IMH/AKB 28/12/2014.

Conclusions : From the readings taken in the last few weeks, the following conclusions may be drawn.

Setup 1 : 42U Rack directly on the cool air inlet in the corr room with all the leakages at the bottom closed. The cool air enters the rack from the front bottom opening and enters the aluminium cage through a window provided in the cage at a height of about 2 feet. One thermometer(T1) and two temperature sensors (S2 & S3) are present at this opening to measure the inlet temperature. Inside the al. cage about a feet high 4 hellogen (with seperate ON-OFF switches in the two extension boards having current carrying capacity of 16amps. These two extension boards are getting power from MSEB metal MCB box through 25amps MCB) lamps of 1 KW each are mounted. Some 3 feet above these lamps there is window in the al cage at the backside for heated air to exhaust. At this poist also one thermometer (T2) and two sensors (S4 & S5) are mounted. Sensor S1 is outside and near to this rack.

Rabbit card gets input on pin numbers 1 to 5 on 64pin FRC male connector from sensors S1 to S5 respectively. +11 volts power has been given to this rabbit card as well all to all temperature sensor cards. An ethernet cable with ip 192.168.4.152 has been connected to this rabbit card for web based monitoring of temperature.

Setup 2 : setup 1 with 3 fans mounted at the height of about 2 feet front side, to suck air in the aluminium cage.

Setup 3 : setup 1 & 2 with whole setup moved about 5 feet away from cool air inlet duct. Cool air brought to the rack's inlet using aluminium sheet enclosure underneath the false flooring.

Setup 4 : setup 3 without fans to suck the cool air in the aluminium cage at 2 feet height.

Setup 5 : setup 3 without aluminium sheet enclosure underneath the false flooring to bring the cool air from the inlet duct to the rack and with fans to suck the air in the aluminium cage at 2 feet height.

Setup 6 : setup 5 but without fans to suck the cool air in the aluminium cage at 2 feet height.

Setup 7 : Rack without any modifications (aluminium cage in the rack removed). Kept 5 feet away from the cool air inlet duct. Input temperature monitoring about 2 feet high at the frontside. Four hellogens of 1 KW each mounted at the centre of the rack. And output temperature monitoring at the top of the rack's rear side.

Setup 8 : Rack without any modifications (aluminium cage in the rack removed). Kept over the cool air inlet duct. Input temperature monitoring about 2 feet high at the frontside, where cool air blows in the rack's bottom. Four hellogens of 1 KW each mounted at the centre of the rack. And output temperature monitoring at the top of the rack's rear side.

T – Thermometer readings average. & S – Temperature Sensors readings average in Deg. Cel.
LH – Left Hand side RH – Right Hand side (from back) F- Front of rack B – Back of rack.

SETUP : 1

42U Rack directly placed on the cool air inlet in the correlator room with all the leakages at the bottom closed. Aluminium cage with cool air in and hot air out and load in the centre of the cage.

Date	Difference in Temperature Readings T	S	Heat load of KW's	Time	Remarks	
10/10/2014	4	4	1	12 – 17	Readings every half an hour	
11/10/2014	7	8.5	2	11 - 17	“	
13/10/2014	3	4	1	10 – 17	“	
14/10/2014	8	8.5	2	10 – 17	“	
15/10/2014	3.5	4	1	10 – 17	“	
16/10/2014	2.5	4.5	1	10 – 17	“	
18/10/2014	3	4.2	1	10 – 17	“	
20/10/2014	2	4	1	10 – 15	“	
21/10/2014	3	4.5	1	10 - 12	LH-1	every 5 min.
	10.5	11.5	3	12 - 13	LH-1 + RH-2	“
22/10/2014	6	8	2	10 - 12	LHB + RHB	every 10 min.
	5.5	8	2	12 - 13	LHF + RHF	“
	12	13	3	14 - 15	LH-2 + RH	“

	Average Readings in degCel. 1KW	2KW	3KW	4KW	Max. o/p temp. 4KW	Themometer +/- Temp. Sensor
Themometer	**3**	**6.6**	**11.2**	**Notdone**		
Temp. Sensors	**4.2**	**8.2**	**12.2**	**Notdone**		

Conclusions : Temperature Sensor results are about 1.2 degCel. more than the Themometer readings. And maximum output temperature for 4 KW is about 20 degCel.

SETUP : 2

setup 1 with 3 fans mounted at the height of about 2 feet front side, to suck air in the aluminium cage.

Date	Difference in Temperature Readings T	S	Heat load of KW's	Time		Remarks
28/10/2014	2	4.2	1	10:00 - 11:40	LHB	every 10 min.
	8.5	9	2	11:45 - 13:00	LHB + RHB	“
	10	12.5	3	14:10 - 15:30	LH-2 + RH	“
	13	15.5	4	15:40 - 16:40	All	“
29/10/2014	11	13.5	4	09:40 - 11:30	All	every 10 min.
	10	12.5	3	11:40 - 13:00	LH-2 + RHF	“
	7.5	9.5	2	14:20 - 15:20	LHB + RHB	“
	2.5	4.5	1	15:55 - 17:10	LHB	“

30/10/2014	2	4.2	1	09:45 - 10:40	LHF	every 10 min.
	2	4	1	10:50 - 11:45	RHF	“
	4	5.2	1	12:00 - 12:55	RHB	“
	2.5	4	1	14:10 - 15:00	LHB	“
	5	7	2	15:30 - 16:10	LH-2	“
	5.5	8	2	16:20 - 17:20	RH-2	“
31/10/2014	6.2	7.7	2	09:50 - 11:30	LHF+RHB	every 10 min.
	5.2	7.7	2	11:35 - 14:20	LHB+RHF	“
	7.2	10.3	3	14:25 - 16:40	LH-2+RHF	“
31/10/2014	11	13.5	4	09:45 - 16:00	All	every 10 min.

Average Readings in degCel.

	1KW	**2KW**	**3KW**	**4KW**
Themometer	**2.6**	**6.3**	**9.0**	**11.7**
Temp. Sensors	**4.3**	**8.2**	**11.7**	**14.2**

Conclusions : Temperature Sensor results are about 2 degCel. more than the Themometer readings. And maximum output temperature for 4 KW is about 22.5 (1/11/2014@14:50hrs)

SETUP : 3

setup 1 & 2 with whole setup moved about 5 feet away from cool air inlet duct. Cool air brought to the rack's inlet using aluminium sheet enclosure underneath the false flooring.

Date	**Difference in Temperature Readings**		**Heat load of**			
	T	**S**	**KW's**	**Time**		**Remarks**
07/11/2014 Sheet 1	6.8	9.3	2	15:20 - 17:10	RHB+RHF	every 10 min.
10/11/2014	16.0	17.82	4	10:00 - 13:00	All	“
sheet 2	12.72	15.25	3	14:15 – 17:10	LH-2+RHB	“
11/11/2014	2.28	5.12	1	10:00 – 14:20	LHF	“
sheet 3	6.50	8.74	2	14:50 – 17:15	RH-2	“
12/11/2014	6.19	9.36	2	10:00 – 14:20	LH -2	“
sheet 4	7.00	10.08	2	14:10 – 15:15	LHB+RHF	“
13/11/2014	7.50	10.54	2	09:50 – 14:35	LHF+RHB	“
sheet 5	1.93	4.04	1	14:40 – 17:10	RHF	“
14/11/2014	3.93	6.13	1	10:20 – 14:40	RHF	“
sheet 6	2.81	5.53	1	14:45 – 17:20	LHB	
15/11/2014	3.30	5.95	1	10:10 – 11:30	RHB	“
sheet 7	9.64	12.02	2	11:35 – 14:20	LHB+RHB	
	12.33	14.63	3	14:30 – 15:50	LHB+RH-2	“
	13.70	16.38	4	15:55 – 17:20	All	
16/11/2014 sheet 8	14.79	18.67	4	09:25 - 20:10	All	“

	Average Readings in degCel.			
	1KW	2KW	3KW	4KW
Themometer	**2.8**	**7.3**	**12.5**	**14.8**
Temp. Sensors	**5.3**	**10.0**	**14.9**	**17.6**

Conclusions : Temperature Sensor results are about 2.5 degCel. more than the Themometer readings. And maximum output temperature for 4 KW is about 25.5 (16/11/2014@12:00hrs sheet no. 8 of temp_readings.ods file.)

SETUP : 4

setup 3 but without fans to suck the cool air in the aluminium cage at 2 feet height.
{Sheet number 13 & 14 in the temp_readings.ods file}

Date	Difference in Temperature Readings		Heat load of			
	T	S	KW's	Time		Remarks
26/12/2014	18.00	21.30	4	11:50 - 15:30	All	every 10 min.
Sheet 13	14.80	17.69	3	15:40 – 17:10	LH-2+RHF	“
27/12/2014	11.54	13.33	2	09:55 - 12:00	LHB+RHB	every 10 min.
Sheet 13	04.53	06.61	1	12:10 – 16:10	LHB	“
	18.33	21.15	4	16:20 - 21:00	All	
28/12/2014	13.44	16.48	3	12:20 – 15:00	LHF+RH-2	every 10 min.
Sheet 14	08.57	11.99	2	15:10 - 16:30	LHF+RHF	“
	02.50	06.15	1	16:40 – 20:30	RHF	“
29/12/2014	19.21	21.70	4	10.10 - 16:40	All	every 10 min.
Sheet 14						

Note : In this setup when bottom of the rack wasn't packed properly, so cool air was passing there. The average readings were about 1 to 4 degrees higher than the above mentioned (Readings in the Sheet number 9 of temp_readings.ods file) readings for 1KW to 4KW load resp.. Above readings are taken again after packing the rack bottom with the floor.

	Average Readings in degCel.			
	1KW	2KW	3KW	4KW
Themometer	**3.5**	**10.0**	**14.1**	**18.5**
Temp. Sensors	**6.4**	**12.6**	**17.1**	**21.4**

Conclusions : Temperature Sensor results are about 1.2degCel. more than the Themometer readings. And maximum output temperature for 4 KW is about 28.0 (26,27,29/11/2014 sheets 13 & 14)

SETUP : 5

setup moved 5 feet away from the inlet cool air duct, without aluminium duct between cool air inlet and rack but fans to suck air at the aluminium cage present.

{Sheet number 11 in the temp_readings.ods file}

Date	Difference in Temperature Readings T	S	Heat load of KW's	Time		Remarks
26/11/2014	11.90	08.23	3	09:50 - 11:30	LHF+RH-2	every 10 min.
Sheet 11	09.60	06.86	2	12:00 - 13:00	LHF+RHF	“
27/11/2014	17.95	11.33	4	11:30 - 13:00	All	every 10 min.
Sheet 11	06.45	05.35	1	14:20 - 16:00	LHB	“
	09.20	06.14	2	16:30 – 17:10	LHB+RHF	“
28/11/2014	18.31	11.37	4	10:20 - 12:50	All	every 10 min.
Sheet 11						
31/12/2014	18.73	12.17	4	10:30 – 16:30	All	“
sheet 16						
01/01/2015	10.14	10.44	3	10:00 – 11:30	LH-2+RHB	“
sheet 16	9.63	06.44	2	14.15 – 16:00	LHF+RHB	“
02/01/2015	3.22	02.18	1	10:10 – 14:10	RHF	“
sheet 16	17.79	12.38	4	15:00 – 16:00	All	“
03/01/2015	19.14	13.14	4	10:00 – 12:10	All	“

Note : In this setup Thermometer reading are higher than the sensor readings!

	Average Readings in degCel. 1KW	2KW	3KW	4KW	Max. o/p temp. 4KW	Themometer +/- Temp. Sensor
Themometer	**4.8**	**9.5**	**11**	**18.4**		
Temp. Sensors	**3.8**	**6.5**	**9.3**	**12.1**		

Conclusions : Temperature Sensor results are about 1 to 6 degCel. less than the Themometer readings. And maximum output temperature for 4 KW is about 33degCel (sheets 11 and 16)

SETUP : 6

setup 5 but without fans to suck the cool air in the aluminium cage at 2 feet height.
{Sheet number 12 in the temp_readings.ods file}

Date	Difference in Temperature Readings T	S	Heat load of KW's	Time		Remarks
28/11/2014	08.00	10.55	1	14:30 - 16:00	LHF	every 10 min.
Sheet 12	18.70	20.61	2	16:20 - 17:00	LHF+RHB	“
01/12/2014	23.85	26.10	3	10:00 - 12:00	LHF+RH-2	every 10 min.
Sheet 12	18.18	19.96	2	12:10 - 14:50	LHB+RHF	“
02/12/2014	32.36	34.08	4	10:00 - 12:50	All	every 10 min.
Sheet 12	17.67	19.64	2	14:10 - 15:30	LH-2	“
30/12/2014	30.11	30.20	4	12:20 - 15:50	All	every 10 min.
03/01/2015	32.56	33.87	4	12:30 – 17:00	All	“

05/01/2015	25.84	27.50	3	12:10 – 17:10	LHF+RF-2	“
sheet 15						

Average Readings in degCel.

	1KW	2KW	3KW	4KW
Themometer	**8.0**	**18.2**	**24.8**	**31.7**
Temp. Sensors	**10.5**	**20.0**	**26.8**	**32.7**

Conclusions : Temperature Sensor results are about 1 to 2 degCel. more than the Themometer readings. And maximum output temperature for 4 KW is about 46 degCel. (sheet no. 12)

SETUP : 7

Rack without any modifications (aluminium cage in the rack removed). Kept 5 feet away from the cool air inlet duct. {Sheet number 17 in the temp_readings.ods file}

Date	**Difference in Temperature Readings**		**Heat load of KW's**	**Time**		**Remarks**
	T	**S**				
22/01/2015	-1.14	1.24	4	11:40 - 16:00	All	every 10 min.
Sheet 17						
23/01/2015	-1.26	2.27	3	10:00 - 14:20	LHB+RH-2	every 10 min.
Sheet 17	-3.22	1.27	2	14:30 - 15:50	LHB+RHB	“
	-5.25	-0.79	1	16:00 - 17:20	RHB	“

Average Readings in degCel.

	1KW	2KW	3KW	4KW
Themometer	**-5.2**	**-3.2**	**-1.3**	**-1.1**
Temp. Sensors	**-0.8**	**-1.3**	**-2.3**	**+1.2**

Conclusions : Temperature Sensor results are about 1 to 4 degCel. less than the Themometer readings. And maximum output temperature for 4 KW is about 31.5 on 22/01/2015 sheet no. 17.

SETUP : 8

Rack without any modifications (aluminium cage in the rack removed). Kept over the cool air inlet duct. {Sheet number 17 in the temp_readings.ods file}

Date	**Difference in Temperature Readings**		**Heat load of KW's**	**Time**		**Remarks**
	T	**S**				
24/01/2015	-2.78	-3.35	4	12:30 - 17:10	All	every 10 min.
Sheet 18						
30/01/2015	-3.17	-2.20	3	10:30 - 14:50	LHB+RH-2	“
Sheet 18	-3.21	-1.70	2	15:00 – 17:10	LHB+RHB	“
02/02/2015	-2.21	-0.50	1	10:00 - 12:00	LHF	“
Sheet 18	-3.04	-1.10	2	12:10 – 15:00	LH-2	“
	-3.14	-1.68	3	15:10 – 17:20	LH-2+RHB	“

Average Readings in degCel.

1KW	2KW	3KW	4KW

Themometer	**-2.2**	**-3.1**	**-3.1**	**-2.8**
Temp. Sensors	**-0.5**	**-1.4**	**-2.0**	**-3.3**

Conclusions : Temperature Sensor results are about 1.5 degCel. more than the Themometer readings. And maximum output temperature for 4 KW is about 9.0 degCel 24/01/2015 sheet no. 18.

Final Conclusions :

	Temperature Difference Range, for the Heat Load of				
Setup No.	**1 KW**	**2 KW**	**3 KW**	**4 KW**	**Remarks**
1	2 – 4	5.5 – 8	10.5 – 12	not done	Thermometer
	4 – 4.5	8 – 8.5	11.5 – 13	not done	Temp. Sensors
Average	**3.2**	**7**	**11.7**	**not done**	
2	2 – 4	5 – 8.5	7.2 – 10	11 – 13	Thermometer
	4 – 5.2	7 – 9.5	10.3 – 12.5	13.5 – 15.5	Temp. Sensors
Average	**3.6**	**7.2**	**9.8**	**13.2**	
3	2 – 4	6 – 9.5	12.3 – 12.7	13.7 – 16.0	Thermometer
	4 – 6	8.7 – 12	14.6 – 15.3	16.4 – 18.7	Temp. Sensors
Average	**4**	**8**	**13.8**	**16.2**	
4	2.5 – 4.5	8.5 – 11.5	13.5 – 14.8	18.0 – 19.2	Thermometer
	6.2 – 6.6	12.0 – 13.3	16.5 – 17.7	21.2 – 21.7	Temp. Sensors
Average	**4.6**	**10.9**	**15.6**	**19.8**	
5	3.2 - 6.4	9.2 – 9.6	10.1 - 11.9	17.8 - 19.1	Thermometer
	2.2 - 5.3	6.1 - 6.8	8.2 – 10.5	11.4 – 13.1	Temp. Sensors
Average	**4.3**	**7.8**	**10.0**	**10.4**	
6	8.0	17.7 – 18.7	23.8 - 25.9	30.1 - 32.5	Thermometer
	10.5	19.6 – 20.6	26.1 - 27.5	30.2 - 34.0	Temp. Sensors
Average	**9.2**	**19.2**	**25.8**	**32.0**	
7	-5.25	-3.22	-1.26	-1.14	Thermometer
	-0.79	1.27	2.27	1.24	Temp. Sensors
Average	**- 3.02**	**- 1.0**	**- 0.5**	**0.05**	

8	-2.21	-3.04 - -3.21	-3.08 - -3.14	-3.35	Thermometer
	-0.50	-1.10 - -1.70	-1.68 - -2.20	-2.78	Temp. Sensors
Average	**-1.35**	**-2.15**	**-2.41**	**-3.1**	

Measurement of Power Consumption by racks :

Two months back measured the power consumption by the GWB host PC with cards, while correlator code running. The Power consumption was near to Typical Values as per the datasheets/documents.

Measurement of Cool air comming out from each inlet :

Once CFM meter gets purchased by Electrical section, we will conduct this measurement.