

ISO Performance Data Based Commissioning Technique for a Hybrid GSHP System

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ABSTRACT: GSHP(Ground Source Heat Pump) system has been extensively disseminated due to the recent increasing demand of the new and renewable energy in Korea. However, the system reliability has been key issues and barriers to insure a better system performance as designed originally in ISO (international standard organization) standard. This paper introduces a systematic method to verify its intended design target-so called as ISO performance data based commissioning technology for a water to air GSHP system. The commissioning technology starts from the standard ISO performance data of hybrid GSHP model and to compare its installed operation data and to calibrate by tuning to the target optimum operation parameters. Results indicated that cooling performance could be improved up to 76.6% from 46.6% from this proposed commissioning technology at the initial commissioning stage.

Keywords: Commissioning(CX), GSHP, Heat pump, Cooling Capacity, COP_c, ISO (International Standardization Organization)

1. INTRODUCTION

One of critical solutions to reduce global GHG warming problem is to use GSHP effectively. In Korea, government provides many subsidy and feed-in-tariff system to disseminate the energy systems including GSHP in the new government building. One of government policy is that new federal public building should include NRE system more than 5% of total initial building construction cost.

GSHP system could be one of the effective NRE system mostly considered for this federal building construction project. However, the reliability issue of GSHP system has been critical problem to be solved in the real projects. This paper introduces a new technique to improve the actual system performance and the system reliability as well.

The commissioning(CX) is defined as the process to improve the actual installed conditions according to the intended designed conditions. This CX process could

improve the system performance of a GSHP system as originally designed as in ISO (International Standardization Organization) performance data such as ISO 13256-1, 2.

The purpose of this paper is to introduce a new system commissioning technique not just for a unit performance but a whole system performance.

The proposed commissioning method is to be demonstrated with water to air GSHP system designed and installed at KIER site for this purpose. The new Commissioning method will be verified and justified with this example study.

2 GSHP PERFORMANCE VERIFICATION

International standard method to test a water to air GSHP unit is so far based on ISO 13256-1. According to the pre-promised test conditions of water to air, brine to air, GSHP unit, Table 1 summarizes the key test conditions for a typical water to air GSHP unit thermal performance.

They include inside air, dry bulb, web bulb temperature in load side while ambient temperature and exchanging liquid temperature at standard and part load condition in source side. The unit should be operated at least more than one hour for steady state conditions before testing.

Table 1: ISO 13256-1 Test conditions of GSHP(water to air)

	Heating	Cooling
Air entering indoor side dry bulb, web bulb	20°C, 15°C	27°C, 19°C
Air surrounding unit, dry bulb	20°C	27°C
Standard rating test Liquid entering heat exchanger	0°C	25°C
Part-load rating test Liquid entering heat exchanger	5°C	20°C
Frequency	Rated	Rated
Voltages	Rated	Rated

The data acceptance criteria the maximum allowable error is $\pm 1.0^\circ\text{C}$ for indoor air temperature and $\pm 0.5^\circ\text{C}$ for entering water temperature. The data needs to be recorded every 5 minutes for at least 30 minutes. The data should be averaged for a later ISO data production. The GSHP supplier should provide this type ISO data and later be verified at the accredited institute. Table 2 shows the ISO data provided from T company S model (8HP).

One critical issue from the previous unit performance approves not address the whole system installation effects.

Table 2: ISO 13256-1 based heat pump performance data (T company, S model)

EWT [°C]	GPM	Cooling					Heating				
		EA [°C]	TC	KW	HR	COPc	EA [°C]	HC	KW	HE	COPh
25	10.0	24/17	23.70	6.60	28.51	3.3	24	24.52	10.93	15.72	2.2
		27/19	23.58	6.79	28.57	3.2	27	24.27	11.27	15.13	2.2
		29/21	23.45	6.98	28.62	3.0	29	24.07	11.49	14.71	2.1
	16.0	24/17	23.19	6.87	31.11	3.8	24	27.31	10.57	18.88	2.6
		27/19	26.03	7.11	31.16	3.7	27	27.04	10.92	18.24	2.5
		29/21	25.87	7.31	31.20	3.5	29	26.83	11.16	17.8	2.4
	22.0	24/17	27.38	6.77	32.17	4.0	24	28.87	10.25	20.74	2.8
		27/19	27.20	6.99	32.21	3.9	27	28.57	10.63	20.28	2.7
		29/21	27.03	7.20	32.25	3.7	29	28.31	10.88	19.62	2.6
TC, HR, HC, HE, KW=[Kilowatts]											

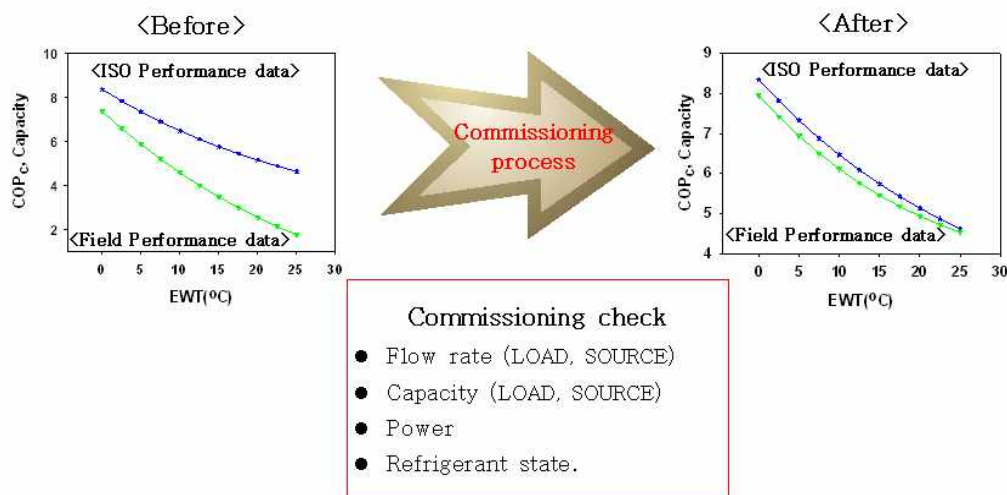


Figure 1: Process of ISO performance data based commissioning

The system effects may include all passive conditions not matching to the ISO test conditions. Therefore, a system based to CX technique is now proposed to reduce the gap between the design stage and the installed stage.

Figure 1 shows this ISO performance data based CX process which include 1) the data comparison before CX, 2) CX process and 3) the data comparison process after CX based the ISO performance data curve and 4) the actual performance data curve.

The main idea is to keep compare the actual data with the ISO data to reduce the gap between the actual and the design situation. This process includes the comparisons of capacity, flow rate, refrigerant electric input and the turning to the target performance as indicated in the ISO performance data.

This continuing CX process could provide a better system performance as in the specific actual conditions

3. ISO PERFORMANCE DATA BASED CX DEMONSTRATION AT KIER

The hybrid GSHP system with air plus ground source coupled is acted to demonstrate this CX technical. Figure 2 shows the system to operation. The hybrid GSHP system refrigerant is R410a and

cooling capacity is 22.9 kW.

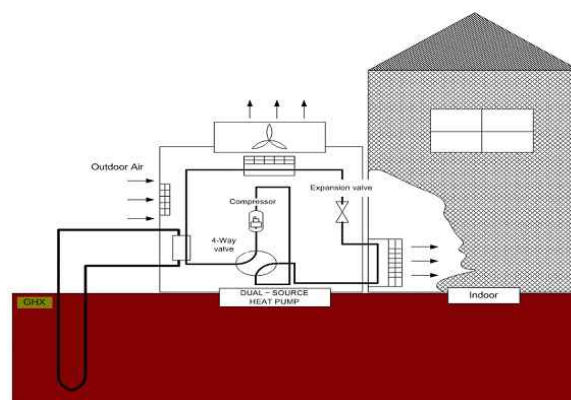


Figure: 2 Schematic diagram of hybrid heat pump system in KIER

Figure 3 shows the cooling capacity comparisons between the ISO data as the actual field data. The cooling capacity varies depending upon the entering water, temperature and was 46.6% less in the actual field condition before the commissioning. The CX technique has been applied to the target performance approach by corresponding the lack of the refrigerant.

Figure 4 shows The CX process has recharged the refrigerant after the CX, the cooling capacity, has been increased to the ISO data son up to 76.6% from 46.6%.

Figure 5 also shows the improvement of COPc as well as the cooling capacity after the CX process.

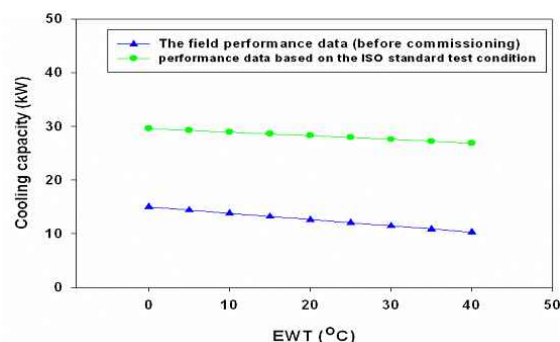


Figure 3: Cooling capacity with respect to EWT(before Commissioning)

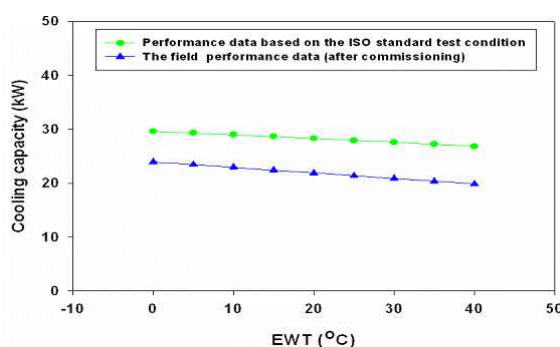


Figure 4: Cooling capacity with respect to EWT (after Commissioning)

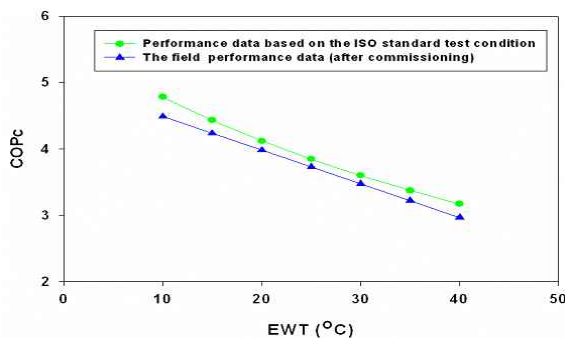


Figure 5: COPc with respect to EWT (after commissioning)

3. CONCLUSION

This paper introduced a simpler and clearer CX technique based on the ISO performance data and the actual field data. A set of curve or line from ISO data provide a reference guideline to meet the target performance as in the actual situation.

Key results indicated that this new

approach could be better implemented in actual data set projects usually without a clear reference to be commissioned. This more clear reference target CX technique could reduce the gap between the design and the actual installed performance.

This CX technique has been verified to actual water to air GSHP system designed and installed at KIER site. The verification study showed that cooling capacity and COPc could be commissioned better to 76% from 46% with this proposed method. This CX technique could be better applied to the present and future GSHP projects to improve the system reliabilities and performance as promised in the design stage as in ISO performance.

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