The Journal of CPRI,
Vol. 10, No. 3, September 2014 pp. 481-486

A Study on the evaluation of sandwich busduct using temperature rise method

Viswanatha C*, Vittal G P* and Mohan Babu V*

Different types of busducts like Isolated Phase Busduct, Segregated and Non Segregated Busducts are used in Power Distribution Network which occupies voluminous, large space of the equipment. Recently, Sandwich Busducts have come into vogue because of their compactness, light weight, low impedance, and fire retardancy besides several other advantages. However Sandwich Busducts need to maintain high quality conductors, superior design, high dielectric withstand voltage. These properties would meet the requirements of electrical parameters but for the requirement of thermal specifications, it is Temperature rise method widely employed to monitor the thermal performance of Sandwich Busducts. In the present investigation, modular designed Sandwich Busducts are chosen and studied using Temperature rise method. The samples of Sandwich Busducts are subjected to Temperature rise method. The temperature at critical points of Sandwich Busducts are monitored and evaluated in the light of International Specifications. Of the many inferences derived, the important observations at thermal steady state for busduct, incoming and outgoing terminals have been obtained. The present paper focuses on assessing the components forming Sandwich Busduct for their evaluation to apply to field conditions in the Electrical Power System Network.

Keywords: *Sandwich busduct, temperature rise,busduct, thermal profile, insulation*

1.0 INTRODUCTION

Sandwich Busducts are recent developed product in the field of Busways for transmitting electrical power from generation end to several distribution points in the power system network. Although Sandwich Busducts offer several advantages such as space saving, compactness, economy besides practical usage in concise space availability. They are widely employed in high raised buildings of commercial and domestic use. They also need to deliver right amount of power to the end users with reliability safely and efficiently.

While type test determines the design compliance and that as routine test verifies each sample of busduct in a given batch of population. Of all the tests of Electrical and Thermal tests, the Temperature and rise of the equipment in actual operation is crucial to verify performance and suitability of Sandwich Busducts in practical conditions. Normally IEC and BIS standards are consulted to check the compliance of specifications required by standard busducts. In spite of compactness, it has to withstand the dielectric stresses and thermal stresses for intended rating which imposes proper selection of busduct materials, insulation and design considerations. Adequate insulation covering on conductors and barrier insulation between the conductors of busbar are required in Sandwich type busducts. Any malfunctioning of insulation cover and their insulators pose serious constraint in the operation of Sandwich Busduct [5]. In this background, it is necessary to understand the performance of whole system of Sandwich Busduct which comprises of conductor busduct, conductor busbar and insulation covered busbar.

*DCCD, Central Power Research Institute, Bangalore- 560080, India, E-mail: viswa@cpri.in

Temperature rise method provides the method to evaluate Sandwich Busduct in the environment of Temperature and Electrical conditions. The samples of Sandwich Busducts are subjected to Temperature rise test and Thermal profile of each point in the system of Sandwich Busduct such as incoming terminals, outgoing terminals, main busbars, barrier insulations, internal temperature in the enclosure and surface of enclosure are considered. The selected temperature points shall cover complete configuration of Sandwich Busduct so that all components are thermally monitored.

2.0 EXPERIMENTAL SETUP

Experiments were conducted on samples of Sandwich Busducts which are intended to actual applications in the network. The samples of 800 Amps rated sandwich Busduct are chosen for the laboratory investigations. For each sample, suitable copper braids of requisite area of cross section are employed to connect the sample to the current source. For the samples of 800 Amps sandwich Busduct, a current source of rating 15V and 3500Amps is employed to pass the required current to the samples. The end view of Sandwich busduct with incoming terminals protruded outside the enclosure consisting of three phases, Neutral, Earth terminals are shown in the Figure 1.

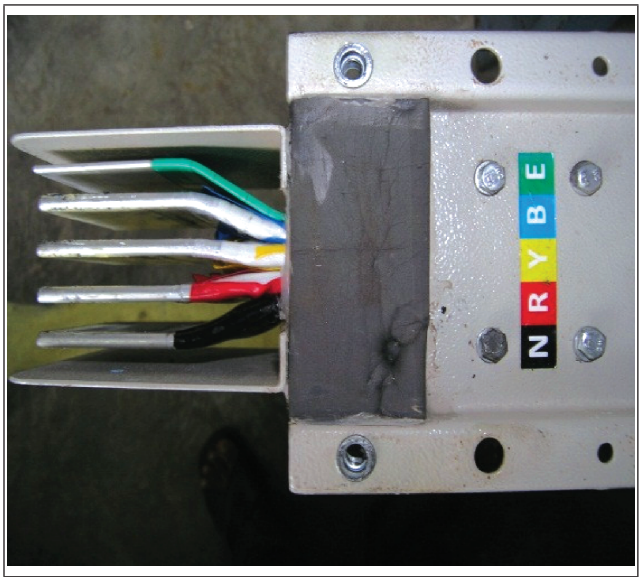

FIG. 1 A VIEW OF THE INCOMING TERMINALS OF SANDWICH BUSDUCT OF RATING 800 AMPS

The copper braids form conductive link to the current source and Sandwich Busduct and it is important component in the circuit of Temperature rise method because the amount of heat to be transmitted to the sample should be exact. Because, there should not be excessive dissipation of generated heat by the current source and the same amount of heat has to be sent from the current source to the experimental sample. Therefore, the copper braids should act as complete heat transmission conductor for the sample and it does not form the heat source of the sample.

After copper braids, temporary busbar connections are connected from copper braids to the sample. The temporary busbars are to be provided both at incoming side and outgoing side of the circuit. The outgoing busbars of temporary connections are shorted with suitable busbar length and the same cross section as the outgoing temporary busbars. While the incoming temporary busbars shall be provided with suitable arrangement to make connections with copper braids of current source. With this the connections from current source, copper braid, and temporary connections will be completed for the experimental sample under investigation. The arrangement of temporary connections at incoming side and outgoing side of the sandwich Busduct is shown in the Figure 2.

FIG. 2 AN ARRANGEMENT SHOWING TEMPORARY INCOMING AND OUTGOING CONNECTIONS TO SANDWICH BUSDUCT

Thermocouple points of the Sandwich Busducts are identified so that the important components of the samples are covered for the investigations. The main incoming terminals, busbars, busbar joints, terminals of outgoing busbars are selected for the critical points of the sample.

The thermocouples of specified ratings with accuracy to measure temperature precisely for the temperature range are fixed to the critical points with suitable glue and cotton tape. The thermocouples fixed are secure and firm during the experiment.

The thermocouples other ends are connected to data logger and from there on they are connected to laptop. The laptop is programmed to collect the temperature data at all thermal points of the sample at regular interval of every half an hour. The experiment is continued till such time that there is no increase of temperature at two consecutive readings taken with time gap of one hour [1]. The experimental data so obtained during temperature rise test is carefully compiled for the samples of three different ratings.

3.0 RESULTS AND ANALYSIS

The experimental data obtained as per the procedures outlined in the previous paragraph is carefully compiled and analyzed. The data of temperature is used to calculate temperature rise at critical points of Sandwich Busduct. Temperature rise is considered for all the points of study to evaluate thermal profile of Sandwich Busduct to verify the compliance of the sample with specifications of International Standard [2].

The variation of temperature with time during temperature rise method are studied for

a. Incoming terminal
b. Joint near Incoming terminal
c. Busduct Joint between two sections
d. Joint near outgoing terminal
e. Outgoing terminal
f. Enclosure

The variation of temperature and rise are shown in the Figure 3 to Figure 8. The temperature of the component initially rises rapidly thereafter the increase is gradually upwards, then tend towards saturation. At this point there is no incremental rise of temperature because of thermal equilibrium of the component with its surrounding environment in the duct. It can also be noticed that the thermal stability is achieved after a period of three and half hours [3]. Each diagram of Figures display is representative of thermal profile of individual component.

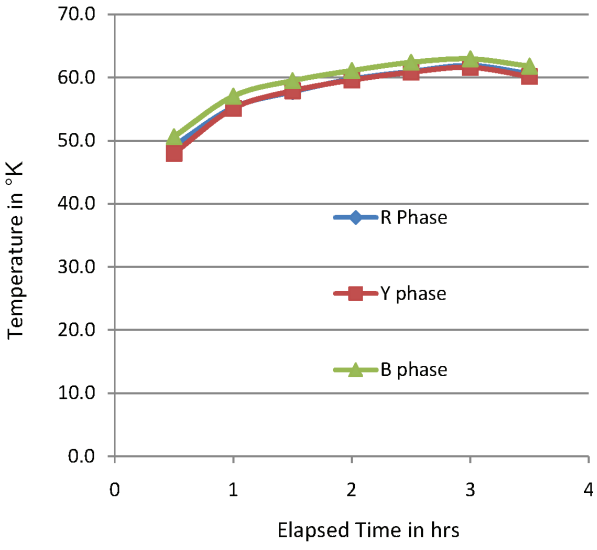

FIG . 3 VARIATION OF TEMPERATURE WITH ELAPSED TIME FOR INCOMING TERMINAL OF 800 AMPS BUSDUCT

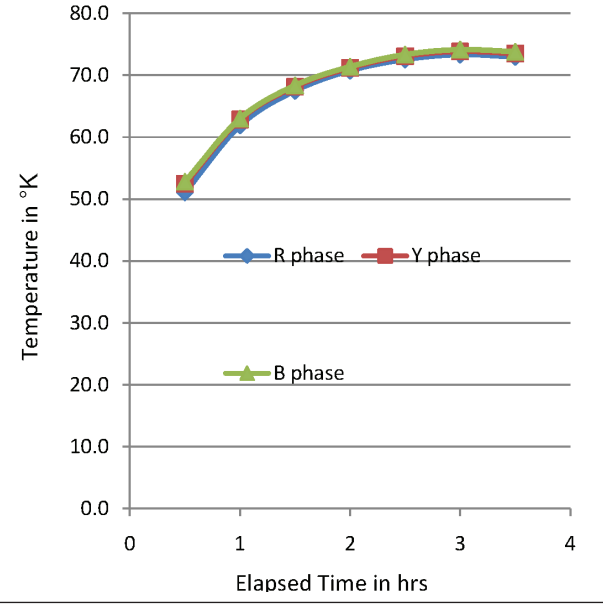

FIG. 4 VARIATION OF TEMPERATURE WITH ELAPSED TIME FOR JOINT NEAR INCOMING TERMINAL OF 800AMPS BUSDUCT

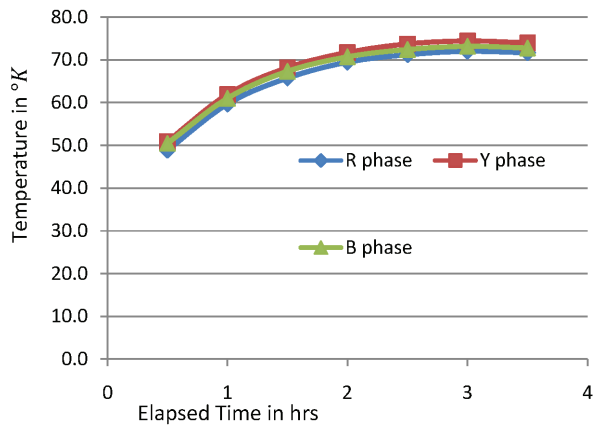

FIG. 5 VARIATION OF TEMPERATURE WITH ELAPSED TIME FOR BUSDUCT JOINT BETWEEN TWO SECTIONS OF 800AMPS BUSDUCT

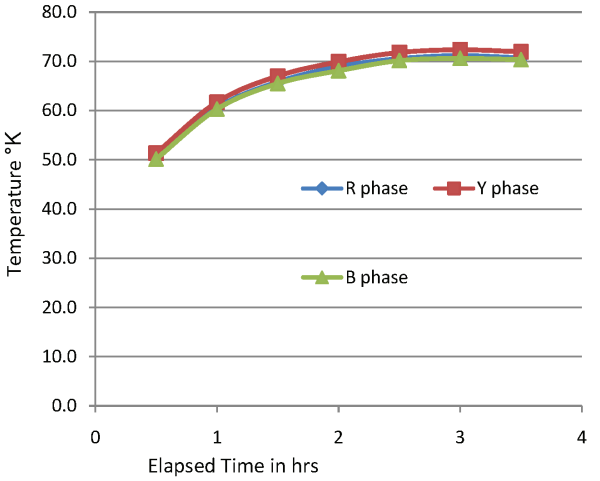

FIG. 6 VARIATION OF TEMPERATURE WITH ELAPSED TIME FOR JOINT NEAR OUTGOING TERMINAL OF 800AMPS BUSDUCT

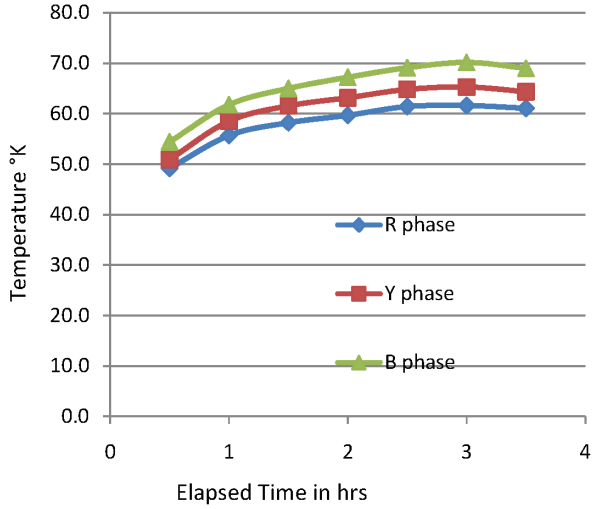

FIG. 7 VARIATION OF TEMPERATURE WITH ELAPSED TIME FOR OUTGOING TERMINAL OF 800AMPS BUSDUCT

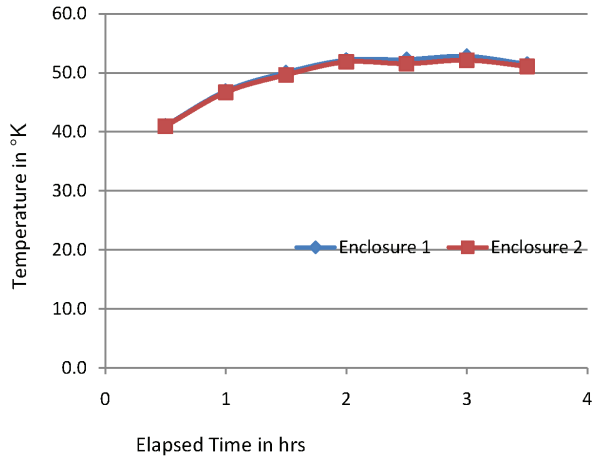

FIG. 8 VARIATION OF TEMPERATURE WITH ELAPSED TIME FOR ENCLOSURE OF 800AMPS BUSDUCT

Figure 9 represents diagrammatically the quantum of rise of temperature for individual components. In this figure, the rise magnitudes are quantified and presented.

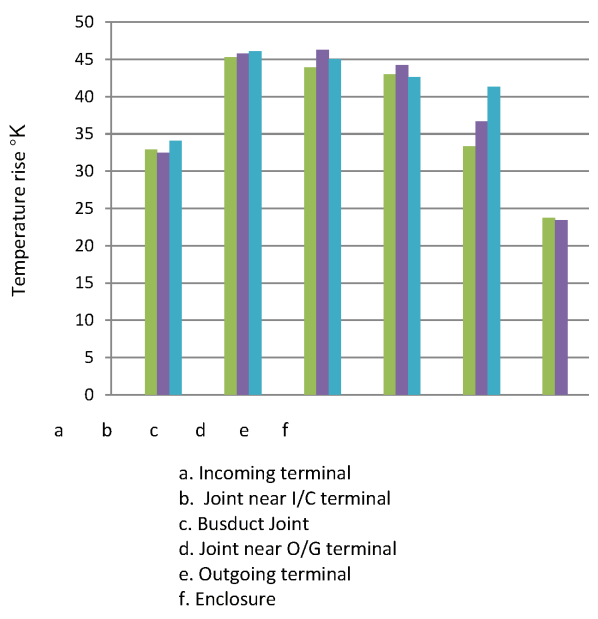

FIG. 9 TEMPERATURE RISE FOR DIFFERENT COMPONENTS OF SANDWICH BUSDUCT

The results obtained from the experiments on the samples of 800 rated Sandwich Busducts are shown in the following Tables

1. The terminals for external insulated conductors, busbars, and enclosures are analyzed with respect to specifications IEC

2. All these points of busduct meet the specification values and hence the Sandwich Busducts performance is suitable for practical usage [4].

TABLE 1

THERMAL EVALUATION OF SAMPLES OF SANDWICH BUSDUCT RATED FOR 800AMPS

SI No	Particulars of assembly of the sample	Temperature rise as per Specifications in deg K	Measured value in deg K
1	Terminals for external insulated conductors		
	a. Incoming terminal	70	34.1
	b. Outgoing terminal	70	41.3
2	Busbars and conductors (Joint between stack 1 and 2)	105	46.3
3	External enclosure	55	23.8

4.0 CONCLUSION

In the light of investigations undertaken on Sandwich Busducts, the following important points of study have been obtained and are mentioned below.

- Although Sandwich Busducts are compact and has advantages, nevertheless they have to be evaluated for thermal profile to determine their suitability for their practical application.
- Temperature rise method provides the method to evaluate Sandwich Busduct in the environment of temperature and electrical conditions.
- The temperatures at monitoring points are so chosen that they completely represent full Sandwich Busduct and complete thermal performance is determined.

REFERENCES

[1] IEC 61439-Part 1, "Specifications for controlled and swichgear assemblies"(2011)

[2] IEC 61439-Part 6- " Low voltage switchgear and controlgear assemblies" (2012)

[3] IS 8623-(1993), part 1, IEC: 60439-1-1985 "Low voltage switch gear and control gear assemblies"

[4] IS 8623-2-1993/ IEC: 60439-2-1987 "Low voltage switch gear and control gear assemblies- Busbar Trunking Systems", RA-2008

[5] Viswanatha C *et al*, "Condition assessment of Busbar insulation system subjected to hazardous fire using Dielectric technique" International conference EEPCECT-2014, held at JNU, Delhi. 2014.