Business Continuity Manual

Business Continuity Plan: E5

Seawater Provision, Chiller & Mechanical Building Management System (MBMS)

		Signature	Revision	Effective Date
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Part I – Seawater Provision

A. System Description

1.0 General

1.1 There are 4 nos. seawater pump houses (i.e. SWPH-1, SWPH-1b, SWPH-5 and SWPH-ITT) at the HKIA supplying toilet flushing seawater to all buildings and cooling seawater to some of the buildings within the CLK Island.

1.2 Major maintenance contractors for the seawater supply system as below:

i. CLPe – E&M equipment inside seawater pump houses
ii. Wing Hing – Underground seawater supply pipework
iii. EMSD – Power supply to seawater pump houses
iv. CLPe – Under water facilities inside seawater pump houses

1.3 Seawater is drawn in from the surrounding sea via intake culverts. Thereafter, they are filtered and chemically treated before being pumped and distributed to the users, generally via dual supply mains.

1.4 Seawater discharged from the cooling circuit is returned to nearby sea via the associated outfalls of the storm water system. Seawater after the toilet flushing is discharged to the foul sewer network.

2.0 SWPH-1

2.1 There are 3 nos. seawater supply circuits for SWPH-1, being PTB circuit, GTC circuit and ATCC Circuit. Each of these circuits have their own seawater pumps and supply pipework.

2.2 Major users and key features for the different circuits as below:

Circuit	Major Users	Key Features
PTB circuit of SWPH-1	Terminal 1	a) 2 x 1100mm diameter mains from SWPH-1 b) 6 nos. seawater pumps operated according to a pre-defined look up table to match the demand c) Discharge mains inter-connected with the GTC circuit of SWPH-1 which in turn inter-connected with the SWPH-1b circuit for enhanced reliability

Circuit	Major Users	Key Features
GTC circuit of SWPH-1	Airport Authority Building, SkyPier Terminal, T1 Satellite Concourse, Ground Transportation Centre, HKIA Commercial Building, Marriott Airport Hotel, Asia World Expo, Regal Airport Hotel, Car Park 4 etc	a) 2 x 800mm diameter mains from SWPH-1 b) 4 nos. seawater pumps operated at variable speeds to match the demand c) Discharge mains inter-connected with the PTB circuit of SWPH-1 and the SWPH-1b circuit for enhanced reliability
ATCC circuit of SWPH-1	ATC Tower and the Back-up Tower, T1 Midfield Concourse, T1 Annex Building	a) 1 x 350mm diameter main from SWPH-1 b) 3 nos. seawater pumps operated at variable speeds to match the demand

3.0 SWPH-1b

3.1 Major users and key features for the SWPH-1b as below:

Circuit	Major Users	Key Features
SWPH-1b	HKIA Tower	a) 2 x 800mm diameter mains from SWPH-1b b) 5 nos. seawater pumps operated at fixed speed to match the demand (Power supply arrangement limited that only 3 nos. can be operated at any one time) c) Discharge mains inter-connected with the GTC circuit of SWPH-1 which in turn inter-connected with the PTB circuit of SWPH-1 for enhanced reliability

4.0 SWPH-5

4.1 Major users and key features for the SWPH-5 as below:

Circuit	Major Users	Key Features
SWPH-5	HACTL's Super Cargo Terminal and Express Cargo Centre, Cathay City, Headland Hotel, Air Mail Centre, Airport Police Station, Airport Fire Station, Government Flying Services, HAECO etc.	a) 2 x 1200mm diameter mains from SWPH-5 b) 9 nos. seawater pumps operated at variable speeds to match the demand

5.0 SWPH-ITT

5.1 Major users and key features for the SWPH-ITT as below:

Circuit	Major Users	Key Features
SWPH-ITT	11 Skies, future development of NCD etc.	a) 4 x 700mm , 2 x 1000mm & 2 x 900mm diameter mains from SWPH-ITT b) 6 nos. seawater pumps operated at variable speeds to match the demand

B. Physical System Risks

Risk	Description	Mitigation
Temporary Power Supply Failure	Interruption of seawater supply due to minor suspension of power (less than 0.2 second with reasonable remaining power on all phases)	<u>PTB circuit of SWPH-1 and SWPH-1b circuit</u> No interruption due to the power support of the control circuit from back-up system <u>GTC circuit and ATCC circuit of SWPH-1 and SWPH-5 circuit</u> Resume within 5 minutes upon power resumption

Power Supply Failure	Interruption of seawater supply due to suspension of power (more than 0.2 second)	<u>All circuits except ATCC circuit of SWPH-1</u> Isolate the defective main and maintain partial resumption of seawater supply via the other healthy dual main within 30 minutes via back-up seawater supply from SWPH-1b circuit (provided that power supply to SWPH-1b circuit is not affected) <u>ATCC circuit of SWPH-1</u> Co-ordinate with CAD to switch their cooling system from seawater cool to air cool <u>SWPH-1b circuit</u> Partial resumption of seawater supply within 30 minutes via back-up seawater supply from GTC circuit of SWPH-1 (provided that power supply to GTC circuit of SWPH-1 is not affected) <u>SWPH-5 circuit</u> Partial resumption of seawater supply within 60 minutes via alterative power feed from 1500kVA mobile generator (provided that the 1500kVA mobile generator is stationed outside SWPH-5)
Seawater Supply Main Failure	Interruption of seawater supply due to bursting of one of the seawater supply mains	<u>All circuits except ATCC circuit of SWPH-1</u> Isolate the defective seawater supply main and partial resumption of seawater supply via the other healthy main (exact time depends on the time taken to locate and isolate the defective main) <u>ATCC circuit of SWPH-1</u> Co-ordinate with CAD to switch their cooling system from seawater cool to air cool

C. Contingency Planning

In accordance with the Contingency Procedures for Seawater Supply System, the indoor temperature of the affected tenants / areas shall be kept at 26^{o}C during the suspension of partial seawater supply.

D. Contingency Procedures

For the handling of incidents of seawater supply system, Seawater System Management Plan shall be referred. The purpose of this plan is to define the responsibilities of the concerned parties and to describe the activities associated with the handling of incidents related to seawater supply system.

E. Cyber Security

System cyber security threat level based on the following risk rating:

Threat Level	System
Low	System uses no IT-based systems.
Medium	System uses some closed data-collection and/or alarm systems based on sensors or IoT devices.
High	System uses integrated SCADA systems, cloud-based data collections systems, or IP-based monitoring and control systems.

- Seawater Pumping System – Threat Level: Medium

Rationale for threat level

The seawater pumping system is being controlled and monitored by the Central Control Consoles and being monitored by the Airfield SCADA System. The Central Control Consoles/ Airfield SCADA Systems are a data-collection system and alarm systems based on sensors, so as to monitor the status of the seawater pumping system in a closed and controlled network.

Mitigation actions taken

The Unidirectional Security Gateway of the seawater pumping system creates a fully functional replica server in the Central Control Consoles/ Airfield SCADA System. It allows 100% visibility of the seawater pumping system CS network while providing 100% protection from IT-based threats.

In case of suspected cyber-attack, Risk & Cybersecurity Team of ITD shall be informed for further investigation.

F. Interface with Other Operational Organizations during Contingency

1. Relevant Maintenance Contractors
2. AA IAC
3. AA TSI

4. AA TOD
5. AA LD
6. AA Aviation Logistics Department

G. Drill Plan

Drill by Maintenance Contractors and TSI on handling of incidents of Seawater Supply System is conducted on annual basis.

Part II – Chiller Systems

A. System Description

1.0 Terminal 1

1.1 The existing chiller system of Terminal 1 comprises 6 nos. seawater cooled HV chillers, 1 no. of LV chiller relocated from Terminal 2 and another 1 no. of newly installed LV chiller for the recently operating Terminal T1 Annex. Each chiller is provided with a dedicated primary chilled water pump.

1.2 The chiller system at GTC, where there are 3 nos. of LV chillers, is integrated with Terminal 1 chilled water circuit with mutual support of chilled water supplies in response to dynamic cooling demands of the buildings.

1.3 The chilled water distribution in Terminal 1 is split into eight groups of secondary chilled water pumps with each group comprising a standby pump, namely,

i Processing Terminal North (PTN) including T1A and HKIA Community Building (HKIACmu)
ii Processing Terminal South (PTS)
iii East Hall North (EHN)
iv East Hall South (EHS)
v East Hall Extension (EH Extension)
vi Sky Bridge
vii Central Concourse (CC)/ West Hall (WH)/ Southwest Concourse (SWC)/ Northwest Concourse (NWC)
viii Ground Transportation Centre (GTC)

1.4 The seawater cooling supply to the Terminal 1 chiller plant is provided by two seawater pipes feeding from nearby seawater pump house (SWPH-1). Each pipe is capable of handling the maximum seawater flow for the operation of three HV chillers.

1.5 The Mechanical Building Management System (MBMS) utilizes a dual redundant server system for Terminal 1 to perform centralized control and user interfacing of the mechanical systems including the chiller system, seawater cooling system, and the Mechanical Ventilation and Air-Conditioning (MVAC) system such as fan coil units, air handling units, fans, etc.

1.6 The power supply for the chillers are decentralized into 3 sources, with each pair of HV chillers fed from switch stations PA, PB and PH respectively.

1.7 The power supply for the secondary chilled water pumps are decentralized with each pump set serving the same secondary chilled water circuit fed by different transformers and LV switchboards fed by different 11kV cable ring feeders.

1.8 The current maintenance contractor for the Terminal 1 chiller plant is Carrier Hong Kong Limited (Carrier) whilst Honeywell is responsible for maintaining the MBMS.

2.0 Terminal 2

2.1 T2 Chiller Plant was completely de-commissioned on 18 March 2020 to facilitate the T2 modification project for 3RS operation.

3.0 T1 Satellite Concourse (T1S)

3.1 The existing T1S chiller plant comprises 4 nos. of air-cooled LV chillers with 5 nos. of chilled water pumps.

3.2 The MBMS utilizes a dual redundant server for T1S to perform centralized control and user interfacing of the mechanical systems including the chiller system and the MVAC system such as fan coil units, air handling units, fans, etc.

3.3 The power supply for the chillers and chilled water pumps are decentralized to ensure no single point of failure.

3.4 The maintenance contractor for the chiller plant is Carrier whilst Honeywell is responsible for maintaining the MBMS.

4.0 SkyPier Terminal

4.1 The SkyPier Terminal consists of two separate chiller plants. One chiller plant comprises 3 nos. of air-cooled LV chillers with 4 nos. of chilled water pumps. The other chiller plant comprises 3 nos. of water-cooled LV chillers with 4 nos. of chilled water pumps, and 3 nos. of cooling towers with 4 nos. of condenser water pumps for chiller cooling.

4.2 The Building Management System (BMS) utilizes a dual redundant server for SkyPier Terminal to perform centralized control and user interfacing of the mechanical systems including the chiller system and the mechanical ventilation and air-conditioning system such as fan coil units, air handling units, fans, etc.

4.3 The power supply for the chillers and chilled water pumps are decentralized to ensure no single point of failure.

4.4 The maintenance contractor for the chiller plant and BMS is Carrier and Johnson Controls respectively.

5.0 T1 Midfield Concourse (T1M)

5.1 The existing T1M chiller plant comprises 5 nos. of water-cooled LV chillers with 6 nos. of chilled water pumps, and 5 nos. of cooling towers with 6 nos. of condenser water pumps for chiller cooling.

5.2 The MBMS utilizes a dual redundant server for T1M to perform centralized control and user interfacing of the mechanical systems including the chiller system, the mechanical ventilation and air-conditioning system such as fan coil units, air handling units, fans, etc.

5.3 Configuration of the power supply for the chillers and chilled water pumps is decentralized to ensure no single point of failure.

5.4 The maintenance contractor for the chiller plant is Carrier whilst Honeywell is responsible for maintaining the MBMS.

B. Contingency Planning

In accordance with the user's requirements for the Chiller Systems, the indoor temperature of the affected tenants / areas shall be kept at 26^{o}C during system fault.

System	Loss of single component	Rectifying action	Impact
Seawater system (For Chiller System at Terminal 1)	Seawater supply main from seawater pump house	There are 2 supply mains. Isolate the seawater main which is faulty and rely on second supply main for providing seawater cooling for 3 nos. HV chillers (50% of total HV chiller capacity).	Momentary interruption
Chiller System	Primary chilled water pump	Manually start another chiller-pump set	Momentary interruption
	Chiller	Manually start another chiller	Momentary interruption
	Secondary chilled water pump (For Chiller System at Terminal 1)	Automatically start standby secondary chilled water pump	Momentary interruption
	Leakage from chilled water supply pipes feeding the secondary chilled	Isolate the faulty chilled water pipe and rectify the	Will lose chilled water supply to the affected zone

System	Loss of single component	Rectifying action	Impact
	water pumps (For Chiller System at Terminal 1)	leakage temporarily	for certain period of time
	Leakage from chilled water supply pipes serving air handling units / fan coil units	Isolate the faulty chilled water pipe and rectify the leakage temporarily	Will lose chilled water supply to the affected zone for certain period of time
Compressed air system for chillers at Terminal 1	Air compressor	Start standby air compressor automatically	Momentary interruption
Power supply for Chiller System at Terminal 1	Failure of one CLP 11kV supply to either HV switch station, PA, PH or PB feeding the chiller	The 11kV generators backup the switch station will be started automatically and feed power to the HV switchboard to resume power supply	Only one third of chillers will be affected. The affected chiller can resume operation after the generators have started up and supply power to the switch station
	Failure of one chiller HV MCC	The faulty MCC shall be rectified after fault clearance	The affected chiller operation will be interrupted but standby chiller can back up the system
	Failure of one 11kV/380V transformer serving the chilled water pumps	The transformer coupled with another transformer feeding the same switchboard and the dual supplies are isolated by a sectional ACB. Manual switching of power supply from the failed transformer to the coupled transformer is required.	The affected chilled water pumps can resume operation when the power supply switching is completed. Only one group of chilled water pumps will be affected. 3 chillers can still maintain operation.
	Failure of one LV switchboard feeding the chilled water pumps	The switchboard faulty part shall be isolated.	The affected chilled water pumps may not be resumed if faulty

System	Loss of single component	Rectifying action	Impact
		Power supply to the affected chilled water pumps may need to be diverted to other switchboards	part cannot be rectified. 3 chillers can still maintain operation.
Power supply	Failure of one LV MCC connecting to the chilled water pumps	The faulty MCC shall be rectified after fault clearance	The affected chilled water pump cannot operate. It will affect one chiller operation but the secondary chilled water pump can be backed up by standby pump fed from different power source.
MBMS/BMS	Failure to perform control and monitoring of the mechanical ventilation and air-conditioning system	Manually controlled the MVAC system	Design temperature settings cannot be achieved should the system's function cannot be resumed.

C. Cyber Security

The system cyber security threat level is based on the following risk rating:

Threat Level	System
Low	System has no IT-based systems.
Medium	System has some closed data-collection and/or alarm systems based on sensors or IoT devices.
High	System has integrated SCADA systems, cloud-based data collections systems, or IP-based monitoring and control systems.

- Chiller Systems – Threat Level: Medium

Rationale for the threat level

The Chiller Systems are either controlled by MBMS or BMS (As mentioned in Section 3.1). The MBMS/ BMS is a closed data-collection system and alarm systems based on sensors, so as to monitor the status of the chiller systems in a closed and controlled network.

Mitigation actions

Access to the locations of system workstations are restricted. Only authorized person is allowed to control the system.

In addition, Unidirectional Security Gateway has been applied for T1 chiller system which acts as a security gateway to control the data flow in single direction and prohibit access or control from external parties, allowing visibility of the chiller system's connected services network while providing 100% protection from IT-based threats.

In case of suspected cyber-attack, Risk & Cybersecurity Team of ITD shall be informed for further investigation.

D. Interface with Other Operational Organizations during Contingency

1. CLPe (maintenance contractor of electrical services)
2. Shinryo (maintenance contractor of mechanical services)
3. Carrier (maintenance contractor of chillers systems)
4. Honeywell (maintenance contractor of MBMS)
5. Johnson Controls (maintenance contractor of BMS)
6. AA IAC
7. AA FRTMO

E. Drill Plan

Drills by Maintenance Contractors and TSI on incident handling of the Chiller Systems are conducted on an annual basis.

Part III – Mechanical Building Management System (MBMS)

A. System Description

1.0 Introduction

1.1 MBMS are installed in Terminal 1, T1S, GTC and T1M to facilitate control and monitor operation of Mechanical Services while BMS serves the Mechanical Services in SkyPier Terminal.

1.2 The systems are equipped with servers, workstations and direct digital controllers (DDC). The servers are of redundant configuration.

1.3 All servers are located inside communication rooms and workstations are installed in IAC, Back-up IAC and FRTMO for remote operations.

1.4 DDC is installed inside plant rooms directly connected to mechanical equipment.

B. Physical System Risk

Risk	Description	Mitigation
Server Failure	Loss of communication between workstation and server due to server failure	• Servers are of redundant configuration • Auto failover to backup server once the duty server fails
Fire	Damage of servers due to fire	• Servers are located inside communication rooms protected by gas flooding system or dry pipe sprinkler system
Water	Damage of server due to ingress of water	• Servers are located inside cabinet in communication rooms protected by gas flooding system or dry pipe sprinkler system

C. Contingency Planning for MBMS Mal-functions

In accordance with the requirements for MBMS, the management platform for mechanical service and equipment is to ensure they are fully available for public usage, twenty four (24) hours a day and all year round.

MBMS Centralized Equipment	Loss of single component	Rectifying action	Impact
Server	Duty Server Failure	The hot-standby server automatically take up the duty server role.	Momentary interruption during failure-over.

Network Switch	Network switch Failure	The related network connection switch to another network switch.	Remote control and monitor is interrupted. The stand-alone controller and loop server can maintain the mechanical services and equipment in normal operation.
Controller	Controller Failure	The related MVAC equipment switch to local mode.	Remote control and monitor is interrupted.

D Cyber Security

System cyber security threat level based on the following risk rating:

Threat Level	System
Low	System uses no IT-based systems.
Medium	System uses some closed data-collection and/or alarm systems based on sensors or IoT devices.
High	System uses integrated SCADA systems, cloud-based data collections systems, or IP-based monitoring and control systems.

- Mechanical Building Management System – Threat Level: High

Rationale for threat level

System is used IP-based for network connection.

Mitigation actions taken

Access to the locations of system workstations are restricted. Only authorized person is allowed to control the system.

The system makes use of the corporate AA-net for the IP-based monitoring where the cyber security is safeguarded by ITD.

In case of suspected cyber-attack, Risk & Cybersecurity Team of ITD shall be informed for further investigation.

E. Interface with Other Operational Organizations during Contingency

1. CLPe (maintenance contractor of electrical services)
2. Shinryo (maintenance contractor of mechanical services)
3. Carrier (maintenance contractor of chillers systems)
4. Honeywell (maintenance contractor of MBMS)
5. Johnson Controls (maintenance contractor of BMS)
6. AA IAC
7. AA FRTMO

F. Drill Plan

Drills by Maintenance Contractors and TSI on incident handling of the MBMS are conducted in conjunction with Chiller Systems on an annual basis.

End of BCP – E5