HEAD ON GENERATION (HOG) : A ENERGY EFFICIENT SYSTEM IN INDIAN RAILWAY

Shailendra Saurabh Sirvaiya[1] , Alok Singh[2]

[1]Research Scholar, Dept. of Mechanical Engineering, M.A.N.I.T, Bhopal, India
[2]Assistant Professor, Dept. of Mechanical Engineering, M.A.N.I.T, Bhopal, India

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Abstract – In present time it is more important to make railway energy efficient and economically by reducing the losses and wastage of diesel fuel which is used to run the hotel load (ac plant and light of coaches) which is only possible if we used a system which can take electrical energy from over head wire and used it for hotel load this system known as HOG. HOG work on the principle that the locomotive hauling the train feeds power supply requirement of the complete train having AC/Non AC coaches through overhead electric equipment (OHE) , transformer and converter in the locomotive without the need for having individual self generating equipment in each coaches.

In this system the hotel load winding of 945 KVA of transformer feed power to two 500KVA static converter which convert single phase 750 V supply into 750 V three phase supply. The three phase supply is transmitted to both the feeder of the existing EOG train through IV coupler. Then a 60KVA transformer is used in coaches which convert this three phase 750V into three phase 415V AC and this supply is used for the hotel load of the train.There are some modification required to convert our system from EOG to HOG, such modification are as – 1. Modification in coaches. 2. Modification in power car. 3. modification in Loco.

Key word: Hotel load , HOG, EOG,OHE,Converter

1. INTRODUCTION:

Indian railway is a biggest serving authority in all over the world, so it is more important to make this system more and more efficient. In initial state of railway some technique was used for power generation to meet requirement of hotel load, which are as –

- Self-generating
- Mid-on-generation
- End-on-generation,

Now a day HOG ie Head on Generation Technique is used for power generation.

1.1 Self generation –

In self generation system a 25KW alternator is used in the under frame of the coach which is driven by V-belt mounted on the axle pulley of the bogie, this 25KW alternator generate AC voltage which is regulate and rectify by RRU unit and convert this AC supply into DC voltage which is used to charge the battery and to run the plant after converting this 110V DC into 415V AC by the inverter.

1.2 End On Generation –

In this system Each EOG train has 2 power cars with 2 x 250 KW alternator each. The power is fed by any two DA sets through IVC. The power is supplied at 3 Φ, 750 V, which is stepped down in individual coach to 3 Φ, 415V for supplying various loads like RMPU, WRA etc. The 110 v AC supply for lights and fans is obtained by further stepping down the 415 v supply. A 24 v battery is used for supplying a few emergency lights provided in the coach.

1.3 Head on generation -

In EOG system rake consist 19 to 20 coaches so minimum two power car required to maintain uninterrupted power supply, hence this is the drawback of EOG system. To overcome these drawback Indian railway has now developed Head on generation (HOG) system. This system will help to minimize the use of two power car and only one can be used for AC supply. In head on generation system power is directly taken from OHE and convert it into 715V three phase AC by transformer which is used to meet hotel load hence there is no use of power car and diesel .

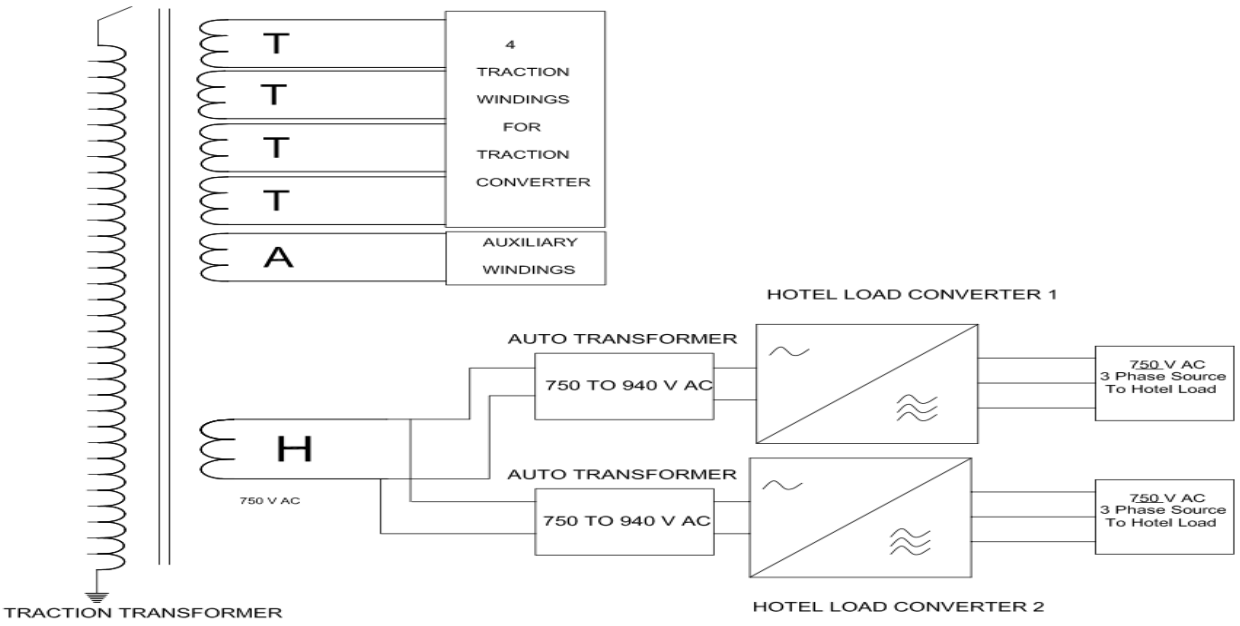

Fig 1: Transformer to convert single phase over head supply into three phase

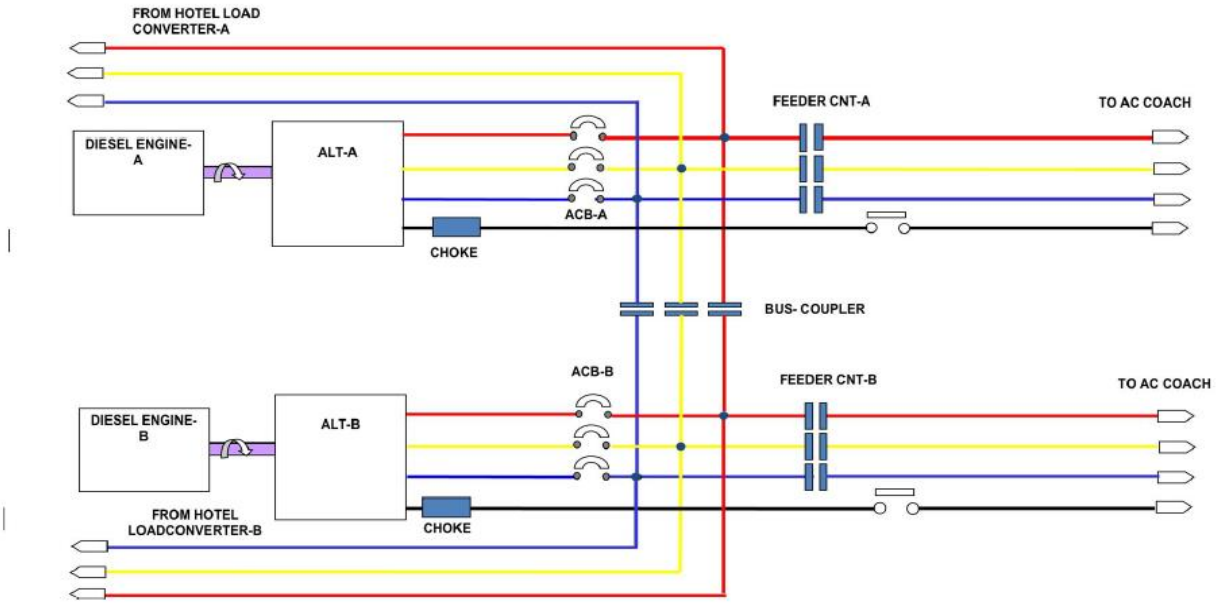

Fig 2 : Conversion of EOG system into HOG by using OHE supply

2. Service detail of Rajdhani and A K Rajdhani Express train working on HOG:

	HOG rake run as EOG										HOG working			service	Analysis	
Month	IV coupler fault	IV coupler not connected due to rain	Cattle run over	Coach non HOG	Loco converter fault	Working on EOG due to LOCO non HOG	PC non HOG	LOCO and PC non HOG	Feeder tripping	total	50-50 one converter and one DG set working	100% HOG working	Total service of HOG rake	Grass total service EOG+HOG	% efficiency of HOG	Services successfully working on HOG
Dec -15										0		5	5	124	100	4
Jan-16					1	11				12		10	22	124	45	8
Feb-16					2	16			2	20		5	25	112	20	4
mar-16					4	16	7	2	5	34		16	50	124	32	13
Apr-16				1	9	10	6			26	5	20	51	120	39	17
May-16					13	23	13	5		54	9	12	75	124	16	10
Jun-16		4			6	17	10	2		39	17	39	95	120	41	33
Jul-16				2	8	11	3			24	18	68	110	124	62	55
Aug-16			1	2	4	15				22	16	86	124	124	69	69
Sep-16	1				3	6				10	9	101	120	120	84	84
Oct-16					4	8	1	1		14	18	92	124	124	74	74
Nov-16						5	2			7	4	109	120	120	91	91
Dec-16				1	1	14				16	7	101	124	124	81	81
Jan-17					2	19				21	15	88	124	124	71	71
Feb-17					1	19				20	9	83	112	112	74	74
total	1	4	1	6	58	190	42	10	7	319	127	835	1281	1820	65	46

Table 1: Service detail of trains working on HOG

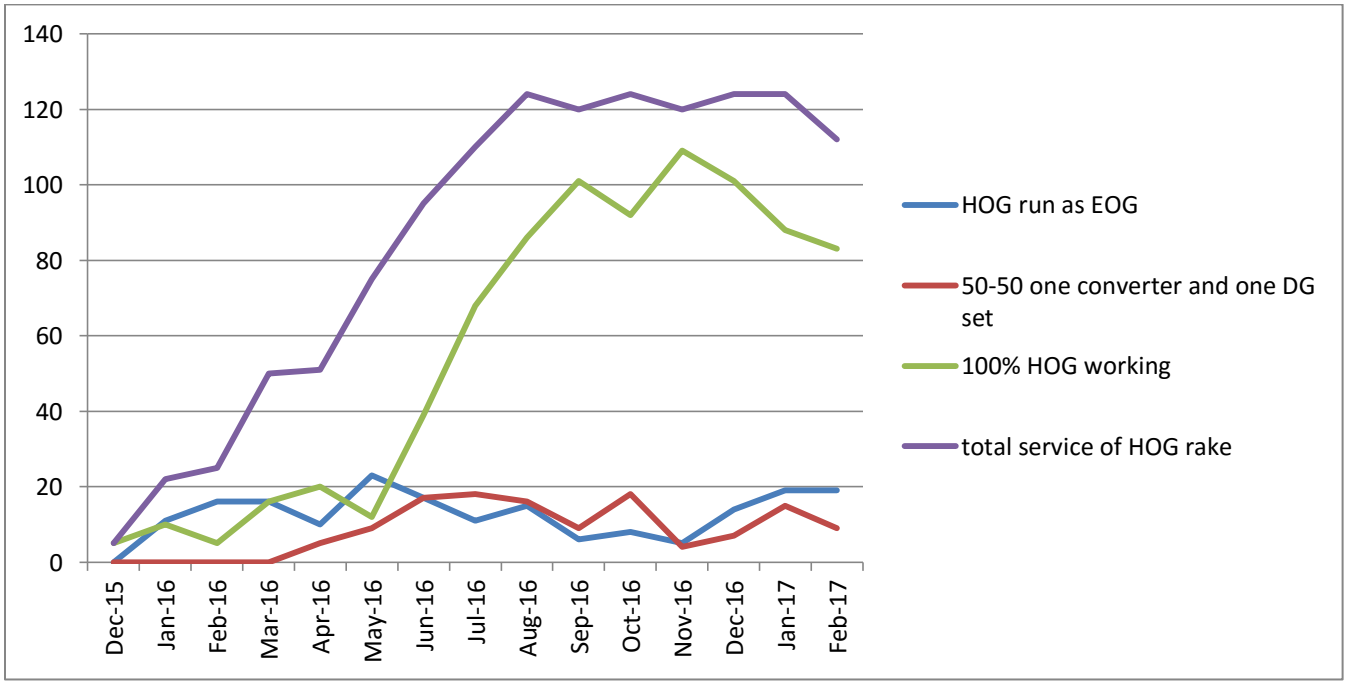

Fig 3 : Service detail of trains working on HOG

3. RESULT AND DISCUSSION :

The trials have established the efficacy of working of HOG scheme on IR. Head on Generation is a superior means of meeting electrical power requirement in coaches and is utilized in developed countries. It overcomes the limitations of the SG and EOG systems. It is very economically advantageous in operation. The saving in operation with HOG system against EOG system underlined in tables given below: HOG system – actual savings incurred during the period from 01/01/2016 to 31/12/2016

Train No	Single trip Hrs	Average no of DG set working per trip	Diesel consumption per trip @ 60 ltrs / hr per DG set	No of single trips run in HOG system in the year 2016	Qty of diesel Saved due to HOG (c X d)	Expenditure saving on diesel @ Rs. 56 per ltr. (Rs. In lakhs)	Average HL consumption in kwh per trip	Total Cost of HOG operation @ Rs. 5/- per KWH (Rs. In lakhs)	Net savings (f-h) (Rs. In lakhs)
	A	b	c	d	e	f	g	H	I
22209 / 22210 NDLS Duronto	16.75	1.50	1507.50	41.00	61807.50	34.61	2763.00	5.66	28.95
12227 / 12228 IND Duronto	11.50	1.50	1035.00	40.00	41400.00	23.18	1311.00	2.62	20.56
12239 / 12240 JP Duronto	14.80	1.50	1332.00	19.00	25308.00	14.17	2053.00	1.95	12.22
12009 / 12010 BCT ADI Shatabdi exp.	6.30	2.00	756.00	59.00	44604.00	24.98	1830.00	5.40	19.58
12951/12952 RajdhaniExp and 12953/12954 Raj / AK Raj. Exp train	16.37	2.00	1964.40	710.50	1395706.20	781.60	2865.00	101.78	679.82
Grant Total			**6594.90**	**869.50**	**1568825.70**	**878.54**		**117.41**	**761.13**

Table 2: Final result in tabular form

4. CONCLUSION

The main benefits that will accrue with the development of hotel load converter i.e. HOG system is described below:

4.1 Increase in revenue and reduction in operational cost:

Based on the analysis/calculations done above, IR will be able to earn annually minimum of Rs 761 lakh with all the rake including rajdhani exp , A K Rajdhani exp and Duranto .

4.2 Pollution free:

In EOG system, there are two types of pollutions –

(i) Air pollution due to burn of High Speed Diesel, and
(ii) Noise pollution by DA sets whereas HOG system is totally free from both types of pollutions i.e. air and noise pollutions.

4.3 Carbon Credits:

Carbon credits can be earned by not emitting the carbon dioxide through burning of high speed diesel into the environment. IR can also sell this carbon credits in international markets.

4.4 Better reliability

Due to reduced number of generating equipment, low maintenance requirement, reduced dead weight as compared to SG and EOG system

5. REFRENCE:

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2. www.railElectrica.com : Head-on-Generation (HOG). Power is supplied from the train locomotive at the head of the train. The single phase 25 kV transformer of the electric locomotive is provided with hotel load winding which is converted to three phase AC at 750 V using 2×500 kVA inverter and supplied to the same system .

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BIOGRAPHIES

Shailendra Saurabh Sirvaiya
Pursuing M. Tech. in Mechanical engineering (Maintenance Engineering and management) from Maulana Azad National Institute of Technology, Bhopal, Madhya Pradesh (India)

Dr. Alok Singh
Designation: Assistant Professor
Qualification: PhD.
Research Area: Maintenance / Thermal Engineering