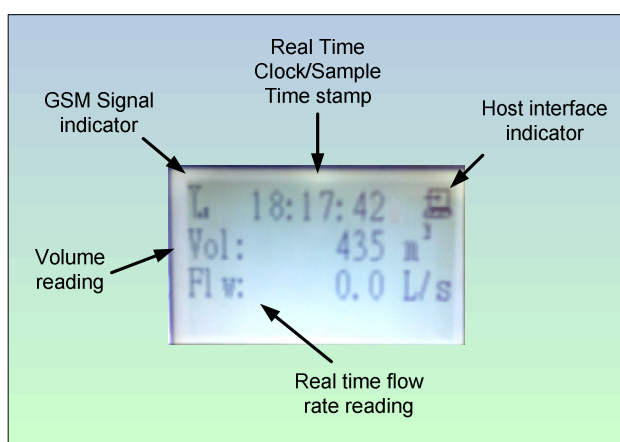
GSM signal indicator

The GSM signal indicator indicates the signal strength of the GSM signal. The signal is at maximum with four vertical lines on the right of the antenna icon. A stable system operation requires signal strength of two or more vertical lines.

Real time clock/sample time stamp

On the server panel, this field shows the system clock in real time.

On the client panel, this field shows the time stamp of the sample received. In an event of the client panel just turned on (with the server already on), a string of samples will received and display. After the client is synchronized with the server, the sample time stamp field will be

update every 30 second.

Host interface indicator

The host interface indicator displays the status of host interface connection. When the host interface is connected (USB/RS232 cable connected and the PC application is running), the indicator will become animated with arrow flashed on top of the PC icon.

Total volume reading

The volume reading is the total volume flow through the pipes which installed flow meters. The reading is reset to zero at 00:00:00 am every day, and start counting for the day.

Flow rate reading

The flow rate reading is the summary flow rate in two pipes with the flow meters installed.

4.1.2 Host PC

The host PC connects to the panel through a serial data link. A communication protocol with a set of command will enable user perform the function as listed below:

1. Collect status information of the signaling system
2. Setup system parameters (i.e. day and time)
3. Set initial values
4. Fine tune reading from external device
5. Setup SMS user and event subscription

A PC application implemented utilized the command set enable user to perform the function listed above with a graphic user interface. The PC application will be described in detail in the PC application section.

4.1.3 SMS subscribers

A user may subscript to SMS message for events from the signaling system. The signaling system is capable to handle up to 12 users. A SMS subscriber of the signal system mush provides a valid mobile phone number, and the selection of events he/she want to subscript to. Some of the event will have one message indicates it happened (i.e. total volume for the day). While others may have two messages for an event (i.e. one message for power failure and one for power back to normal).

4.2 Host application

The host application is a software application running on PC. The application will acquire time status from the server panel and display result on the screen in real time. The status is

stored at the PC in a format of data file. The host application use the data file to create report in excel format.

The host application provide graphic user interface for setting system parameters and manage SMS subscriber, as well as subscriptions.

The function is divided in to two GUI screen. The system setup and operation monitor screen is used for system setup and real time monitoring. The second screen is used for manage SMS subscriber and subscription, and report mange reports. The following section will have a detail description of how to use the functions in host application.

4.2.1 System setup and operation monitor

This is the main screen of the host application. The screen provides the following functions:

1. Set up connection with signaling system
2. Set up system time
3. Monitor pumps operation (accumulated on time for each pump)
4. Set up initial value for volume
5. Monitor flow rate and volume in real time
6. Display track record of flow rate
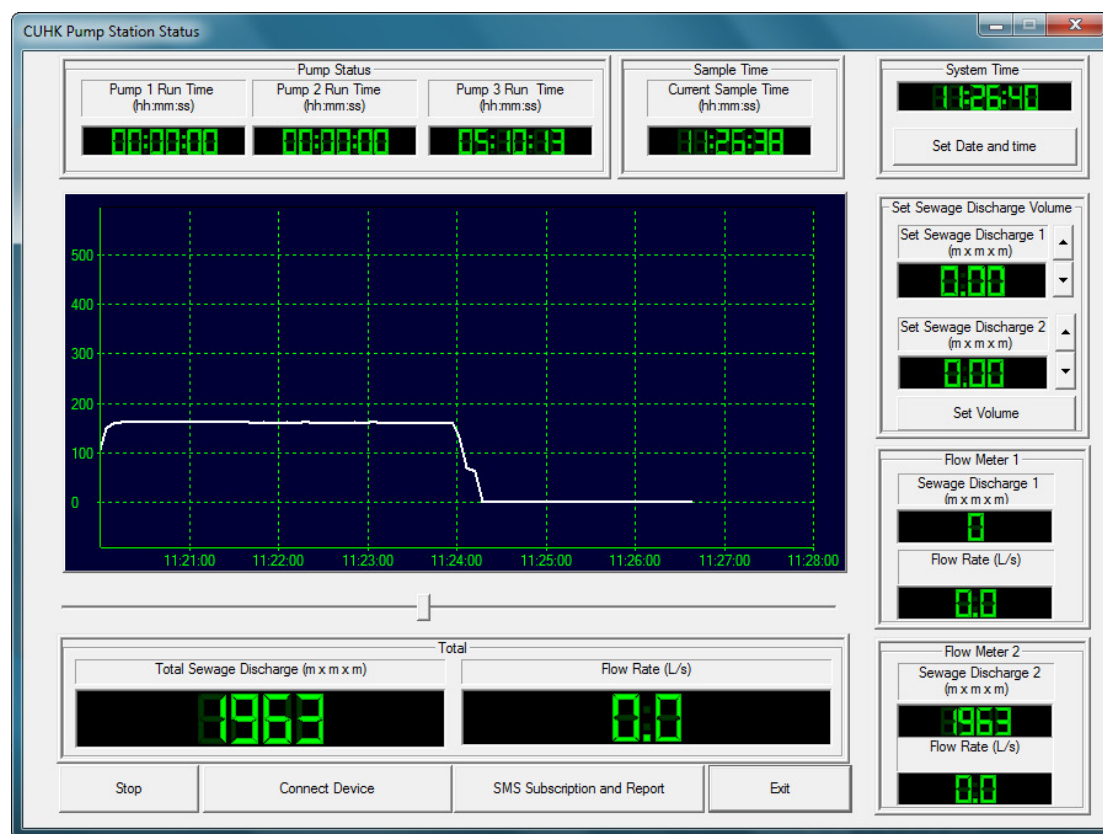
Set up connection with signaling system

The PC connects to signaling system through RS232. When the system is connected, a port is assigned for the connection. The "Connect Device" button enable user to select the port

number use for the connection. When the two systems are connected, the Start/Stop button will be enabled.

Setup system time

The signaling system has its own real time clock. The clock should be synchronized with the outside world (i.e. the computer time). The system time field display the computer time, while the current sample time shows the signaling system time. The "Set data and time" button will change the signaling system clock to the computer time.

Set up initial value for volume

The discharge volume for the signaling system is reset to zero and start counting from 00:00:00 am. When the signaling system is interrupted and restarted again, an initial value may be set to adjust for the interruption time.

4.2.2 SMS subscriber and report generation

The GUI screen is designed mange the SMS subscriber, event subscription of each subscriber, and the report. The "SMS subscriber and the report screen" is showed below:

SMS subscriber and event subscription

SMS subscriber may be modified by selecting the user from the list, make change of name, phone number and the subscription.

Report generator

Reports are generated by selected the day first and click the "Create Report" button. A report in excel format for the selected day will be create at the "Reports" folder of under the installation folder.
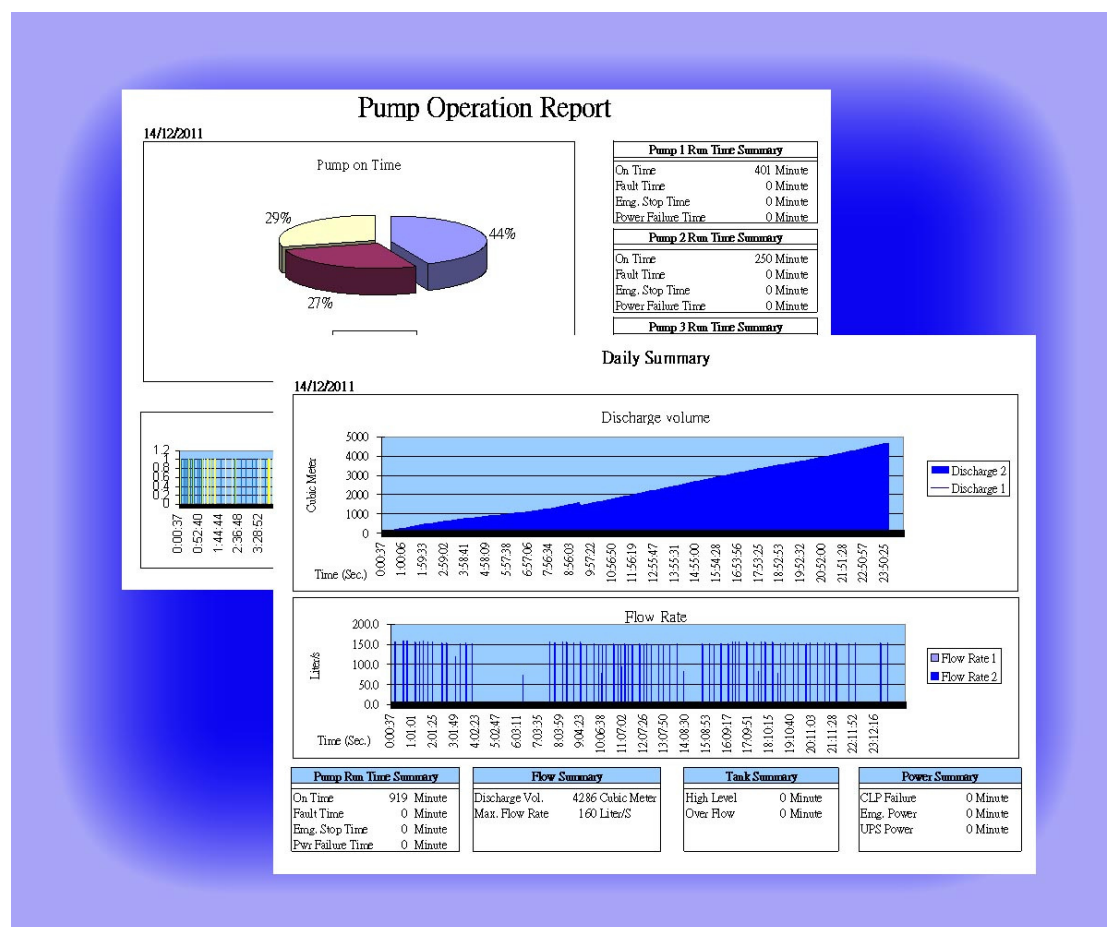
The report file name is generated automatically according to the data selected. There are three sheets (work sheets) in the report: data log, discharge volume and pump operation report.

5 Maintenance

The signaling system will run 24 hours a day continuously. When the pump station or the signaling system is start up after repair or failure, it is important to have system up and running correctly. This section will specify the procedures to identify system failure and recover from failure.

5.1 Normal operation

5.1.1 Lamp test button

The "Lamp test button" is located in the lower right hand corner of the panel box. The "lamp test button" is designed to check if the LED display is function correctly. The respond to the button push is also an indication of the system is still running. When the button is pushed, all the LEDs will be turn on.

If none of the LED responds to the button push, please follow the procedure listed below:

1. Check connector
2. Check wiring
3. Check LED
4. If 1,2,3 step could not correct the problem, the system need to be reset

5.1.2 LCD display

5.1.2.1 System clock (server panel)

As indicates by previous section, the LCD display shows the system clock of the signaling system. The clock will be updated every second, and it is an indication of the system is running. If the clock stopped, please follow the procedure listed below:

1. Check connection cable from the PCB to the LCD
2. "Lamp test button". If the "Lamp test button" failed the system is down and need to be reset or restart.

The system clock may have a variation of +- 3~4 second per day. Please check and synchronize the system clock using the host application.

5.1.2.2 Sample clock (client panel)

The clock display the time stamp of the current sample received. The clock will be updated approximately 30 second (20 second if the one or more pump is on).

5.1.2.3 Host Link

As described in the previous chapter, the host link icon indicates the status of host connection. Under normal operation, the host should be connected to the panel at the server side. If the animated icon is not moving, please follow the procedure listed below:

1. Check the USB cable to the PC,
2. Check host application.
3. If step 1,2 could not correct the problem, restart the host application

5.1.2.4 Flow rate and calibration

The flow rate field will display the total of flow meter 1 and 2. The reading should be within +-5% of the reading show at flow meter. A re-calibration will be needed if the discrepancy exceeded the range. Flow rate calibration may be performed when system is running. However, since this is a critical procedure, calibration should not be performed by ordinary user.

5.1.3 Data link LED (client)

The data link LED indicates the linkage between the server and client. The under normal operation, data link LED should be always on. In circumstances like network traffic is congested, or server has a large number of SMS to send, the data link LED may be temporary for a while. However, if the data link LED is off for a few minute, please follow the procedure listed below:

1. Check GSM antenna and signal strength
2. Check GEM modem light blink at the frequency of about 1 Hz
3. If the blink faster then 1 Hz, check SIM card, connection and subscription expiration date.
4. If step 1,2,3 could not correct the problem. Go to the server site and
5. Check GSM status LED and check if it blinks twice every 30 second.
6. Reset the server panel if GSM status LED does not blink
7. Consult network service provider

5.2 System start up

This section will specify the procedure for reset or power down/up the system.

5.2.1 Before reset/power down

When system is reset or power down, there will be data lost. Some may need to be recorded and restored when the system is up. Please follow the procedure listed below prior to system reset or power down:

1. Record the flow volume on signaling system
2. Record the flow volume on the flow meter
3. Record the pump on time for all three pumps
4. Record the data/time of the reset/power down

5.2.2 After reset/power up

When system is back on running, data has to be re-installed and system parameters have to be set. Please follow the procedure listed below after system reset or power down:

1. Reset system clock (click "Set date and time" button on the main screen)
2. Set volume (use up arrow at "Sewage discharge volume" field and click set button)

5.2.3 Reset and Power down/up

There is a power switch on the right hand side of the panel box. In order to reset the system, please open the cover of the panel box and locate the SCB and push the button indicated in the SCB physical layout section.

6 Summary

The introduction of the signaling system into the pump station elevated the automation of pump station management into a new level. Since the operation of a pump station for a sewage system is critical for the environment of the area. The addition of advance signaling system in the pump station will enable pump station status to be recorded automatically, monitored remotely. Important status (i.e. abnormal system behavior) or data (i.e. end of the day data) will be notice by SMS immediately.

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Appendix A Hardware interface (with other system components)

Connection Block Diagram

Flow meter convertor 1	C (4)		A (37)	
		Signaling (Digital Interface board)	B (37)	PLC
Flow meter convertor 2	D (4)		E (4)	
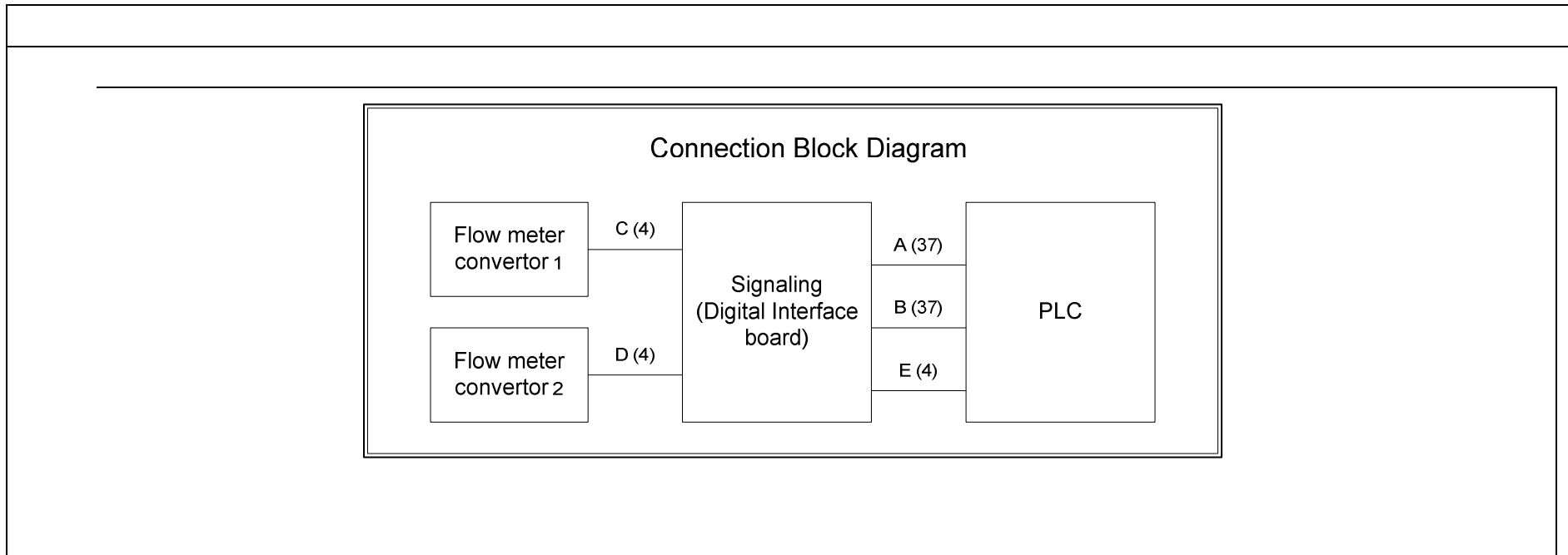
Table of Cables

Cable	Name	From	To	Wire	Specification	Remark
1	A	PLC	DIB	37	1.5 mm2/37 core	
2	B	PLC	DIB	37	1.5 mm2/37 core	

3	C	Flow Convertor 1	DIB	4	4x4.0 mm2/ single core	
4	D	Flow convertor 2	DIB	4	4x4.0 mm2/ single core	
5	E	DIB	PLC	4	4x4.0 mm2/ single core	

Table of Connectors				
	Connector Name	To	No. of Wire	Remark
1	Pump 1	PLC	10	Status of pump 1
2	Pump 2	PLC	10	Status of pump 2
3	Pump 3	PLC	10	Status of pump 3
4	Station Status	PLC	8	Status of the station
5	Power Status	PLC	8	Status of power
6	Flow Convertor 1 In	FMC	4	Data from flow meter convertor 1
7	Flow Convertor 2 In	FMC	4	Data from flow meter convertor 2
8	Volum Out	PLC	4	Volume out to PLC
9	Flow Rate Out	PLC	4	Flow rate signal to PLC (analog)

Table of Connectors, pin and wire assignments						
	Label	Pins (on connector)	Connector	Signal Name	Wire	Remark
1	Pump 1	P1_ON	1.1	Pump 1 Con (10	Pump1_On	A1	Pump 1 RUNNING STATUS (E5)

				Pins)		A2	Pump 1 RUNNING STATUS (E6)
2		P1_ON_GND	1.2			A2	Pump 1 RUNNING STATUS (E6)
3		P1_FAULT	1.3		Pump1_Fault	A3	Pump 1 TRIP STATUS (E7)
4		P1_FAULT_GND	1.4		Pump1_Fault	A4	Pump 1 TRIP STATUS (E8)
5		P1_EMG STOP	1.5		Pump1_Emg_Stop	A5	Pump 1 E-STOP (E3)
6		P1_EMG STOP_GND	1.6		Pump1_Emg_Stop	A6	Pump 1 E-STOP (E4)
7		P1_PWR_FAILURE	1.7		Pump2_Pwr_Failure	A7	Pump 1 POWER FAILURE (E1)
8		P1_PWR_FAILURE_GND	1.8		Pump2_Pwr_Failure	A8	Pump 1 POWER FAILURE (E2)
9		NC	1.9			A9	
10		GND	1.10			A10	(CUP-K-6793-9)
11	Pump 2	P2_ON	2.1	Pump 2 Con (10 Pins)	Pump2_On	A11	Pump 2 RUNNING STATUS (E5)
12	Pump 2	P2_ON_GND	2.2	Pump 2 Con (10 Pins)	Pump2_On	A12	Pump 2 RUNNING STATUS (E6)
13	Pump 2	P2_FAULT	2.3	Pump 2 Con (10 Pins)	Pump2_Fault	A13	Pump 2 TRIP STATUS (E7)
14	Pump 2	P2_FAULT_GND	2.4	Pump 2 Con (10 Pins)	Pump2_Fault	A14	Pump 2 TRIP STATUS (E8)

15		P2_EMG STOP	2.5		Pump2_Emg_Stop	A15	Pump 2 E-STOP (E3)
16		P2_EMG STOP_GND	2.6			A16	Pump 2 E-STOP (E4)
17		P2_PWR_FAILURE	2.7		Pump2_Pwr_Failure	A17	Pump 2 POWER FAILURE (E1)
18		P2_PWR_FAILURE_GND	2.8			A18	Pump 2 POWER FAILURE (E2)
19		NC	2.9			A19	
20		GND	2.10			A20	(CUP-K-6793-10)
21		P3_ON	3.1		Pump2_On	A21	Pump 3 RUNNING STATUS (E5)
22		P3_ON_GND	3.2			A22	Pump 3 RUNNING STATUS (E6)
23		P3_FAULT	3.3		Pump2_Fault	A23	Pump 3 TRIP STATUS (E7)
24	Pump 3	P3_FAULT_GND	3.4	Pump 3 Con (10 Pins)		A24	Pump 3 TRIP STATUS (E8)
25		P3_EMG STOP	3.5		Pump2_Emg_Stop	A25	Pump 3 E-STOP (E3)
26		P3_EMG STOP_GND	3.6			A26	Pump 3 E-STOP (E4)
27		P3_PWR_FAILURE	3.7		Pump2_Pwr_Failur	A27	Pump 3 POWER FAILURE (E1)
28		P3_PWR_FAILURE_GND	3.8			A28	Pump 3 POWER FAILURE (E2)

29		NC	3.9			A29	
30		GND	3.10			A30	(CUP-K-6793-11)
31	Station Status	OVER_FLW	4.1	Station Status (8 Pins)	Over_Flw	B1	EMER. OVERFLOW (E1)
32		OVER_FLW_GND	4.2			B2	EMER. OVERFLOW (E2)
33		HIGH_LEVEL	4.3		High_Level	B3	HIGH LEVEL (E3)
34		HIGH_LEVEL_GND	4.4			B4	HIGH LEVEL (E4)
35		LOW_LEVEL	4.5		Low_Level	B5	LOW LEVEL (E5)
36		LOW_LEVEL_GND	4.6			B6	LOW LEVEL (E6)
37		NC	4.7			B7	
38		GND	4.8			B8	(CUP-K-6793-12)
39	Power Status	CLP_PWR_FAILURE	5.1	Power Status (8 Pins)	CLP_Pwr_Failure	B9	CLP POWER FAILURE (E5)
40		CLP_PWR_FAILURE_GND	5.2			B10	CLP POWER FAILURE (E6)
41		EMG_POWER	5.3		Emg_Pwr	B11	ESSENTIAL POWER (E3)
42		EMG_POWER_GND	5.4			B12	ESSENTIAL POWER (E4)
43		UPS_FAILURE	5.5		UPS_Failur	B13	
44		UPS_FAILUR_GND	5.6			B14	
45		NC	5.7			B15	
46		GND	5.8			B16	(CUP-K-6793-13)

47	Flow Covertor 1 in	Vol_1+	6.1	Flow Convertor 1 (4 Pins)	Vol_1_In	C1	
48		Vol_1-	6.2			C2	
47		Flow_1+	6.3		Flow1_In	C3	
48		Flow_1-	6.4			C4	
49	Flow Convertor 2 In	Vol_2+	7.1	Flow Covertor 2 (4 Pins)	Vol_2_In	D1	
50		Vol_2-	7.2			D1	
49		Flow_2+	7.3		Flow2_In	D3	
50		Flow_2-	7.4			D4	
49	Volume Out	Vol_1_PLC+	8.1	Volume to PLC (4 Pins)	Vol_1_Out	B17	((CUP-K-6793-12)
50		Vol_1_PLC-	8.2			B18	
49		Vol_2_PLC+	8.3		Vol_2_Out	B19	
50		Vol_2_PLC-	8.4			B20	
47	Flow Rate Out	Flow_1_PLC+	9.1	Flow Rate Out (4 Pins)	Flow1_Out	E1	
48		Flow_1_PLC-	9.2			E2	
49		Flow_2_PLC+	9.3		Flow2_Out	E3	
50		Flow_2_PLC-	9.4			E4	

Appendix B Internal cables and signal assignment

CUHK Pump Station

GSM Antenna

←———300 mm———→

400 mm

1 ● Power   2 ● GSM Status   3 ● Data Link

Power Status
4 ● CLP Power Failure   6 ● Emergency Power Supply
5 ● UPS Failure

Flow Rate and Level
114.5 l/s
Tol.10000 l
22/07/2011 21:31:60

▲ K1 7 ● High Level Alarm
● K2 8 ● Over Flow Alarm
▼ K3

Pump Status
	P1	P2	P3	
9	●	B2 ●	B6 ●	On/Off
10	●	B3 ●	B7 ●	Fault
11	●	B4 ●	B8 ●	Emergency Stop
B1	●	B5 ●	B9 ●	Power Failure

K4 ● Lamp Test

● H1   ● H2   ● H2

SWITCH

STSTPW

GSM Antenna

←———300 mm———→

400 mm

1 ● Power   2 ● GSM Status   3 ● Data Link

Power Status
4 ● CLP Power Failure   6 ● Emergency Power Supply
5 ● UPS Failure

Flow Rate and Level
114.5 l/s
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22/07/2011 21:31:60

▲ K1 7 ● High Level Alarm
● K2 8 ● Over Flow Alarm
▼ K3

Pump Status
	P1	P2	P3	
9	●	B2 ●	B6 ●	On/Off
10	●	B3 ●	B7 ●	Fault
11	●	B4 ●	B8 ●	Emergency Stop
B1	●	B5 ●	B9 ●	Power Failure

K4 ● Lamp Test

PWR   SWITCH

	Label	Pins (on connector)	Connector		Signal Name	Wireling	Remark
1		Power	10.1		LED 1	F1	Green LED on panel
2		GSM Status	10.2		LED 2	F2	Green LED on panel
3		PLC connection	10.3		LED 3	F3	Green LED on panel
4		CLP Power Failure	10.4		LED 4	F4	Red LED on Panel
5		UPS Failure	10.5	LED	LED 5	F5	Red LED on Panel
6	LED 1	Emg. Power supply	10.6	Con 1	LED 6	F6	Green LED on panel
7		Hig Level Alarm	10.7	(12	LED 7	F7	Red LED on Panel
8		Over Flow Alarm	10.8	Pins)	LED 8	F8	Red LED on Panel
9		Pump 1 On/Off	10.9		LED 9	F9	Green LED on Panel
10		Pump 1 Fault	10.10		LED 10	F10	Red LED on Panel
11		Pump 1 Emg. Stop	10.11		LED 11	F11	Red LED on Panel
12		VCC	10.12			F12	
13		Pump 1 Power Failure	11.1		LED 12	G1	Red LED on panel
14		Pump 2 On/Off	11.2		LED 13	G2	Green LED on Panel
15		Pump 2 Fault	11.3		LED 14	G3	Red LED on Panel
16		Pump 2 Emg. Stop	11.4	LED	LED 15	G4	Red LED on panel
17	LED 2	Pump 2 Power Failure	11.5	Con 2	LED 16	G5	Red LED on Panel
18		Pump 3 On/Off	11.6	(12	LED 17	G6	Green LED on Panel
19		Pump 3 Fault	11.7	Pins)	LED 18	G7	Red LED on panel
20		Pump 3 Emg. Stop	11.8		LED 19	G8	Red LED on Panel
21		Pump 3 Power Failure	11.9		LED 20	G9	Red LED on Panel

22		NC	11.10		LED 21	G10	Green LED on board (internal use)
23		NC	11.11		LED 22	G11	Green LED on board (internal use)
24		VCC	11.12			G12	
25		Lamp Test	12.1		Key 1	H1	K4
26		Up Key	12.2		Key 2	H2	K1
27		Down Key	12.3		Key 3	H3	K3
28	KEY	Enter Key	12.4	KB (8 Pins)	Key 4	H4	K2
29		Key5	12.5		Key 5	H5	Not used
30		Key6	12.6		Key6	H6	Not used
31		NC	12.7			H7	
32		GND	12.8			H8	

Appendix CEvent and SMS message

Event and Event Messages

Client Link

Person Link

Host Link

Host PC

Persons

Table of Event and Event messages
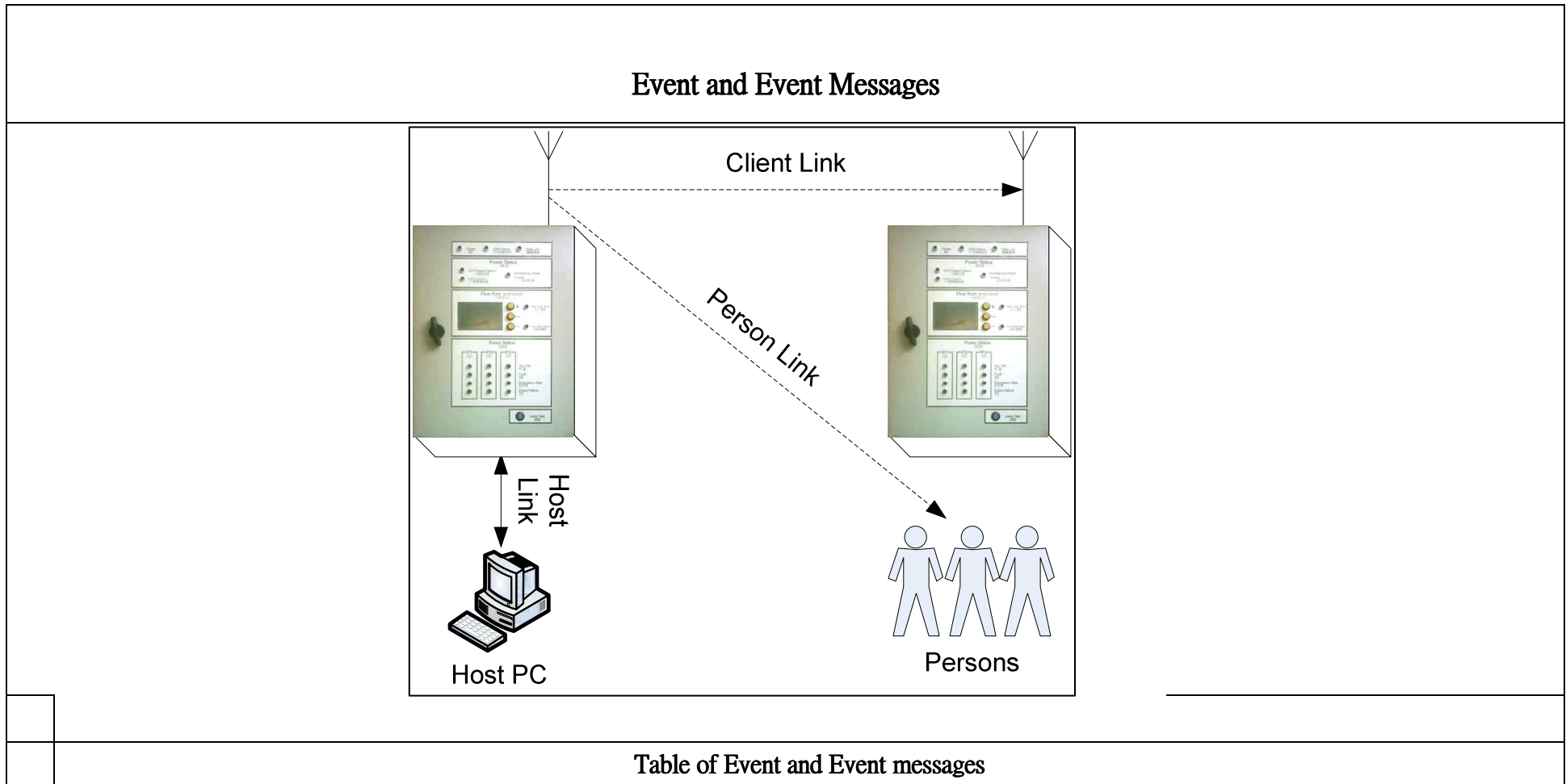
	Event	Client Notice	Host Notice	Personal Notice	On message	Off message
1	PUMP1 ON EVENT	Yes	Yes	No		
2	PUMP1 FAULT EVENT	Yes	Yes	Yes	DC/2009/14 TSPF in CUHK Pump 1 Tripped	DC/2009/14 TSPF in CUHK Pump 1 back frm Trip
3	PUMP1 STOP EVENT	Yes	Yes	Yes	DC/2009/14 TSPF in CUHK Pump 1 E-Stop Pressed	DC/2009/14 TSPF in CUHK Pump 1 E-Stop released
4	PUMP1 PWR FAILUR EVENT	Yes	Yes	Yes	DC/2009/14 TSPF in CUHK Pump 1 Power Failure	DC/2009/14 TSPF in CUHK Pump 1 back frm Power Failure
6	PUMP2 ON EVENT	Yes	Yes	No		
7	PUMP2 FAULT EVENT	Yes	Yes	Yes	DC/2009/14 TSPF in CUHK Pump 2 Tripped	DC/2009/14 TSPF in CUHK Pump 2 back frm Trip
8	PUMP2 STOP EVENT	Yes	Yes	Yes	DC/2009/14 TSPF in CUHK Pump 2 E-Stop pressed	DC/2009/14 TSPF in CUHK Pump 2 E-Stop released
9	PUMP2 PWR FAILUR EVENT	Yes	Yes	Yes	DC/2009/14 TSPF in CUHK Pump 2 Power Failure	DC/2009/14 TSPF in CUHK Pump 2 back frm Power Failure

11	PUMP3 ON EVENT	Yes	Yes	No		
12	PUMP3 FAULT EVENT	Yes	Yes	Yes	DC/2009/14 TSPF in CUHK Pump 3 Tripped	DC/2009/14 TSPF in CUHK Pump 3 back frm Trip
13	PUMP3 STOP EVENT	Yes	Yes	Yes	DC/2009/14 TSPF in CUHK Pump 3 E-Stop pressed	DC/2009/14 TSPF in CUHK Pump 3 E-Stop released
14	PUMP3 PWR FAILUR EVENT	Yes	Yes	Yes	DC/2009/14 TSPF in CUHK Pump 3 Power Failure	DC/2009/14 TSPF in CUHK Pump 3 back frm Power Failure
16	TANK OVER FLW EVENT	Yes	Yes	Yes	The water tank is overflowed	The water tank is back to normal
17	TANK HIGH LEVEL EVENT	Yes	Yes	Yes	The water level reached high limit	The water level is back to normal
18	TANK LOW LEVEL EVENT	No	No	No		
20	POWER PWR FAILUR EVENT	Yes	Yes	Yes	Pump station power failoure	The power is back to normal
22	POWER EMG PWR EVENT	Yes	Yes	No		
23	POWER UPS FAIUR EVENT	Yes	Yes	No		
24	DAY END EVENT	No		Yes	DC/2009/14 TSPF in CUHK Sewage Discharge Volume: XXX m^3	DC/2009/14 TSPF in CUHK Sewage Discharge Volume: Reset to Zero