

## **GUIDELINES FOR HEALTH CHECK REPORT**

### **1. Cover Page**

- Report title
- Name of client (company for which facility or building has been audited)
- Location of facility or building
- Iconic photo of the building (optional)
- Date of report
- Details of ESCO/ M&E Professional Engineer
- ESCO KQP/ M&E Professional Engineer, audit team leaders, project officers and their project designations
- Signature of KQP/ M&E Professional Engineer
- Statement by the company accepting the report and verifying that the ESCO's recommendations
- Signature of company's representative

### **2. Executive Summary**

All information in the Executive Summary should be drawn from the detailed information in the full report. The Executive Summary should contain a brief description of the audit, including:

- Name of client, location of facility or building audited
- Objectives of audit
- Key systems and equipment analysed
- Dates of audit
- Summary of recommendation on overall and major components of the central plant, including estimated cost, energy savings and payback period.

### **3. Table of Contents**

- Introduction
- Declaration of code compliance
- Methodology and instrumentation
- Calculation methodology
- Data analysis and findings including graphs and plots
- Summary of recommendations
- Conclusion
- Appendices
- CD containing raw measurement data collected during the audit, in a readable file format

### **4. Introduction**

- Objectives of audit – e.g. to study the energy consumption of the facility or building or system with a view to identifying the central air conditioning plant efficiency

- Brief description of facility or building audited – number of floors, GFA, air-conditioned areas, type of usage, occupancy, hours of operation, year built, etc.
- Information on tenants in facility or building audited (If applicable)
- Scope of audit, elaborating what systems or equipment were studied

#### **1. Declaration of code compliance**

- The measurement works must need to comply with ASHRAE Standard 22, ARI550 and this BCA Health Check report guideline.

#### **5. Methodology and Instrumentation**

- Instrumentation table (see example below)
- Proposed instrumentation plan in detail; Schematics or point listings of where instruments are installed.
- Detailed instrument installation and measurement procedure/method statement.
- Pictures and maps showing the locations of the installed instruments and sensors
- All sensors must be calibrated before installation. Manufacturers' calibration data may be sufficient as long as the installation conditions match the conditions of calibration. Manufacturers' calibration data should include documents of traceability to the calibration facility and, ultimately, traceability to national standards.
- Measurement error analysis (mandatory)

ID	Point Description	Measurement Range	Sensor Type or Calculation Method	Installation Location	Input Type	Instrument Range	End-to-end Accuracy (% of reading unless noted)	Data Resolution	Refresh Interval (min)	Trend Interval (min)
<b>Power Measurements</b>										
kW01	Chiller 1 Power									
kW02	Chiller 2 Power									
kW03	Primary ChW Pump 1 Power									
kW04	Primary ChW Pump 2 Power									
kW05	Secondary ChW Pump 3 Power									
kW06	Secondary ChW Pump 4 Power									
kW07	Chiller 1 CW Pump Power									
kW08	Chiller 2 CW Pump Power									
kW09	Cooling Tower Fan 1 Power									
kW10	Cooling Tower Fan 2 Power									
<b>Flow Measurements</b>										
FT01	Chilled Water Flow									
FT02	Condenser Water Flow									
TT01	Chilled Water Supply Temperature									
TT02	Chilled Water Return Temperature									
TT03	Condenser Entering Water Temperature									
TT04	Condenser Leaving Water Temperature									
TT05	Ambient Dry-Bulb Temperature									
TT06	Ambient Wet-Bulb Temperature									
<b>Calculated Values</b>										
CC01	ChWPlant Thermal Cooling Output									
CC02	chilled-water plant Efficiency									
CC03	Plant Heat of Rejection									

## 2. Calculation Methodology

- The calculation of the chiller plant Thermal Load, system efficiency (kW/Ton, COP etc) must follow the ASHRAE guideline 22 or equivalent.
- The calculation of the measurement error for all the instrument & auxiliary instrument used.
- Measurement total error analysis by using the formula of ASHRAE guideline 22.

## 6. Data Analysis and Findings

- Date of audit
- Dates of data collection and logging
- Baseline energy consumption and the methodology used to establish it
- Description of systems or equipment audited their capacities and ratings, design and operating conditions, equipment schedules, etc, including information such as the type of systems, controls, type and number of auxiliary equipment, etc.
- Performance of systems or equipment audited e.g. COP or kW/ton
- Heat and mass balance where applicable
- Findings and observations

### Chiller plant

- a. Details of the equipment, their age, type and number of chillers, pumps, cooling towers and operating schedules.

Description	Qty	Rated kW or RT	Operating Hours	Year Installed
Chillers (CH1-3) (Centrifugal, R134)				
Chilled water pumps (CHWP 1-3)				
Condenser water pumps (CWP 1-3)				
Cooling towers (CT1 – 3)				

- b. Details of the cooling load profile of facilities or buildings audited, illustrated with the following graphs:
- i. Plot of cooling load (Ton) profile over at least two week
  - ii. Super-imposed plot of daily cooling load (Ton) profile; daily plots should be fine-lined and in different colours
- c. Chilled water plant system performance

- System performance measurement error shall not exceed **±5%**. *This implies the use of high accuracy thermometry and calorimetry.*
- Detailed method statement explaining how the required degree of accuracy was achieved with the instruments and data acquisition hardware employed.
- Data required to establish system performance must be sampled and acquired simultaneously and continuously for a minimum of 2 week at one-minute intervals.
- Required data points:

i. Chilled water temperature, flow rate and pressure differential (using gauges)

- Each chiller (if common header is not available)
  - Supply and return temperature profiles as well as temperature differential profile (super-imposed)
  - Chilled water flow rate profile
- Main chilled water supply and return header (bypass connection should be considered to capture the actual condition)
  - Supply and return temperature profiles (super-imposed)
  - Chilled water flow rate (supply header only)
  - Pressure differential (gauges)

ii. Condenser water temperatures (supply and return to and from chillers system), flow rate (spot measurement) and pressure differential (gauges)

iii. Chillers

- Average values in table format (for system)

	Parameter	Design	Chiller system
Chilled Water	Supply Temp ( $^{\circ}\text{C}$ )		
	Return Temp ( $^{\circ}\text{C}$ )		
	Flow rate (l/s)		
Condenser Water	Supply Temp ( $^{\circ}\text{C}$ )		
	Return Temp ( $^{\circ}\text{C}$ )		
	Flow rate (l/s)		
Operating Performance	Capacity (Ton)		
	Power (kW)		
	Efficiency (kW/Ton)		
	Evaporator dP (Pa)		
	Condenser dP (Pa)		

iv. Power Measurement

- kW profile for each chiller (or system)

v. Chilled water calorimetry

- Cooling Ton profile of system using super-imposed plot
- Cooling Ton histogram in percentage

vi. Chilled water pumps

Parameter		Flow Rate (based on header flow rate unless it is not possible to measure at the header) (l/s)	Pump Head (m)	Motor Power (kW)	Efficiency (kW/Ton)
Design	CHWP 1				
	CHWP 2				
	CHWP 3				
Actual	CHWP 1				
	CHWP 2				
	CHWP 3				

For pumping systems with variable speed drives, provide

- kW vs. time

vii. Condenser water pumps

Parameter		Flow Rate (based on spot measurement of header flow rate) (l/s)	Pump Head (m)	Motor Power (kW)	Efficiency (kW/Ton)
Design	CWP 1				
	CWP 2				
	CWP 3				
Actual	CWP 1				
	CWP 2				
	CWP 3				

For pumping systems with variable speed drives, provide

- kW vs. time

viii. Cooling towers

General observation

ix. Overall chiller plant

(Ton refers to cooling load; kW refers to energy consumed)

- Daily chiller plant system efficiency profile vs. time (24 hours)
- Histogram of chiller plant system efficiency
- Plot of kW/Ton vs. Ton (chiller part load efficiency)
- Plot of kW vs. Ton
- System level heat balance

8. **Conclusions**

- Summary of recommendations on area of improvement, in table format
- Brief description of the present situation and shortcomings identified related to Chiller System Efficiency.

## 9. Appendices

Information of significant importance, which cannot be presented as a part of the text report (because of number of pages, quality of presentation, etc.) should be presented in appendices.

The appendices should include:

- Schematics and layout drawings of facility or building audited
- Details of instrumentation used – parameters monitored and duration of monitoring for each parameter
- Data plots of performance of systems or equipment audited
- Energy efficiency of major equipment compared against industrial benchmarks
- CD-ROM containing the raw measurement data

## 10. General Notes to the Report

- Documentation – All numbers related to the results should be supported by information showing how they were derived.
- All calculations in the report should be checked for mathematical accuracy.
- SI units must be used in all parts of the report.
- Measurement and instrumentation accuracy - Where possible, measurements should adhere to ASHRAE Guidelines 22.
- Grammar and style – The report should be written in proper prose. The language should be clear, concise and understandable.
- All graphs and plots should be properly labelled and show the dates when the readings were taken.
- Examples shown in this guideline serve as a guide; actual tables should show more detailed information where possible.
- The report can be printed on both sides to save paper.
- The CD-ROM, containing the raw measurement data in a readable file format, shall be copied and sent to BCA.