MOD. SHEET
WAM4-179 10/2/94

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
RESEARCH DESIGNS AND STANDARDS ORGANISATION
Manak Nagar, Lucknow-226011

EL/3.1.3 Dated 10-02-1994

MODIFICATION SHEET NO. RDSO/WAM4-179

CONVERSION OF WAM4 LOCOMOTIVE TO DUAL BRAKE SYSTEM

1. INTRODUCTION

CLW had produced over 500 WAM4 AC Electric Locos which are being operated all over Indian Railways . These Locomotives were designed for working vacuum brake trains only. This report deals with the details of modification work required to be carried out to convert WAM4 AC Electric Locomotives to dual brake system so that the locos are capable of hauling either vacuum brake stock or air brake stock.

2. GENERAL:

Railway Board vide their letter No. 89/Elect/TRS /440/21 dated 28.9.93 desired that all WAM4 locos should be converted to dual brake /air brake system to meet immediate requirements of locos for hauling air braked trailing coaching stock.

3. APPLICATION:

This Modification shall be applicable to all WAM4 locomotives fitted with TAO659/HS1050 traction motors and nominated for mail/express trains.

4. OBJECT OF MODIFICATION:

Existing system on WAM4 Locos is a vacuum piloted system suitable for hauling only vacuum braked stock. Automatic brake valves and connected equipment directly control vacuum in vacuum train pipe.The object of this modification is to adopt IRAVB-II brake system on these locomotives.

IRAVB-II (twin pipe) brake system has been designed for hauling stock equipped with either graduated release type single pipe or twin pipe air brakes or vacuum brakes.

Important features of the system are :-

- Locomotive brakes may be applied/released with any desired pressure between the minimum and maximum and this pressure will be automatically maintained in the Locomotive brakes cylinder within maximum specified leakage from them, until released by the brake valve.

- Braking of vacuum passenger/freight stock and at the same time proportional application of brakes on Locomotive through distributor valve.

- Braking of air brake passenger/freight stock fitted with the graduated release type brake equipment and at the same time proportional application of brakes on Locomotive through distributor valve.

- Multiple unit operation with Electric Locomotive fitted with similar type of brake system.

- Application of emergency brake pipe operation of emergency brake valve provided in front of assistance driver's seat by venting brake pipe and vacuum train pipe.

- Release of Locomotive brake independent of train brake.

- Automatic power cut during emergency brake application.

- Visual indication during train operating/alarm chain pulling or guard emergency brake valve operation or Loco operating while hauling air brake stock.

5. DETAILS OF MODIFICATION TO BE DONE:

5.1 Pneumatic Equipment/Valves:

RDSO had issued Report No. MP-499/86 indicating general arrangement of Brake Schematic diagram for conversion of "EQ" brake system to Dual Brake System on WAM4 locomotives. This report is to be followed in this modification. However, the report did not cover the equipment layout, location of additional pneumatic valves /compressor etc. required for conversion to dual brake system and changes required in electrical circuit.

5.1.1 To make the system suitable for air brake train operation, it would be necessary to provide air brake pipe and brake valves for controlling pressure in the air

brake pipe. Some of the valves connected with vacuum brakes including driver's automatic brake valves would be removed. Modifications required to the system have been shown in RDSO' Drawing No.SK.DP-2622 Alt. 2. The valves and the piping which are to be retained in the Locos have been shown in dotted lines and the items which are to be deleted have been shown in hatched dotted lines. The additional equipment and the pipes required are shown in firm lines.

5.1.2 It would be necessary to provide five additional pipe lines from one end to the other i.e.2 Nos.of 32mm dia seamless pipes for brake pipe and feed pipe, 2 Nos. of 15 mm dia seamless steel pipes for independent application pipe and control air pipe for B.P.and one 10 mm O.D. copper pipe for the air flow indicator gauges provided in both the cabs. Existing vacuum brake application pipe (one inch dia) will not be essential and may be deleted.

5.1.3 The equipment layout for proposed dual brake system has been explained in RDSO's Drawing No. SKEL-4275, 4276 and Sketch placed at Annexure V.

Provision of dual brake system on WAM4 Electric Locomotive would require fitment of additional compressor in addition to one compressor already provided on these Locomotives. It may be noted that additional space required for provision of compressor would necessitate elimination of rheostatic braking resistor and its motor blower set from these Locomotives. The space occupied by rheostatic braking resistor blower motor set would be utilised for mounting additional motor compressor set.

5.1.4 Air braked coaching and freight stock are provided with brake pipe and feed pipe end connections on the right of the longitudinal center line of the vehicle. While coupling one vehicle to another, the brake pipe and feed pipe hose couplings are coupled with diagonally opposite end fittings. Hence the BP and FP end couplings to be provided on the converted locomotives, should also be located on the right of the longitudinal center line of the locomotive as existing on the coaching and freight stock, so that coupling between locomotive and trailing stock can be connected with diagonally opposite corresponding pipes. The locations for BP and FP end connections may be kept same as on WAG5 locomotives. In this connection RDSO's letter No. SD.DEV.IRAVB-2 dated 18-5-1993 may also be referred (Copy placed at Annexure IV) CLW's Drawing No. 05/1/37/38 shows the proposed arrangement.

5.1.5 The function of the additional important equipment is indicated below:

Automatic Brake Valve(Item A 38)

WABCO A - 9 automatic brake valves (A 38) have been proposed in place of existing vacuum brake valves. A-9 brake valve controls pressure in the brake pipe with the help of additional C-2 relay valves(A43) for application and release of brakes on the train.

D-1 Emergency Brake Valve (Item A 57)

In place of existing vacuum emergency brake valve, D-1 emergency brake valves (A 57) would be provided in front of the Assistant Driver's seat in both cabs for use in case of emergency. This has connections for the air brake pipe as well as vacuum brake pipe for simultaneous venting of the two pipes when brake valve is operated.

Air flow indicating Device
(Item A51 to A53 & A59)

Air flow measuring valve (A51) with R-6 relay valve (A59) and indicators (A53) have been introduced between the brake valve and the main reservoir to provide an indication to the driver regarding air flow through the brake valve to the brake pipe. It would provide indication to the driver in case of train parting/alarm chain operation.

VA-1B Control Valve (Item B30)

Since the driver would be operating automatic brake valve which controls air pressure, VA-1B control valve (B-30) has been provided for creation and destruction of vacuum in vacuum trains when air pressure in the brake pipe is increased or reduced by A-9 automatic brake valve (A38)

C-3W Distributor (Item A40)

For proportionate application of air brakes on Locos whether hauling air brake or vacuum brake trailing stock, C-3W distributor valve (A40) has been provided.

Compressor (Item A1)

For air brake train operation, it is always better to store compressed air at higher pressure. Therefore, generally compressors suitable for operation at 10 kg/cm2 are used on Locos meant for air brake train operation. In case compressors of 1500 lpm capacity each are available, they should be preferred over 1000 lpm capacity each.

Exhausters (Item B1)

High vacuum exhausters are required for the proposed system for operating vacuum braked stock.It may therefore, be desirable to replace existing exhausters by the high vacuum exhauster identical to exhausters being fitted on WAG5 Locomotive as per CLW's Specification No. CLW/ES/E4(WK)/DEV with latest amendment. M/s. BBVL, Calcutta and M/s. SLM Manik Lal, Ahmedabad had developed and supplied these exhausters.

MU-2B and F-1 Selector Valve (Item A54 & A55)

For automatic application of brakes on Locos in case of parting between Locos, when used in MU operation, these two valves have been provided. MU-2B valves (A54) has two positions namely 'Lead' and 'Trial' / 'Dead'. On leading Locos this is placed in 'Lead' position and on trailing Locos it is placed in 'Trail' position, F-1 selector valve (A55) automatically occupies lead/trail position depending upon the placement of MU-2B control valve in 'Lead ' or 'Trail' position.

Feed Valve (Item A45 and C48)

Two feed valves one set at 8 kg/cm2 (C48) and the other at 6 kg/cm2 (A45) are required. Feed valve set at 6kg/cm2 is to be used for controlling the pressure in the feed pipe whereas the feed valve set at 8kg/cm2 is used for supplying compressed air to electrical controls.

Brake pipe control governor (A50)

Brake pipe control governor (A 50) which is a pressure switch, has been provided in the air brake pipe for automatic regression of power, in case of emergency application.

5.1.6 The list of items to be deleted from existing system is given in Annexure I. Annexure II indicates the additional brake equipment required for dual brake system along with the part numbers of the various valves. Annexure III shows the list of existing equipment in which quantity per loco has been changed while converting the existing brake system to dual brake system.

5.2 ELECTRICAL EQUIPMENT, AUXILIARY POWER & CONTROL CIRCUIT:

5.2.1 Motor Compressor set shall be connected to output from Arno convertor similar to all other auxiliary machines through electromagnetic contactor.

5.2.2 Emergency braking control circuit shall be modified and an additional relay QRS shall be required to

be provided to ensure functioning of brake valve.(Ref. RDSO Drawing No. SKEL 4283 & SKEL 4278)

5.2.3 Compressor selection switch HCP may be replaced by modified HCP identical to the switch being used in WAG5 Locomotive at present. It will be possible to run either of the compressor or both compressors simultaneously depending on the requirement. Compressor control circuit is shown in RDSO's Drawing No. SKEL 4279.

5.2.4 RGCP circuit for compressor control shall be similar to the scheme issued by RDSO vide Modification Sheet No. RDSO/WAG5/4 Dated 19.2.91.

Auto drain magnetic valve energise to open shall be provided additionally to ensure release of air in the pipe line to atmosphere so that compressor does not re-start against back pressure.

5.2.5 Cable to VEF circuit shall be connected from cable No. 100 in lieu of 412 in the existing system. Eliminate cable No. 412 as shown in RDSO's Drawing No. SKEL-4282.

5.2.6 Tap changer control circuit for regression of tap changer in case of emergency brake application needs to be modified. Please refer RDSO's control circuit No.SKEL 4280.

6.0 MATERIAL REQUIRED :

As indicated in Annexure II & III

7.0 MATERIAL SURPLUS:

As indicated in Annexure I

8.0 SCHEDULE OF IMPLEMENTATION :

WAM4 locomotives in a phased manner.

9.0 AGENCY OF IMPLEMENTATION :

Electric Loco Sheds, POH Shops

NOTE: In view of the restricted capacity of Compressors and also due to absence of dynamic braking locos with this modification are not suitable for air braked freight trains.

(P K JAIN)
for Director General (Electrical)

ANNEXURE I

LIST OF ITEMS TO BE DELETED DURING CONVERSION
FROM VACUUM BRAKES TO DUAL BRAKES

S.No.	Ref.No.	Description	No. OFF
1.	A-4	3/4" Safety valve type E1 set at 8.5kg/cm2	1
2.	A-13	3/4" Relay valve type B2	1
3.	A-14b	3/4" Choke fitting choke size 4.7mm	2
4.	A-17	3/4" Double check valve	2
5.	A-22	1/2" Isolating cock with vent	1
6.	A-24	Vac./air proportional valve	1
7.	A-31	3/4" C.D.C. TEE and strainer	1
8.	A-32	1/2" Auto drain valve type FA2	1
9.	B-6	2" Release valve with bypass type VA-1	2
10.	B-7	Magnet valve energise to open	2
11.	B-8	Driver's vacuum brake valve	2
12.	B-9	4" Duplex vacuum gauge	2
13.	B-10	Vac. emergency brake valve flap type	2
14.	B-12	Vacuum release valve	1
15.	B-13	4" Single vacuum gauge	1
16.	B-14	12" x 16" vacuum chamber	1
17.	B-15	1/2" Isolating cock with vent	1
18.	B-16	2" Isolating cock without vent	1
19.	B-17	2" Release valve without bypass VA-1	1
20.	B-18	Magnet valve energise to open	1
21.	B-20	6" x 12 " Equalising reservoir with choke	1

22.	B-21	Air admission valve	1
23.	B-22	6" x 12" Timing chamber and choke	1
24.	X-2	1/2" Three-way cock	1
25.	X-3	Choke fitting	1
26.	QPV	Relay for Exhauster control ckt	1

ANNEXURE II

LIST OF ADDITIONAL ITEMS REQUIRED FOR CONVERSION OF WAM4 LOCO BRAKE SYSTEM FROM VACUUM BRAKES TO DUAL BRAKES

S.No.	Drg.No SKDP 2622 alt.2	Description	No. off/ Loco	P.C.No.
1	2	3	4	5 6
1.	A-34	1-1/4 unloader Valve	2	WSF B 70525/1
2.	A-35	Auto drain valve (Salem type)	2	CLW 0/4/65/220
3.	A-36	700 cc volume Reservoir	2	CLW 0/4/65/222
4.	A-37	3/4" safety valve set at 10.5 kg/cm2	1	WABCO 558296 or WSF IB 70279/2
5.	A-38	Automatic Brake Valve A-9	2	WABCO 564140 with 564142
6.	A-39	3/4 Isolating Cock	1	WSF IB 70376/6
7.	A-40	C-3-W Distributor with filters and control reservoir, pipe bracket and isolating cock	1	WABCO France 190397
8.	A-41	4"Duplex pressure Gauge(MR&FP)	2	WSF IB 70400
9.	A-42	Reservoir 110 cu.in.(2 l.)	1	CLW 0/3/65/236
10.	A-43	C-2 relay valve with 3/4" tapped hole in port Nos. 1 & 3 and 6 mm choke in exhaust.	1	WABCO 579991
11.	A-44	3/4" safety valve set at 11.5 kg/cm2	2	WABCO 558296 or WSF IB 70279/2

S.No.	Drg.No SKDP 2622 alt.2	Description	No. off/ Loco	P.C.No.
1	2	3	4	5	6
12.	A-45	D-24 B feed valve set at 6 kg/cm2	1	WABCO 542008-0084
13.	A-46	1-1/4"x26" Hose coupling (Brake pipe) FP-5	2	RDSO(W) SK-73547 alt.5
14.	A-47	1-1/4"self locking cock with vent	4	SIL Drg. No. 08.39.17.21 Escorts Drg.No. 3B66513 alt.5
15.	A-48	Dummy cylinder 3 l	1	CLW 0/3/65/237
16.	A-50	Relay air valve H-5	1	WABCO 528561
17.	A-51	Air flow measuring valve	1	WB&S CO C-76574/ 003
18.	A-52	Pressure switch for AFMV cut in 7.0+-0.1 kg/cm2 cut out 6.0 +/- 0.1 kg/cm2	1	CLW 0/03/65/288 Sl.No. 8
19.	A-53	Flow indicator gauge	2	WB&S CO.C-76488 /002
20.	A-54	Mu-2B valve	1	WABCO 564144
21	A-55	F-1 selector valve	1	WABCO 557995
22.	A-56	6" single pressure gauge(BP)	2	CLW 0/2/65/293
23.	A-57	D-1 Air/Vac. emergency brake valve	2	WABCO 564786
24.	A-58	Emergency application valve	1	CLW 0/3/65/197
25.	A-59	R-6 relay valve	1	WB&S CO. 279180
26.	A-60	50 cm x 110 cm main reservoir (203 l)	1	CLW 0/3/65/234

S.No.	Drg.No SKDP 2622 alt.2	Description	No. off/ Loco	P.C.No.
1	2	3	4	5	6
27.	A-61	Indication lamp for AFMV	1	--
28.	A-62	C-2 Relay valve	1	WABCO 579991
29.	B-23	Exhauster Control Switch	2	--
30.	B-24	1/32" choke and 1/64" exhaust	1	CLW 0/3/65/242
31.	B-25	Single vacuum gauge (150 mm)	2	CLW 0/3/65/283
32.	B-26	Vacuum Reservoir 50 cm x 110cm (203 l)	1	CLW 0/3/65/234
33.	B-27	Control air valve HS-4	1	WABCO 561128
34.	B-28	4" single pressure gauge	1	WSF IB 70330/2
35.	B-29	Reservoir 180 cu. in. (3 l.)	1	CLW 0/3/65/237
36.	B-30	VA-1-B Control Valve	1	WABCO 564523
37.	B-31	A-1 Differential pilot air valve	1	WABCO 564940
38.	B-32	Reservoir 435 cu. in. (7 l)	1	CLW 0/3/65/238
39.	B-33	VA-1 Release valve without bypass	1	WABCO 563510
40.	B-34	Double check valve - 24.A	1	WSF IB 70006/2
41.	B-35	2" Isolating Cock	1	WSF B 78086/1
42.	B-36	2" Filter type GD-80-E	1	CLW 0/1/65/239

S.No.	Drg.No SKDP 2622 alt.2	Description	No. off/ Loco	P.C.No.
1	2	3	4	5	6
43.	B-37	Pressure switch cut out 4.2 kg/cm2 cut in 2.8 kg/cm2 type-Danfoss	1	CLW 0/3/65/288 Sl. No.6
44.	B-39	Relay valve HB-5	1	WABCO 549930
45.	C-47	Magnet valve (Energised to open)	1	CLW 0/3/65/292
46.	C-48	D-24-B Feed Valve set at 8 kg/cm2	1	WABCO 542008/ 0114
47.	A-49	1-1/3 x 26 Hose Coupling (Feed pipe)	2	RDSO(W)WD-81027 5-01 Alt.2
48.		Seamless Pipes (32 mm dia and 15mm dia)	As Requi-red	IS:1239
49.		Copper pipe (10 mm outer dia)	"	IS:2501
50.		Cables and accessories	"	RDSO's Specification No. E-14/01 Rev.2
51.		Electromagnetic Contactor	1	CLW make
52.		Relays QRS type PC 8	1	BBC make

ANNEXURE- III

LIST OF ITEMS IN WHICH NO. OFF. PER LOCO CHANGED FOR CONVERSION OF WAM4 LOCO BRAKE SYSTEM FROM FROM VACUUM BRAKES TO DUAL BRAKES

Sl.No.	Item Ref. Drg.No. SK.DP-2622 Alt.2	Description	No. / Loco Existing	Changed
1.	A-1	Main air compressor	1	2
2.	A-2	After cooler	1	2
3.	A-3	1" C.D.C. with drain cock and reservoir	1	2
4.	A-5	1.1/4" check valve	2	4
5.	A-8	1/2"drain cock	10	16
6.	A-10	1/2" Isolating cock without vent	4	10
7.	A-15	3/4" Isolating cock with vent	4	2
8.	A-16	3/4"x30" bogie hose connection	4	2
9.	A-26	Magnet valve (energised to open)	1	2
10.	A-29	1" Isolating cock without vent	1	4
11.	A-33	4" Single pressure gauge	3	1
12.	B-4	2" check valve (flap type)	2	3

Sl.No.	Item Ref. Drg.No. SK.DP-2622 Alt.2	Description	No. / Loco	
			Existing	Changed
13.	B-19	2" Suction filters type GD-80-H	2	3
14.	C-15	3/8" Isolating cock with vent	1	2

ANNEXURE-IV

तार : 'रेल मानक' लखनऊ
Telegram : 'RAILMANAK' LUCKNOW

Telephones 60567 & 60017

भारत सरकार-रेल मंत्रालय
अनुसंधान अभिकल्प और मानक संगठन
Government of India-Ministry of Railways
RESEARCH DESIGNS & STANDARDS ORGANISATION

पत्र संख्या
Our Reference No. SD.Dev. JRAVB-2

लखनऊ-226011 दिनांक
LUCKNOW-226011 Date 18-6-1993

The General Manager(Elect.),

1. Central Railway, Bombay VT-400 001
2. Western Railway, Churchgate, Bombay-400 020.
3. Eastern Railway, Fairlie Place, Calcutta- 700 001.
4. Southern Railway, Madras-600 003.
5. South Central Railway, Secunderabad-500 371.
6. Northern Railway, Baroda House, New Delhi-110 001.

Sub: Pneumatic End Connections for Dual Brake/ Pure Air Brake Locomotives.

Ref: RB50's letters No.EL/3.2.119 dt.12-4-91 and 11/13-9-91.

On WAG5, WAP1 and WAP3 electric locomotives, the brake pipe and feed pipe pneumatic end connections are located on the left of the longitudinal centre line of the locomotive and vacuum train pipe is on the right. On the air braked coaching and freight stock the brake pipe and feed pipe end connections are on right of the longitudinal centre line of the vehicle. With this arrangement while coupling two vehicles the brake pipe and feed pipe hose couplings are connected diagonally, whereas, while coupling air braked freight/coaching stock to the locomotives BP and FP hoses are coupled on the same side. This causes kinking of hoses and difficulty during coupling. No trouble, however, is experienced when two locomotives are coupled in multiple. Further, the brake pipe end connection is located below the feed pipe end connection in all air braked stock and electric locomotives. With this arrangement, there have been cases of breakage of brake pipe angle cocks, whenever there is a cattle run over.

2. To overcome the problem it is considered necessary to standardise the arrangement on locos and trailing stocks, by relocating BP and FP end connections on the locomotive on the right of the longitudinal centre line

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similer to the arrangement on the air braked coaching and freight stock facilitating diagonal coupling.

3. Vide RDSO's letter No.EL/3.2.119 of 12-4-91, it was proposed to shift the brake pipe from left hand to right hand of centre line of locomotive (as per RDSO drawings No.SKEL-4030 for WAG5 locos and SKEL-4029 for WAP1 and WAP3 locomotives) retaining the FP end connection on the left of centre line. In addition, provision of two additional cocks one at each end in the brake pipe, to be located inside the underframe as shown in RDSO Drawing No.SKEL-4026 has been suggested to eliminate the problem of continuous air venting in case of damage to the existing brake pipe angle cock. It was understood that Bhusawal had modified few locos and S.E.Railway reported of an accident due to wrong coupling between the brake pipe and feed pipe with the locomotive modified by Bhusawal Workshop in accordance with RDSO Drawing No.SKEL-4030.

4. The problem of relocation of end connection was further studied in consultation with CLW and it has been decided to provide brake pipe and feed pipe end connections on the right of the longitudinal centre line of locomotive in accordance with CLW Drawing No.05/1/37/38. In this drawing, the brake pipe end connection has been located above the feed pipe to avoid damages to brake pipe angle cock due to cattle run over. Since the brake pipe on the coaching and freight stock is located below the feed pipe, an additional steel pipe with proper clamps has been provided to bring down the brake pipe hose coupling location below the feed pipe hose coupling, for proper coupling between the locomotive and air braked stock. CLW were to manufacture 10 locomotives incorporating the above modification and few locomotives with this change have already been turned out by them.

5. In view of the above, it is recommended that:

i) BP & FP end connection on 10 WAG5 locomotives are modified by Bhusawal in accordance with CLW's latest Drawing No.05/1/37/38 and based on the experience of the Railways necessary action could be taken to standardise the location of the end connections on electric locomotives.

ii) Modification for BP & FP end connections proposed in RDSO letter No.EL/3.2.119 dt. 12-4-91 and 11/13-8-91 along with Drg.No.SKEL-4026, 4029 & 4030 is withdrawn.

iii) Railways may send their views and experience of the modified arrangement provided on locos by CLW and on locos to be modified by Bhusawal Shops in accordance with CLW's latest Drg.No. 05/1/37/38.

(S.Sethuraman)
for Director General(Elec.)

DA:Nil

Copy to: The General Manager, Chittaranjan Locomotive Works, Burdwan Dist., West Bengal - 713 331.

It is requested that the Sl.Nos. of the locomotive provided with end connections in accordance with CLW's latest Drg.No.05/1/37/38 along with the allottee Railways be advised to this office as well as to Zonal Railways to monitor the performance of the modified locomotives.

2. Dy.Chief Elect.Engineer,Electric Locomotive Workshop,Bhusawal - 425 201 with the request to modify 10 WA35 locomotives in accordance with CLW's latest Drawing No. 05/1/37/38. He may also advise the locomotives modified to RDSO's Drgs. SKEL.4026, 4029 & 4030.

3. The General Manager(Elect.), South Eastern Rly., Garden Reach,Calcutta- 700 043. This has reference to their letter No.CEE/RS/169 dt.5-4-93 to this office and EL/ORIG/22 dt. 5-3-93 to Chief Elect.Engineer,Central Railway and Chief Works Manager,South Eastern Railway,Kharagpur. It is noted from S.E.Rly.'s letter dt. 5-3-93 that the colour code for feed pipe has been indicated as green and for brake pipe white, instead of feed pipe white and brake pipe green. It may please be ensured that the feed pipe angle cocks and brake pipe angle cocks and couplers are painted white and green respectively.

4. The Chief Works Manager,Loco Workshops:

a) Eastern Railway, Kanchrapara-743 145.
b) Northern Railway, Charbagh,Lucknow.

5. The Chief Project Manager, South Eastern Railway, Kharagpur.

6. Dy.Chief Electrical Engineer, POH Workshop, Southern Railway,Perambur,Madras.

7. Sr.Divisional Electrical Engineer(TRS), Electric Loco Shed:

- Northern Railway, Ghaziabad-201001.
- Northern Railway, Kanpur-208001.
- Eastern Railway, Mughalsarai-232 102.
- Eastern Railway, Asansol-713 310.

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- South Eastern Railway, Tatanagar - 831 002.
- South Eastern Railway, Waltair - 530 001.
- South Eastern Railway, Bondamunda (Orissa).
- South Eastern Railway, Bhilai Marshalling Yard, Bhilai-1.
- Southern Railway, Arakkonam(Tamil Nadu).
- South Central Railway, Vijayawada - 520 001.
- Central Railway, Jhansi (U.P.)
- Central Railway, Bhusawal - 425 201.

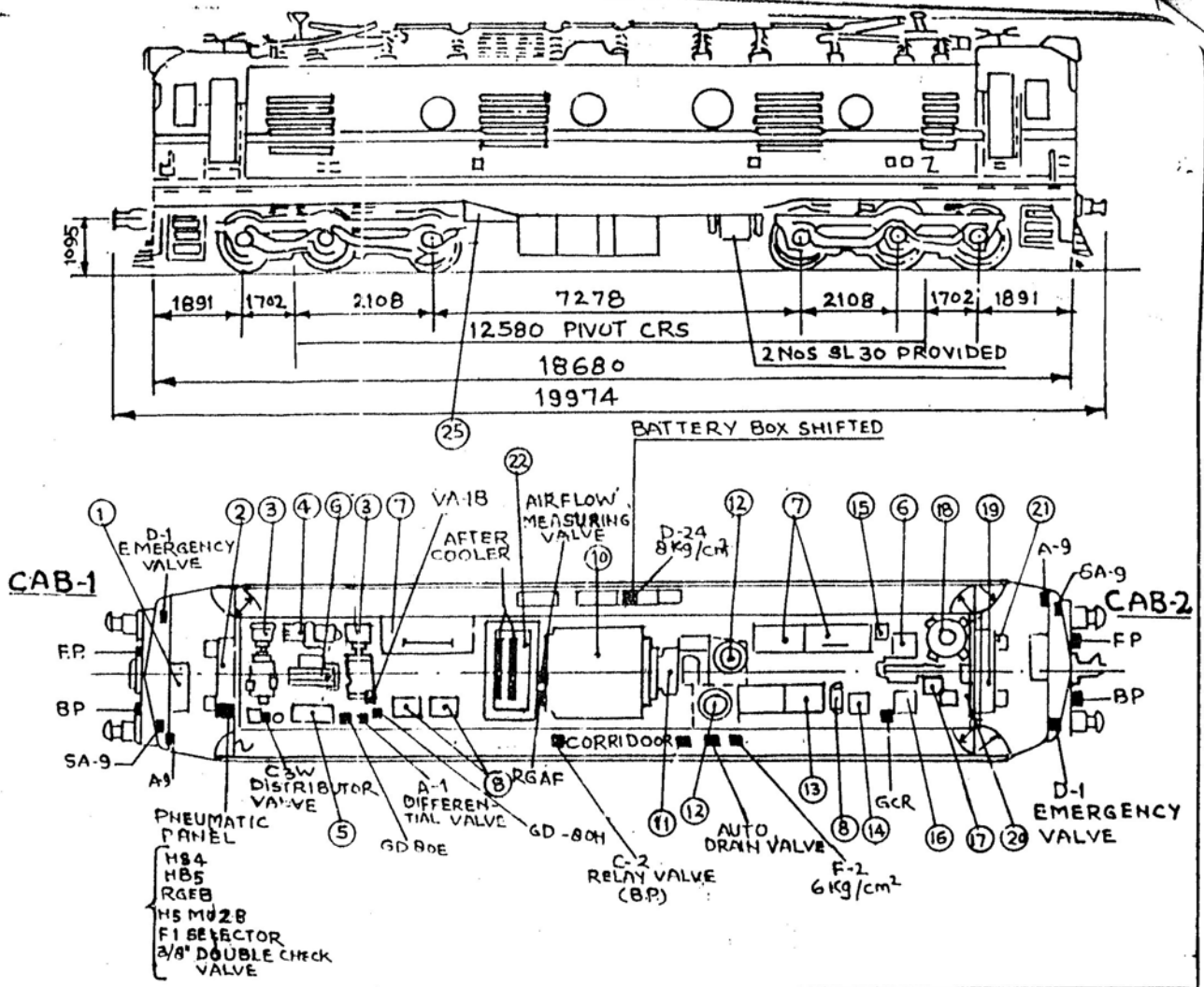
8. Sr.Divisional Electrical Engineer(TRS), Electric Loco Sheds

- Western Railway, Bulsar(Gujarat)
- Western Railway, Tuglakabad.
- Western Railway, Baroda- 390 002.

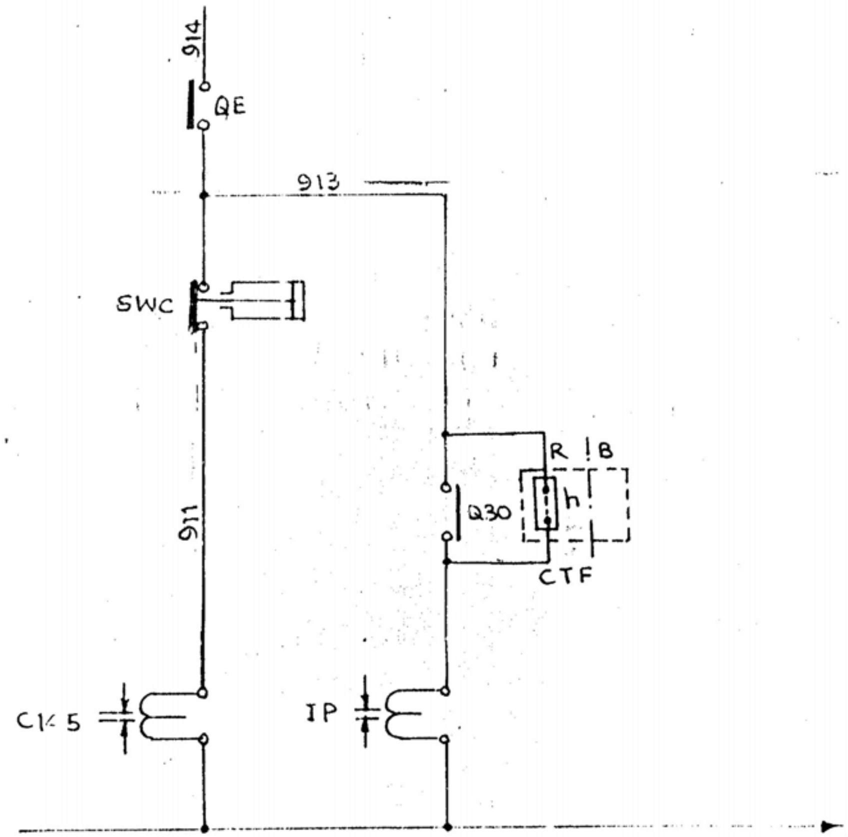
(S.Sethuraman)
for Director General/Elect.

DA:Nil.

1. DRIVER'S DESK
2. PNEUMATIC CABINET
3. EXHAUSTER
4. COMPRESSOR
5. PNEUMATIC PANEL
6. T.M. BLOWER
7. H.T. PANEL
8. INDUCTIVE SHUNT
9. BRAKE RESISTOR
10. TRANSFORMER ASSEMBLY
11. TAP CHANGER
12. MVSL
13. RECTIFIERS
14. R.C. NET WORK
15. HEAD LIGHT TRANSFORMER
16. BATTERY CHARGER
17. ARNO STARTING RESISTOR
16. BATTERY CHARGER
17. ARNO STARTING RESISTOR
18. ARNO
19. CONTROL CABNET
20. CONTROL PANEL
21. DRIVERS SEATS
22. COMPRESSOR
23. DISTRIBUTION VALVE
24. FILTER
25. AFTER COLLER

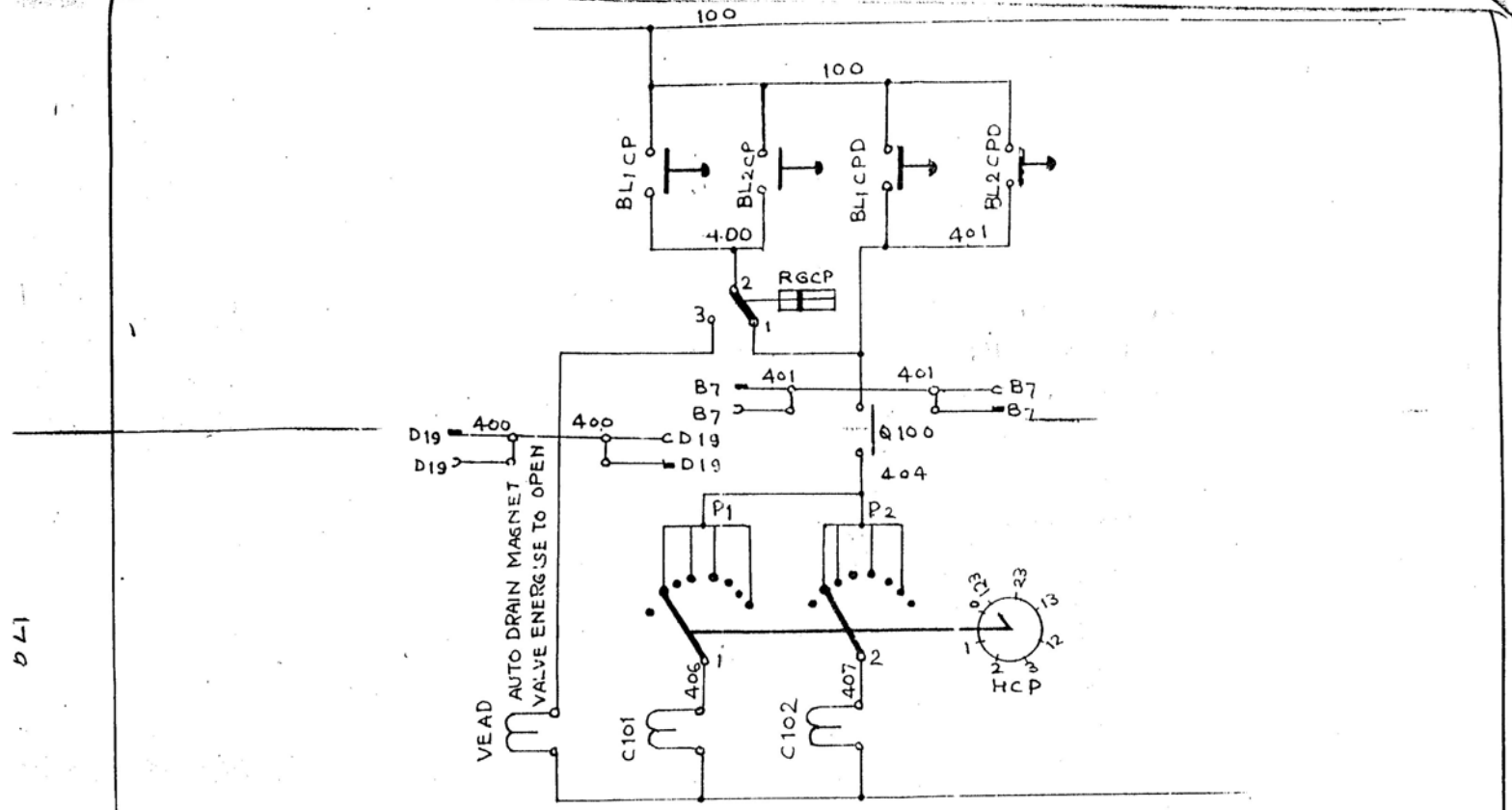


PNEUMATIC VALVES LAYOUT FOR WAM4 LOCO FOR DUAL/AIR BRAKE SYSTEM



REF:- WAM4 LOCO	SCALE- NTS	APPROVED BY प्रति FOR DG
EMERGENCY BRAKING CONTROL CIRCUIT FOR DUAL/ AIR BRAKE SYSTEM		
RDSO. ELEC. DTE.	SKEL-4278	

14.2.94

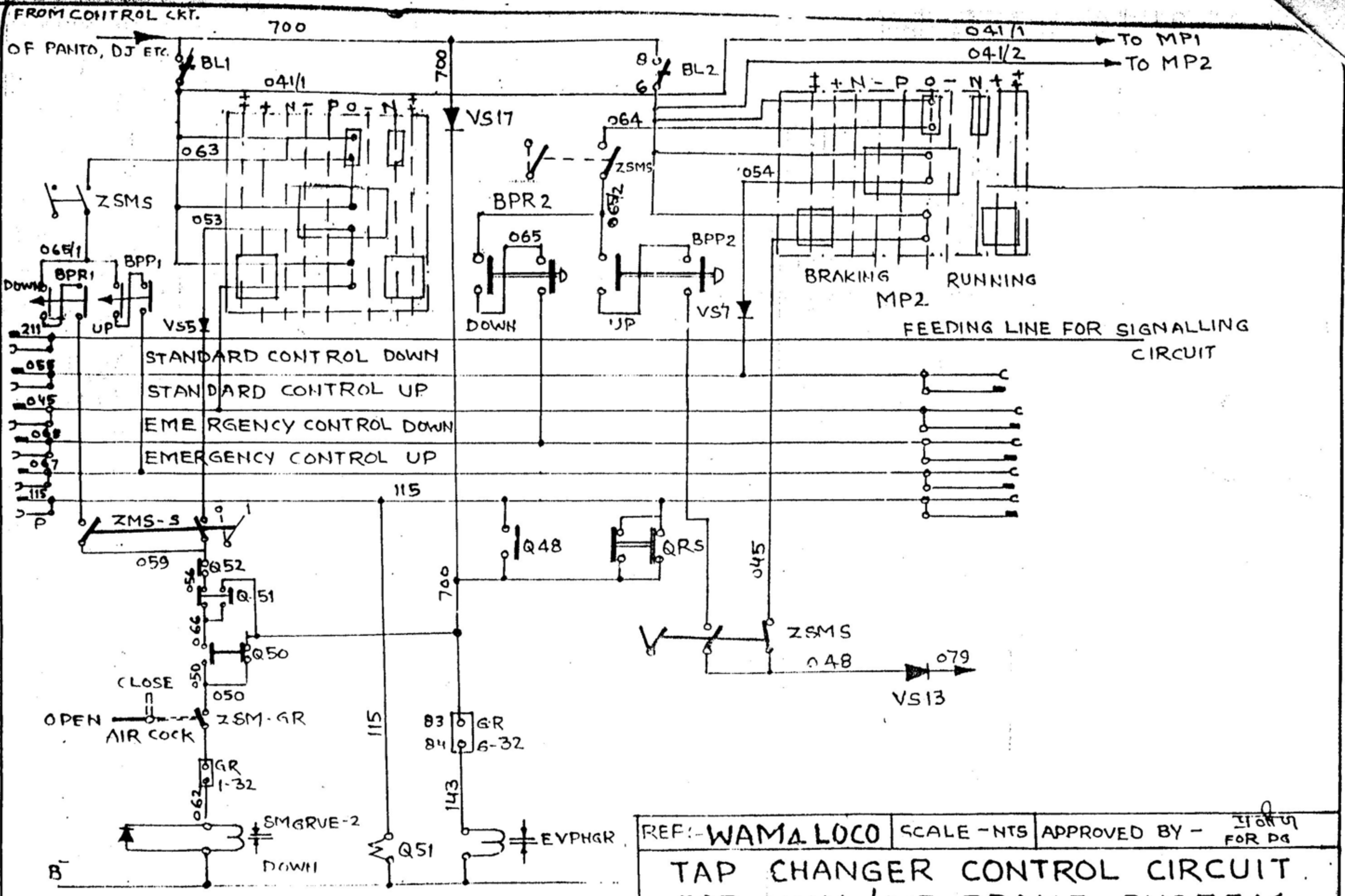


REF:-WAM4 1.0C0	SCALE- NTS	APPROVED BY

COMRESSOR CONTROL CIRCUIT FOR DUAL BRAKE SYSTEM

RDSO. ELEC. DTE.	SKEL- 4279

9.2.94
Kelkar
SR



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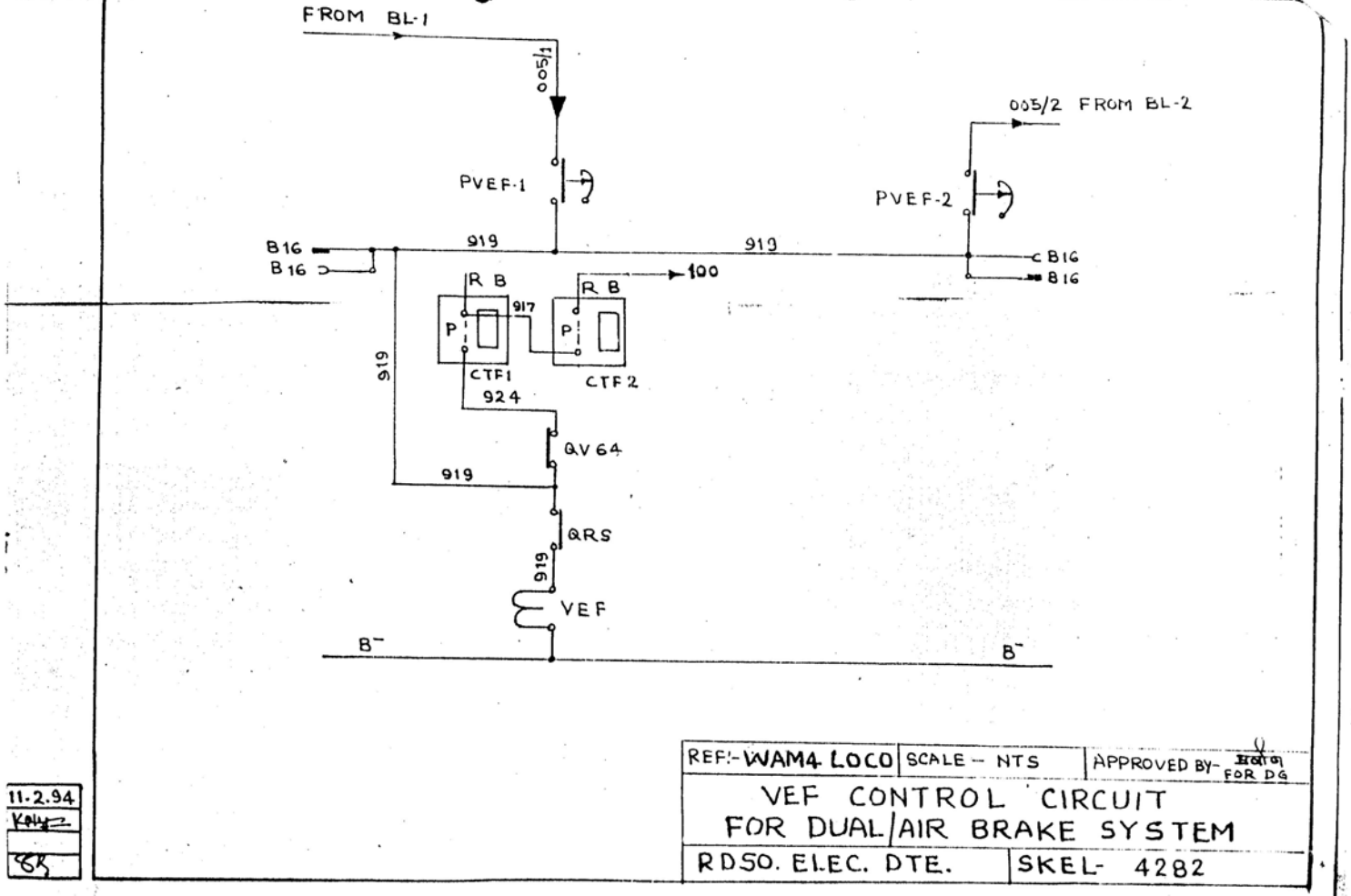
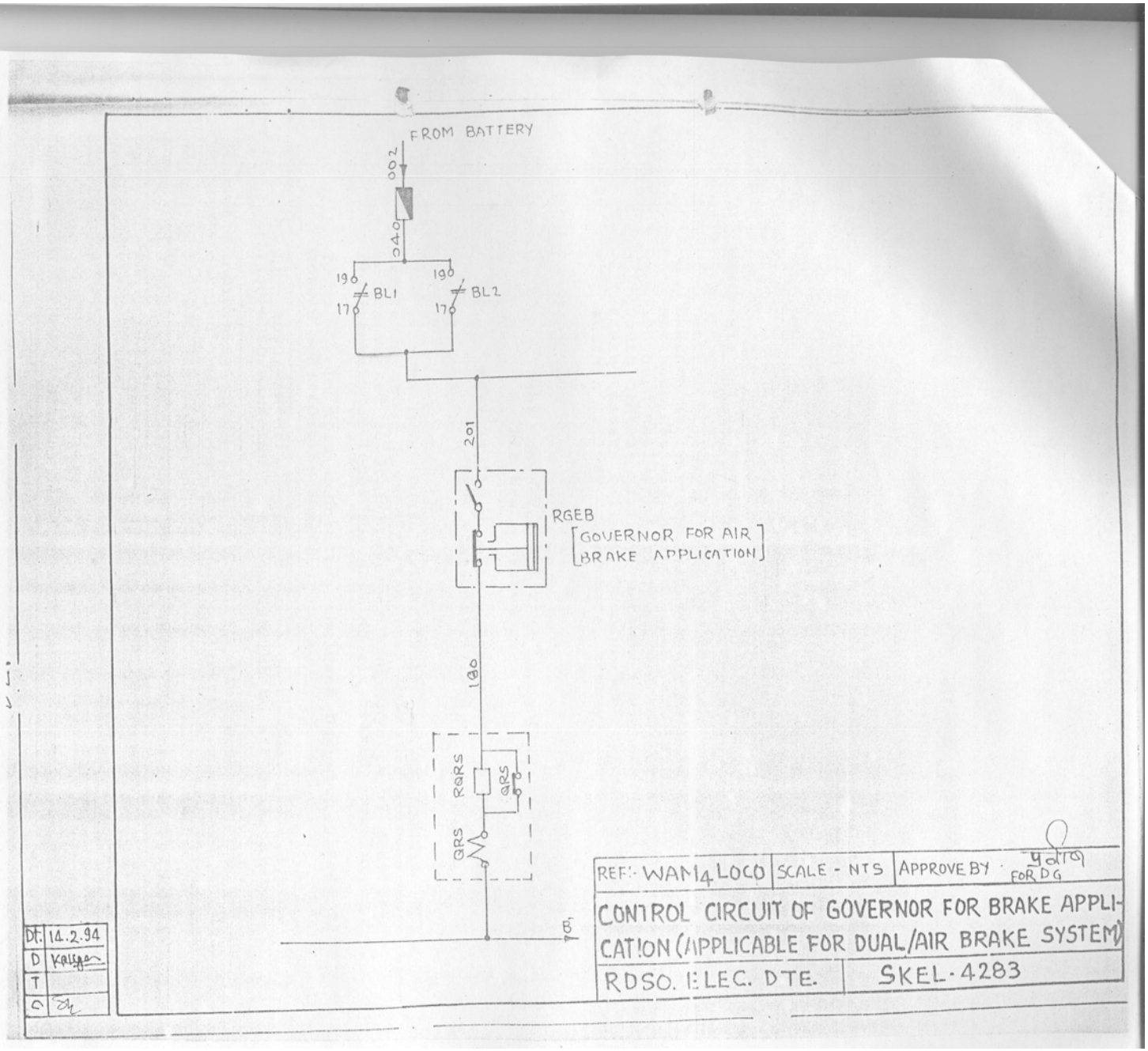
TAP CHANGER CONTROL CIRCUIT FOR DUAL/AIR BRAKE SYSTEM.		
RDSO. ELEC. DTE.	SKEL - 4280	

Dt.	10.2.94
D	[illegible]
T	
C	[illegible]



REF:- WAM4 LOCO	SCALE – NTS	APPROVED BY- FOR DG
VEF CONTROL CIRCUIT FOR DUAL AIR BRAKE SYSTEM		
RDSO. ELEC. DTE.	SKEL- 4282	

11.2.94
KNH
SK



Dt.	14.2.94
D	Kalyan
T	
C	

REF:- WAM4 LOCO | SCALE - NTS | APPROVE BY पवार FOR DG

CONTROL CIRCUIT OF GOVERNOR FOR BRAKE APPLICATION (APPLICABLE FOR DUAL/AIR BRAKE SYSTEM)

RDSO. ELEC. DTE. | SKEL-4283