



GOVERNMENT OF INDIA
MINISTRY OF TOURISM AND CIVIL AVIATION
(COMMISSION OF RAILWAY SAFETY)

**RAILWAY ACCIDENT INVESTIGATION REPORT
ON
DERAILMENT**

of

322 Down Nagpur—Tatanagar Passenger Train at Km. 325/28 between Sonua and Lotapahar stations on the Rourkela—Chakradharpur Double Line Electrified Broad Gauge Section of Chakradharpur Division of South Eastern Railway at 11:36 hours

on

27th November, 1981

SUMMARY

Date	27-11-1981
Time	11.36 hours.
Railway	South Eastern.
Gauge	B. G. (1676 mm.)
Location	Km. 325/28 on the Down line between Sonua and Lotapahar stations on Chakradharpur Division of South Eastern Railway.
Nature of Accident	Derailment
Train involved	322 Down Nagpur-Tatanagar Passenger.
Speed	70 Km/h.
System of Operation.	Absolute Block System.
Number of track	Double
Alignment	Straight.
Gradient	Falling 1 in 125.
Weather	Bright and sunny.
Visibility	Clear.
Cost of damage	Rs. 7,20,000/-
Casualty	Killed Nil Grievous injury 1 Simple injury 19
Relief arrangements and Medical attention	Prompt and efficient.
Cause	Most likely due to distortion of short welded Rail Track which had been fully opened out for through packing compounded by presence of jammed joints in rear of the point of drop.
Persons held responsible	The following staff were blameworthy : 1. Shri Subhas s/o Aparajit, Permanent Gangman. 2. Shri L. Dutta, Permanent Way Inspector/ Grade III, Chakradharpur. 3. Shri H. C. Sen, Permanent Way Inspector/ Chakradharpur.
Important recommendations	1. Caution to be observed while opening consecutive sleepers of short welded panels for track maintenance even when rail temperature does not exceed $T_s + 25^\circ\text{C}$, particularly in certain unfavourable circumstances. 2. Some of the provisions of SWP manual to be modified in the light of this accident.

(i)

(ii)

3. Temporary casual labour gangs not to be deployed on maintenance of track except when assisting permanent gangs.
4. Railway Boards final orders on the maximum number of jammed joints that can be allowed for SWP may be expedited.
5. Railway to take concerted action to overcome the problem of creep and of missing fittings.

Inspection and Inquiry.

Date of Inquiry.	Place of Inquiry.
1st to 3rd December 1981	Chakradharpur.
Press Notification	Issued.
Civil and Police Officials	Notified.

Railway Officials

1. Shri M. K. Gangopadhyay, CTSS, Garden Reach.
2. Shri N. Venkatesan, CEE (Loco), Garden Reach.
3. Shri K. S. Swaminathan, CBE, Garden Reach.
4. Shri I. S. Sandhu, DRM, Chakradharpur.

Non-Railway Officials

- | | | |
|--|---|----------------------------------|
| 1. Shri V. N. Mishra, District Commissioner, Chaibasa. | } | Called on me on 3-12-1981 |
| 2. Shri R. P. Verma, Superintendent of Police, Chaibasa. | | |

Witnesses

Number of non-railway witnesses examined	6
Number of railway witnesses examined	41
Total number of witnesses examined	47

Note : In this report, the terms 'right.', 'left', 'leading', 'trailing', 'front and 'rear' where used, are in reference to the direction of movement of 322 Down Nagpur-Tatanagar Passenger Train.

Abbreviations used in this report

CTSS	Chief Traffic Safety Superintendent.
CEE (Loco)	Chief Electrical Engineer (Loco) .
CBE	Chief Bridge Engineer.
DRM	Divisional Railway Manager.
ATFO	Assistant Traction Foreman.
ARME	Accident Relief Medical Equipment.
POH	Periodical Overhaul.
IB	Two Monthly Inspection
NGP	Nagpur
OHE	Over-head Equipment.
DTM	Directed Track Maintenance.

GOVERNMENT OF INDIA,
MINISTRY OF CIVIL AVIATION
(COMMISSION OF RAILWAY SAFETY).

From : S. Subramanian,

Commissioner of Railway Safety, South Eastern Circle,
14, Strand Road (12th floor), Calcutta-700 001.

To : The Secretary to the Government of India,
Ministry of Tourism & Civil Aviation,
Sardar Patel Bhavan, Parliament Street, New Delhi.

Through : The Chief Commissioner of Railway Safety,
16-A, Ashok Marg, Lucknow-226 001.

Sir,

I have the honour to report, in accordance with Rule 4 of the Statutory Investigation into the Railway Accidents Rules 1973, the result of my inquiry into the derailment of 322 Down Nagpur-Tatanagar Passenger Train at Km. 325/28 between Sonua and Lotapahar stations on the Rourkela-Chakradharpur Double Line Electrified Broad Gauge section of Chakradharpur Division of South Eastern Railway at 11.36 hours on 27-11-1981.

2. The Accident

(a) At 11.36 hours on 27-11-1981, 322 Down Nagpur-Tatanagar Passenger train became derailed on the straight track between Sonua and Lotapahar stations of Rourkela-Chakradharpur double line Electrified Broad Gauge section of Chakradharpur Division of South Eastern Railway. As a result of the derailment, Locomotive No. 21212 WAM-4 came to rest at Km. 325/20 with all wheels on rails. The 4-wheeler covered wagon No. 67367-WR next to loco was attached to the locomotive but derailed of all wheels. There was train parting between the first wagon and remaining wagons and the coaches. The 2nd to 6th, 4-wheeler wagons all derailed, capsized and fell down the slope of the embankment in a tangled heap. The 7th vehicle, a passenger bogie No. 2047-SE (IRS Coach) as well as the coach behind also derailed capsized and fell down the embankment coming to rest more or less on their sides. The 3rd passenger coach SE-443 (FC) derailed and came to rest against OHE Mast No. 325/26. The next passenger coach 2564-ER also became derailed of all wheels. The next 2nd Class coach 5284-SE became derailed by both the wheels of the front trolley. The remaining passenger coaches and two 4-wheelers, all remained on the rails.

(b) The speed at the time of derailment could have been 60 to 70 Km/h.

(c) Visibility

The weather at the time of derailment was bright and sunny and the visibility clear.

3. Casualties

As a result of the accident 28 passengers sustained injuries of whom one was grievously hurt and 19 sustained simple injuries, 8 others sustained trivial injuries. I visited the Divisional Railway Hospital on 28-11-81 and met 5 of the injured passengers who were not yet discharged and satisfied myself that they were receiving due care and attention.

The carrying capacity of the train was 464 and it was estimated that the train was carrying 500 passengers.

4. Inspection and Inquiry

(a) I was informed about the accident telephonically on the afternoon of 27-11-81. I reached the site of accident at 9.00 hours on the morning of 28-11-81, while the clearance of derailed coaches of the train was in progress the track had been kept in more or less the same state as it was immediately after the derailment. Accompanied by the Chief Bridge Engineer, Chief Traffic Safety Superintendent, Chief Mechanical Engineer, Chief Rolling Stock Engineer of South Eastern Railway as also the Divisional Railway Manager of Chakradharpur Division I inspected then and later.

- (i) the site of the accident which was slightly ahead of Km. 325/28;
- (ii) the capsized and heavily damaged wagons which were 2nd to 6th from the locomotive and were lying in a heap on the slope of embankment;
- (iii) the next 5 passenger coaches, the first 2 of which had capsized and the remaining 3 derailed;
- (iv) the locomotive and the 1st wagon which had not capsized.

(b) The inquiry was held at Chakradharpur from 1st to 3rd December 1981. The holding of the inquiry of these days was adequately publicised by inserting advertisements in the local and national newspapers. Civil and Police authorities were also duly notified. Shri V. N. Mishra, District Commissioner, Chaibasa and Shri R. P. Verma, Superintendent of Police, Chaibasa called on me on 3rd December 1981 while the inquiry was in progress. The evidence of 47 witnesses was recorded, 6 of them being public witnesses.

II. RELIEF MEASURES

5(a) Information about the accident was communicated to the Control office at 11.42 hours, within 7 minutes of the occurrence. This was possible as the Lower Wagon of the Electrical Department was approaching the site of accident on the adjacent track from Chakradharpur at about the time of the accident and ATFO arranged to inform all concerned from the emergency telephone connection at site. He also arranged to shift six seriously injured passengers by Lower Wagon to Lotapahar station, where they were transferred to the ARME Van which had arrived at the station meanwhile. The ARME Van went to the site of accident at 12.40 hours and left the site at 13.25 hours with the remaining injured passengers, arriving at Chakradharpur at 14.00 hours. The Station Master, Lotapahar had managed to obtain the services of a local Homeopathic Doctor who also helped with medical attention. The patients were all admitted to the Hospital before 14.13 hours on 27-11-81.

(b) The uninjured passengers were shifted from the site of accident by 144 Down Puri Express to Lotapahar and Chakradharpur stations and their onward destinations.

6. Restoration

(a) The clearance operation commenced at 19.35 hours on 27-11-81. The clearance of wreckage continued till the next afternoon and the track was restored for traffic by 19.00 hours on 28-11-81 with a speed restriction of stop dead and proceed at 8 Km/h.

(b) Interruption to traffic

As a result of the accident 3 trains were cancelled and 3 trains were short terminated on the day of the accident. On the following day 2 trains were cancelled and 3 trains short terminated.

III. THE TRAIN

7. Locomotive

The ill-fated Passenger train was hauled by WAM-4 locomotive No. 21212 belonging to Bhilai shed. The length of the locomotive was 18.5 m. and its weight 112.8 tonnes. The locomotive was manufactured at Chittaranjan Locomotive Workshop, Chittaranjan in 1980 and commissioned on 30th April 1980. The brake power of the locomotive was 66 tonnes and it was provided with air brakes for the loco and vacuum brakes for the train. The loco is not yet due for POH. The last trip inspection was done at Bhilai on 19-11-81 and schedule trip IB on 23-11-81. VEF i.e. the proportionate arrangement between vacuum brakes and air brakes was in service.

8. Coaches

The trailing load consisted of 15 coaches. The length of the train was 223 metres and its weight 514 tonnes and brake force 210 tonnes (all excluding the locomotive). While the bogie coaches had two vacuum brake cylinders each, the 4-wheelers had one cylinder each. The brake power of the train being 90%. The marshalling order of the train is indicated as Annexure I.

Damages

9(a) *Locomotive No. 21212 WAM-4*—There was no damage to the locomotive except to the pantograph which was damaged.

(b) *Coaches*

Damages to the coaches were as follows :—

Position of coach from the locomotive	Wagon/Coach No.	Damage and disposition
1st	WR 67367 C	Derailed of all wheels with no damage to the wagon or the coupling.
2nd	ER 89061 C	Derailed, capsized and resting on its side. Front screw coupling broken and body of the wagon damaged and axle guards bent.
3rd	CR 54314 C	Capsized and resting on its roof, Heavy body damages, with both ends deformed. Both the wheels had come out and the axle boxes had got detached and fallen out. The interior of the axle boxes was intact with brasses in place and packings found soaked in oil.
4th	ER 1965 C	Wagon capsized and partly resting on the ground and partly on wagon No. CR 54314. The wheels were in position and the screw coupling intact. End panels and body panels badly damaged.
5th	ER 1606 C	Wagon capsized and resting on its wheels embedded in the ground away from the embankment. The brake shaft assembly damaged. End panels heavily damaged, side panels depressed inwards. Both screw couplings intact.
6th	ER 81805 C	Wagon capsized and resting on its side. Wheels got detached. Leading screw coupling deficient and rear end screw couplings intact. The end panels of the wagon were heavily damaged and punctured.
7th	SE 2047 GSY	Coach capsized and came to rest partly on the ground and partly on wagon ER 81805. Both screw couplings intact and no damage to the under-gear was noticed. End panel of NGP end badly damaged.
8th	SE 1999 GS	Coach derailed and capsized partly resting on its side. Both ends of the coach interlocked with adjacent coaches. Some damage occurred to the leading trolley causing dislodging of dash pots.

Position of coach from the locomotive	Wagon/Coach No.	Damage and disposition
9th	SE 443 WFC	Derailed of all its wheels. Leading trolley leading axle bent and out of gauge by 30 mm. Bolster spring and axle springs displaced from trolley. Two dash pots of leading trolley were dry.
10th	ER 2564 WGS	Derailed of all wheels, no damage to the coach.
11th	SE 5234 WJS	Leading trolley derailed of all wheels. Rear trolley all on rail. No damages were found.

The remaining two bogie vehicles and two 4-wheelers remained on rails with no damages.

(c) The track came in for severe punishment over a length of about 120 m. (3 panels) with the rails being badly bent and twisted and broken. About 42 wooden sleepers were completely destroyed and another 40 steel trough sleepers badly damaged.

(d) One OHE mast was bent and some damage occurred to the insulators and catenary.

(e) The total cost of damages to the railway assets was as under :—

(i) Rolling stock	Rs.	6,00,000/-
(ii) Permanent Way	Rs.	1,10,000/-
(iii) O.E.E.	Rs.	7,000/-
(iv) Locomotive	Rs.	3,000/-
Total	Rs.	7,20,000/-

IV. LOCAL CONDITIONS

10. The Section and the Site

(a) The accident occurred on the straight about 35 metres ahead of OHE Mast No. 325/28. The track in this portion runs in a North East direction and lies on a bank of 3 to 4 metres height. The terrain is plain with cultivated lands on either side. The alignment is on a falling gradient of 1 in 125 preceded and followed by a level stretch. The locomotive as well as the 1st coach came to rest on the gradient of 1 in 125 just short of the level stretch.

(b) The permanent way consists of 52 Kg. Flat Footed 3 rail-welded panels (3×12.8 metres), on steel trough sleepers to density of M+7 with wooden sleepers at joints and anti-creep bearing plates. The cushion of stone ballast consisted of 100 mm of clean ballast and 100 to 150 mm caked up ballast.

(c) The Kilometrage of stations referred to in this report are reckoned from Howrah is as under :—

Howrah	00.00 Kms.
Chakradharpur	311.852 Kms.
Lotapahar	321.259 Kms.
Site of Accident	325/28 Kms.
Sonua	332.709 Kms.
Goilkera	372.902 kms.
Rourkela	412.864 Kms.

There are on an average 15 masts per kilometre and these are numbered serially for the Up and Down tracks with even number masts referring to Down track and odd number masts referring to Up track.

11. System of Train working, Headquarters and Train Speed

(a) The section from Rourkela to Chakradharpur is a controlled section and the Train Control Office is located at Chakradharpur which is also the Divisional Headquarters. The Assistant Engineer, the Permanent Way Inspector Grade I of the section, Permanent Way Inspector Grade III under him are all headquartered at Chakradharpur.

(b) The trains are worked on the Absolute Block System with double line Lock and Block SGE type Instruments. The stations are equipped with Multiple Aspect Colourlight signals.

(c) The maximum permissible speed on the section is 110 Km/h for two specified Mail/Express trains and 100 Km/h for all other trains. The booked speed of 322 Down Passenger is shown as 72 Km/h in the Working Time Table (which appears to be erroneous and it is actually 68 Km/h). There was a temporary speed restriction of 50 Km/h due to scanty ballast from Km. 324/28 to 323|28 which is about a kilometre ahead of the accident spot.

V. SUMMARY OF EVIDENCE

12(a) *Sri S. R. Bal* (Witness No. 1), Guard 'A' at Chakradharpur worked 322 Down from Jharsuguda to Chakradharpur on 27-11-1981. At about 11.35 hours, when the train was on the run between Sonua and Lotapahar, he experienced a severe jerk and fell down inside the brakevan. On coming out, he found that a serious derailment of the train had occurred and arranged to rescue all the injured passengers from the capsized and derailed passenger coaches of 322 Down with the help of the public and some staff of the traction department. He then conveyed information about the accident to the control through the portable telephone and requested immediate despatch of the Ambulance and the break down train. He rendered first-aid to the injured passengers making use of his first-aid box. He instructed his second Guard to protect the Down line in the rear of the passenger train. By this time the Ambulance Van with doctors and other railway officers arrived at the site of accident.

(b) Answering questions Sri Bal stated that the train was travelling at a speed of about 60 Km/h at the time of accident. After the accident the brakevan had come to a halt about 10 yards ahead of Kilometer 325/28 out remained on rails. Some gang tools were lying here and there but he could not make out the Permanent Way gangmen from among the villagers who had collected at the accident spot. He saw some loose keys of steel sleepers lying but did not see any fishplates near the track. He also saw one journal box lying near the spot where all the 4-wheelers had capsized. He had with him all the safety equipments prescribed except for the fire extinguishers and sprays which were not supplied. He did not come across any complaints of looting of the belongings of passengers after the accident.

13(a) *T. D. Kaibarta* (Witness No. 2) Guard 'C' Chakradharpur was working as the second Guard of 322 Down on 27-11-1981. He generally corroborated the evidence of Sri S. R. Bal.

(b) Answering questions, Sri Kaibarta stated that it was about 12 noon when he completed protection of the Down line in rear of the ill-fated train. The train was travelling at about 50 to 60 Km/h when it met with the accident. He also did not see any gangman working on the track when the train passed by just before the derailment. After he felt the severe jerk, the train came to stop almost immediately thereafter. On getting down he observed that the ballast had been opened out for the gang's work. He also saw one axle box lying between the Up and the Down track where the capsized wagons were lying heaped up. He did not notice any other part of the under gear of the wagons or coaches lying near the track. Asked whether he received any complaints of looting, he replied that he did hear one woman passenger saying that someone had stolen her belongings containing some cash.

14(a) *Sri Prabhu Sahay*, (Witness No. 3) Driver Grade 'A' Spl. Chakradharpur—was working 322 Down passenger on 27-11-1981 from Jharsuguda to Chakradharpur, duly observing the various speed restrictions as per the caution order. At Rourkela he was given a fresh caution order according to which he had to obey engineering signals from Km. 330/26 to 329|14. Accordingly, while approaching this spot, he reduced the speed to about 40 Km/h but found no engineering staff present. He continued at the same speed on the down gradient and the curve ahead. Soon after he came out of the curve, he saw a man without any hand signal flag waving his hands to signal him to go slowly. He saw another man a little ahead, also signalling by hand that he should go slowly. Soon after he passed the 2nd man showing the hand signal, his asstt. driver should that there was buckling of track ahead. While he was trying to control his speed further, he reached the spot of buckling and experienced a heavy lurch in the loco. Immediately he and the asstt. driver applied full emergency brakes. At that very moment, the

loco tripped and the train came to stop at Km. 325/20. Looking back he found that the panto had dropped, and the first wagon behind the loco was derailed. He sent his asstt. driver to protect up-line. A Tower wagon was approaching on the adjacent track just then, which he stopped. The ATFO and the asstt. driver went to the nearby level crossing gate to advise the control about the accident to the train. He applied the hand brakes of the loco, and went back to the accident spot and helped evacuate the passengers from the capsized coaches.

(b) Answering questions, Driver Sahay added that he did not himself notice the track buckling at first. However after the asstt. driver shouted about the buckling of track, he also felt that there was something like buckling in the track. Simultaneously with his making the emergency application of brakes he felt a severe jerk. The asstt. driver also applied the emergency brake at that moment. The train travelling further for 1 IP or so, the loco tripped and the train came to a halt immediately thereafter. On looking back he found that the Panto of the loco was damaged, the first 4-wheeler behind the loco had derailed and the other wagons as well as some bogie coaches had parted and capsized, coming to rest in a tangled heap on the slope of the embankment.

(c) Answering questions on the existence of any instructions regulating the application of emergency brakes, he replied that he was not aware of any such instructions but knew that in times of danger he had to apply the emergency brakes. He was aware that application of emergency brakes when the train was negotiating sags with a portion of the train on the up gradient and a portion on the down gradient in rear might result in jumping of wagons. However he felt such a severe jerk that he was afraid that the loco would derail and he had no alternative but to apply the emergency brakes. He did not observe any part of the undergear of the coaches lying on the track as he walked back from the loco to the accident spot. After leaving Sonua he had picked up a speed of 65 Km/h to 70 Km/h upto Km. 330.

(d) The witness was recalled on 3-12-1981 for further examination and stated that except for the damage to the pantograph, the undergear and the wheels of his loco were upwarded and undamaged. The coupling between the loco and the first wagon was intact and quite tight. He felt the first jerk only after his asstt. shouted about the zig zag track and the loco had passed the culvert (i.e. the rack was seen to be distorted at the Chakradharpur and of the culvert). He made only partial application of brakes on seeing the hand signals of the gangmen and applied the emergency brakes only when he felt the severe lurch as if the loco was going down (which was after passing the culvert).

15(a) *Sri T. Krishna*, (Witness No. 4) Asstt. Driver (Electric), Chakradharpur was working as asstt. to Sri Sahay. The train left Sonua at 11.27 hrs. and was running at a speed of about 40 Km/h. While approaching Km. 326/4-3 some gangmen exhibited hand signals to slow down the train. Accordingly he asked the driver to slow down and the driver controlled his train suitably. Just then he noticed that the track in front was in a slightly zig zag condition. He applied the emergency brakes, and simultaneously the driver also made an emergency application. They felt a jerk in the loco and the loco tripped and train stopped at Km. 325/20. On looking back he found that the train had parted, with some vehicles in the rear derailed and capsized. The Pantograph of the locomotive was damaged. At that time a tower wagon was coming on the up line and he ran forward to stop the tower wagon. The chargeman of the tower wagon had already stopped the tower wagon and using his emergency control phone advised the control office about the accident. While the train approached the accident spot, no banner flags or red hand signals were exhibited by the gangman. After suitably protecting the track, he rendered assistance in rescuing the injured passengers from the capsized coaches.

(b) Answering questions, the witness stated that he first noticed the hand signals being shown by the gangman when the locomotive was at Km. 326/4. The men were approximately 4 masts ahead. There must have been about 3 to 4 men standing on the cess side of track. He did not see any tools of the gang. On his telling the driver, the latter started controlling his train by making a partial application of the brakes. He first saw that there was something wrong with the track after passing 2 masts Km. 326/4 i.e. at 325/28 and shouted to the driver "Master Dekhiye track tera tera dikhta hai. Aap jaldi control keejiye" ("Master the track appears kinky. You better control the train immediately"). By that time the train had almost reached the spot where the track was distorted and he felt a severe jerk. Both of them simultaneously applied the emergency brakes. Even after the application of the emergency brakes they continued to feel severe lurches and felt as if the engine might have derailed. The loco stopped after passing about 1 or 2 masts. The tripping had taken place perhaps immediately after the application of the emergency brakes. When asked whether anyone else was travelling in the cab other than him and the driver, the witness replied in the negative.

(c) The witness was recalled on 3-12-1981 and asked to recollect whether he or the driver applied the emergency brake first on seeing the zig zag track. He clarified that as soon as he shouted that the track was distorted, he was thrown back. At that time the driver had taken handle fully to zero. He himself then got up and applied the emergency brake. Asked whether he could definitely say whether the jerk was felt before or after the driver made the emergency application, the witness clarified that he felt a slight jerk as soon as he shouted about the distorted track. The driver then made a sharp application of the brakes, after which they felt a severe jerk.

16(a) *Sri O. K. Popley* (Witness No. 5) driver Grade 'C' Chakradharpur, was working M/BAMC, goods train on 27-11-81 ex. Jaraikela to Chakradharpur. He was given a caution order to obey engineering hand signals between Sonua and Lotapahar from Km. 330/26 to Km. 329/14. He did not find any work going on at that location but found some gangmen working at Km. 326/12 without banner flag protection. A gangman signalled him to proceed slowly. Accordingly he controlled his train and proceeded at a cautious speed. He passed the spot without any difficulty and arrived at Lotapahar at 11.20 hours. (His train preceded the ill-fated passenger train and must have passed through the accident spot about 20 minutes earlier).

(b) Answering questions Sri Popley stated that he was travelling at 40 Km/h and reduced the speed to 30 Km/h at the spot mentioned in the caution order. As he did not find any gang working there, he continued at the same speed. On seeing some men working near Km. 326, he slowed down to 20 Km/h on the hand signals shown by one of the gangmen. After negotiating the spot where work was going on, he increased his speed to 40 Km/h. The gang was packing the track and when he whistled, the gangmen moved aside. The alignment of the track appeared to be straight when the gang moved aside. He did not feel any jerk while passing over the track where the gang was working.

17 (a) *Sri Subhas*, son of Aparajit (witness No. 6) was a permanent gangman to DTM, Unit No. 14. He had been put in charge of a gang of about 24 CPC scale gangman and used to do regular track maintenance work with this gang. He had received written instructions from PWI Grade III Sri Dutta to carry out through packing between Km. 325/26-28. Accordingly, on 27-11-1981 he distributed gang tools to his men and took them to Km. 325/26-28. While opening out the ballast preparatory to doing the through packing, Sri Jhuman, a CPC gangman working on PWI/III's trolley, informed him that two fish bolts were broken on the Up road at Km. 326/9-11 and requested him to fix new fish bolts. He instructed Sri Narayan, a CPC gangman working under him, to look after the through packing work in his absence and proceeded to Km. 326/9-11 alongwith three men from the gang to fix new fish bolts. While he was engaged on this work, he noticed two Goods trains go through the spot where through packing was being done on the Down Road. He then noticed a Down passenger train coming at high speed and heard a big sound when the train was near Km. 325/26. He turned in that direction and found that the train had derailed. After putting in the rail closure on the up road, he proceeded to the accident spot when he was informed by one of the gangmen that the train had met with an accident resulting in some injuries to passengers. He immediately proceeded towards Sonua to inform PWI/III. On returning to the spot of accident after some time he found a number of officers and staff already present, engaged in restoration work.

(b) Answering questions Sri Subhas testified that he asked his gangmen to open out the track for doing through packing over a length of six rail lengths viz. 120 metres. About the condition of the track on the down road when it was opened out for through packing, the witness stated that he checked the cross level variation and found that the cess rail had gone down by about 5 to 15 mm. The alignment of the track was however quite all-right. He had not checked the gauge but the sleepers had not gone out of square. The witness then described how he put in the rail closure and replaced the fish bolts on the up road. It transpired from his testimony that he did not carry out proper protection of up road when doing this work.

18. *Sri M. P. Gupte*, Leave reserve Station Master (Witness No. 7) was working as Station Master at Lotapahar on 27-11-1981. He gave line clear to Sonua for 322 Down at 11.22 hours and received the departure of the train at 11.32 hours. At 11.52 hours he got information from the Controller that the train had derailed between Sonua and Lotapahar. Immediately, he sent three RPF staff to the site of accident to protect the railway property and also arranged for the presence of a village local doctor. In reply to a specific question

the witness stated that no driver of any previous train reported about rough running or bad condition of the track between Sonua and Lotapahar.

19. *Sri R. S. Jadav*, (Witness No. 8) Driver, Rourkela was working Shalimar Down Goods train from Rourkela to Chakradharpur on 27-11-1981. He passed Sonua at 10.32 hours and Lotapahar at 10.55 hours. Though he had received a caution order to obey Engineering signal between Km. 330/26 and 329/14, he did not find anyone working there. Nor did he find any gangman working at the spot where the accident to 322 Down took place later. He did not feel any jerks or rough running between Sonua and Lotapahar. He was travelling through at a restricted speed of 25 Km/h owing to a broken spring on one BOX wagon.

20. *Sri A. R. Dutta*, (Witness No. 11) Driver Bondamunda was working KS-95 from Chakradharpur to Bondamunda on 27-11-81. He passed through on the up track from Lotapahar to Sonua between 10.52 hours and 11.18 hours. While passing through the spot where 322 Down derailed later, he found about 10 to 15 gangmen working on the down road. Some of them were lifting the track with crow bars and others were packing. In answer to a specific question the witness stated that he did not observe any kink or buckling of the track of the down road, and the track appeared to be quite normal.

21 (a) *N. L. Tanti*, (Witness No. 12) Guard Grade 'C', Chakradharpur was working train No. M/BAMC from Jaraikela to Chakradharpur. His train left Sonua at 11.05 hours and he found some gangmen working without any banner flag protection at the spot where the accident later occurred. The train passed through that spot at a speed of 20 to 25 Km/h. He did not notice what type of work they were doing on the track. Asked about the condition of the track after the train passed the spot, the witness replied that the track seemed to be all-right and the running was also smooth. The train passed through Lotapahar at 11.25 hours.

22 (a) *Sri B. N. Prasad*, (Witness No. 13) ATFO (OHE) headquartered at Chakradharpur was proceeding to Goilkera on the Down line on 27-11-1981 in a Tower Wagon. He saw the accident happening when he reached Km. 325/3. He then arranged for switching off the power on the Up line and informed all concerned. The witness described in detail the action taken by him to arrange relief measures to the injured passengers and shifting them by the tower wagon to Lotapahar.

(b) Answering questions the witness stated that when he passed through Km. 325/3 on the up road, he saw heavy dust and smoke on the down line. He then saw the bogies of 322 Down falling down the embankment. After informing the control about the accident, he sent the tower wagon ahead to bring back the seriously injured passengers towards Chakradharpur. Asked to describe the derailed coaches and the damage to the track the witness stated that the loco was resting with all wheels on rails apparently undamaged while the first wagon behind had derailed of all wheels. Four wagons loaded with bananas had capsized and were lying on the bank jumbled up with one another. The next three passenger coaches had also capsized while two more coaches in the rear had derailed. He did not notice any components of the coaches lying on the track. Some ONE insulators were damaged and the counterweight was lying on the ground. Some fittings of OHE mast No. 325/24 were damaged while the next mast at 325/26 was badly bent and twisted out of shape. The contact wire was touching the first class coach. The witness also mentioned that he heard the Assistant Driver of 322 Down excitedly shout in the presence of passengers as follows :—

“Ham Kya Kareng Line Khula Huvata. Gangmen Lok Bhag rahete, Hamne socha kuch danger hai aur emergency brack lagaya”

(“What can we do? The track was opened out, the gangmen were running away. We thought there was some danger and applied the emergency brakes”)

23. *Sri Digambar Tanti*, (Witness No. 14), Headmaster, Tujur Middle School Sonua Block was travelling by the ill-fated 322 Down on 27-11-1981 and sustained some injuries on the right side of his forehead. He stated that the speed of the train at the time of the accident was higher than the usual. He frequently travelled by this train and hence he could feel that the speed that day was more than usual. Asked whether the train was travelling at the same speed right up to the time of derailment or whether the brakes were applied just before the accident, the witness replied that the train was travelling at the same speed right till the time of accident without slowing down.

24 (a) *Sri N. C. Pathak*, (Witness No. 15) was working as TXR at Bhusawal on the Central Railway. On 25-11-1981 he examined about 8 wagons for their being fit for moving by passenger train and found that all the wagons were fit to run by passenger train. He gave a memo accordingly. He conducted various tests on all the wagons and replaced missing hose pipes and syphon pipes as necessary. He also provided two numbers of brake blocks to wagon No. 5810-ER. He was positive that none of the wagons could have been made into a TP wagon (train pipe vehicle) as every one of them had the full complement of braking gear.

25. *Sri Gajanan Balakrishna*, (Witness No. 16) was working as TXR Central Railway, Nagpur. The witness stated that he checked all the 8 wagons and found that 4 of them were due for oiling. Except for the oiling of these 4 wagons, there was no other defect on any of the 8 wagons which would have rendered them unfit to be attached to a passenger train. According to the witness all the vacuum cylinders on the 8 wagons were found operative and the brake gears were in good fettle.

26. *Sri S.A. Thakre*, (Witness No. 17) Train Examiner, Nagpur was on duty at Nagpur and examined all the 8 wagons of 322 Down rake. Two of the wagons were marked sick due to certain defects and the remaining 6 wagons were found to be fit for moving by passenger train. At his instance he got 3 wagons oiled by the TXR/NGPE (Central Railway). The dates of oiling were written down not by paint but by chalk. He confirmed that all the wagons were in a fit state to move by passenger train and that the couplings of all the 4-wheelers were tightened fully.

27. *Sri N. B. Pandey*, (Witness No. 18) TXR at Dongargarh. 322 Down arrived at Dongargarh at 14.20 hours on 26-11-81. The examination was completed at 14.26 hours and the train left at 14.55 hours. During the period of halt at Dongargarh he was in a position to rectify some minor defects noted in the brake gear of some of the vehicles and the train left Dongargarh with 100% brake power i.e. all the 20 cylinders were working. According to him the couplings between the wagons and the loco were all tight.

28. *Sri Y. Kalidas*, (Witness No. 19) TXR Rourkela was on duty when 322 Down arrived at Rourkela at 8.15 hours on 27-11-1981. The witness deposed that one wagon No. WR 20501 in the rear was detached and two 4-wheeler Nos. 3108 and CR 58447 were attached. These vehicles were examined and found all right. He checked the coupling between the wagons as well between the locomotive and the first wagon and found all coupling were tight. The rolling in examination was done to check hanging parts, deficiency of brake beam pin, brake beam hanging, bearing spring broken, existence of safety bracket etc. and no defect was found whatever. The axle boxes were felt and found to be normal and so were the wheels when checked by tapping. In fact no defects were found in any of the wagons of the train.

29. (a) *Sri Narayan*, (Witness No. 21) CPC Gangman headquartered at Km. 328/13—Ganghut was working on through packing of the track between Kms. 326/26½ to 28½ on 27-11-1981. Through packing work was being done under the supervision of Sri Subhash, Permanent Gangman who, whoever, left the spot after sometime along with three of the gangmen to replace the broken fish bolts on the up line. After the track was aligned they worked on packing of the track. One Goods train passed by. At this stage they stopped the work to drink water. After sometime they heard sound of a train approaching at a very high speed. The train which was 322 Down passed the place where they were standing without reducing speed and almost immediately some wagons derailed. One gangman was sent to inform Sri Subhash. The gang waited at the site of the accident till the PWI and other officers came to the site.

(b) Answering questions the witness stated that Sri Subhash had allotted the work of thorough packing of 120 sleepers at the rate of 12 sleepers per man. He checked the alignment and marked the direction in which the track had to be slewed. Then the gang started opening out of ballast and completed this work by 10 O' clock. Sri Subhash left the site after the alignment was corrected but before the alignment packing was done, leaving the supervision to the witness. While the gang was working two or three Goods trains passed at speeds of 40 to 50 Km/h. No deterioration in the alignment was noticed after the passage of each train. The gang dispersed to drink water at about 10.30 hours and while drinking water and resting they found two more Goods trains pass on the Down road but not at high speed. Asked about the condition of the track just before the passage of the passenger train the witness replied that the track was all-right. Seeing that the ill-fated train was approaching at a very high speed the gang stood on the cess side on the Up line to recommence the work after passage of the train, when the train

met with the accident. No parting of the train was noticed before the derailment. Asked about the first wagon to derail the witness replied that he saw the second wagon from the engine derail first, after passing the culvert. It travelled for a very short distance and then capsized down the embankment. The other wagons behind as well as the three passenger coaches also capsized and fell on the sides of the embankment. The witness was positive that none of the gangmen showed any hand signal to the Driver to slow down.

30. (a) *Sri Ganga*, (Witness No. 22) CPC Gangman worked at this location on 27-11-81. He generally corroborated the statement of *Sri Narayan* and further added that soon after the derailment the Driver of the derailment ill-fated train came to them and questioned them as to why they were pulling back without caution order. The witness replied to the Driver that they were not pulling back but doing through packing which required no caution order.

(b) Answering questions the witness stated that the condition of the track was good right through the time they were working. None of the gangman showed any hand signal to the train to slow down. The second wagon behind the locomotive first derailed and capsized dragging the other wagons along with it. It appeared to him as if the second wagon just jumped the rails and immediately capsized. The witness added that normally the gang worked under the supervision of *Sri Subhash*, the permanent gangman and if he went on leave, some other permanent gangman supervised their work.

31. (a) *Sri H. C. Sen*, (Witness No. 23), PWI Grade I, Chakradharpur was in charge of the maintenance of the train where the derailment took place. He came to know about the accident to 322 Down at 13.10 hours on 27-11-81. He reached the site of accident by the Relief Train at 14.20 hours. He noticed an electric loco standing at Km. 325/20 alongwith one covered wagon with all wheels of the latter derailed. A little further on, he found 5 covered wagons and 2 second class bogies capsized down the slope of the bank.

(b) Answering questions *Sri Sen* stated that on reaching the spot of accident, he learnt from the gagumen present there that they were just going to do the through packing after correcting the alignment when the accident took place.

(c) He had last inspected the track at this location by push trolley on 23-11-81 just four days prior to the date of accident. He found the cross level variation upto a maximum of 18 mm and instructed the PWI/III(West)/Chakradharpur to start through packing from Km. 325/26. The percentage of missing keys at this location was 4 to 5%. According to his observation the cross levels did not go out frequently at this location but it generally required attention twice in a year. Giving his observations at the site of accident, he stated that he saw an axle box of a wagon lying between up and down lines at a distance of 142 metres from the end of the derailed wagon attached to the locomotive. Just opposite the axle box were lying capsized, the remaining five 4-wheeler wagons and the first second class coche. The next 4 coaches had also derailed. The other coaches all remained on rails. There was considerable damage to the track. Two welded rail panels were completely damaged while two panels on the Sonua side and one panel on the Chakradharpur side were twisted and bent. 42 wooden sleepers were smashed and 130 steel trough sleepers were completely damaged. He did not find any other bogie component lying on the track.

(d) The witness questioned the gangmen whether they were trying to slow down the train by showing hand signals but the gangmen denied doing so. However there was a general tendency among the gangs to slow down the train by showing the hand signals at the time of taking alignment. Explaining how he allowed the gang to work without the supervision of a permanent mate, he stated that as there was no sanction for a permanent mate, he had deputed an intelligent and experienced permanent gangman to supervise the working of the CPS gang. Such gangs were never allowed to work by themselves without the supervision by a permanent man from a regular gang.

32. (a) *Sri L. Dutta*, (Witness No. 24), PWI Grade III (West)/Chakradharpur was travelling by an up Goods train from Chakradharpur to Sonua on 27-11-81 and at about 10 A.M. he found the CPC gang working at Km. 325/26-28. He saw *Sri Subhash* a little ahead on the fairway side at Km. 326/9-11. He busied himself checking the work of another gang of DTM unit No. 14 at Km. 328/6½ (about 2½ kilometers from the accident spot). He saw 322 Down pass by at a considerably high speed. He was informed at 11.50 hours by *Sri Subhash* about the derailment of 322 Down. He arrived at the spot of accident at 12.00 hours. He found that the first point of drop was near the joint at Km. 325/28 and there was no damage to the rail end or the fish plate. He found 76 numbers of sleepers opened out towards the Sonua end and 26

numbers of sleepers towards the Chakradharpur end. While the track towards Sonua side was intact with all fittings, the track was considerably damaged towards Chakradharpur side. All the wooden sleepers provided over the bridge No. 248 were completely destroyed.

(b) Answering questions the witness stated that when he passed the spot of accident by a Goods train in opposite direction at 10.25 hours, he found the track already opened up and some 10 to 12 men working on packing the track. When he was at Km. 328/6½, the 322 Down passed by at speed of 80 to 90 Km/h. He last checked the track at the accident spot on 23-11-81 when PWI, Sri Sen informed him that through packing was needed at Km. 325/26-28. He found the cross level variation to be from 5 to 15 mm. The condition of the track was not alarming and he programmed the through packing for 27-11-81. Asked whether the CPC gang was sometimes allowed to work on the track without the supervision of a permanent gang man, he replied that it was not so.

33. *Sri Raghu Maji*, (Witness No. 25) CPC gangman generally corroborated the statement of Sri Narayan and Sri Ganga. He also noticed that the second wagon was the first to jump out and capsize on the embankment. The remaining wagons as well as two passenger coaches went down the embankment along with it. After the accident he went and informed Sri Subhash who then went ahead to inform PWI Grade III.

34. *Sri N. Maiti*, (Witness No. 29) Dy. Controller worked from 8.00 to 16.00 hours on 27-11-81. He was informed by the Section Controller from the Rourkela Board at 11.42 hours about the derailment of 322 Down passenger. Immediately he ordered the Ambulance Van and the Relief Train from Chakradharpur and informed all concerned officers. The Hooter was sounded at 11.44 hours and the Ambulance Van along with DMO, ADRM and other officers left Chakradharpur at 11.55 hours. At 12.55 hours all the injured persons were brought from the accident spot by Tower Wagon to Lotapahar and shifted to the Ambulance Van which returned Chakradharpur at 13.45 hours.

35. (a) *Sri A. K. Ganguly*, (Witness No. 40) DEN/I, Chakradharpur was travelling in his Inspection Carriage No. 3108 attached in the rear of 322 Down on 27-11-81. After the train left Sonua he entered the toilet to get ready. Suddenly he felt the emergency brake being applied and within 5 to 10 seconds thereafter he felt three severe jerks all in the direction of the movement of the train, the intensity of each jerk increasing progressively. After the last jerk the train stopped abruptly. On rushing out of the carriage, he found there was a serious derailment of the train with almost all the 4-wheelers wagons and some of the bogie coaching stock derailed and capsized down the embankment and some other coaching stock tilted precariously on the bank. He noted the time of accident at about 11.35 hours. He was informed by the OHE staff who had come to the spot in a Tower Wagon that most of the passengers had a miraculous escape and there were only a few cases of minor injuries. He arranged to send them to Lotapahar by the Tower Wagon. He observed that the track near the accident spot had been opened out by the gang. He examined the condition of the permanent way and fittings and found that they were intact in rear of the point of drop but were totally disturbed after the point of the drop.

(b) The PWI Grade III of the Section Sri L. Dutta informed him that the gang was doing through packing at this location. It was a temporary gang under the supervision of a permanent gangman called Subhash. He then closely questioned the gangmen as to what they were doing at the time of the accident. They all told him that they had been deputed to do through packing and that they had opened out the track and had taken the alignment and were doing the alignment packing when the accident occurred. He also saw an axle box cover of a wagon which was lying between the two tracks. He then busied himself in supervising the transshipment of the passengers into 144 Down Express train and making arrangements for restoration work.

(c) Answering questions the witness stated that he did not calculate the speed of the train while travelling in his Inspection Carriage from Rourkela. Being accustomed to judge the speed of the train by the oscillations of his carriage, he felt that the speed of the train between Sonua and Lotapahar was approximately 75 to 80 Km/h. Referring to the location of his coach when he felt the first application of the emergency brake, the witness stated that his inspection carriage was somewhere between 326/4 and 326/2. (This would approximately place the locomotive at Km. 326/4 at the time of application of emergency brakes). When he closely questioned the gang about the work they were doing at the time of the accident, the gang told him that they were doing through packing at that location. When he suggested that they had opened out one of the joints for pulling back of rails they stoutly denied that it was so and insisted that they had opened the track, taken the alignment and were doing the alignment packing, and had done nothing else.

When he asked them whether they had lifted the track which could have caused buckling they denied that they did any lifting. Neither did they open out the Keys from the sleepers nor did they show any signal to the driver of 322 Down to slow down.

VI. OBSERVATIONS AND TESTS

36. *Track*—When I reached the site of accident at 9.00 hours on 28-11-81 i.e. about twenty-two hours after the accident, I was told by the Chief Bridge Engineer, South Eastern Railway that the track had been left undisturbed, while the clearance operations of some of the capsized passenger coaches had just been taken in hand. The position that emerged from my inspection then and later during the course of the inquiry is detailed in the following paragraphs.

37. *Point of Drop*—The point of drop was on the cess side, screw spike (Chakradharpur end) of the ACB plate on the last joint sleeper on the panel L1R1 (sleeper No. 60—See Note below regarding numbering of sleepers and panels) and was situated 6.40 m from OHE mast No. 325/28. The head of the screw spike was sheared over half its width. The next wheel mark could be seen to the left of the right rail R2 on sleeper No. 62 of panel L2 R2. No corresponding wheel mark on the outside of the left rail (L2) could be seen on this sleeper. On the adjacent sleeper No. 63 of panel L2 R2 five wheel marks on the right side and three wheel marks on the left side of Rail L1 could be clearly seen. *No mounting mark could be made out at all.*

Note : For facility of reference, the intact welded panel behind is denoted as Lo Ro and the others consecutively as L1 L1, L2 R2, L3 R3—and so on, L for the left and R for the right. The fish-plated rail joints are designated as Lo—L1, Ro—R1, L1—L2, R1—R2—and so on. Sleepers are reckoned consecutively, commencing from the 1st joint sleeper on L1 R1 numbered 1.

38. *Wheel marks on sleepers*—Wheel marks and dent marks occurred in all the remaining sleepers of panel L2 R2 and L3 R3; while some of the sleepers carried five to six marks between the rails and one or two marks on the left outside, others had five to six marks between the rails and almost an equal No. of marks on the left outside. In panel L3 R3 while some sleepers had as many as ten wheel marks/dent marks, other sleepers had only three or four marks on them. Panels L3 R3 and L4 R4 were completely destroyed in the accident. Beyond panel L5 R5 and upto panel L8 R8 where the locomotive came to a halt, clear wheel marks could be discerned on all the sleepers owing to the movement of the wagon next to the locomotive in the derailed condition.

39. *Damage to Fish Plates and Fish Bolts*—The condition of the fish bolts and fish plates were as under :—In joint L0 L1, R0 R1 and L1 L2 all the fish plates and all the fish bolts were in tact. In joint R1 R2 while both the fish plates were in tact one bolt out of the four was found freshly broken while the other three bolts were intact. In joint L2 L3 fish plates on both sides of L2 L3 were thrown out on the cess about 3 metres away but had no marks on them, while two bolts were intact on rail L2, two bolts were found freshly broken on L3. In joint R2 R3 the fish plates on both sides were intact while three fish bolts were found broken, two on R2 and one on R3; a gap of 25 mm was found at this joint. In joint L3 L4 the fish plates on both sides had fallen free of the rails on to the cess and all the four bolts were found freshly broken. The left outside fish plate of L3 L4 had its lip cut over half its length at L4 end while the right inner fish plate had some cut marks of wheels but no damage. In joint R3 R4 the left inner fish plate, had no marks on it while the right out fishplate had its lip chamfered over one eighth of its length. The fishplates and fish bolts of all the remaining joints right up to panel 8 and 9 were found fully intact and in position.

40. *Damage to rail ends*—While there was absolutely no damage to the rail ends of joints L0 L1, R0 R1, L1 L2 and R1 R2 the running on end of rail L2 had got entangled with the 1st class bogie which had capsized. The running on end of rail L3 had a wheel hit mark on the top edge of the head and was dented considerably. Rail L4 had grazing marks on the side of the head and the flange of the rail was cut on the inside over a length of 95 cm. commencing from 87 cm. from the running on end. It appeared as if a wheel had cut it while the rail lay tilted. Apart from the two rails none of the other rails had any hit mark and all were completely free from any damage.

41. *General condition of track at the spot of accident*—The sleepers had been continuously opened out for through packing by the gang over a distance of 50.3 m. in rear of the point of drop (76 sleepers) and 17 m. ahead of the point of drop

(26 sleepers). While rail panels L0 R0 and L1 R1 did not suffer much damage, panels L2 R2, L3 R3 and L4 R4 suffered extensive damage. Rails L2 L3 and L4 separated from each other (owing to the joints getting severed) and were bent into U-shape. The right hand rail R2, R3 and R4 however remained fished together. Steel trough sleepers in panels L2 R2, L3 R3 and L4 R4 were considerably dented and bent as a consequence. Wooden sleepers, 42 in number, provided over a culvert in panel L2 R2 were smashed into smithereens. The track in rear of the point of drop in panel L1 R1 had a pronounced kink about 13 m. in rear of Jt. L1 L2. It appeared as if the kink might probably have been as a result of the accident because of the opened out track and the violent damage to the rail of the panels ahead namely L2 R2, L3 R3 and L4 R4. I observed the alignment and cross-levels of the track in rear of the panel L0 R0 and ahead of panel L7 R7 and found that the general condition of the track at these locations was quite satisfactory. The track readings under no load taken jointly by 3 inspectors of the Railway are at Annexure IIA.

42. *Cross-levels and Twist*—Cross-levels under load were measured at every metre for distance of about 30 m in rear of point of derailment and at every 3 metres for a further distance of 60 m. The effective twist over a 4 m. wheel base was also worked out based on this observations. (These are shown at Appendix IIB). It was seen that the twist varied from a minimum of 0 mm. per metre to a maximum of 4.5 mm per metre. The worst twist of 4.5 mm per metre occurred between stations 17 and 13 and the next lower twist of 4 mm per metre occurred between stations 7 and 3 in rear of the point of drop. Elsewhere the twist varied from 0.25 mm per metre to 2 mm per metre with isolated figures of 3.5 mm per metre to 4 mm per metre. Incidentally it may be stated that the highest figure of twist of 4.5 mm per metre which occurs between stations between 17 and 13 in rear of the point of mount corresponds to the existence of the pronounced kink mentioned in para 41 above. It is probable that this twist also could have been due to the disturbance in the track caused by the accident. The twist under load measured ahead of the point of mount and at the place where the locomotive came to a halt was found to be much lower being 1.5 mm per metre.

43. *Missing fittings*—The percentage of missing/dropped keys in rear of the point of mount in the various panels is as follows :—

Panel L ₀ R ₀	15%
Panel L ₁ R ₁	13%
Panel L ₂ R ₂	17.5%
Panel L ₃ R ₃	16%

44. (a) *Creep*—The following amounts of creep have been recorded by the railway :—

Km. 325 left hand—155; mm right hand—150 mm.

Km. 326 left hand—130; mm right hand—155 mm.

According to these readings the amount of creep was approaching the maximum permissible limit of 150 mm laid down in the Way and Works Manual. The Railway stated that the track in this region was last pulled back and the creep adjusted only in October 1981.

(b) *Expansion gaps*—The expansion gaps were measured in rear of the point of drop as well as ahead of the place where the locomotive came to a halt, at 11:20 hours on 28-11-81 one day subsequent to the accident. The readings recorded were as follows :—

Joint No.	Gap in mm.	
	Left Side	Right side
(i) In rear of the point of mount		
(i.e. L ₀ L ₁)		
J-1	Nil	Nil
J-2	Nil	Nil
J-3	Nil	Nil
J-4	Nil	Nil
J-5	Nil	Nil

1	2	3
J-6	Nil	1
J-7	Nil	Nil
J-8	Nil	Nil
J-9	1	1
J-10	Nil	Nil
J-11	1	2
J-12	1	1
(ii) Ahead of the point where loco came to rest.		
J-1	Nil	Nil
J-2	3	1
J-3	4	3
J-4	4	2
J-5	5	4
J-6	10	8
J-7	10	9
J-8	10	8
J-9	3	4
J-10	4	4
J-11	4	2
J-12	4	2

It would be seen from the above that in rear of the point of drop there were 5 successive jammed joints followed by a 1 mm gap and again 2 successive jammed joints for right rail and 1 mm, 2 successive jammed joints, 1 mm, 4 successive jammed joints for the left rail. There were no jammed joints in the portion ahead of the point where the loco came to rest.

(c) *Rail temperature*—The rail temperature measured between 11.20 hours and 12.20 hours on 28-11-81 the day following the accident was found to be 46° centigrade. The place where the accident took place falls in zone III as per the manual, the mean temperature t_m for which is 35°C and t_s is 30°C ($t_m - 5^\circ$). As per para 4.1.1 of the manual reproduced as Annexure III, it was permissible to open the sleepers continuously as rail temperature was not more than $t_s + 25$.

(d) *Ballast cushion*—The ballast cushion available in rear of the point of drop was not measured at my instance and it was found that the ballast cushion varied from a minimum of 175 mm to 250 mm, a maximum of which comprised 25 to 50 mm of clean cushion and 150 to 200 mm of caked up ballast. The width of the shoulder ballast on the cess side was an average of 1 m and on the fair way side the ballast shoulder was full between the two tracks. The ballast cushion and the shoulder provided was therefore satisfactory.

(e) *Age of track*—The rails and sleepers were laid in 1971. The condition of the rails and steel trough sleepers was satisfactory.

The Locomotive

45(a) The locomotive was jointly checked by the SLI/Chakradharpur and CDTI(M)/Chakradharpur whose observations are enclosed as Annexure IV. The Driver's emergency brake as well as the Assistant Driver's emergency brake were found in applied position.

(b) I had an opportunity to examine the Locomotive No. 21212 on the pit at Chakradharpur on the 2nd day of the inquiry. None of the wheels showed any marks of having come across an obstruction on the track, or hitting against a rail. There was no ballast mark visible on the

wheels either. The wheel profile and the axle box clearances of the locomotive were got measured and it was seen that the wheel profiles had not reached condemning limits; the wheel diameters were all within acceptable limits. The longitudinal and lateral clearances of the axle boxes were also within the prescribed limits. The only damage that occurred was to the pantograph No. 1 of the locomotive, which obviously was post-accident. The locomotive appeared to be fully road-worthy and it was clear that the derailment could not be due to any defect in the locomotive.

Couches

46. 1st Wagon (WR 67367C) This wagon remained attached to the locomotive and came to rest at Km. 325/20 but was derailed of all wheels. The coupling between the locomotive and this wagon as well as the rear coupling of this wagon were intact. The wagon appeared to have suffered no damage as a result of the accident. The wheel gauge varied from 1599 to 1601 mm. and the thicknesses of the flanges from 23 to 27 mm, the measurements being within acceptable limits. Dent marks could be seen all over on the left leading wheel with one heavy dent mark of 25 mm length and 4 mm depth. There were ballast mark on all the wheels, as a result of the wagon travelling in a derailed condition for about 250 metres. The other parameters such as clearance between axle box groove and guards, clearance between brass and collar of journals, brass thicknesses camber of spring under load etc. were all found O.K. There were no rejectable defects in the wagon. The next P.O.H. of the wagon was due in 4/82.

47. 2nd Wagon—(ER 89061C)—This wagon had derailed and capsized and was resting on its side on the slope of the embankment. The front screw coupling had been broken, the body of the wagon extensively damaged and the axle guard badly bent and damaged. All of these were fresh damages and quite clearly as a result of the accident. The wheels had ballast marks and a few dent marks. While parameters such as wheel gauge and tyre profile were within acceptable limits, other parameters such as spring camber, axle box clearance etc. could not be measured because of the way in which the wagon lay capsized and entangled with the wagon in rear. The eyes of springs were not touching the solebar of the wagon. This wagon had become uncoupled from the wagon in rear. All the buffers were intact and one buffer which was infringing the track was gas-cut and removed from the wagon during clearance operations. The wagon was due P.O.H. on 1/83.

48. 3rd Wagon—(ER 54314C)—This wagon capsized and came to rest on its roof at the farthest point from the track and suffered very heavy damages. Both the wheel sets had been dislodged from the wagon and one pair of wheels was laying under the debris of the wagon while the other pair was laying near wagon No. 1606-C. Both the axle boxes had also separated from the wheel assembly, one of which was lying between the up and down track near Km. 325/24, but both axle boxes had the brasses slipper plate and packing intact and there was no sign of hot axle. Dent marks and ballast marks were present on the wheels. On the wheel set which was accessible, the flange thicknesses were found to be between 27 mm and 28 mm and the wheel gauge 1601 mm both these being within permissible limits. The other parameters such as axle box clearance, spring camber, height of buffers etc. could not be recorded owing to the awkward capsizing of the wagon. The screw coupling at Sonua end was intact and remained coupled to the wagon in rear. The coupling was found in tight condition with no more threads left for tightening. Only one buffer was visible and found to be active. This wagon was due P.O.H. in August 1982.

49. 4th Wagon (ER 1965C)—The re-packing of this wagon was done at Jhansi on 4-7-81. The oiling was done at WATK on 5-10-81. This was the 4th wagon from the locomotive and the 3rd in sequence to have capsized. It was resting on its side on the ground and lay sandwiched between the 3rd wagon and the 5th wagon. The wheels of this wagon were in position and the screw coupling at either end was intact. As already mentioned in Para 48 above, the wagon remained coupled to the 3rd wagon i.e. at Chakradharpur end. The rear screw coupling had however become uncoupled. The end panels and the body panels of this wagon sustained heavy damage. All the springs of this wagon were found intact with no damages or deficiencies. The right hand leading shackle pin was found freshly broken. The vacuum cylinder was found intact and operative. Only one pair of wheels could be approached and on checking, the tyre and wheel profile dimensions were found to have not yet reached condemning limits. Ballast marks could be seen but there were no dent marks. Owing to the awkward position in which the wagon lay, none of the other parameters of the wagon could be measured. The wagon had its last P.O.H. in July 1981 and was due P.O.H. probably in Jan. 1985. (Return Date not marked).

50. 5th wagon—(ER 1606C)—This wagon had its P.O.H. on 9-5-1979 at Liluah. It was due P.O.H. on November 1982. It had been re-packed on 24th June 1981 at CCD and oiled on 7th November 1981 at BRC. The wheel gauge, the flange thicknesses and the tyre profile were within limits. The other parameters could not be measured as the wagon was lying capsized. The spring assembly was intact and without deficiencies. The vacuum cylinder was found operative. All wheels had ballast marks and a few dent marks. The four buffers were intact and both the screw couplings at either end were intact.

51. 6th wagon (ER 81805C)—This wagon had its last P.O.H. at Liluah on 12-11-1979 and was due P.O.H. in May 1983. It was re-packed on 14-8-1981 at SSB. None of the parameters of this wagon could be measured as the wheels were buried in the debris. The brake gear was intact and operative. The brakes were found applied. The draw bar gear assembly at either end was found intact. All the buffers were also intact and active.

52. 7th Coach—No. SE-2047 (IRS Coach)—This coach was periodically overhauled at Kharagpur Workshop on 17-10-81 and was due P.O.H. in May 1983. This coach was in a capsized condition partly resting on the ground and partly on wagon No. ER 81805C (6th wagon). There was a heavy rubbing mark on the front end panel at the centre for a length of one metre at the height of about 1.5 metres from the headstock. The leading screw couplings and the draw gear assembly were found to be intact. The rear end screw coupling was also intact and was on the hook of the adjoining rear coach No. SE 1999. The right hand leading buffer and both the buffers of the trailing end were intact while the left hand leading buffer was buried into the ground. The buffers at the Nagpur end though intact condition had to be gas-cut to release the interlock at the time of relief operations. Unfortunately the parameters such as the axle box clearances and the wheel profile and wheel gauge etc. could not be measured in view of the way in which the coach was lying. The bolster of the rear trolley was dislodged from the assembly and bolster springs scattered. None of the bolster springs were however broken. Both the centre pivots were in position and all side bearer intact.

53. 8th Coach—(SE 1999-GS)—This coach, an ICF Coach with laminated springs was in a tilted condition, partly resting on its side and inclined at 45° with reference to the track alignment. The undergear of the coach had sustained some damage such as one axle lug of leading right hand axle box being freshly broken, the right hand safety bracket of the trailing brakebeam being bent and partly cracked. Ballast marks and hit marks could be seen on some components of the undergear. The leading wheel on the right hand side had 3 dent marks near the inner side of the rim and the leading axle of the leading bogie had a dent mark 0.5 mm deep situated 125 mm away from the Boss. The wheel profiles were checked with tyre defect gauge and found to be O.K. So were the wheel gauge, wheel diameter and thickness of flanges. The bolster spring cambers of the rear trolley (which only could be measured) were O.K. All the dash pots were found full with oil. All the screw couplings were intact. While all the buffers were intact, two buffers at Nagpur end got interlocked and one of them had to be gas-cut to release the interlock. It was due for its next P.O.H. on Oct. 1982.

54. 9th Coach—(SE 443-WFC)—This was an ICF all-coil coach which had derailed by all its wheels but was coupled to the adjoining coaches. The leading trolley axle had been bent and the wheel gauge was out by about 30 mm. The leading trolley bolster assembly was displaced as a result of the one of the stirrup links dislodged from its place. It was clear that all these were results of the accident. 2 dash pots of this bogies were found in a dry condition. The side bearers were however full with oil. All the 4 equalising stays were in position and undamaged. Both vacuum cylinders were functioning as seen from the shiny piston rods. The left leading anchor link was found bent. The inside of the trolley frame of the leading bogie had a grazing mark over a length of 55 cms which was fresh. The dash pot of the right leading of the front was found displaced from its position and had a fresh dent mark. All the 4 pairs of wheels were checked for tyre profile and found to be O.K. The leading wheel of the leading trolley had fresh dent marks of about 5 cm in length and 3 mm in depth. The left hand axle box of the trailing pair of wheels of the leading trolley had two face plate lugs freshly broken. Heavy ballast marks were noticed on all the wheels. It was due for its next P.O.H. in December 1981.

55. 10th Coach—(ER 2564-GS)—This was an ICF All coil coach which had derailed of all wheels. There were no damages of any kind to the coach. Both the trolleys of the coach had their shock-absorbers in working order and the dash pots had oil in them. The side bearers were also fully lubricated. Both the vacuum cylinders of this coach showed shining piston rods indicating the working condition of the cylinders. The buffers and the screw couplings were intact and the coach remained coupled to the adjoining coaches. It was due for its next P.O.H. in October 1982.

56. 11th Coach (SE 5284—WGS) 11th from the engine—This was also an ICF All coil coach. The leading trolley of this coach derailed of all wheels while the rear trolley was on rail. No deficiencies were noticed in this coach. The wheel profiles and the wheel gauge were all O.K. The trollies had shock absorbers functioning and dash pots filled with oil. The side bearers were also fully lubricated with oil available in side bearer cups. The buffer gears and screw couplings were all intact. The coach remained coupled with adjoining coaches with the couplings intact. It was due for its next P.O.H. in October 1982.

57. The remaining coaches which were 12th, 13th, 14th and 15th from the locomotive were all on rails and intact with no damages or deficiencies being noticed.

VII. DISCUSSION

Time of the Accident

58. According to the Guard's journal the train left Sonua at 11.20 hours and the accident took place at 11.35 hours. The other evidence regarding the time of accident is the time of tripping of OHE Power supply on the down road which according to the Divisions record was 11.36 hours. Accordingly, the time of accident is accounted as 11.36 hours.

Speed at derailment

59. There was no Speed Recorder fitted in the loco presumably as it was working only a slow passenger train. Various witnesses have given various estimates of the speed at which the train was travelling just before the accident, as detailed below.

Witness No.	Name	Speed in Km/h.
1	2	3
1.	S. L. Baul/Guard	More than 60 Km/h.
2.	T. D. Kaibarto/Guard	50 to 60 Km/h.
3.	Prabhu Sahay/Driver	40 Km/h. and subsequently 25—30 Km/h.
4.	T. Krishna/Asstt. Driver	40 Km/h.
14.	Digambar Tanti/Public	Higher than usual.
21.	Narayan/Cpc Gangman	High Speed
40.	A. K. Ganguly/DEN-I/CKP	75 to 80 Km/h.

The figure given by the Driver of the train, who is an interested party, is somewhat low. A reasonable assessment of the speed of the train just before the accident would be between the figure mentioned by the witness No. 1 the Guard of 60 Km/h and the figure mentioned by Shri A. K. Ganguly, DEN of 75 to 80 Km/h. Accordingly, I consider that the train was travelling at a speed of about 70 Km/h just before the accident took place.

Analysis of causes

60. A mid-section derailment can occur due to various factors and some of the more common factors are discussed in the following sub-paragraphs.

(a) No unauthorised interference with track

A derailment owing to unauthorised interference with the track always has some special features such as the locomotive being the first to derail, presence of loose fish-plates and fish-bolts at the spot of the accident, marks left by the opened rail on the surface of the wheels of the locomotive etc. All these features were absent in the present case. The locomotive did not derail, nor was there any mark on the wheels of the locomotive. All the fish-bolts and fish-plates were duly accounted for and there were no undamaged fish-plates or fish-bolts lying loose at the site of the accident. Besides, the permanent way gang was working at this exact location just prior to the accident and therefore I rule out the possibility of the accident having resulted from unauthorised interference with the track.

(b) The weather at the time of the derailment was clear and the possibility of the mishap having been caused by any localised causes of nature such as a heavy gale or tornado also does not arise.

(c) *No obstruction in the path*

There was no evidence of any obstruction having formed in the path of the train which the wheels had to mount. As already stated in para 45(b) above all the wheels of the locomotive were unmarked and did not show any evidence of having to mount any disjointed components of the track. Some of the wheels of the wagons in the rear however showed some wheel marks which were presumably due to the derailment already having occurred and hence were as a result of the accident. Therefore the derailment could not have been due to any obstruction in the path of the train.

(d) *Excessive speed*

It would be seen from para 59 above that the speed at the time of the derailment has been assessed to be of the order of 70 Km/h. The maximum permissible speed for passenger trains on this section is 72 Km/h. Therefore the derailment could not have been due to excessive speed.

(e) *Uneven loading*

All the six wagons adjacent to the locomotive were loaded with bananas and soon after the accident most of the bananas were removed from the derailed wagons and taken away by the owner. Loading of bananas would not have caused uneven loading of the wagons as the bananas were uniformly loaded in the wagons from the floor to the ceiling. There was also no possibility of any wagon being lightly loaded, as the six wagons were found to be fully loaded with bananas. Therefore the possibility of the accident having occurred either as a result of the uneven loading or as a result of the presence of a lightly loaded wagon between two heavily loaded wagons has to be discounted.

61. The simpler and more apparent causes of derailment having thus been examined and eliminated, further consideration of the cause of the accident has necessarily to be confined to the two dominant causes of such derailments viz. defects in the track and defects in the rolling stock acting either singly or in combination. These are discussed in paragraphs that follow.

62. *The condition of the rolling stock*

(a) The condition of the locomotive has been described in para 45 above and the condition of the wagons and the coaches have been detailed in paras 46 to 57 above. As the locomotive appeared to be fully road-worthy the possibility of the derailment having been occasioned by any defect in the locomotive could be ruled out. As far as the wagons and the coaches are concerned it was possible to obtain complete measurements of only the first wagon. This was found free from any defect which could have led to the derailment (para 46). The position with reference to other wagons were as follows :

- (i) 2nd wagon (which was in all likelihood the first vehicle to derail)—The wheel flange and profile of both the wheel sets were fully within accepted limits. The eyes of the springs were not touching the sole bar of the wagon and hence were fully operative (para 47).
- (ii) 3rd wagon—Only one pair of wheels could be measured, profiles of which were found to be O.K. Though both the axle boxes had separated, the interior of the axle boxes were found to be in good condition with all components intact. There was no evidence of any hot axle (para 48).
- (iii) 4th wagon—All the springs were found to be intact with no deficiencies found. In the only one pair of wheel sets which could be measured, the tyre and wheel profile were found O.K. (para 49).
- (iv) 5th wagon—Both the wheel sets could be checked for the flange thickness, wheel gauge and tyre profiles which were found O.K. The spring assembly was also found intact and without any deficiency (para 50).
- (v) 6th wagon—No parameter of this wagon could be measured (para 51).

(b) While with the measurements that could be recorded of the 5 wagons no defects could be found in the wagons which could have led to the derailment, there was one wagon which was

so badly capsized that no measurement at all could be taken of any of the parameters. These wagons were however examined as many as 5 times by 5 different TXRs at various points during their journey from Bhusawal to the place where the train came to grief. They were examined in detail by TAR/Bhusawal before they were declared fit for being attached to the passenger train. They were then examined by TXR, Central Railway, Ajni, TXR S.E. Railway, Nagpur, TXR, S.E. Railway, Dongargarh and TXR, Rourkela. Their testimony has been summarised in Paras 24 to 28 above respectively. They have all emphatically stated that they did not find any thing wrong with the wagons which they examined. TXR, S.E. Railway, Nagpur got 2 wagons marked sick and allowed the remaining 6 wagons to proceed. In view of the overwhelming evidence furnished by various train examiners of Central and S.E. Railway as further confirmed by a detailed examination after the accident. I cannot but conclude that there were no defects in the wagons which could have caused the derailment.

(c) As far as the passenger coaches are concerned it would be seen from paras 52 to 58 above that almost all the passenger coaches had no deficiencies which could have even remotely been responsible for the derailment. Even the fact that two dash-pots of the 9th coach were found in a dry condition could hardly have resulted in a derailment and in any case the first vehicle to derail was the 4-wheeler wagon second from the locomotive and the 9th coach was too far away to have played any part in the derailment. It could, therefore, be said with some certainty that the derailment was not caused by any defect in the loco 4-wheeler wagons or the coaches.

63. *The state of the track when the train came along*

(a) According to the observations recorded after the accident the track had been opened out for through packing for a total length of 67.3 m., 50.3 m. in rear of the point of drop and 17 m. ahead of the point of drop (see para 41 above). The track in this reach consisted of steel trough sleepers and ballast had been removed upto 50 mm. below the bottom of the sleepers. Ballast had also been removed beyond the ends of the sleepers for correcting the alignment. The gang deployed for carrying out through packing at this stretch was not a permanent maintenance gang but a temporary CPC scale gang consisting of about 17 men working under the supervision of a permanent gangman Shri Subhas. The permanent gangman had, after giving the alignment, apparently left the spot for attending to broken fish-bolts on the Up road, a little ahead towards Sonua, and at the time the accident took place the work was being supervised by another CPC scale gangman Shri Narayan. According to the evidence of this gangman, (para 29 above) the gang took about two hours to open out the track and after correcting the alignment and doing some alignment packing, had dispersed to take a little rest and drink some water. Apparently the gang were resting from 10.30 to 11.30 hours, during which time two Goods trains passed over the opened track without any mishap. The ill-fated passenger train passed through the spot at about 11.36 hours when it derailed.

(b) According to observations of cross-levels under load made after the accident, the maximum twist that existed in the track behind the point of drop was of the order of 4 to 4.5 mm per metre while the twist varied from 0.25 mm to 2 mm per metre with isolated figures of 3.5 mm to 4 mm per metre (para 42 above). The percentage of the missing keys in the steel trough sleepers was respectively 18%, 13%, 17.5% and 16% in the four panels in the rear of point of drop (para 43 above). The extent of creep was of the order of 130 mm to 155 mm, though the PWI had adjusted the creep only one month previously. There were at least five successive jammed joints on the right rail and four successive jammed joints on the left rail in rear of the point of drop [para 43(d) above].

64. *The evidence of the Driver and Assistant Driver*

(a) According to the evidence of Shri Sahay, Driver of the ill-fated passenger train [para 14(a) above] he had picked up a speed of 65 to 70 Km/h upto Km. 330, where he had to obey the engineering signals, according to the caution order given to him. He reduced the speed to 40 Km/h but finding no engineering gang working, continued to proceed ahead at the same speed. A little distance beyond, he saw two gangmen standing some distance apart signalling with their hands to proceed slowly. Soon after he passed the second man, his Assistant Driver shouted that there was buckling of track ahead. While he was trying to control his speed he approached the spot of buckling and experienced a heavy lurch in the loco. He immediately applied the full emergency brakes. The Driver however admitted on further questioning that he did not himself notice the track buckling at first but on his Assistant's drawing his attention to it, vaguely felt that there was something like buckling in the track. Though he knew that the application of emergency brakes while a train was negotiating a

sag might lead to a derailment (in the present case, derailment took place while the train was still on the down gradient, and had not yet reached the level portion), yet the lurch which he felt was so severe that he could not but apply the emergency brakes. The Assistant Driver Shri T. Krishna testified (para 15 above) that he noticed the track ahead being in a slightly zigzag condition and shouted to his Driver to control the train immediately. By that time the train had reached the spot where the track was distorted and they felt a severe jerk due to which he was thrown out from his seat. The Driver applied the emergency brakes then. He also got up and applied the emergency brakes.

(b) The Driver's statement that he had slowed down to 40 Km/h when he approached the place where the gang was working is in conflict with the evidence of the Guard of the train, the Divisional Engineer who was travelling in his inspection coach at the rear of the train and that of some of the passengers on the train (para 59 above). Accordingly I have to discard the evidence of the Driver about the speed of the train and conclude on the basis of the latter evidence that the Driver had been running his train at a fairly good speed from Sonua and on finding no men working at the mileage given in the caution order had continued at the same speed. When he suddenly encountered some men working on the track at Km. 326, he assumed that this was the spot where he had to obey the engineering hand signals as mentioned in the caution order and finding two men showing hand signals, he must have hurriedly applied the emergency brakes to control his train. This is borne out by the clear evidence of the Divisional Engineer according to which he felt the first application of the emergency brakes when his inspection coach was somewhere between 326/4 and 326/2. Assuming that the train was travelling at a speed of 19.4 metres per second (i.e. 70 Km/h) and that the time of propagation of brakes from the loco to the inspection coach was about 9 seconds @ 0.6 second per vehicle, the Divisional Engineer must have felt the brakes after the train had travelled a distance of $19.4 \times 9 = 174$ m. The length of the train being 241 m., this would mean that the locomotive was approximately near Km. 326/4 when the emergency brakes were applied. This is further confirmed by the statement of Assistant Driver [para 15(a)] that while approaching Km. 326/4, some gangmen exhibited hand signals to slow down the train, and his reported exclamation to the ATFO [see subpara (c) below].

(c) *Distortion of track*

As mentioned in para 41 above, a pronounced kink was noticed in panel L₁L₂ of the track about 13 m. in rear of the point of drop. The driving crew of 322 Down have testified that they found the track distorted as they were nearing Km. 326/4 (paras 14 and 15 above). But this is contrary to the evidence of witnesses, Gangmen Shri Narayan and Shri Ganga, who have testified that the track was perfectly in alignment both when they broke off for taking some rest and when they came back to recommence the work just before the passage of the passenger train [vide paras 29(b) and 30(b) above]. The Driver and Guard of M/BANC Down Goods train which passed the spot just prior to the ill-fated passenger train have stated that they found nothing wrong with the track when they passed through the accident spot about 20 minutes earlier [paras 16(b) and 21 respectively]. While the Driver of the ill-fated train Shri Sahay was somewhat equivocal in his testimony as to whether he actually noticed the distortion in the track, his Assistant Driver Shri Krishna was however emphatic that he saw the track distorted. What makes this statement of the Assistant Driver somewhat doubtful is the fact that the gangs which were working at this very spot failed to detect any distortion in the track as testified by them and that the Assistant Driver in his conversation with ATFO immediately after the accident did not make any reference to the distortion of the track. He is merely reported to have remarked "What can be done? The track was opened out, the gangmen were running, we thought that there was some danger and applied the emergency brakes" [Para 22(b) above]. Even the Driver, when he met the gangman Shri Ganga, merely questioned him as to why they were pulling back without caution order and did not make any mention about the track being disturbed [para 30(b) above]. It is probable that the Driver and the Assistant Driver, after seeing the distorted track after the accident, might have decided to claim that the track was distorted even when they approached the spot prior to the accident, in order to explain their application of emergency brakes. On the contrary it is also possible that they might have seen the track actually getting distorted just as the train approached the spot. Notwithstanding the fact there is some doubt about the genuineness of the claim of the Assistant Driver about the track being distorted, the possibility of the accident having happened due to distortion of track has been considered in para 67 below.

65. *Was the derailment due to the cross levels and twist in the track*

The cross levels measured under load and the twist calculated therefrom have been referred to in para 42 above. (Details are in Appendix 11B). On the basis of the measurements made after the accident the twist varied from a minimum of 0 m to a maximum of 4.5 mm per metre. The worst figure of twist occurred between stations 17 and 13 and the next lower figure of 4 mm per metre occurred between stations 7 and 3 in rear of the pair of drop. Though there is a possibility that the worst figure of 4.5 mm per metre was actually as a result of the accident and the twist that existed in the track just before the accident was of a much lesser magnitude. I have nevertheless carefully considered whether the twist as measured after the accident was the cause of the derailment. According to the tolerances for track geometry laid down for high speed routes maximum twist permitted on a 3.5 m. base is 2 mm per metre which may go up to 3.5 mm per metre for isolated locations. For track in category C (100 Km/ph) the limits of twist should not exceed 3.5 mm/m generally (No limit has been prescribed for isolated location). It would appear that a twist of 4 to 4.5 mm per metre could not be regarded as dangerous enough to cause a derailment of a slow speed passenger train with a maximum permissible speed of 72 Km/h. Again, according to the studies carried out by ORE (ORE B/55) the safety tolerance for twist parameter for speeds upto 30 Km/h applicable to yards was found to be 1 in 144 i.e. 7 mm per metre for a 5 metre base of measurement. For a wheel base of 4 m., a steeper twist can be tolerated. Considering all aspects I feel that a twist of 4 mm or 4.5 mm per metre could not therefore have caused the derailment in the present case.

66. *Can the application of the emergency brakes cause a derailment?*

During the inquiry the engineering officials tried to suggest that the application of the emergency brakes by the Driver could have been one of the causes for the derailment. I have carefully considered whether the derailment could be due to the application of the emergency brakes. It is true that a number of derailments had taken place on the Indian Railways (and other world railways too) by the sudden application of emergency brakes. Such occurrences are more frequent when the gauge is small such as in metre gauge and where the train is negotiating a sag with a portion of the train on the up-gradient and a portion on the down gradient. Such derailments also occur when a lightly loaded 4-wheeler wagon is marshalled between two fully loaded wagons and the light wagon tends to jump on application of the brakes. In the present case all the six 4-wheeler wagons behind the locomotive were fully loaded with bananas. The train was coming down gradient and had not reached the sag when the brakes were applied. Besides emergency brakes are being applied by train drivers in several instances every day on the B.G. system of Indian Railways and rarely does it result in derailment. I am, therefore, inclined to think that this derailment was not due to the application of the emergency brakes. Application of emergency brake however has another effect on the track, in that it induces certain axial forces in the track, which aspect is discussed in the following paragraph.

67. *Axial forces due to temperature and braking*

(a) *Axial force due to braking and tractive effort.* Several investigations have been carried out by the European Railways on the axial forces induced in the track by braking/tractive effort. In an article entitled "Axial and Lateral Track Ballast Resistance" by P. Dongneton published in the book "Rail Road Track Mechanics and Technology"—proceedings of symposium held in Princeton University in April 1975", the author has mentioned that the longitudinal stresses in the rail during the starting and braking could be upto 0.9 daN/mm² giving an axial force 50 kN per rail. Under unfavourable circumstances such as ballast deconsolidated or coach screws loosened etc. (as in the present case where ballast was opened out continuously and there were some missing keys) much higher axial forces must be anticipated. According to the author this could be of the order of 100 kN or more per rail. Converted to metric units this gives an axial force of 10 tonnes per rail. This would act in addition to the thermal forces acting on the rail due to variations of temperature.

(b) *Axial force due to temperature*

Unfortunately the Railway was not in a position to furnish information regarding the temperature at which the rails were originally laid at the time of track renewal. However assuming that there is no stress in the rail at the mean annual temperature, the force in the rail due to the temperature effect on the day of the accident can be worked up from the well-known formula

$$P = AE\alpha T$$

Substituting the value of A, E, α , being the physical properties of the rail and T being difference between the rail temperature observed at the time of accident and the mean

annual temperature, this gives a value of 26.2 t to the axial force present in the rail due to thermal stresses at the time of the accident, (this is valid for a LWR only). According to the theory of long welded rails, it is well-known that the area in the middle of the EWR panel does not undergo any movement whatever be the rise in temperature and that in the area at the ends designated as "breathing length", expansion is partly prevented by the resistance offered by each sleeper. In the case of 3 rail short welded panel however, there is no area where movement is completely prevented and in the entire reach some movement takes place. Assuming that a steel trough sleeper offers a ballast resistance of 0.6 tonnes per rail seat, the maximum force which a 3 rail panel can take with restricted movement is limited to the maximum resistance which can be mobilised by half the number of sleepers in a panel which is $30 \times .6 = 18$ tonnes. When the force in the rail exceeds this amount, the rails move freely at either end. In the normal case the expansion gaps available in the fish-plated joint is expected to take up the movement caused in the SWP as a result of thermal forces in the rail with the maximum rise in temperature, assuming of course that the track is fully boxed up. When the track is fully opened out it is clear that the ballast resistance offered by each sleeper will sharply reduce. If we assume that it reduces by about 60%, then the maximum resistance offered by the sleeper in the panels will correspondingly reduce to 7.2 tonnes and the movement of the rail that takes place at the fish-plated ends would correspondingly increase. Again, if we take into account the axial forces caused in the panel by the application of brakes as an addition to the thermal forces, the movement of the rail at the fish-plated end will further increase. According to the joint observations made after the accident it was found that there were as many as five successive jammed joints in rear of the point of drop. This would mean that there was no room for the expansion of rail to take place and the SWP was acting like a LWR; the possibility of the track distorting under such unfavourable circumstances would be very real indeed.

68. Probable cause of the derailment

(a) The main distinctive feature of this derailment was the absence of mounting mark on rail and eye-witness account of the gangmen that the 2nd wagon appeared to have derailed all of a sudden taking the other wagons with it. The vehicles seem to have derailed and capsized in a very short distance of 100 metres after the first point of drop. All these are suggestive of the derailment having taken place owing to distortion of the track. The fact that the buffers of 8th coach and 9th coach were found interlocked (para 53 above) also seems to point towards the distortion of track as being the main cause of the derailment.

As already explained in para 67 above the distortion of track must be due to the fact the track was completely opened out in a continuous stretch which sharply diminished the lateral resistance available in the panel to withstand the axial forces developed in the track due to temperature and braking, coupled with the fact that due to the number of jammed joints in the rear, movement of the rails at the fish-plated ends was prevented. Under such unfavourable conditions the track must have distorted either under or in front of the approaching train.

(b) This derailment had some identical features in common with three similar derailments of Express trains which had taken place earlier on the Central Railway (derailment of 16 Down GT Express between Narkher and Kalambha at Km. 957/6 on 2-12-77, derailment of 28 Up Varanasi Express at Km. 147/24-6 between Asvali and Ghoti stations on 9th April 1979 and derailment of GT Express at Sindi station of Nagpur Division on 24-5-77. In all cases the accident occurred while the gang was working on track laid in short welded rails and while the train was running at high speed. No mounting mark could be seen. In at least two of those accidents the track had been completely opened up as in the present case. While two of the accidents took place in the summer months, one took place in winter as in the present case. All these derailments were held to be due to buckling of track/distortion of track.

69. Other matters brought to light

(a) The normal practice in the various Railways and in other Division of South Eastern Railway is not to deploy temporary gangs independently for through packing of track or any other track operations but to make them work along with the permanent gang. They are, however, deployed independently in other operations such as cleaning of side drains, making up ceases etc. not involving actual work on the track. It is surprising that in Chakradharpur Division the practice of deploying temporary gangs for track maintenance has been prevalent for quite sometime. The permanent employee Shri Subhash who was supervising the work of this temporary gang was not even a mate but only a permanent gangman. PWI when questioned stated that

as there was no sanction for a permanent mate, he had deployed this temporary gang to work, under Shri Subhash, an intelligent permanent gangman. As working on short welded panels requires experienced gangmen, it was unfortunate that temporary gangmen were deployed for through packing of the track on this important trunk route carrying heavy rail traffic with some of the important mail and express trains running at 110 Km/h.

(b) While it was bad enough to allow the temporary gang to work under the supervision of only a permanent gangman, in the event even the permanent gangman left the spot to attend to some other spot on the uproad and that too on the instruction of a CPC scale trolleyman of the PWI Grade III to replace some broken fish bolts. This state of affairs indicates a certain slackness in the tightness of supervision by the higher officials of the Engineering Department of the work on Permanent Way maintenance which needs to be put right in the interests of safety.

70. Need for review of the SWP Manual

As already mentioned in para 44(c), the manual for maintenance of soft welded panels permits continuous opening of the ballast in the panels for maintenance operations as long as rail temperature does not exceed T_s+25° . A more conservative limit of T_s+15° is laid down in para 4.3 of the Manual (Annexure III) for operations such as measured shovel packing, heavy lifting, etc. (qualified by the requirement that there should be no butting of rails). In the light of what has been discussed in para 67 above there seems to be a need to review the limit laid down for continuous opening out of ballast for normal maintenance operations and examine whether it would be advisable to bring it down to T_s+15° with the added qualification of there being no butting of rails. It also needs to be examined whether the complete opening of ballast should be altogether prohibited regardless of rail temperature in certain special locations like long down gradient sags etc. It may be advisable to stipulate that before opening out any panel the missing/loose rail fastenings should be restored in the adjacent panels.

VIII. CONCLUSIONS

Cause

71. On a careful consideration of the factual, material and circumstantial evidence, I have reached the conclusion that the derailment of 322 Down Nagpur-Tatanagar Passenger train between Sonua and Lotapahar stations on the Rourkela-Chakradharpur double line electrified Broad Gauge section of Chakradharpur Division of South Eastern Railway at 11.35 hours on 27-11-81 was in all probability due to the distortion of track at Km. 325/28 under the running train or just moments before its arrival caused by the opening out of the track for through packing which impaired its lateral resistance and which was compounded by the presence of five successive jammed joints in the rear of the point of drop. While the application of emergency brakes may not have directly contributed to the derailment, it is likely that it caused some axial forces to the track which contributed to the distortion of the track.

Responsibility

72. While I do not hold any individual staff responsible for this accident, I however feel that the following staff were blameworthy for their acts of commission and omission detailed against each :

- (i) Shri Subhash, S/o Aparajit, Permanent Gangman, for having allowed the temporary gang to continue to work on the track in his absence, under the supervision of another CPC scale gangman. When informed by the trolleyman to attend to the broken fish plates on the up-road, he should have asked for assistance from the PWI/III as he himself was supervising the temporary gang.
- (ii) Shri L. Dutta, PWI/Grade III, Chakradharpur should have taken care to note the existence of jammed joints in the region where the track was to be through packed, and taken adequate measures to restore missing/fallen keys in the adjacent panels.
- (iii) Shri H. C. Sen, PWI/Chakradharpur is also considered blameworthy for the same reason i.e. not spotting the existence of jammed joints. The PWI however struck me as a competent PWI and gave evidence in a forthright and unequivocal manner. The records maintained by him were also complete and he had been awarded prizes for best maintenance of track. These factors may be taken into account by the Railway while disciplining him.

Relief Measures

73. I am satisfied that the medical relief was prompt and efficient.

IX. REMARKS AND RECOMMENDATIONS

74. This accident as well as similar accidents in the past has underscored the need to observe caution while opening out consecutive sleepers of short-welded panels for track maintenance even when the rail temperature does not exceed $T_s+25^{\circ}\text{C}$, particularly in unfavourable circumstances such as existence of a number of jammed joints in the welded panels in the vicinity; existence of missing/fallen keys in the adjacent panels, locations on continuous down gradients or sags etc. As discussed in para 70 it may be examined whether the manual of instructions for maintenance of short-welded panels framed by the RDSO should be modified to lay down a more conservative limit of T_s+15 for continuous openings out of ballast for normal maintenance operations as well with the added qualifications of there being no butting of rails and to lay down the precautions to be observed before opening out the track continuously by way of pulling back creep, restoring the missing track fittings etc. It also needs to be examined whether complete opening of ballast should be altogether prohibited regardless of rail temperature in certain special locations like long-down gradients, sags etc.

75. As discussed in para 69 above, the practice prevalent in certain Divisions of South Eastern Railway of allowing temporary gangs to work on the maintenance of track under the supervision of permanent gangman needs to be reviewed and it may be worthwhile to ensure that temporary/casual labour gangs are not deployed of maintenance of track except when assisting permanent gangs. The Railway may also tighten up the supervision by the subordinates or the working of the gangs.

76. The then CRS/Central Circle in his accident report on the derailment of 28-Up (Varanasi-Dadar) Express train between Asvali and Ghoti stations in Bhusaval Division of Central Railway on 9th April, 1979 had recommended that the Railway Board should lay down the maximum number of jammed joints that can be allowed for short-welded panels. The Railway Board vide their O.M. No. 79/Safety(A&R)/1/9 dated 6th April 1981 had mentioned that the suggestion of the CRS would be examined in consultation with the RDSO. No instructions have yet been issued by the Railway Board on this important aspects. which may be expedited.

77. During the course of inquiry it was stated by the PWI that creep had been pulled back in this reach in October 1981 and yet in the course of one month the creep had again approached 150 mm, the limit prescribed in the Way and Works Manual. The presence of jammed joint in rear of the point of drop was most probably due to the creep of the rails. The importance of arresting creep in SWP has been repeatedly emphasised by the Commissioners of Railway Safety in their accident reports on such accidents as well as in many circulars issued by the Railway Board. Another area of great concern is that the percentage of missing keys in rear of the point of drop varied from 15% to 17.5% (para 43-Figure worked out from joint observations at Annexure IIA). The question of missing fittings in track has also been repeatedly high-lighted in the reports of Commissioners of Railway Safety on recent accidents. The Railways should take concerted action to overcome the problem of creep and of missing fittings from the track, in the interests of safety of rail travel.

Yours faithfully,

Sd/- (S. SUBRAMANIAN)
Commissioner of Railway Safety,
South Eastern Circle, Calcutta.

Calcutta,

Dated : 22nd October, 1982


ANNEXURE— I

MARSHALLING ORDER OF ILL-FATED 322 DOWN

Sl. No.	Owning Railway	Coach No.	Type	Year Built	Date of last POH	POH Due	AT/Non-AT
1	2	3	4	5	6	7	8
1.	WR	67367	C		31-10-78	4/82	4-Wheeler
2.	ER	89061	C		18-7-79	1/83	4-Wheeler
3.	CR	54314	C		23-7-79	8/82	4-Wheeler
4.	ER	1965	C		24-7-81	Not recorded	4-Wheeler
5.	ER	1606	C		9-5-79	11/82	4-Wheeler
6.	ER	81805	C		12-11-79	5/83	4-Wheeler
7.	SE	2047	GSY		17-10-81	5/83	IRS/Non-AT
8.	SE	1999	GS		19-3-81	10/82	ICF(L)/AT
9.	SE	443	WFC		21-11-80	12/81	ICF(AC)/AT
10.	ER	2564	WGS		30-7-81	8/82	ICF(AC)/AT
11.	SE	5284	WGS		10-4-81	10/82	ICF(AC)/AT
12.	SE	1916	GS		12-4-79	10/81	IRS/Non-AT
13.	SE	4712	SLR		9-7-81	2/83	BEML/AT
14.	SE	3108	ERB		17-4-75	4/77	4-Wheeler
15.	CR	58447	C		31-10-78	4/82	IRS

ANNEXURE — II-A

TRACK READINGS WITHOUT LOAD

Sleeper No.	Track, gauge	Cross levels	Condition of Fastenings	Remarks
1	2	3	4	5
60	-5	4 LL	One F. Bolt on right sheared. One Bearing plate fresh broken. R. H. outside one Key deficient. L. H. one inside Key deficient.	Jt. L ₁ L ₂ Point of drop.
59	-5	4 „	R. H. outside one Key deficient.	 <p>Towards rear of point of drop.</p>
58	-4	4 „	R. H. inside one Key deficient. L. H. inside Key deficient.	
57	-4	0		
56	-5	6 RL	R. H. outside Key deficient.	
55	-6	8	R. H. inside Key deficient.	
54	5	11		
53	-2	13	L. H. Out Key + Jaw deficient.	
52	-2	20	L. H. One Key + Jaw missing.	
51	-1	22		
50	-2	24		
49	-3	24		
48	-2	24		
47	1	24		
46	-1	24	L. H. inside Key deficient.	
45	0	22	R. H. 2 Keys deficient. L. H. 1 Key deficient. inside.	
44	-2	20		
43	0	19		
42	-1	17	L. H. inside Key deficient.	
41	-3	-15 RL		
40	-2	-12 „	R. H. Outside Key deficient.	
39	-1	-7 „		
38	-2	-3 „	R. H. inside Key deficient.	
37	-3	-6 LL	R. H. inside Key deficient + Jaw	
36	-2	-6 „		
35	-1	-10		
34	0	-10		
33	+1	-10	L. H. Outside One Key + One Jaw def.	
32	+2	-12		
31	+1	-14		
30	0	-14		
29	+1	-12	R. H. inside Key deficient.	
28	-2	-9		
27	-5	8		
26	-7	-8	R. H. Both Keys worked out. L. F. One Key deficient.	

Sleeper No.	Track gauge	Cross levels	Condition of fastenings	Remarks
1	2	3	4	5
25	-8	-7	R. H. both Keys worked out.	
24	-9	5	R. H. inside Key W/Out.	
23	-8	6	R. H. inside Key W/Out.	
22	-7	-6	L. H. One Key def. out.	
21	-2	-6	R. H. inside W/out.	
20	-1	-6		
19	-2	-5	R. H. inside Key deficient.	
18	-2	-4	R. H. inside one Key deficient.	
17	-2	-0	L. H. inside one Key deficient.	
16	-4	-0	L. H. inside Key deficient.	
15	-2	-0		
14	-1	-8 RL	R. H. outside Key deficient.	
13	-1	8		
12	+1	-9		
11	+1	-9	Keys LH + RH Deficient.	
10	+2	-9	L. H. Jaw + Keys deficient.	
9	+2	-9	R. H. outside Key + Jaw deficient.	
8	+1	+9	L. H. inside Jaw + Key deficient.	
7	-1	-9	R. H. inside Key deficient.	
			L. H. inside Key deficient.,	
6	-3	-10		
5	-1	-7		
4	-2	-7		
3	-5	-4	R. H. Jaw + Key deficient.	
2	-12	-2	R. H. Jaw + Key W/out.	
1	-9	-2	L. H. in Key worked out.	
-1	-12	-2		Joint L ₀ L ₁
-2	-5	-5 LL		
-3	-2	-0		
-4	-5	-8		
-5	-8	-8	R. H. & L. H. Keys deficient.	
-6	-6	-9 LL		
-7	-6	-8		
-8	-5	-8		
-9	-7	-7		
-10	-4	-8	R.H. inside Key deficient.	
-11	-2	-5		
-12	-1	-5	R. H. inside Key deficient.	
-13	-2	-5	LH in Jaw + Key deficient.	
-14	-2	4		
-15	-1	-2	L. H. inside deficient.	
-16	-1	-2	Upto here ballast opened.	
			L. H. Out Key deficient.	
-17	-1	-3	L. H. Out Key deficient.	

↓
Towards rear of
point of
drop.

Joint L₀ L₁

↓
Towards rear of
point of drop.

Sleeper No.	Track gauge	Cross levels	Condition of fastenings	Remarks
1	2	3	4	5
-18	-2	-3		
-19	-5	-4	L. H. in Jaw + Key deficient.	
-20	-5	-2	L. H. in Jaw + Key deficient.	
-21	-3	4 RL		
-22	-1	-4	L. H. inside Key deficient.	
-23	-2	4		
-24	-3	-4	L. H. + R.H. inside Key deficient.	
-25	-2	-4		
-26	-5	-3		
-27	-5	-3 R.L.	L.H. in Keys deficient.	
-28	-4	-3		
-29	-2	-3		
-30	-E	-3	Inside Key deficient L. H.	
-31	+2	-4	L. H. inside Key deficient.	
-32	+2	-4		
-33	+2	-2		
-34	E	-2		
-35	-E	-3		
-36	-1	-2	RH/LH Jaw + Key inside.	
-37	E	-2		
-38	-2	-5 LL		
-39	-4	-5	LH inside Key + Jaw deficient.	
-40	-3	-5	L.H. inside Jaw + Key deficient.	
-41	-3	-1		
-42	-2	-2	L.H. Both Jaw + Key deficient.	
-43	-2	-2		
-44	-2	-3RL		
-45	+2	-3		
-46	E	-3		
-47	E	-3		
-48	-1	-2		
-49	-2	-2		
-50	-3	-0		
-51	-4	-0	L.H. inside Key deficient.	
-52	-8	-0		
-53	-8	-3 LL		
-54	-6	-5		
-55	-2	-6	L.H. One Key deficient.	
-56	-2	-6		
-57	-2	-4	R.H. in Key deficient.	
-58	-4	-5		
-59	-4	-4	L. H. in Key deficient.	
-60	-5	-6 LL	R.H. outside Key deficient.	
-61	-7	-6	R.H. in Jaw + Key deficient. etc. etc.	Joint Lo L ₁ .

↓
Towards rear of
point of drop.

Sd/-
PW1/CKP.Sd/-
CF/CKPSd/-
DTI/CKP

Annexure II B

Evaluation of twist effective for 4m. wheel base (readings of cross level taken under load.)

Station Nos.	Cross levels	Twist over base of measurement mm/m	Effective twist over 4m. wheel base	REMARKS
0	-4	4		Joint L ₁ L ₂
1	-8	6		(point of drop)
2	-2	4		
3	-6	8		
4	+2	2		
5	0	12		
6	+12	2		
7	+10	-		
8	+10	6		
9	+	1		
10	+5	1		
11	+6	0		
12	+6	6		
13	0	-		
14	0	-		
15	0	-		
16	0	18		
17	-18	10		
18	-8	7		
19	-15	3		
20	-12	3		
21	-15	3		
22	-12	2		
23	-14	2		
24	-12	-		
25	-12	4		
26	-16	2		
27	-14	2		
28	-16	6		
29	-10	1		
30	-9	-		

Towards rear of point of drop

ANNEXURE-III

Extract from Manual of instructions for laying and maintenance of short welded rails (SWR) (Provisional) May 1976—Issued by RDSO.

4. Maintenance of short welded rail

4.1 Regular maintenance operations

4.1.1 Regular track maintenance including all operations involving packing, lifting, aligning, local adjustments of curves, screening of ballast other than deep screening and scattered renewal of sleepers may be carried out without restriction when the rail temperature is below $t_s+25^\circ\text{C}$.

4.1.2 If the maintenance operations have to be undertaken at temperatures higher than $t_s+25^\circ\text{C}$, not more than 30 sleeper spaces in one continuous stretch shall be opened, leaving at least 30 fully boxed sleeper spaces between adjacent lengths which are opened out.

4.1.3 Before the end of the day's work, it shall be ensured that the ballast is boxed up.

4.1.4 Adequate number of joggled fishplates with special clamps shall be provided to the gangs for use in case any rail or welded joint fails. In the case of any fracture in the weld or in the rail, the portion of the rail with fracture is cut and removed for a length of not less than 4m to carry out the re-welding duly introducing a rail piece of equivalent length also ensuring that no weld lies closer than 4m from the fishplated joint.

4.2 Major lifting, major realignment of track, deep screening and renewal of sleepers in continuous lengths : Each of these operations shall be done under suitable precaution and normally when the rail temperature is below $t_s+15^\circ\text{C}$. If it becomes necessary to undertake such works at rail temperature exceeding $t_s+15^\circ\text{C}$, adequate speed restriction shall be imposed.

4.3 Measured shovel packing

4.3.1 Through MSP/joint MSP on short welded rails shall be carried out only when the rail temperature is below $t_s+15^\circ\text{C}$, provided the rails are not butting and are not likely to butt during the course of the work.

4.3.2 MSP of wooden sleepers at joints may be undertaken even when the rail temperature is above $t_s+15^\circ\text{C}$ provided the gaps are not closed and the temperature is falling as normally obtainable in the late afternoon.

4.4 Maintenance of gaps in short welded rails

4.4.1 Gap survey and rectification of gaps is to be carried out as explained in clause 5 in stretches where track develops excessive creep, jammed joint, sun-kinks, buckline, wide gaps, battered and hogged joints, fractures at joints, bending of bolts, etc. If such adverse features are being experienced with 5 or 10-rail panels, the panels should be cut into 2½ rail panels, as gap rectification on 5-rail or 10-rail panels is not expected to eliminate them.

4.4.2 It will be desirable to convert the existing 10-rail panels and 5-rail panels into 2½-rail panels wherever maintenance problems cannot be solved otherwise. Further, wherever conditions permit, conversion of short welded rails (3, 5 or 10-rail panels) into long welded rails may also be considered.

5. Gap survey and rectification

5.1 The gap survey on 3-rail shall be conducted between 12 hours and 15 hours on a clear and sunny day when the rail temperature is between t_s-10° and $t_s+15^\circ\text{C}$. The length over which the gap survey is to be done should wherever possible be divided into suitable subsections each bounded by fixed points such as level crossings, points and crossings, etc. The gap survey on each subsection should be completed within short time during which the rail temperature is not likely to vary appreciably. For this, adequate number of survey parties should be engaged.

5.2 The joint gaps shall be measured by taper-gauge (similar to one shown in Fig. 3) in mm and the readings entered in the proforma shown in Annexure I.

5.3 The recommended range of values for the gaps, both individual and average, for various ranges of rail temperature are laid down in Table 5.3.

TABLE 5.3
Recommended values of Gaps (in mm) during Service for the Various Rail Temperature
Ranges (In C)
(Gap Survey being carried out when rail temperature is in rising trend only).

Temp. during gap survey	ts—12.5	ts—7.5	ts—2.5	ts+2.6	ts+7.6	ts+12.6
	to	to	to	to	to	to
	ts—7.6	ts—2.6	ts+2.5	ts+7.5	ts+12.5	ts+17.5
Permissible value of gaps	11 to 14	9 to 13	7 to 11	5 to 9	3 to 7	1 to 5

NOTE : The gaps given above are to be distinguished from the gaps given in Table 3.1 which are intended to be provided at the time of initial laying of SWR.

5.4 The average of the measured gaps is worked out as shown in the proforma. Comparison of the entries with the concerned range for joint gap stipulated in Table 5.3 will lead to one of the following cases :

Case I : Average gap is within the recommended range; but some of the individual gaps fall outside the range.

Case II : Average gap falls outside the recommended range.

5.5 The action to be taken in each of the above two cases shall be as follows :

Case I : Rectification work should be restricted to correcting the individual gaps which fall outside the recommended range. Rectification should be done by pulling the minimum number of rails. Under no circumstances shall the adjustment be done by cutting a rail or introducing a longer rail.

Case II : The joint gaps shall be systematically adjusted from one end to the other end of the subsection. The rails shall be un-fastened over convenient lengths, the gaps adjusted to the initial laying gaps as per Table 3.1 and rails fastened. In this case, introduction of a longer or a shorter rail will be involved. Efforts should be made to see that only the minimum number of joint sleepers are disturbed.

5.6 As far as practicable the day chosen for rectification should be a day on which the rail temperature is not likely to vary much during rectification period.

ANNEXURE-IV

Joint checking of Loco reading of Loco No. 21212 WAM-4 Loco Power of 322 Down on 27-11-81 at the Accident site at 12.55 hrs.

1. Driving from Cab-2.
2. Yankey Type Speedometer in working order. VDO Disc and Watch not provided.
3. R. P. Gauge Needle on Zero.
4. I.A.B. Needle showing 0.5 KG Pressure.
5. Vacuum needle on Zero.
6. BL unlocked.
7. H.B.A. on Zero.
8. ZPT on Zero.
9. MPJ on 'N' position.
10. 'N' Repeater on Zero.
11. SMCR Drum on Zero.
12. MP on Zero.
13. DVB on applied (E. Position).
14. Assistant Driver's Emergency Brake applied.
15. All B. L. Switches were opened.
16. VEF Cock in open condition.
17. Rear Panto i.e. P. T. damaged.

Sd/-
S. K. Ganguly,
SLI/CKP,
27-11-81.

Sd/-
T. M. Mani,
CDTI (M)/CKP,
27-11-81.

VIEWS OF THE RAILWAY BOARD ON VARIOUS PARAS OF THE REPORT

The findings of CRS with regard to cause and responsibility therefor as given in paras 71 and 72 is accepted.

The remarks of this Ministry with regard to Para 74 of CRS's report are as follows :—

“The Board have considered the suggestions for reducing the range of temperature maintenance of short welded track and has decided that as an additional precaution during summer months, to be specified by the Chief Engineer, for attention to run down track even if rail temperature is less than $T_s+25^{\circ}\text{C}$, not more than 30 sleepers in one continuous stretch shall be opened, leaving at least 30 boxed sleepers spaces between adjacent lengths which are opened up.

Further, if joint gaps are not available at the time of opening of track even when rail temperature are less than those specified in clause 4.1.1 of SWR manual, not more than 30 sleepers in one continuous stretch should be opened leaving at least 30 boxed sleepers space between adjacent lengths which are opened up.”

The above instructions have also been incorporated in the Corrigendum slip No. 5 of October 1984 to Manual of Instructions for laying and maintenance of short Welded Rails.

Para 75 : The suggestion regarding supervision of work of a temporary gang by a permanent mate has been accepted and necessary instructions in the matter have been issued under Board's letter No. 82/W6/PRA/6 dated 8-7-83. (

Para 76 : Instructions have been issued to the Railways under Board's letter No. 82/W6/PRA/6 dated 8-7-83 that in case of short welded rail panel track, not more than two jammed joints at temperature T_s or lower should be permitted.

Para 77 : Railway has taken action to recoup missing fittings, and will continue to be vigilant in this regard.

PRI-297
500-1991 (C.L.K.) IV

Price : Inland Rs. 76.00
Foreign £ 2.92 or \$ 4.55

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