1.0   *Testing and Commissioning Reports*

1.1   Automatic Condenser Tube Cleaning System for Chiller No. CH-01

System	:	Ball Technic BSS-10
System Number	:	1
Location	:	Nokia
Chiller Model	:	Trane CVGE045
Chiller No.	:	CH-01
Date of Measurement	:	29 December,2007
Compressor Operating Voltage	:	395 V.
Compressor Operating Current	:	425 Amp.
Power Factor	:	0.9
Chilled Water Flow Rate	:	0.0662 m^3/s
Oil Pressure	:	500 KPa
Oil Temperature	:	63.1 ^{o}C
Saturated Evap. Refrigerant Temperature	:	4.2 ^{o}C
Saturated Cond. Refrigerant Temperature	:	33.7^{o}C
Condenser Water Entering Temperature	:	30.7 ^{o}C
Condenser Water Leaving Temperature	:	35.1^{o}C
Chilled Water Entering Temperature	:	10.4^{o}C
Chilled Water Leaving Temperature	:	7.1 ^{o}C
Number of Balls added into the system	:	70
Operation of Injection Valve	:	Normal
Operation of Drain Valve	:	Normal
Number of Balls return to the injector	:	Normal

1.2   Results and Conclusion

(a)   Data taken before tube cleaning and ATC installation on 29 December,2007

Cooling Capacity   Q =   m x 4.19 KJ/Kg/°C x   (T out – T in)

=   0.0662 m³/s x 4190 J/Kg.°C x (10.4 °C – 7.1°C)

=   915.35 kW or 260.34 ton

Active Power   P = $\sqrt{3}$ x U_L x I_b x cos θ

= $\sqrt{3}$ x 395 x 425 x 0.9

=   261 kW

Chiller efficiency   = measured as 0.997 kW/ton

(b)   Data taken after tube cleaning and ATC installed on 27 February 2008

Cooling Capacity   Q =   m x 4.19 KJ/Kg/°C x   (T out – T in)

=   0.0662 m³/s x 4190 J/Kg.°C x (10.0 °C – 6.3 °C)

= 1026 kW or 292ton

Active Power P = $\sqrt{3}$ x U_L x I_b x cos θ

= $\sqrt{3}$ x 387 x 409 x   0.9

=   246.7 kW

Chiller efficiency   = measured as 0.845 kW/ton

(c)   Data taken after tube cleaning and ATC installed on 2 May 2008

Cooling Capacity   Q =   m x 4.19 KJ/Kg/°C x   (T out – T in)

=   0.0662 m³/s x 4190 J/Kg.°C x (10.0 °C – 6.4°C)

= 999 kW or 284ton

Active Power P = $\sqrt{3}$ x U_L x I_b x cos θ

= $\sqrt{3}$ x 396 x 382 x   0.9

=   235.8 kW

Chiller efficiency   = measured as 0.830 kW/ton

Use the average KW/TR from the about readings with loading from
(0.845 + 0.830)/2=0.8375
(0.997-0.8375)/0.997=15.9%

1.0 Testing and Commissioning Reports

1.1 Automatic Condenser Tube Cleaning System for Chiller No. CH-02

System : Ball Technic BSS-10
System Number : 1
Location : Nokia

Chiller Model : Trane CVGE045
Chiller No. : CH -02

Date of Measurement : 29 December,2007

Compressor Operating Voltage : 396 V.
Compressor Operating Current : 453 Amp.
Power Factor : 0.9

Chilled Water Flow Rate : 0.0662 m^3/s

Oil Pressure : 470 KPa
Oil Temperature : 63 ^{o}C
Saturated Evap. Refrigerant Temperature : 4.1 ^{o}C
Saturated Cond. Refrigerant Temperature : 33.9^{o}C

Condenser Water Entering Temperature : 26.9 ^{o}C
Condenser Water Leaving Temperature : 32.1 ^{o}C

Chilled Water Entering Temperature : 10.1^{o}C
Chilled Water Leaving Temperature : 6.6 ^{o}C

Number of Balls added into the system : 70
Operation of Injection Valve : Normal
Operation of Drain Valve : Normal
Number of Balls return to the injector : Normal

1.2   Results and Conclusion

(a)   Data taken before tube cleaning and ATC installation on 29 December,2007

Cooling Capacity   Q =   m x 4.19 KJ/Kg/^{o}C x   (T out – T in)

$\quad$ =   0.0662 m^3/s x 4190 J/Kg.^{o}C x (10.7 ^{o}C – 7.0^{o}C)

$\quad$ =   1034.05 kW or 294.1 ton

Active Power   P = $\sqrt{3}$ x U$_L$ x I$_b$ x cos θ

$\quad$ = $\sqrt{3}$ x 396 x 453 x 0.9

$\quad$ =   279.6 kW

Chiller efficiency   = measured as 0.95 kW/ton

(b)   Data taken after tube cleaning and ATC installed on 27 February 2008

Cooling Capacity   Q =   m x 4.19 KJ/Kg/^{o}C x   (T out – T in)

$\quad$ =   0.0662 m^3/s x 4190 J/Kg.^{o}C x (9.6 ^{o}C – 6.4 ^{o}C)

$\quad$ = 887.6 kW or 252.5ton

Active Power P = $\sqrt{3}$ x   U$_L$ x I$_b$ x cos θ

$\quad$ = $\sqrt{3}$ x 393 x 363 x 0.9

$\quad$ =   222 kW

Chiller efficiency   = measured as 0.88 kW/ton

(c)   Data taken after tube cleaning and ATC installed on 2 May 2008

Cooling Capacity   Q =   m x 4.19 KJ/Kg/^{o}C x   (T out – T in)

$\quad$ =   0.0662 m^3/s x 4190 J/Kg.^{o}C x (10.0 ^{o}C – 6.0^{o}C)

$\quad$ = 1109.5 kW or 315.6ton

Active Power P = $\sqrt{3}$ x   U$_L$ x I$_b$ x cos θ

$\quad$ = $\sqrt{3}$ x 392 x 371 x   0.9

$\quad$ =   226.7 kW

Chiller efficiency   = measured as 0.718 kW/ton

Use the average KW/TR from the about readings with loading from
(0.88 + 0.718)/2=0.799
(0.95-0.799)/0.95=15.9%

1.0 *Testing and Commissioning Reports*

1.1 Automatic Condenser Tube Cleaning System for Chiller No. CH-03

System	:	Ball Technic BSY-10
System Number	:	1
Location	:	Nokia

Chiller Model	:	Trane CVGE045
Chiller No.	:	CH -03

Date of Measurement : 29 December,2007

Compressor Operating Voltage	:	399 V.
Compressor Operating Current	:	380 Amp.
Power Factor	:	0.9

Chilled Water Flow Rate	:	0.0667 m^3/s

Oil Pressure	:	470 KPa
Oil Temperature	:	61.4 ^{o}C
Saturated Evap. Refrigerant Temperature :		5.3 ^{o}C
Saturated Cond. Refrigerant Temperature :		36.2^{o}C

Condenser Water Entering Temperature	:	29.9 ^{o}C
Condenser Water Leaving Temperature	:	33.6 ^{o}C

Chilled Water Entering Temperature	:	9.6 ^{o}C
Chilled Water Leaving Temperature	:	6.6 ^{o}C

Number of Balls added into the system	:	70
Operation of Injection Valve	:	Normal
Operation of Drain Valve	:	Normal
Number of Balls return to the injector	:	Normal

1.2 Results and Conclusion

(a) Data taken before tube cleaning and ATC installation on 29 December,2007

Cooling Capacity $Q =$ m x 4.19 KJ/Kg/^{o}C x (T out – T in)

$\quad\quad = $ 0.0667 m^3/s x 4190 J/Kg.^{o}C x (9.6 ^{o}C – 6.6^{o}C)

$\quad\quad = $ 838.4 kW or 238.5 ton

Active Power $P = \sqrt{3}$ x U_L x I_b x cos θ

$\quad\quad = \sqrt{3}$ x 399 x 380 x 0.9

$\quad\quad = $ 236.4 kW

Chiller efficiency $=$ measured as 0.99kW/ton

(b) Data taken after tube cleaning and ATC installed on 27 February 2008

Cooling Capacity $Q =$ m x 4.19 KJ/Kg/^{o}C x (T out – T in)

$\quad\quad = $ 0.0667 m^3/s x 4190 J/Kg.^{o}C x (9.2^{o}C – 6.3 ^{o}C)

$\quad\quad = $ 810.5 kW or 230.5ton

Active Power P $= \sqrt{3}$ x U_L x I_b x cos θ

$\quad\quad = \sqrt{3}$ x 387 x 333 x 0.9

$\quad\quad = $ 200.9 kW

Chiller efficiency $=$ measured as 0.872 kW/ton

(c) Data taken after tube cleaning and ATC installed on 2 May 2008

Cooling Capacity $Q =$ m x 4.19 KJ/Kg/^{o}C x (T out – T in)

$\quad\quad = $ 0.0667 m^3/s x 4190 J/Kg.^{o}C x (9.8 ^{o}C – 6.0^{o}C)

$\quad\quad = $ 1062 kW or 302ton

Active Power P $= \sqrt{3}$ x U_L x I_b x cos θ

$\quad\quad = \sqrt{3}$ x 395 x 374 x 0.9

$\quad\quad = $ 230.3 kW

Chiller efficiency $=$ measured as 0.76 kW/ton

Use the average KW/TR from the about readings with loading from
(0.872 + 0.76)/2=0.816
(0.99-0.816)/0.99=17.5%