



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

## **RAILWAY ACCIDENT INVESTIGATION**

# **REPORT**

**ON**

**SIDE COLLISION OF B-90 UP LOCAL WITH CM-15 DOWN LOCAL  
AT RAOLI JUNCTION ON THE HARBOUR BRANCH OF THE  
SUBURBAN SECTION OF CENTRAL RAILWAY'S BOMBAY  
DIVISION AT 16.19 HOURS ON 24-4-1981**

## S U M M A R Y

1. Date : 24th April, 1981.
2. Time : 16.19 hours.
3. Railway : Central.
4. Gauge : 1676 mm (Broad Gauge).
5. Location : Km. 10.22, at Raoli Junction, where the Harbour Branch forks into Mahim Chord and Kurla Chord.
6. Nature of Accident : Side-Collision.
7. Trains involved : (i) B-90 Up Bandra-Bombay VT Local; and  
(ii) CM-15 Down Bombay VT-Chembur Local.
8. Consisting of : Each of 9-coach Electric Multiple Unit Stock (3 units of 3 coaches each).
9. Estimated speed, at the moment of impact : (i) B-90 : 40 Km/h.  
(ii) CM-15 : 70 Km/h.
10. System of Operation : Automatic Block System, with Colour Light Signals at Raoli Jn. manually controlled by Panel Interlocking from Cabin.
11. No. of tracks : Two, on each Chord.
12. Gradient : (i) 1 in 91 falling for B-90 ; and  
(ii) Level for CM-15.
13. Alignment : (i) 21/2° right-handed curve for B-90; and  
(ii) Straight for CM-15.
14. Weather : Clear.
15. Visibility : Normal.
16. Casualties : Killed -28  
Injured-79 (53 Grievous and 26 Simple).
17. Cost of Damage : Rs. 9.95 lakhs.
18. Cause : B-90 having been driven past the King's Circle Up Starter Signal at 'ON'.
19. Responsibility : (i) Motorman of B-90 (Primary).  
(ii) Guard of B-90 (Contributory).
20. Important Recommendations in brief : (i) Recommendations aimed at improving safety at Raoli Junction—
  - Extension of Flank Protection at RVJ;
  - Protection of RVJ against run-away vehicles ;
  - Visibility of Signal No. RVJ-5 at KCE to be improved.(ii) Measures to improved safety generally on the Suburban Section—
  - Reassessment of Motormen's workload for reclassifying Motormen from "continuous" to "intensive" category;
  - Expediting the introduction of AWS on Central Railway's Suburban System;

- Improvement of the visibility of Platform “Starters” on the Suburban Section;
  - Advantage to be availed of the existing Guard’s or Platform Repeaters;
  - Safety at double-line running junctions in quadruple-line territory by segregation of traffic-streams on the fast and slow lines and strictly restricting the use of the available cross-overs.
- (iii) Measures aimed at improving the level of confidence in the functioning of the S & T Department on the Suburban Sector—
- Railway to restrictedly regularise the recourse to short-cut methods under specified exceptional circumstances ;
  - Creation of the post of Signal Fault Controller ;
  - Display of Route Control Charts to be provided at Cabins.
- (iv) Review of Policy regarding the maintenance of Counters provided with emergency buttons on Control Panels.

NO. C-10(INQ)/50

GOVERNMENT OF INDIA

MINISTRY OF TOURISM & CIVIL AVIATION

(COMMISSION OF RAILWAY SAFETY)

**FROM :** The Commissioner of Railway Safety,  
Central Circle,  
Churchgate Station Building Annexe,  
2nd floor, Maharshi Karve Road,  
Bombay-400 020

**To :** The Secretary to the Government of India,  
Ministry of Tourism & Civil Aviation,  
Sardar Patel Bhavan,  
Parliament Street,  
New Delhi-110001

**THROUGH :** *The Chief Commissioner of Railway Safety, Lucknow-226 001.*

SIR,

I have the honour to submit, in accordance with Rule 4 of the "Statutory Investigation into Railway Accidents Rules, 1973", issued under the Ministry of Tourism and Civil Aviation's Notification No. RS. 13-7(8)/71 dated 19-4-1973, the Report of my Statutory Inquiry into the Side-Collision of B-90 Up Local with CM-15 Down Local at Raoli Junction on the Harbour Branch of the Suburban Section of Central Railway's Bombay Division at about 16.19 hours on 24th April, 1981.

## 2. Inspection and Inquiry

(a) At the time of the accident, I was conducting at Bina Station my Statutory Inquiry into another accident and, temporarily suspending that Inquiry, I returned by the first available means to Bombay to inspect, during the afternoon of 25-4-81, the accident site as well as the Cabin at Raoli Jn. in the company of the Railway's Additional General Manager (Operations). In view of the imperative need to maintain the suburban services in the metropolitan city of Bombay, all the wreckage had already been cleared overnight after the accident and the affected portion of track suitably attended to after getting slewed back into position. Nevertheless, based on the information recorded immediately after the accident, 3 sketches were got prepared, to enable an appreciation to be gained of this accident, as may be seen from Annexures I(a) to (c).

(b) Besides the press notifications issued in the 'Free Press Journal' and 'Nav Bharat Times' (both dated 26-4-1981), inviting members of the public having knowledge relating to this accident to give evidence at the Inquiry or to otherwise communicate with me by post, almost all the other Dailies published from Bombay carried information on the Statutory Inquiry which I commenced at Bombay-VT on 26-4-81 at 10.00 hours.

(c) Despite this publicity, as only one public witness turned up, a further appeal to the public was made through the press media on 30-4-81, in response to which one more passenger on the ill-fated B-90 Up Local tendered his evidence. Evidence was recorded in all of 40 witnesses, including 4 public witnesses, 2 of whom were passengers on B-90 Up Local and one was a retired Railway Officer. Written communications were also received from 2 outsiders.

(d) The Presidency Magistrate as well as the Commissioner of Police (both of Greater Bombay) and the Superintendent of Railway Police, Pune, as also the Additional Superintendent of Railway Police, Churchgate, were all duly notified of the Inquiry. Yet, no Civil or Police Officials called at any stage of the Inquiry at which the following Railway Officers were present :—

Shri P.C. Johorey .. \*Chief Transportation Safety Superintendent, Bombay.  
Shri R. K. Jain .. \*Divisional Railway Manager, Bombay.

Shri K. S. Sreenivasan .. @ Chief Electrical Engineer, Bombay.

Shri T. S. Vardya .. @ Chief Signal & Telecommunication Engineer, Bombay.

\*Present throughout the sittings at Bombay-VT.

@Available as and when their presence was required.

(e) The assistance rendered during the course of this Inquiry by Shri J. Bhattacharjee, Dy. Commissioner of Railway Safety (S & T) from Calcutta and Sarvashree M.C. Sinha and Vishwa Prakash, Dy. Commissioners of Railway Safety respectively for Mechanical and S & T disciplines in the Technical Wing of the Commission's headquarters at Lucknow, is thankfully acknowledged.

(f) Having visited the various hospitals in the company of the Additional General Manager (Operation) on 25-4-81, I was satisfied with the care and medical attention that was bestowed on the victims of this accident, although the sudden influx of patients tended to overstretch the available resources.

(g) In this Report, unless otherwise apparent from the context, the terms, "right", "left", "leading", "trailing", "front", "rear", etc. are generally in reference to the direction of travel of B-90 Up Local.

### 3. The Accident

(a) CM-15 Down Local (hereinafter referred to simply as CM-15), running 3 minutes late ex : Bombay-VT was running through Racli Jn. (RVJ) at full speed towards Chembur at 16.19 hours. In the meantime B-90 Up Local (hereinafter termed simply as B-90), which commenced its journey ex : Bandra on right time, passed the Starter of King's Circle Station (KCE), where it had its scheduled stop, at 'Danger' and collided at the diamond crossing situated as RVJ, with the speeding CM-15 on the latter's left side at 16.19 hours,

(b) It was the second coach from the front on CM-15 that was hit and, right up to its last coach, the left side of CM-15 was badly ripped and torn, inflicting severe injury in this process to passengers travelling on that side. After suffering the side collision, this train travelled 105 m before it came to a halt. None of its 9 coaches derailed, however. This the front (or, the Leading Driving Trailer) coach of the colliding B-90 was not only thrown clear of the Down track, but it had tilted precariously away and clockwise (or, to the right) at an angle of 45° with the vertical, with the result that the damage to CM-15 was much more extensive just above the coach-floor level than at a higher heights in the train on its left side, causing the side-wall and stanchions to be deformed "rearwards" in the lower region.

(c) Reckoned from the instant of impact, B-90 traversed a distance of 41.4 m before it came to halt. The leading left corner of its front (or, the Leading Driving Trailer) coach was found lodged in the second door-way of the last coach of CM-15. The second (or, the Motor) coach had also rebounded/deflected by C-15 to be finally found tilted clockwise (or, to the right) by about 30° off the vertical and the pantograph on its top got disengaged from the OHE contact wire to cause the power to "trip off", by coming into contact either with the pull-off wire or with some other part of Electric Structure No. 10/7. The trailing 7 coaches had not even derailed, however.

(d) At the moment of the impact, the speeds of the 2 colliding trains were as under :—

B-90 : 40 Km/h

CM-15 : 70 Km/h.

(e) The afternoon weather at the time of the accident was sunny, bright and clear, with the visibility in no way impaired.

### 4. Passenger Occupation and Casualties

(a) According to the Railway's calculations, the marked carrying capacity of B-90 and CM-15 were respectively 1734 and 1788 passengers. Having regard to the time of the accident, which was well before the evening peak period, it was most unlikely either that CM-15 was over-crowded or that B-90 (which was proceeding traffic-flow-wise in the "wrong" direction, as it were) was fully filled up with passengers.

(b) I regret to report that 28 commuters travelling in CM-15 died, with an additional 79 injured in this accident, including 53 grievously hurt. Excepting for the injured Motorman of B-90, all the other injured were also travelling by CM-15.

## II. RELIEF MEASURES

### 5. Intimation

(a) The collision having taken place right opposite the RVJ Cabin, all concerned were immediately informed of the tragedy. The Byculla-based breakdown train, ordered at 16.25 hours, left Byculla at 17.05 hours and arrived at the site by 19.00 hours. Western Railway's breakdown train, based at Bandra Marshalling Yard (BAMY), which was also ordered as it was located nearer the accident site, arrived at 18.20 hours.

(b) The City's fire-brigades were also simultaneously intimated without any delay. No less than 8 fire engines rushed to the scene to undertake rescue operations but, even before their arrival at the site at 16.43 hours, the nearby hutment dwellers and others pitched in to help in organising the rescue operations and transport of the injured to the close-by Sion Hospital, by pressing into service whatever road transport that happened to be passing by.

(c) The Byculla-based Medical Van, also ordered at 16.25 hours, could not start earlier than 17.18 hours, because a diesel engine had to be arranged. Eventually, this Van's progress to the site was terminated 'en route' at Kurla, as the Railway doctors had already arrived by road ambulances at 17.10 hours by which time, however, almost all the injured had already been evacuated from the accident site; the remaining few were then transported to, besides the Railway Hospital at Byculla, 2 Civil Hospitals (both located at Parel : namely, the KEM Hospital and the MGM Hospital).

### 6. Medical Attention

Under the given circumstances of the sudden intake of accident victims, with most of them requiring emergency treatment in a situation characterised by the stretching to the limit of whatever the existing resources, medical care of the highest possible order was nevertheless provided by the Sion and other Hospitals almost on a "war footing" and, with requests for donation of blood having been flashed through the all media (Press, Radio and Television) the response from the public was heartening. In spite of all this, however, a total of 11 patients succumbed of their injuries, after admission into the Civil Hospitals.

### 7. Clearance and Restoration

(a) The power failure caused at 16.20 hours by the tripping of Traction Feeders Nos. 13 and 14 in the Sub-Station at RVJ affected the Harbour Branch between RVJ and Cotton Green. Power was restored at 17.00 hours on this section, excepting on the accident-affected reach, which was carefully inspected visually for any evidence of physical damage to the Over-Head Equipment (OHE). When it became clear that the OHE suffered no damage, power was fed to the area around RVJ also at 18.25 hours.

(b) Trains already on the run towards the accident site had to be terminated and pulled back before breakdown services could gain access to the site. A diesel engine removed the unaffected rear string of 7 coaches of B-90 towards Bandra at 18.55 hours. By 19.20 hours the empty rake of B-87 Dn Local was brought from the rear to couple up with the last coach of CM-15. Although CM-15 had not derailed, as its 9th or last coach was found en-angled with the front end of B-90, the front string of 8 coaches of CM-15 was hauled by another diesel engine at 19.37 hours towards Kurla. After the power was switched on in the accident area, this last coach of CM-15 was disentangled and then pulled back by B-87 towards Vadala Road.

(c) The Byculla breakdown crane started work on B-90's first coach at 20.40 hours and, as its damaged front trolley had to be replaced and its rear end tackled by "Lukas" rerailling equipment, all the related operations lasted until 02.40 hours of the next day. In the meanwhile, the Western Railway's breakdown crane set about rerailling B-90's motor coach to complete that task by 01.10 hours of the next day (i.e. 25-4-81).

(d) Deflected by the passing CM-15, the leading coach of B-90 ploughed through the formation and disturbed the alignment of the track immediately in rear of the acute crossing of the Diamond (between the Down Kurla Chord and the Up Mahim Chord) and also just beyond the Turnout No.104 that leads to the Down Line of Mahim Chord. As soon as the front 2 coaches of B-90 were withdrawn from the site, these 2 stretches of track were immediately attended to and the entire track given safe for traffic at 05.05 hours of 25-4-81.

(e) As a result, the Up and Down Harbour Branch services, which had to be suspended with immediate effect right after the accident, could be restored only at 05.05 hours of the next day, leading to the cancellation of no less than 121 "Locals" during the intervening period, besides the earlier short-of-destination termination of all those suburban services which could not proceed onwards.

### III. COMPOSITION OF TRAINS AND DAMAGE

#### 8. The train-consist of the EMUs involved in the Collision

(a) Each of the 2 colliding trains comprised 3 Electrical Multiple Units (EMUs) with 9-coach formation of indigenous (Jessop) manufacture as below :—

| *CM-15             |         | Type & Description       | **B-90             |       |
|--------------------|---------|--------------------------|--------------------|-------|
| S. No. & Coach No. |         |                          | S. No. & Coach No. |       |
| 9                  | 76110@  | YSYL Driving Trailer     | 1                  | 76187 |
| 8                  | 70135   | YSZZ Motor Coach         | 2                  | 70187 |
| 7                  | 72130   | YFYS Non-Driving Trailer | 3                  | 72187 |
| 6                  | 72128   | YFYS Non-Driving Trailer | 4                  | 72186 |
| 5                  | 80002   | YSZZ Motor Coach         | 5                  | 70186 |
| 4                  | 76100 @ | YSYL Driving Trailer     | 6                  | 76186 |
| 3                  | 72113@  | YFYS Non-Driving Trailer | 7                  | 72185 |
| 2                  | 70109 @ | YSZZ Motor Coach         | 8                  | 70185 |
| 1                  | 76129   | YSYL Driving Trailer     | 9                  | 76185 |

\*All coaches, excepting those marked @ (which were built in 1964) were built in 1966.

\*\*All coaches were built in 1977.

(b) Other salient features of the 2 colliding trains are as under :—

| CM-15        | Description            | B-90        |
|--------------|------------------------|-------------|
| 109-002s-135 | Unit No.*              | 187-186-185 |
| 26-7-80      | Last POH done on       | 16-6-80     |
| 192.02 m     | Length over Buffers    | 194.23 m    |
| 400.41 t     | Tare Weight            | 366.75 t    |
| 326.22 t     | Brake Force            | 327.27 t    |
| 2            | Ineffective cylinders@ | Nil.        |

\*The Unit No. is derived from the last 3 digits (upto hundreds) of the Serial Number of the Motor Coach of each EMU in the formation.

@Each train has in all 48 cylinders for Electro-Pneumatic (EP) as well as Auto-brake operation.

(c) The rakes of both these trains were fitted with 'Ferodo' composition brake blocks/shoes. It was however, too soon for the Railway to have acted upon the Railway Board's directive of January, 1981 (in respect of fitment of additional limiting valves and the modification to existing air-pipe connections, in order to increase the brake pipe pressure from the erstwhile 2.6 Kg/cm<sup>2</sup> to the desired 4.5 Kg/cm<sup>2</sup> for the purpose of improving the discrimination capability by the Motorman of emergency brake application by the Guard) to modify the order rake of CM-15; the newer rake of B-90 was duly modified.

(d) Neither of the 2 rakes was overdue any of its scheduled maintenance cycles, either in respect of brake blocks or of all undergear. Likewise, nothing remarkable was discovered during the last routine daily inspection carried out on these 2 rakes (Unit No. 109-002s-135 was stabled on the Water Column Siding at Thane while Unit No. 185-186-187 was stabled in the Harbour Siding at Bcmabay VT) on the night of the 23rd; the Railway's so-called Schedule 'A' incorporates quite a comprehensive check-list for the tasks to be performed during the over-night stabling.

## 9. Damage

(a) The coach-dispositions at the instant of impact and after the 2 colliding trains came to halt are depicted in Annexure I(c), whence it may be observed that on CM-15 only the first coach escaped entirely unaffected, whilst all the rest (excepting for the leading portion of the 2nd coach and the trailing portion of the last coach, which had also escaped the slicing action of the colliding B-90) sustained extensive damage to the left side panels, including door-ways, windows, shutters, flooring, seats, luggage racks, etc. Excepting on the leading portion of the 7th coach, nowhere else did the damage include the roof as well. Heavy damage was also sustained by the "controls" located in the driving cab of the Driving Trailer coach (marshalled the 4th in the formation) and the HT (High Tension) compartment of all the 3 Motor Coaches (marshalled the 2nd, 5th and 8th in the formation). On CM-15, all the trolleys/bogies underneath remained relatively unaffected, excepting for superficial damage to the occasional axle-box on the left side, whilst the undergear and air-pipe connections remained intact throughout; nor were the semi-permanent "Schaku" couplers stretched at any location.

(b) As regards B-90, all damage was confined to its leading 2 coaches. The 1st coach had already shed its leading trolley after the impact and the entire left-side of its driving cab had virtually caved in, causing limited distortion as well as some displacement of all the control-stands and the associated controls and equipment located thereat. Understandably, the leading bogie that parted was quite destroyed, with both its wheel-sets dislocated, dash-pots smashed, springs badly twisted, the equalising stay rod bent, etc. The trailing bogies on this first coach, which had also derailed, sustained comparatively minor damage, such as broken swing-links. The body-work of the 2nd coach also sustained substantial damage, particularly at its shunting cab; considering that both its trolleys/bogies and also entirely derailed, the resulting damage was minimal. The semi-permanent "Schaku" coupler between the first 2 coaches was found stretched; elsewhere, it was undisturbed. All the air-pipe connections were, however, intact over the entire train-length of B-90. Whereas the brake rigging of the 1st coach was more or less destroyed "in toto", it was generally intact under the 2nd coach with practically little damage of any consequence.

(c) The overall cost of damage to Railway assets was estimated at about Rs. 9.45 lakhs, comparison wholly of the damage to EMU stock, excepting for Rs. 5000/, which accounted for damage to Permanent Way.

## IV. LOCAL CONDITIONS

### 10. The Section and the Site

(a) The Central Railway's Suburban system in Bombay has two main branches: one following the Main Line up to Kalyan (excepting for a minor detour from Thane Bridge to Mumbra Bridge, while the Main Line passes through the Parsik Tunnel) and the other, called the Harbour Branch (which branches off at Masjid Station via a fly-over at Sandhurst Road Station), generally following the island's Eastern coast-line. The Harbour Branch itself has a chord that joins the Western Railway at Mahim Station and it is this Mahim chord that bifurcates from the Harbour Branch at RVJ (Raoli Junction), where the subject accident occurred.

(b) At RVJ the Harbour Branch runs roughly due North-South, with the Kurla chord taking a gentle curve to the right (or, in the Easterly direction) beyond the junction and the Mahim chord veering sharply to the left (or, to the North-West) following a  $2\frac{1}{2}^\circ$  curve. The Mahim chord also rises sharply from RVJ on a 1 in 91 rising gradient so as to provide vertical clearance underneath for 2 road under-bridges and also to serve the elevated King's Circle Station platforms; it was this very gradient that B-90 was descending, in the side-collision took place at RVJ's diamond crossing between the Down Line to Kurla chord and the Up Line of Mahim chord.

(c) The docks of Bombay Port Trust (BPT) are all situated along the island's East coast and the BPT Railway's train services enter the Indian Railways system at RVJ to join the Western Railway's stream via the Mahim chord or join the Central Railways' stream via Kurla chord. For the sake of clarity as also brevity, no reference will be made in this Report to the BPT racks, etc. unless it becomes material to the discussions.

(d) Trains are worked on the Automatic Block System (described in Chapter XI of General Rules) with Multiple Aspect Colour Light (MACL) Signals controlled by the RVJ Cabin manually operated in terms of GR 265.

(e) Almost all Signals on the Harbour Branch are of 3-aspect Colour Light type, with a few exceptions. While all Signals controlled by the Cabin at RVJ are provided with the "cascading" facility, the others on the Harbour Branch are not provided with this safeguard but the standard "Red Lamp Protection" exists via the 'ECR' Relay which ensures that, in the event of failure of the 'Red' aspect of any Signal, the Signal immediately in its rear will automatically display a 'Red' aspect.



(f) In view of 1500 v DC traction, track circuits (TCs) employ 50 Hz AC supply, with conventional double-element 2-position track-relays. At RVJ, Double-Rail TCs are provided on plain track, while Single Rail TCs are provided on Points & Crossing zones and, in either case, adjacent TCs have staggered polarities. Relays have metal-to-metal contacts, with "dynamic proving" of back-contacts in the various circuits.

(g) The accident site was on a low bank, as evidenced by the presence of culverts for cross-drainage purposes. The track structure comprised 52 Kg. FF rails 13 m long joined by 'E' type holed steel fish-plates and laid upon wooden sleepers to M+7 density with 4-holed ACB (Anti-Creep Bearing) plates overlying 20 cm ballast cushion. Further, particulars of track, not being quite relevant to this accident, need no mention in this Report.

(h) On the Harbour Branch, 4 Special Class Level Crossings exist at the undermentioned locations and all of them are protected by Signals :—

| Level Crossing No. | *Km.     | Between Stations       |
|--------------------|----------|------------------------|
| 1                  | 13/12-13 | Kurla and Chunabhatti  |
| 6                  | 7/18-19  | Vadala Road and Sewri  |
| 6                  | 7/3-4    | Vadala Road and Sewri  |
| 8                  | 6/3-4    | Sewri and Cotton Green |

\* There are on an average 22 Electric Structures (ES) to a kilometre on the Harbour Branch and the inter-ES distance may be reckoned as approximately 45 m.

#### 11. The RVJ PI (Panel Interlocking) Cabin

(a) This Cabin, commissioned in 1975, was provided with panel interlocking system of standard Siemens Entrance and Exit type. The desk-type Control Panel, built up from standard modules of domino pattern, displays the yard lay-out schematically including the "approach tracks" (so as to afford an early warning to the panel Operator about arriving trains) in rear of the Signals controlled by the Cabin. Such an "approach track" extends up to a distance of 1188 m in rear of Signal No. RVJ-1 and of 1259 m in rear of Signal No. RVJ-5.

(b) Besides the usual buttons to operate Points, Signals, Point Groups and Routes (and those meant to regulate the intensity of the various indication lamps provided on the Control Panel, depending upto the general level of illumination in the Panel Room) etc., there are 4 special buttons as below:

- "COGN" for taking 'OFF' a Calling on Signal;
- "ERN" for Emergency Signal Cancellation;
- "EWN" for Emergency Setting of Points; and
- "EUUYN" for Emergency Route Release†.

(c) The Panel indications are standard :

Once the route is set from one Signal to another, an illuminated white strip light is displayed on the entire route set

The passage of a train is depicted by the "strip lights" Turning from the erstwhile white to red as and when the corresponding TCs get occupied by the train;

In rear of the train, these "strip lights" briefly revert back to white as and when the corresponding TCs get cleared by the train, provided further that as and when an entire sub-route gets released by the passing train the corresponding strip of white lights disappears at that moment;

Any failure of TC is revealed by the appropriate strip getting lit with a red indication; and

\*\*Each of those buttons has its own 'Counter' for digital display of the number of times they have been used.

† The Station Working Orders for RVJ specify that "approaching locking" of a route shall be for a duration of "at least 90 seconds" and further that, even in the event of the indication on the Route Control Lamp disappearing before the elapse of this 90 second interval, the Cabin ASM shall anyhow wait for full 2 minutes before cancelling the route.

As regards the "Point Zone," once the points are properly set, a steady strip light shines on the set direction (normal or reverse) and a white "dot light" also appears near the Point Button (located close to the intersection of the 2 directions), but until then (and also wherever the "Points" are not homing/locked properly or, if the Points are damaged) the "strip light" meant for the intended direction keeps "flashing."

(d) Should a set route not get cancelled either in the normal way by the passage of a train or by the actuation of the "EUUYN" button, the 'UYN' (Emergency Route Section Release) button, (provided *inside* the Panel) would have to be operated. As this operation requires the opening of the back cover of the Control Panel, it will be the ESM (who has the key for gaining the required access beneath the Panel) who would perform this task. The release of *each* sub-route would require the *separate* use of the 'UYN' button, which has its own 'Counter.'

(e) Whilst para V(c) of the Station Working Orders for RVJ did call for the Cabin ASM on duty to "keep a proper record of all operations" of the 'COGGN', 'EWN', 'EUUYN, and 'UYN' buttons "by stating clearly the circumstances under which the emergency operation had to be resorted, to" detailed instructions were given, vide Note (iii) under para V(b), in respect of the items to be included in the Register for the use of *only* the 'UYN' button as below :

- Serial No.
- Date and Time.
- Route to be cancelled.
- Reason mentioning train No. before/after which to be cancelled.
- Signature of CASM on duty.
- Time Route cancelled.
- Reading of the YUN counter after cancellation of the route.
- Signature of ESM.
- Remarks.

(f) Signals encountered in the vicinity of RVJ by a Down Local towards Kurla and by an Up Local from Bandra are located thus.

| Signal No.             | Location   | Remarks  |
|------------------------|--|--|
| (For Down Kurla Local) |  |  |
| H-903                  | "Starter" of Vadala Road Station, located 765m in rear of RVJ-1.   | Automatic, 4—aspect.                                 |
| RVJ—1*                 | With a "Signal Overlap" of 266m to the Fouling Mark (FM) of Cross-over No. 102 ahead (against the prescribed 120 m Adequate Distance). | Manual, 3—aspect.                                    |
| H-110†                 | Near ES No. 11/1 and located "beyond" RVJ.   | Automatic, 3—aspect.                                 |
| (For Up Bandra Local)  |  |  |
| M—1106                 | At 536 m in rear of RVJ-5.   | Automatic, 3—aspect.                                 |
| RVJ-5 PG**             | Guard's Repeater on KCE Up platform, located 163.5m in rear of RVJ—5.  | Automatic 2—aspect and suspended from platform roof. |
| RVJ—5*                 | Starter of KCE and located 499.4 m in rear of the FM of the Diamond Crossing ahead.  | Manual, 2—aspect.                                    |
| H—922†                 | Near ES No. 9/22 and located "beyond" RVJ.   | Automatic, 3—aspect.                                 |

\* Equipped with a Route/Junction Indicator and also a Calling-On Signal.

\*\* Please see Annexure IV for further details.

† These Signals could not be passed because of the subject side-collision.

(g) Maintenance of RVJ Cabin and associated track-side\* as well as other Signalling equipment is the direct responsibility of the Electrical Signal Maintainer (ESM) 'A', or which a person is posted at RVJ\*\* round the clock in 3 shifts† and who reports to the—

Signal Inspector (SI) (Grade III), located at Byculla and who reports to the—

SI located at Bombay VT, and who is under the control of the—

Chief Signal Inspector (CSI) (South), again located at Byculla and who further reports to the—  
Assistant Signal & Telecommunication Engineer (ASTE) (South), also located at Byculla, but reports in turn to the.

District Signal & Telecommunication Engineer (DSTE) (South) at Bombay VT (the Divisional Headquarters), who is responsible to the—

Senior DSTE, at Bombay VT, who is in overall command of all S&T matters with jurisdiction over the entire Division.

(h) As per available records, the Panel was last overhauled by the CSI on 16-1-83 and comprehensively tested by him on 21-2-81. The RPI installation at RVJ was regularly inspected and/or tested at various levels as evidenced by the following information provided by the Railway and at no stage was anything found except that the entire system was performing satisfactorily :

| Inspection/Testing | By       | Last date |
|--------------------|----------|-----------|
| ✓                  | Sr. DSTE | 5-2-81    |
| ✓                  | DSTE(S)  | 3-3-81    |
| ✓                  | ASTE(S)  | 30-1-81   |
| ✓     ✓            | CSI      | 17-3-81   |
| ✓     ✓            | SI at VT | 18-3-81   |
| ✓     ✓            | SI (III) | 23-3-81   |

(i) Records show that none of the TCs that effected the working of the RPI Cabin at was overdue its Periodic Overhaul (the earliest amongst the dates for the last POH done was 29-9-71 for M-1106 AT and the latest POH was on 11-12-75 for 214 T). Limited over-energisation was in evidence to counteract the observed frequency of TC failures.

(j) As regards Cables, a number of them are linked to the RVJ Cabin. With reference to Signal No. RVJ-5, however, 5 cables are involved.

A power cable;

A very short one\* from the Relay Room to the Junction Box at nearby Location H-1004;

A 19-core cable (from Location H—1004 to Location H—1022) that carries, inter alia, the controls of this Signal;

A 19-core cable that carries, inter alia, 'ECC' circuits from Western Railway's Mahim Panel; and

A very short "tail cable"‡ from the Apparatus case at Location H—1022.

## 12. Features Relevant to the EMUs (as per available evidence)—

(a) CM—15 was running 3 minutes late on that day and, as per the Working Time Table, its right-time departure from Vadala Road is 16.16½ hours. B-90 was running to time and its scheduled time of

\* There is a separate 'Cable Gang' under the charge of an ESM 'A'.

\*\* As the work load relating to the RPI Cabin at RVJ (including the associated surroundings controlled by it) did not justify the positioning of a separate whole time complement of S&T staff exclusively for RVJ, the ESM posted here has additional responsibilities extended to Sandhurst Road (High Level) Station in the South, to the limit of the Central Railways' jurisdiction on the Mahim chord and on the Kurla chord in the North upto Bhunabhatti Station (exclusively).

† As 3 ESMs are positioned at RVJ, scheduled maintenance work was conveniently sub-divided as below :

North of Signal No. RVJ—1

Between Signal No. RVJ—1 and Level Crossing No. 8 ; and

South of Level Crossing No. 8.

‡ No records exist of meggering, if done at all, of these cables, while the 19 core cables are meggered once a year during winter.

departure from KCE is 16.18 hours. According to Inter-Station running times and halting duration (published at pp 68—69 of Bombay Division's current Working Time Table for the Suburban Section) the figures relevant to this collision are as below :—

*Dn train (Kurla chord)*

|                     |                  |
|---------------------|------------------|
| Halt at Vadala Road | ½/               |
| Vadala Road to RVJ  | 1½/ running time |

*Up train (Mahim chord)*

|             |                  |
|-------------|------------------|
| Halt at KCE | ½/               |
| KCE to RVJ  | 2/ running time. |

(b) By an amazing coincidence, the Additional Chief Signal & Telecommunications Engineer (Planning) and Bombay Division's DSTE(S) happened to have monitored earlier in the day on 24-4-81 both the EMUs involved in the subject collision : namely, Unit No. 109—002s—135 (which subsequently ran as CM—15) from Bombay VT to Mankhurd while it ran as M—31 Down (even at that stage, the speedometer in the Driving Cab was not working) and Unit No. 185—186—187 (which subsequently ran as B—90) from Mankhurd to Kurla while it ran as MS—8 Up. (at which stage the speedometer in the driving cab was found to be in working order).

(c) The Joint Observations of the Controls etc., in the Driving Cab of B—90, made by the under-noted officials soon after the collision revealed as follows :—

|                     |                                |
|---------------------|--------------------------------|
| Shri D.B. Lokhande  | Sr. Loco Inspector (EMU)       |
| Shri R. Venugopalan | Transportation Inspector (Hq). |
| Shri K.R. Kaimal    | Sr. Foreman (EMU)/Line         |

- (i) DMH was found to have come into operation, as expected;
- (ii) Reversing Handle in 'Forward' position, consistent with the forward motion of the train; but the reversing key was *not* in position\*;
- (iii) ICS (the brake pipe Isolating Cock Switch) was in shut or isolated position, which was most unusual (for, no Motorman would start his train without first having set the ICS in the 'open' position and, in this case, this observation was also inconsistent with the train having successfully halted at Mahim and KCE after starting from Bandra). Its key was also missing\*.
- (iv) Master Controller was found in the 2nd notch or "series position" (i.e. *not* in the Power 'OFF' position, in which it should have normally been, had the Motorman been trying to control the speed while the train was in fact negotiating the falling gradient of 1 in 91). As, when tested, the Master Controller with its DMH was found to be moving freely (i.e. *not* "jammed", in the position found, nor sufficiently damaged to move in jerks or stiffly), the possibility of the DMH jumping off the 'OFF' position (in which it gets "engaged" or "locked" of through the impact the collision was remote, had it really been in the 'OFF' position prior to that instant;
- (v) Brake Controller was found 10° away from the "release" position (i.e. practically no application because for "Full HP" the handle has to be swung by 60° the segment beyond which being meant for "Auto" brakes, with the last segment for "Emergency" application). Had "Full EP" or 'Emergency' brakes been applied, it was again unlikely that the Brake Controller handle would have moved *back* by the jarring impact, which usually tends to push things "forward" due to own momentum;
- (vi) No air pressure was registering in the dial gauges indicating damage to the piping on this coach\*\* itself :

\* The Reversing Key cannot ordinarily get disengaged ( or come loose and fall off ) once the Handle is *not* in the OFF position. In this case, there was some wear and tear both on this key itself as also on the Reversing Handle, which, also evidenced some fresh damage at the top of its notch ( caused most probably by this accident ), which possibly facilitated the dislodging of this key. As regards the ICS Key, it, too, cannot be removed when the switch is 'ON'; but as the ICS was found in the 'OFF' position, the key could have easily come off. Both these keys were, later on recovered by carefully searching through the debris ( mostly fragmented glass, with the odd metallic bits and pieces ripped off the left-side front part of the cab ) in Kurla Car-Shed.

\*\* All the brakes on the rear 7 coaches were all found in a released condition because, within the 2-hour period that elapsed after the accident and before the said joint inspection was carried out, the air pressure had "held" off.

- (vii) The hand brake had *not* been applied; and
- (viii) Consistent with the damage sustained by the left side of the cab, several plug-in fuses had got unseated by the impact and fallen off, besides the expected tripping of MCBs (Miniature Circuit Breakers) because of damage to the electric circuitry.

(J) The Joint Observation of B—90's Guard's Cab made by the same 3 officials was as follows :

- (i) The emergency brake had not been applied, which indicated that the Guard was not aware of any impending danger;
- (ii) The hand brake had, however, been applied, which must have been a post-accident safety-measure adopted by the Guard;
- (iii) The blinker light was *not* switched on; and
- (iv) Every thing else was quite normal.

(e) Similar inspection made with reference to the Driving Cab of CM-15 yielded the following information :

- (i) Reverser Handle in 'OFF' or neutral position, with key removed (obviously by the Motor man, as he left the cab after the accident);
- (ii) Master Controller in the 'OFF' position, with Brake Controller in 'Full EP' position\* (both indicating that the Motorman had indeed applied the EP brakes); and
- (iii) ICS Key was in position and the switch in the "engaged" mode as might be expected.

(f) As regards the Guard's Cab of CM-15, following Joint Observations were recorded :

- (i) Brake Controller in the applied position, which showed that the Guard, too, took some action to control this train;
- (ii) Guard II MCB had tripped, because of shorting of some cables as a result of the damage caused to the leading left side of his coach; and
- (iii) The blinker light was not switched on.

(g) When the rear string of 7 coaches of B-90 was moved [see para 7(b) supra] to the Central Railway EMU siding at Bandra, it was thoroughly examined overnight jointly by the following officials for brake power (brake block thickness and piston strokes) and bogie isolations, when nothing particularly abnormal was noticed. Particulars noted at this inspection are briefly mentioned in Annexure I(a).

Shri K.S. Gujare, Jr. Loco Inspector (EMU) of Kurla; and

Shri G.S. Devath Raj, Sr. Electrical Foreman (Traction) of New Car Shed.

(h) After rail communications were restored at RVJ on 25-4-81, these 7 coaches were worked back to the New Car Shed at Kurla and the braking capability of this rake was tested at this stage jointly by the same 2 officials between RVJ and Kurla, when it was found that it could be brought to halt with 2 structures (90 m) and 1½ structures (70 m) respectively from a starting speed of 60 Km/h and 50 Km/h, by the application of 'Full EP' braking.

(i) As regards the rake of CM-15 although it had not derailed, damage to the left side of its shells was so extensive that it was generally considered unsafe to conduct braking trial with it, as some loose parts of its shattered inside fittings could be anticipated to fall down on the run and conceivably foul that flange-way of the speeding wheels to cause another havoc. However, the most careful visual examination of its under-gear by Shri M.C. Sinha, Dy CRS (Mechanical) as well as by Railway Officials did not reveal anything unusual, excepting for the known situation of 2 ineffective cylinders already pointed out in para 8(b).

(j) Annexure I(b) provides the braking distance calculations for both the trains.

### 13. Features Relevant to the Infrastructure at RVJ (as per available evidence)

(a) The Joint Observations recorded† of the Control Panel at 17.20 hours on 24-4-81 by the 2 under noted officials were as below and Annexure I(b) may be referred to for site particulars :

Shri K.T. Iszac, CSI(S); and

Shri R. Venugopalan, Transportation Inspector(Hq).

\* The brake blocks/shoes were found still gripping the wheels treads on the train, even though a couple of hours had elapsed since the application of brakes.

† Although the time entered against this record showed that as much as an hour had elapsed since the accident, its notes tall ed wholly with evidence separately tendered about observations independently made by other officials who reached the RVJ PI Cabin very soon after the accident,

(i) Signals No. RVJ—1 and RVJ—5 were both 'ON' \*(which merely demonstrated that these Signals were not defective, i.e. they were not "stuck" for some reason on the 'OFF' aspect, nor were they permanently displaying the 'Off' aspect due to any fault);

(ii) The 'Calling-On' indication did not appear at Signal No. RVJ—5 (which showed that this particular facility had not been used at that time);

(iii) TC 201T displayed white light (proving that the route had been set for CM-15, which had already cleared it);

(iv) TCs 202T, 207T and 208T displayed red light (consistent with occupation of track by the stranded CM-15);

(v) On Mahim Chord, TC 205T was *clear* (i.e. no illumination and which proved that the route was not cleared for B—90 for, otherwise, there should have been a white strip light here);

(vi) On Mahim Chord, TC 206T was illuminated red (consistent with occupation of track by the stranded B-90);

(vii) Points Nos. 101, 102, 104, 107 and 108 were all set in their normal position (as evidenced by the location of the lit patch lights) and locked/set properly (as evidenced by the shining white dots), which further proved firstly that the route could not have been and was not, ipso facto, set for B-90 at the time of the accident and, secondly, that none of the said points sustained any damage as a result of this accident, because the patch lights would have otherwise been flashing with no indication appearing in the dot light; and

(viii) The Cancellation Registers were checked to find that there was no discrepancy between the various Counter readings\*\* and the corresponding entries†.

(b) The doors to the Relay Room (basement of the RVJ Panel Room) were locked and sealed in the presence of the following at about 17.00 hours on 24-4-81 by Shri K.B. Gadge, ASM :—

Shri V.P. Thamaya, Assistant Station Master (ASM);

Shri R. Venugopalan, Transportation Inspector (HQ); and

Shri D.C.Ghosh, Signal Inspector/III.

(c) Records show that the Crank Handle was removed from its case at 20.25 hours on 24-4-81 for organising restoration operations and replaced at 04.20 hours on 25-4-81. With the Crank Handle having thus been used for setting points locally, it can be safely surmised that the Panel was left untouched after the accident and until the 'joint observations' were conducted of the Relay Room at 05.00 hours on 25-4-81 in the presence of Bombay Division's Divisional Safety Officer and DSTE(S). In other words, the relays continued to remain in their last-operated-positions at the time of the accident.

(d) The Joint Observations/Tests at the RVJ Room by the undernoted officials yielded the following information :

Shri K.T. Isaac, CSI(S) Byculla;

Shri L.C. Teckchandani, Sr. Loco Inspector (EMU); and

Shri R. Venugopalan, Transportation Inspector (HQ).

(f) When the seal was broken and the Relay Room entered. Route Sections 102A and 104A, which relate to the passage of a Down Local on the Kurla Chord, were found "set and locked"; and

\* This was also confirmed by besides other witness, the Motormen of Lccals (B.87 Dn and B.92 Up on the Down Kurla Chord and Up Mahim Chord respectively) which immediately followed the colliding Lccals.

\*\* None of the Registers had lodged any emergency measure for that day, excepting for the "UYN" which cancellation was resorted to during the "current shift" as well as the preceding shift that ended at 12.00 hours.

† Contrary to "established" Practice at RVJ, where by entries of Counter readings are made *only* at the *end* of any shift' duty of the Cabin Assistant Station Master (CASM), the entry for 'UYN' had *already* been recorded by the CASM and countersigned as required by the SI/III *prior* to the time of the Joint Observations, even though the "current" shift would in fact end *only* at 18.00 hours.

(ii) Repeated comprehensive functional tests on the structural integrity of the RI showed that everything was as it should be and further that route cancellation via the EUUYN took 120 seconds in either case (after Signal No. RVJ—1) was put back to danger with its approach track shorted and also after Signal No. RVJ—5 was similarly normalised).

## V. SUMMARY OF EVIDENCE

### 14. Evidence of Shri H.G. Vayda, a passenger on B-90

(a) He was a habitual commuter by rail from Bandra to Reay Road in the afternoons. On 24-4-81, as B-90 speed faster than usual after it left King's Circle, it occurred to him that the train had probably gone out of control. The accident occurred immediately and, when he jumped off the 2nd coach in which he was travelling, he found that it had tilted precariously to the right.

(b) He did not realise the havoc already wrecked on CM—15 by the accident, as that scene was screened from him by the intervening B-90 itself. So, he walked ahead to find the Motorman standing in the closed doorway of the Driving Cab in a dazed condition. Guided by the somewhat incoherent Motorman, he managed to push the door open and help the Motorman down to the ground.

### 15. Evidence of Shri Krishna Kumar, Motorman of B-90

(a) He was on the very last leg of his "Detail" for the day, when he found RVJ—5 (the Starter at KCE already at "Yellow," as he arrived at KCE. He got one beat from the Guard., to which he responded by giving 2 beats indicating that the Signal was 'OFF' and then started as soon as he received 2 beats from the Guard. When he started, the Starter was still showing 'Yellow.' He picked up a speed of 35 Km/h, which was controlled down to 15 Km/h because of the speed restriction ahead. As he approached the Junction, he could see the other train coming, but found nothing unusual in this situation as the other could be going to Bandra.

(b) When he realised that the other train did not take the Mahim Chord, he immediately applied emergency brakes and also released the DMH (Dead Man's Handle). Before the impact could occur, he was also able to sound his "horn" twice and he recalled that, before suffering a blackout, he moved to the right to save himself from the glass splinters flying in the Cab. Later, he was helped down to the ground by an outsider.

(c) During the subsequent questioning, he revealed that he was working on Motorman's "Detail" since 1978, prior to which he was a Goods Train Driver. He did receive the prescribed 5—month training in Kurla Car Shed before being put on EMU working. This was also the first round trip of his for the day on that particular rake, in controlling which an experienced Motorman like himself had no particular difficulty even though its brake-power was, like on most other Locals not 100% effective.

(d) According to him, the Automatic Signal No. M 1106 [See Annexure I(b)] was showing its 'Green' aspect when he approached KCE, but he had no recollection of having sighted the "Guard's Repeater" provided on KCE Up Platform. He clarified that he had no difficulty in sighting Signal RVJ-5 and also confirmed that no one was working on the track. He claimed that the speedometer on this journey was not in working order; hence, he could only give his best estimates of the speeds attained. When confronted with its gist, he repudiated the contents of the Joint Observation [para 12(c)] of the Controls in the Cab.

### 16. Evidence of Shri H.S. Saini, Guard of B-90 Up

(a) His Local was keeping to time right from its departure from Bandra at 16.12 hours. After stoppage at King's Circle Station, he gave one beat to the Motorman in order to ascertain the indication of the Starter No. RVJ—5; to this, the latter responded with 2 beats, which meant that the Signal was 'OFF'; he himself then gave 2 beats for starting the train. A couple of minutes later, he felt a big jerk that dropped the pressure in his gauge to zero and the train halted. He looked out to discover that a collision had taken place and as he was chased by furious passengers before he could render any assistance, he took shelter in RVJ Cabin.

(b) During the ensuing examination, he provided the following clarifications :—

(i) The train left King's Circle station at 16.18 hours, after halting there for 30 seconds, which duration was later on amended to more than a minute, as he recollected that some passengers, who were running alongside the track were able to catch the train;

(ii) The cab doors having been kept shut, he had peeped out of the window, but a number of passengers holding on to the stanchion in the nearest doorway obscured his view of the "Platform Repeater";

(iii) A convention had developed over the years that the Motorman would, while stopping at a scheduled halt, give a single 'beat' only if the Starter Signal ahead were showing 'RED'; in such a case, the Motorman

would give 2 beats as soon as the Signal was taken 'OFF'. On the other hand, if the Signal ahead has already 'OFF' when the train came to a halt, the Motorman would *not* give any beat, and there was no question of the Guard acknowledging the same; in such a case, the train would start the moment the Guard gave two beats;

(iv) On that fateful day, it was only because the Platform Repeater happened to be unsighted that he gave the single beat for the sole purpose of enquiring about the aspect of the Signal ahead;

(v) After the accident, the atmosphere became dust-laden on the left side and his first thoughts were that a fire may have erupted; so, he got down on the right side to find that the first 2 coaches of his train were leaning rather precariously. In the haste, he forgot to switch on the "Blinker lights."

#### 17 Evidence of Shri L.S.Wawa, Motorman of CM-15

(a) He was on his first trip for that day, having signed on at 15.42 hours after availing 22 hours clear rest and subsequently left Bombay VT at 15.57 hours on that "Local". After leaving Vadala Road Station on a "Green Starter", he proceeded cautiously, however, because of excessive trespass and unauthorised encroachments rendering the visibility of Signal No. RVJ-1 rather difficult. Upon sighting RVJ-1 at 'Green', he applied traction once again. Moments later, he felt a severe jerk and immediately applied the emergency brakes. He looked back as the train stopped, to discover that an accident had taken place and then proceeded to advise RVJ Cabin accordingly.

(b) In response to questions he replied that he was unaware of the other train until he was passing the Diamond Crossing and that his application of brakes and the collision had both occurred simultaneously. As the other track was unaffected, he did not switch the "Blinker Lights" on in his cab.

#### 18 Evidence of Shri K.U.Nemade, Guard of CM-15

According to him, his train was maintaining right time throughout and the collision occurred at 16.16 hours. The train had started on a "Green Started" from Vadala Road station and he felt 2 or 3 severe jerks before the train halted. After applying the hand-break, he protected his train from the rear. He reasoned that he did not switch the "blinker lights" on possibly because there was no "power".

#### 19 Evidence of Shri P.K.Thomas, Cabin Assistant Station Master (CASM) at RVJ:—

(a) He was the CASM on duty at the time of the accident. He had set the route for CM-15 which appeared on his Panel at 16.17 hours (running about 3 minutes late) and taken Signal No. RVJ-1 'OFF'. At 16.18 hours, B-90 appeared on his Panel, As CM-15 was running past the Cabin at 16.19 hours, he suddenly noticed on his Panel TCs 205T & 206T going down, and he rushed to the window of his Cabin to look out, he could see B-90 which was not signalled\*, collide with CM-15. There was no damage to any turn-out as a result of this accident as could be inferred from the absence of any "flashing" indication on his Panel.

(b) During the cross examination he stated that he had been working at RVJ for the past 1 year prior to the accident. Unless Information was received from the 'Control' regarding any train cancellations, or late running, etc.; the normal practice was to clear a Local, as and when it appears on the Control Panel, strictly in accordance with the precedence of Locals as reflected in the printed "Train Register Book" for the day. In other words, the established sequence of train movements would not be upset, unless under specific instructions from the 'Controller' or if a train was late by over 5 minutes which, if the "ordering" were not modified to suit, could conceivably set up chain-reactions of late running. In the subject instance, as CM-15 was due to pass RVJ at 16.19 (hours its right time passage was at 16.16 hours,) with B-90 to pass by yet a minute later on at 16.20 hours, he had acted correctly in signalling the passage of CM-15.

(c) During his shift, which commenced at 12.00 hours, there was no occasion to use the Calling On (COGGN) button or the Emergency Route Release (EUUYN) button. However, at the beginning of the shift, the SI was actuating the Emergency Sectional Route Release (UYN) button provided under the Control Panel in order to continue his testing of the setting of the relatively scarcely used sub-routes to and from Bombay Port Trust. He confirmed that no signal staff had attended to the COGGN button or its counter during his shift.

(d) Questioned as to why he was unable to detect the occupation of 205T by B-90 immediately as it occurred (i.e. after it has passed Signal No. RVJ-5 at 'Danger') and then put back RVJ to 'Danger' in order to stop CM-15, he replied that the normal tendency for a CASM would be to concentrate on the safe passage of the train signalled until the section is cleared so that further movements could be planned. He felt that he was probably looking at CM-15 arriving from his left and not looking at the Control Panel at that

\* Shri Babasaheb Kisan Suryawanshi, the Assistant Pointsman on duty at RVJ was in the Cabin at that time and he corroborated that Signal No. RVJ-5 had been displaying 'Red' on the Panel when CM-15 was signalled.



critical juncture. Although, in further defence, he also alluded to the 5 telephones provided in the Cabin, he conceded that he could not truthfully say whether his attention was actually diverted by any "call" at that crucial time.

(e) He then clarified that putting back the "manual" Signal No. RVJ-5 to 'Danger' once it had already been taken 'OFF' for a train, was a very very rare occurrence and, before any such action was taken, the Station Master at KCE was invariably advised under exchange of Private Numbers to personally caution the Driver or Motorman of the affected train about the change in the Signal aspect.

(f) He further asserted that the use of "UYN" was never resorted to for the purpose of cancellation of a set route, which was always effected by utilising the "EUUYN", even if this entailed a delay of not less than 90 seconds. As the use of UYN required the presence of a "Signalling official", he submitted that route cancellation via the 'UYN' implied collusion between CASM and S & T personnel of a most improbable nature.

(g) There was no power failure just prior to the accident, nor were any S & T staff with him in the Panel Room. To the best of his knowledge, there was also no one in the basement Relay Room; he had been told earlier by the SI that the S & T staff were going away to attend to a lifting barrier at Level Crossing No. 6. Located between Sewri and Vadala during that afternoon.

## 20. Evidence of Shri T. M. Verghese, Cabin Assistant Station Master, RVJ

(a) On 24-4-81 his duty ended at 12.00 hours and during his shift no trouble was experienced except when Signal No. RVJ-1 had gone back to 'Danger' because of 'bobbing' of track circuit No. 207-T at about 11.48 hours, which necessitated recourse to the "Calling on" Signal, whereby Local No. CH-21 suffered 1 minute's detention.

(b) As the SI had been doing some testing of his own, utilising the Emergency Section Route Release (UYN) button several times for that purpose, he spoke\* to the SI about the "sticking" COGGN counter; he had not entered this in the "Signal Failure Register" maintained in the Cabin. Nor was the "bobbing" of TC 207 T even recorded in the Signal Failure Register, as this problem did not persist; such "bobbing" being a fairly frequent occurrence, a record was made of it only if the fault continued.

## 21. Evidence of Shri A.S. Phanse, Electrical Signal Maintainer, RVJ.

(a) Although in charge of the "Cable Gang", he was performing the duties of Rest Giver ESM from 08.00 to 17.00 hours on 24-4-81 at RVJ. Under the instructions of his SI, he was working on the tracks in the vicinity of RVJ up to 11.15 hours, engaged on the tasks of drilling holes in rail-ends for providing track-lead connections in the portion covered by TC 202 T and of the replacement of track-lead junction-box covers in the stretch covered by TCs 206 T & 207 T.

(b) During the post-lunch session, he was directed to proceed to Sewri Level Crossing Gate No. 6 to attend to the lifting barrier. Accordingly, he left with his gang at 14.00 hours, accompanied also by his SI under whose directions he lubricated the 'Down'-side barrier and did other work as necessary. The SI\*\* left the Level Crossing site at about 15.30 hours whereas, upon completion of all tasks entrusted to him, his gang and himself reached Vadala Road Station at about 17.00 hours, where he learnt about this accident.

(c) As the keys for the Relay Room were throughout in his possession, he was certain that there could not have been any one in the Relay Room at the time of the accident. There was, of course, one key lodged in the Panel Room at RVJ Cabin, but he was not aware if this was used for effecting an entry by anybody.

## 22. Evidence of Shri D.C. Ghosh, Signal Inspector, Grade III, Byculla.

(a) He has been in charge of the Harbour Branch since February 1979. On 24-4-81 he commenced inspection of his section at 08-30 hours at Sewri proceeding northwards to reach RVJ at about 11.00 hours, at which time he inspected the work of the Cable Gang. In the afternoon, he went along with this Gang to attend to Sewri Level Crossing Gate No. 6 and, while he was just in rear of Signal No. RVJ-1 on his return by walk towards RVJ, he witnessed the accident. He then rushed to the Cabin to note down what all was displayed by the Control Panel. The Relay Room underneath was then got sealed.

\* When confronted with the SI's denial in this respect [ See para 22 (d) infra ], he confirmed that he did speak to the SI about the mal-functioning COGGN counter.

\*\* Shri Gopal Malhari Jamkhandi the Gateman on duty Gate No. 6, confirmed that SI ( Shri Ghosh ), ESM ( Shri Phanse ) and others arrived at about 14.45 hours and that where as he SI walked towards Vadala Road at 15.45 hours, the rest left for Sewri Station.

(b) It was only in response to a specific query that he referred to his use on that day of the Emergency Sectional Route Release (UYN) button 11 times around noon time. His explanation was that, as train movements to and from the Bombay Port Trust Railway were relatively scarce, experience had revealed some problems\* with reference to the setting/release of routes involved in such movements. Almost each move involved 2-sub-routes, and, as the UYN had to be used separately for each sub-route, the counter would indeed move so many times during any comprehensive testing manouvre.

(c) He clarified that the CASM is not necessarily kept apprised of any work going on in the Relay Room underneath, provided that such work related only to activities which may fall under "good house-keeping" and which could not accordingly interfere in the least with "safe working per se". However, if any work was to be done that affected the performance of the relays, a "dis-connection memo" was invariably served on the CASM to alert him about the nature and location of such work. In any case, major-maintenance works were always programmed for and executed during night blocks.

(d) He denied having received any complaint verbally or otherwise from the RVJ CASM regarding mal-functioning of the COGGN counter. However, when confronted with the evidence of the CASM in question, he argued that, although he might have been spoken to, the conversation might not have registered on his mind at a time when he was particularly very busy with the testing on hand; else, he would have attended to the erring counter immediately, as was normally the practice.

### 23. Evidence of Shri K. T. Isaac, CSI (S)

(a) Considering the size of the PI installation at RVJ, there was no need to deploy whole-time S & T staff here but, whenever the ESM left the Cabin, he would advise in advance the CASM of his movements so as to enable the establishment of contact with himself.

(b) He confirmed having personally repaired the 'COGGN' counter on 15-5-81, as a further complaint had been reported of its mal-functioning\*\*. He conceded that, the design of all counters being almost identical it was quite possible that the 'EUUYN' counter may also have got "stuck" (instead of advancing by a digit as it should, each time that the corresponding button was operated), but emphasised that there was no evidence on record to support such a supposition.

(c) As regards the conflicting evidence tendered by B-90's Motorman and the RVJ CASM as to the aspect of Signal No. RVJ-5 just before B-90 left KCE, he argued that all the subsequent observations and tests vindicated the CASM's stand and, had the Motorman's version been true, then this change should, not have occurred "automatically" i.e. without any repair-work etc. He also submitted that the 'UYN' was never used for cancelling a Route set for a train, unless and until it had been prior established that the 'EUUYN' was tried unsuccessfully for that purpose; such was not the case at RVJ, (nor was there any evidence indeed show that a need arose for an attempt as such route cancellation.

### 24. Evidence of Shri A. K. Ghosh, DSTE(S)

(a) The flank protection provided at RVJ, which accorded well with the standard practice obtaining on the Indian Railways, was achieved during the route initiation stage itself. A similar circumstance occurred at several locations on the Railway's suburban system when a train diverted from a Fast to Slow Line (or, viceversa) crosses the path meant for an opposite train, with the "Diamond Crossing" protected by only one Signal at 'Danger'. The only safeguard was to instal the AWS (Automatic Warning and Stop System) in the Driver's cabs.

(b) Queried about the possibility of Signal No. RVJ-5 getting stuck on its "OFF" aspect (i.e. its failure to normalise upon the passage of the preceding Up train on the Mahim Chord), he clarified that, in such an event, the route set would remain uncancelled and the circuitry was such that all further moves (excepting for Down Locals to Mahim Chord) could not be signalled. Likewise, he discounted the possibility of anyone tampering with the inner coloured lenses in the Signal unit, particularly as nothing unusual was observed after the accident with the aspect of this Signal.

(c) As regards 'bridging the circuitry', it was an extremely complex issue as it involved a "false feed" to the 'OFF' aspect simultaneous with the disconnection of available feed to the 'Red' aspect, etc, but all this was really pointless, he submitted, when Signal No. RVJ-5 was equipped with the 'Calling-on' facility.

\* Ideally, both the Relay and the Panel Rooms should be air-conditioned in order to be dust-proof. However, such was not the case at RVJ and dust-deposits on the relatively unused relays could prove problematic.

\*\* The mechanical pawl was not getting engaged with the ratchet due to inadequate spring tension which was suitably adjusted by the CSI.

## 25. Evidence of Shri L.C. Teckchandani, Sr. Loco Inspector (EMU)

(a) He said that the static tests/measurements recorded of B-90's 7 undamaged cars at Bandra and the subsequent "road test" revealed nothing abnormal with the brake power.

(b) He clarified that no Motorman would pay any heed to the 'Repeaters', nor would he give "two beats" to the Guard unless the Signal ahead was 'OFF'. However, some-times the Signal ahead may be too close to the place of his stoppage that the Motorman's view of the Signal may be obstructed by the sun-shade/canopy/hood provided to shield the wind-screen. In such a case, the Motorman may start a train, purely as a reflex\* action in response to the Guard's '2 beats', which could happen particularly if his attention was concentrated on commuters trespassing across the track in number right in front of him. Were the Signal some distance ahead, say 100 m, then an errant Driver could not fail to become aware of the 'Red' Signal head to pull his train up to an immediate halt.

(c) He also felt that, because of the peculiar layout and the 1 in 91 falling grade towards the diamond crossing, the "flank protection" should extend upto all the conflicting Signals.

## 26. Other Relevant Points brought out

(a) Shir .S.V. Raman, Station Master at KCE (who was on duty from 07.15 hours to 15.45 hours on 24-4-81) stated that on none of the occasions that he came out of his office on to the Down platform did he see any S & T staff working at the Up platform; nor did any S & T staff report to him (as they usually do) that they were going to attend to Signal No. RVJ-5 or Repeater No. 5-PG.

(b) Shri M.P. Thamaya, Station Master at Vadala Road (who was also on duty from 07.15 hours to 15.45 hours on 24-4-81) stated that he boarded the ill-fated CM-15 at Vadala Road. When he rushed\*\* to the RVJ Cabin, he found the Relay Room locked with no S & T personnel near-by. Afterwards, he saw SI (Shri Ghosh) coming to the Cabin from Vadala Road direction.

(c) Shri R. Venugopalan, Transportation Inspector, stated that the whole purpose of reconciling the observed Counter Readings with those recorded in the various registers was vitiated if there was any doubt that a Counter would not advance by one step each time that its button was operated. Earlier in his service life, he was himself a CASM at RVJ and he felt that, because of several reasons (including the activities of miscreants) leading to frequent failure/bobbing of TCs in RVJ region, one could not deduce with certainty that a train had actually passed Signal No. RVJ-5 at 'Danger' merely because TC 205T had bobbed to red on the Panel.

## VI. TESTS AND OBSERVATIONS

### 27. Inspection of Accident Site on 25-4-81

(a) Repeated tests made in the RVJ Cabin in the company of the Additional General Manager (Operations) and the Sr. DSTE (to see if, once a Signal had been taken 'OFF', any conflicting move could also be signalled) revealed no short-comings whatsoever with the structural integrity of the PI as provided. It became evident that no route could be initiated unless it was established "a priori" clear of occupation/infringements and, for this purpose, TCs over points and crossings extended upto at least the fouling marks to prove flank protection.

(b) However, a deficiency readily became apparent in that there was no "Route Control Chart" for the PI (equivalent to the "Locking Chart" or "Selection Table" for the orthodox mechanical interlocking system). Hence, with regard to the essential requirements to be met before a Signal could be taken "OFF" there was just no way for *anybody* to discover if any modifications were locally introduced in the original circuitry. This rather serious situation noted at RVJ is not an exception on this Railway, because it so happens *not* to be a practice here to prepare such charts for RI installations. At my request, an effort is being made to develop a "Route Control Chart" from the circuitry diagrams existing at RVJ.

\* Similar evidence was tendered by Motorman Shri Joseph A. Fara, who added that a recent development was the frequency with which outsiders indulged in enquiries or alterations with Motorman thus not only distracting their attention but also unsettling their minds. Shri D. J. Khambatta (retired Assistant Electrical Engineer) emphasised that the nature of the Motorman's duties was highly fatiguing, with a large number of starts/stop and Signals to be sighted, which factor tended to reduce him to a mechanical Robot by the shift.

\*\* Shri Babasahab Kisan Suryawanshi, the Assistant Pointsman on duty at that time in RVJ Cabin corroborated that Shri Thamaya was the first to reach the Cabin, followed first by CM-15's and then B-90's crews, at which stage TI Sh. R. Venugopalan had also arrived.

(c) The RVJ Cabin is located to the West of all tracks and 164 m to the South of the Fouling Mark between the Down Kurla Chord and the Up Mahim Chord. The CASM has thus a very limited, narrow and oblique view of the Mahim Chord from the "front" (or, East) window of the Panel Room, which is further partially obstructed by the foliage of a tree.

(d) Signal No. RVJ-5 was examined, lest at the critical time of 16.18 hours the fall of any sun-light directly on the 'Yellow' aspect and its angle of incidence may lead to an impression that that aspect was actually lit when it was factually not, but such was not the case at all. Anyhow, such "phantom" indication must be coupled with the simultaneous failure of the lamp/bulb inside the 'Red' aspect, because the fall of sun-light did certainly not make it appear 'Yellow'.

(e) There was no record of any electrical failure at about 16.18 hours on 24-4-81, which could have the effect of no Signal exhibiting any aspect and which in the case of B-90's Motorman, could have misled him to conclude, if and when the 'Red' aspect got extinguished, that the 'Yellow' aspect \*above it must "ipso facto" have appeared. The follow-up to my inspection of the various registers maintained at RVJ and KCE, with particular reference to S&T items, including the last 2 recorded failures of Signal No. RVJ-5; is separately given as Annexure II(a).

#### 28. Field Testing at RVJ by the Dy. CRS (S&T), Calcutta

(a) Comprehensive field testing of the PI installation was carried out on 26-4-81 and the next day by Shri J. Bhattacharjee at RVJ in the presence of the DSTE(S) with regard to the effectiveness of the approach-locking time-release by 'EUUYN' of a set route, the effectiveness of "back-locking", the verification of actual aspects of Signals and track lay-outs with those observed on the control panel, etc., when it found follows:—

- (i) The Control Panel was accurately representing all the field particulars/aspects;
- (ii) The route cancellation via the 'EUUYN' button took 105 seconds, which compared favourably with the minimum of 90. seconds interval that was prescribed in Para V(b) of the Station Working Orders for RVJ;
- (iii) "Back-locking" was fully effective (in other words, once the track ahead of the Signal was "shunted", whereas the Signal got normalised instantaneously, even the repeated use of the 'EUUYN' to release or cancel the route proved futile);
- (iv) Once a route initiation proved a certain 'lie' of the points, none of these points could be individually "reversed" even by recourse to the 'EWN' button and there was also no question of initiating any other "conflicting" route(s);
- (v) Similarly, once a Signal was taken, 'OFF', the shunting of any TC included in the concerned route section(s) immediately caused that Signal to re-assume its 'ON' aspect, as expected; and
- (vi) As para 504(d) of the Signal Engineering Manual provides for staggering of polarity of adjacent TCs, this aspect was verified\*\* by appropriate tests.

(b) Some important observations made, as a result of the detailed inspection carried out by him, were as under :—

- (i) The Crank Handle was not interlocked with the Panel;
- (ii) The Relay Room on the ground floor of the Cabin was not locked in the manner prescribed by the Railway Board;
- (iii) In view of the restrictive speed limit of 15 km/h imposed while traversing RVJ, the 'Green' aspect of the Automatic Signal M 1106 in rear of Manual Signal No. RVJ-5 could, with more logic be replaced by a 'Double Yellow' aspect; and
- (iv) Cross protection of 'cut-section' TCs shall be provided as soon as possible (if not already done) in terms of para 506 of Signal Engineering Manual.

\*If not directly visible because of the hood over the Cab's wind screen.

\*\*The staggered polarity of adjacent TC's No. M 1106 AT, 205 T and 20 Ton the Up Mahim Chord was verified by me through the examination of the performance of the concerned relay provided in the apparatus Case of Location H 1022, situated close to Signal No RVJ-5.

### 29. Braking Trials with the undamaged rake of B-90 on 27-4-81

As already explained in para 12(i), braking trials with the damaged rake of CM-15 were ruled out. Hence, further to the tests conducted vide para 12 (h), fresh braking trials were conducted with the undamaged rake of B-90 by attaching 2 extra coaches in the front to make up the full complement of a 9-car formation, a report on which is given in para 2 of Annexure II(a). One feature noticed regarding the functioning of the speedometer was that its needle/pointer moved sluggishly, or jerkily in the lower speed-ranges; because of the inertia effect intrinsic to the mechanism, such a performance is in fact generally true of most speedometers.

### 30. Trial on B-90 of 28-4-81

(a) In order to reconstruct the likely events of 24-4-81, the normal run of B-90 was monitored on 28-4-81 ex: Bandra to Vadala Road in the company of Shri M.C. Sinha (Deputy CRS, Mech'), Shri R.K. Jain, Divisional Railway Manager and other Senior Railway Officers, when the following was noted :

Unit No. 136-417-155

Leading Driving Trailer Coach No. 76138

Speedometer—Not fitted (i.e. deficient)

Motorman—Shri T.J. Barnabas.

(b) On the approach to KCE, the Automatic Signal No. M 1106 was 'GREEN'. The 'GREEN' aspect of the platform Repeater No. 5-PG was not particularly discernible against the generally greenish background provided by the platform rear wall sheeting. The 'Yellow' aspect of signal No. RVJ-5 was clearly visible after entering the platform, but its view with respect to a standing Motorman was obstructed by the sun/rainshade provided over the wind-screen of the cab, unless the Motorman peeped out through the side-window in the door on his left, or bent to the right to peer obliquely to sight the same, or else bent forward, were he already in a sitting posture. The stoppage at KCE was timed at 40 seconds and it was once again verified that the after-noon sun-light did not "play any tricks" on the Signal unit.

(c) On its way past KCE, the Local attained a maximum speed of the order of hardly 25-30 Km/h, with the Motorman, doubtless influenced by my presence, accelerating for only 15 seconds or so before cutting out the traction and gently applying thereafter the EP brake by about 15° in order to be certain that this Local would enter RVJ at no more than 15 Km/h of speed.

(d) With the Motorman located at the left side in the Cab, the visibility of the lines ahead was restricted because of the 2½° right-hand curve. In general, while negotiating this curve, the visibility\* ahead on the Up track was 150 m and 100 m on the adjacent Down Mahim Chord (to the right).

(e) The turn-out No. 104 could be distinctly and unmistakably made out when the cab was 5 meters in rear of ES 10/11, on which mast the speed-limit Board of 15 km/h\*\* was affixed. The Motorman was then asked to release both his hands (the Cab must have covered some 25 meters after passing the mast of ES 10/11 when he complied with this request) and the train came to halt at a distance of 30 metres still in rear of the Fouling Mark. The speed Limit Board was provided at a distance of (499.4—414.3)=85.1 m in rear of the Fouling Mark, whence the actual braking distance may be deduced as 30.1 m.

### 31. Visibility Trial on M-51 of 28-4-81

(a) This test was carried out in the presence of the aforesaid officials ex: Vadala Road, when the following particulars were noted:

Unit—103-11-127.

Leading Driving Trailer Coach No. 76131.

Speedometer—not working.

Motorman—Shri M.M. Ansari.

\*This was substantially the observation also of Shri J. Bhattacharjee, Dy. CRS (S&T), Calcutta who conducted an independent visibility test earlier on 27-4-81 by B-58 Up.

\*\* This was also the observation of Shri J. Bhattacharjee, Dy. CRS (S&T), who conducted an independent visibility test B-51 Dn on the previous day.

(b) The visibility of Signal No. RVJ-1, which was barely 200 m, could be improved by shifting it closer to the track (it is at present set back 4.27 m from the centre-line of the Down line). Once this Signal/ was passed, the visibility improved substantially because of the comparative openness of the space beyond the tracks on either side and no encroachments.

(c) Whereas the southern end of the Mahim Chord could be easily distinguished from ES 10/3, its visibility was unmistakably excellent from ES 10/4, where the Speed Limit Board of 15 km/h\* was affixed in the Down direction. Reckoned from the Fouling Mark beyond (ibid), these 2 structures are located respectively at a distance of 226.9 m and 147.7 m, as can be gauged from Annexure I (b).

### 32. Isolation of run-through lines

(a) Had the Kurla Chord been physically isolated from the Mahim Chord by the provision of trap points, this accident would have been averted. The full implication of this issue is discussed in para 2 of Annexure II (c).

(b) Constructional features and train-consist of EMU trains are such that train-partings are virtually ruled out, which explains the absence of any safeguards on the Harbour Branch by way of 'slip sidings' to trap any parted cars rolling back from causing a collision, although severe grades do exist on approaches to high-level or "elevated" Stations like KCE.

(c) However, as mentioned in para 10 (c), the situation at KCE is that goods trains ex: BPT do move to Western Railway via RVJ and, as parting of loads on goods trains is certainly not an unknown feature, it would be essential to provide a trap point on the Down Mahim Chord just ahead of RVJ to protect this junction from being fouled by any parted load off a goods train rolling back down the I in 91 gradient. Such a protection has indeed been existing for decades on Mahim-side of KCE to safeguard the Western Railway from a similar contingency of a parted load (off a BPT-bound goods train) rolling back down the gradient on the Western Railway side.

### 33. Flank Protection—

(a) During my subsequent testing of the PI at RVJ, the following features came to light :

- (i) Occupation/shunting of TCs 205 and /or 206 had no effect on Signal No. RVJ-1; i.e. if this Signal were already taken 'OFF', it would *not* go back to 'ON' upon shorting these TCs, although this condition could certainly imply that a train was on its way to RVJ on a collision path; and
- (ii) With the route set for an Up Local from KCE and Signal No. RVJ-5 taken 'OFF', Points No. 104 and 109 were free (i.e. they could be set in either direction)—which was a hazard prone situation, because if they were set for the 'straight' and either an Up or Down Local ran past respectively Signal No. RVJ-5 or Signal No. RVJ-1 at Danger.

(b) These observed features did not, however, contravene in any way the conceptual logic of interlocking as evidenced by the circuit diagram. Thus, the process of route initiation did not attract any safeguards beyond the minimum requirements mentioned in para 27(a) supra.

(c) The latest thinking on the British Railways, as reflected at pages 52-3 of the 1980 Edition of O.S. NOCK's "Railway Signalling—A treatise on the recent practice of British Railways", stipulates that the following conditions must be met, *inter alia*, before clearing a Signal :

- (i) TCs forming flank protection against overruns past the Entrance Signals of conflicting routes must be clear;
- (ii) Points which trap conflicting movements or overruns or otherwise give flank protection to the route must be set, locked and detected in the correct position; and
- (iii) The Entrance Signals of directly opposing routes must be proved to be at 'Red'.

(d) The effect of such flank protection on the safety of movements at RVJ is discussed at some length in para 3 of Annexure II (c) which demonstrates that the protection referred to in sub-para (c) (i) above would prove an effective safe-guard against an accident, unless the Motorman of a Down Kurla-bound Local ignores the restoration of Signal No. RVJ-1 to 'Danger' (caused by the over-shooting of an Up Local past Signal No. RVJ-5 at 'Danger'). A firm deterrent to such an eventuality like this lies, of course, in the Automatic Warning and Stop (AWS) System.

### 34. Automatic Warning and Stop (AWS) System—

(a) Installation of such sophisticated control systems which are designed to bring the train to halt unaided by human agency in the event of the failure of that very human element in the face of an unsafe

\* This 15Km/h permanent speed restriction finds surprisingly no mention in Appendix V of Bombay Division's Working time Table for the Suburban Section that has been in force ever since 15-10-1979, although the fact that such restrictions on account of track-layout ought also to be included in the Working time table is borne out by its page 72, which showed a similar 15 Km/h speed limit between ES 15/1 and ES 15/4 for the Down Road at Kurla Station due to a 1 in 12 Turn-out leading to Platform No. 1.

situation has been consistently highlighted by successive Railway Accidents Enquiry (Inquiry) Committees. For instance, vide its Recommendation 85, the Kunzru Committee advocated Automatic Train Control (ATC) on some Suburban Sections as well as selected Trunk Routes, whereas vide its Recommendation 148 (i), the Wanchoo Committee emphasised that the provision of ATC was a matter in which there should be little diversity of opinion and that, even in the face of financial constraints, its phasing out must be done with a sense of urgency. The latest (Sikri) Committee also dealt with this issue comprehensively in no less than 7 Recommendations (153 to 159 inclusive).

(b) The AWS is a sanctioned project on the Suburban system of both the Central and Western Railways. Yet, curiously enough, while work on AWS is in progress on the Western Railway, a similar contract for the Central Railway has been rejected by the Railway Board. From the Railway Boards' published views on Para 117 of the Sikri Committee Report (Volume I), it appears that extension of AWS to other sections would be considered only upon a performance appraisal, after their completion, of the 2 such projects on hand, namely, the Delhi-Howrah route and Western Railway's Suburban Section in Bombay.

### 35. Erosion of Motorman's Confidence in the Signalling Branch

(a) Besides the evidence tendered at this Inquiry by individual Motorman and a Retired Assistant Electrical Engineer (Operations), written communication was also received from the Central Railway Motorman's Association about the growing disenchantment and restiveness felt by them about the so-called short-cum-methods employed by officials of the Signalling Branch. The main reason for this state of affairs was that, whereas several instances of "Fail Unsafe" occurrences were reported, nothing abnormal was apparently discovered by the Signalling Branch, when they investigated those "failures".

(b) There is a wide-spread conviction amongst Motormen that Signalling Staff resort to bridging of relays (which act also goes by other terms such as "giving false or direct feed to Signals") for the purpose of clearing Signals (when the Cabins are unable to do so for a variety of reasons ranging from, *inter alia*, miscreant activity to working on track by Permanent Way gangs) with the sole aim of avoiding detention to traffic.

(c) It became apparent during the Inquiry that the Central Railway not only does not take positive steps to disabuse the Motormen of their apprehension in this regard but does not also seem to be perturbed by the resultant drop in morale. In this context, it would be quite pertinent to note here that a similar situation does *not* obtain on the Suburban Section of Western Railway, where complaints from Motormen not only receive very prompt attention but also the feed-back given to the complainant has invariably the salutary effect of reassuring the Motormen as a key group of rail personnel. It is in recognition of the crucial importance of this issue that the Western Railway have also established a special position of 'Signalling Controller' at Bombay Central with the sole object of keeping a close and effective watch over signalling defects, of organising the speediest possible remedial action and further follow-up action via the Safety Counsellors as necessary. Alas, no such position exists at Central Railway's Victoria Terminus with comparable duties.

### 36. The stresses and strains that Motormen on duty are subjected to

(a) Compared to a locomotive Driver, a Motorman's degree of concentration on his look-out duties is of higher order simply because he is all by himself in the Cab to pick out the aspects of the Signals ahead. That such mental acuity can be highly fatiguing has to be recognised and accepted. (Indeed, scarcely ever has a Suburban accident occurred in India when there was someone else in the Cab besides the Motorman).

(b) In the by-gone days, the 1/2 minute halt at a Station did give a breathing spell and afforded some respite to the Motorman, albeit of very limited duration without doubt, within which his fatigue would vanish in part. During the present times, however, Motormen are almost incessantly accosted by inquisitive and occasionally irate passengers on the Central Railway, where late-running has unfortunately been prevalent because of having to operate with several over-aged and virtually unmaintainable stock. Thus, even this 1/2 minute of halt at Station acts a stress-inducer also.

(c) The rampant evil of trespass in front of trains, whether standing or on the move, imposes further strain on Motormen for, quite apart from anything else, the consequence of running over trespassers can prove tragic to the person of the unwary Motorman. Thus, the hitherto virtually peaceful run between Stations has become an unending vigil or alertness to sound horn almost continuously, because trespassers seldom seem to pay any heed to one or two blasts on the hooter.

(d) Even when changing from one end to the other of the *same* EMU at the end of one Local's run or, all the more so, when shifting from one EMU to another, frequently requiring the use of the foot over-bridge), the Motorman has often to exert hard in pushing through a mass of humanity. With late

arrival almost inevitable, the time available to reach the Driving Cab of the next Local on his "Detail" is invariably cut short, forcing him to rush through and face on several occasions irate passengers who are all too anxious to berate the hapless Motorman for any late start. However, the extant policy of not acknowledging late-running unless the Local is delayed by over 4 minutes implies that the records do not always reflect many such cases, which nevertheless do impose further strain on the Motorman in the stated manner. Particularly when heavy accent is placed on punctuality statistics, it is only to be expected that the factual situation should be quite different from what has been recorded with regard to late-running.

(c) Besides the known feature of relatively closely spaced Signals (the pace at which they are sighted can be truly exhausting and wearisome), the observations made in the preceding sub-para would make it abundantly clear that due entirely to changes in "externalities" or environmental factors, the Motorman is, once he gets on to a Local, now-a-days under constant, continuous and relentless pressure throughout his duty-hours, which is so highly fatigue-some that he deserves to be classified as "intensive" as per HOER (Hours of Employment Rules) and in terms of the definition contained in Section 71(A) (d) of Chapter VI (A) of the Indian Railways Act (reproduced below) :

"The employment of a railway servant is said to be 'intensive' when it has been declared to be so by the prescribed authority on the ground that it is of a strenuous nature involving continued concentration or hard manual labour with little or no period of relaxation".

(f) Lest there be material increase as well in a Motorman's workload through the years, the Railway was queried about it, in response to which the following information was provided under its letter No. T-102/P/2/81-82 of 31-3-81 :-

(i) In contrast to an average of 5.41 trains worked by a Motorman in 1962 (649 trains off 120 "Details"), only 3.95 trains were worked on an average in 1981 (862 trains off 218 "Details"); and

(ii) Currently, the minimum and maximum rostered duty on any day was 3h.23' and 8h.38' respectively, with no Motorman required to work for over 7h.45' a day on an average.

(g) Let us now consider the kilometers covered by Motorman through the years 1960-80 in quinquennial stages as below :-

| Year           | Total No. of Trains per day | Total Kilometres covered in a day | No. of "Details" or Motormen | Average No. of trains per Detail | Average daily distance (Km) |
|----------------|-----------------------------|-----------------------------------|------------------------------|----------------------------------|-----------------------------|
| 1960 . . . . . | 692                         | 20,062                            | 112                          | 6.2                              | 179                         |
| 5 . . . . .    | 682                         | 19,190                            | 141                          | 4.8                              | 136                         |
| 1970 . . . . . | 703                         | 19,732                            | 155                          | 4.5                              | 127                         |
| 5 . . . . .    | 789                         | 24,877                            | 191                          | 4.1                              | 130                         |
| 1980 . . . . . | 864                         | 27,955                            | 218                          | 4.0                              | 128                         |

From this tabulation, it does appear that the statistic cited by the Railway vide sub-para (f) above is not apt, for a truer picture of Motorman's workload emerges from the average distance travelled by a motor man in a day. This latter statistic, which remained sensibly steady for the past decade, demonstrate that the "quantity" of his work-load, as distinct from the "quality", had not actually aggravated.

(h) On the day prior to the accident (i.e., on 23-4-81), Shri Krishna Kumar earned 201 km. within 7h.57' of duty which ended at 16.32 hours. As his "Detail" started at 09.24 hours on the day of the accident, he is deemed to have had adequate rest and, prior to the subject collision, he had actually covered 191 Km. of the scheduled 201 Km, as he was on the very last "leg" of his "Detail" for that day.

## VII. DISCUSSION

### 37. As to the time of the Accident and the Speeds of the colliding Locals

(a) Based on the following post-accident material evidence available at the site, it has been possible to deduce the likely speeds of the 2 colliding locals as shown in Annexure I (b).

(i) Results of braking tests as mentioned in Annexure I (a);



- (ii) Number of ineffective cylinders, vide para 8 (b);
- (iii) The gradients and curvature of track, vide Annexure I (b); and
- (iv)—

- Location of that point where an Up Local from KCE would collide with a Down Kurla-bound Local;
- Disposition of CM-15 at the instant of suffering the collision, as evidenced by the damage contracted; and
- Disposition of the 2 EMUs after the collision.

(b) From a consideration of the distances covered by the 2 Locals after their respective last 'stoppages, their progress on the 'collision-path' has been closely analysed in Annexure III (b), leading to the following conclusions :

- the collision took place at 16.19 hours;
- the speed of CM-15 at that instant was 70 Km/h; and
- the speed of B-90 at that instant was 40 Km/h.

38. As to whether Signal No. RVJ-5 could have been taken 'OFF' for B-90

(a) According to B-90's Motorman [paras 15(a) and (d)] Signal No. RVJ-5 was "Yellow" and the preceding Automatic Signal M-1106 was "Green" as he arrived into KCE. Yet, CM-15's Motorman left [para 17(a)] from Vadala Road Station on a "Green" Starter" Referring now to para 3(a) of Annexure II(b), the aspects of Signals as allegedly observed must have occurred at 1.51' and 1.49' before the accident respectively for B-90's Motorman and CM-15's Motorman. These 2 observations are non-concomitant in that if one were true the other cannot also be true. To wit, the Down "Starter" from Vadala Road cannot assume a "Green" aspect unless Signal No. RVJ-1 had already been taken 'OFF' for CM-15 and repeated testing of the PI installation [paras 13(d) (ii), 27(a) and 28(a) (iv)] did establish the impossibility of simultaneously taking 'OFF' of conflicting Signals.

(b) Since the said 2 observations of the aspects of Vadala Road "Starter" and Signal No. RVJ-5 occurred practically simultaneously, the use of the Emergency Cancellation Device, 'EUUYN' is also ruled out in this instance, entailing as it did [para 28(a) (ii)] a time lapse of 105 seconds.

(c) The only other alternative to be probed is whether the Emergency Sectional Route Release Device 'UYN' could have been actuated, because this acts instantaneously. Consistent with all available material evidence, the hypothetical sequence of events could then be as below, despite what the CASM stated in para 19(f) :

- (i) B-90 appears on the 'Panel' at RVJ first at about 3' prior to 16.19, or at 16.16 hours, vide para 3(a) of Annexure III (b). Validity of this supposition is established in para 3 (b) of Annexure II (b);
- (ii) RVJ Cabin ASM reacts immediately by taking OFF Signal No. RVJ-5, and consequently B-90 is able to pick up the 'Green' aspect of Automatic Signal No. M-1106;
- (iii) CM-15 thereafter appears on the 'Panel' at about 2½' prior to 16.19, or at 16.16½' hours, vide para 3 (a) of II (b) ;
- (iv) Either realising himself that he must give preference to CM-15 [para 19(b)] or under specific instructions from the Control of that effect, the RVJ Cabin ASM proceeds to "rectify" the situation to allow CM-15 to go ahead first ;
- (v) As established in sub-paras (a) and (b) above, CM-15 cannot be "signalled" when Signal No. RVJ-5 is itself taken 'OFF' nor, having regard to the known time-element, by recourse to the 'EUUYN' with its in-built time-release. Hence, the 'UYN' is used\*, with the help of SI@, to effect instantaneous cancellation of the route previously set for B-90, so that CM-15 is signalled;

\* From para 5 (B) (ii) of II (a), it may be noted that the UYN was factually used 4 times during the very shift in which the accident occurred.

@ As per the 'Note' under para 21, the SI started walking from Gate No. 6 towards Vadala Road at 15.45 hours. This Gate is located at Km. 7/18-19 (or about 7.84Km.) vide para 10(h), whereas RVJ is at Km. 10.22 vide Annexure I (a). The distance from Gate No. 6 to the Cabin at RVJ, which is of the order of 2.38 km. can be covered, walking at the comfortable pace of 5 Km./h. very easily in half an hour, which means that the SI could have reached the Cabin by 16.15 hours, if not quite sooner.

(vi) CM-15 arrives Vadala Road at 16.17 hours and leaves on a "proper Starter" at 16.17½ hours and

(vii) B-90 arrives KCE at 16.17½ hours and, having already earlier picked up the 'Green' aspect of Automatic Signal No. M-1106, concludes straightaway that Signal No. RVJ-5 must, *ipso facto*, be 'OFF'. Failing to notice\* that it is in fact at 'Danger', he departs from KCE at 16.18 hours to cause the collision.

(d) Since nobody may be expected to incriminate himself, whilst there has been no evidence at all in support of what has been elaborated in sub-para (c) above, the following other factors argue against the said hypothesis :

(i) No S&T staff would ever resort to the 'UYN' [para 23 (c)] merely to assist the CASM and, that, too, in a situation when the approach track behind that Signal which had been previously taken 'Off' was already lit;

(ii) Whereas restoring Signal No. RVJ-5 to 'Danger' in the face of an approaching train was prohibited by Bombay Division's Operating Circular No. 135— the provisions of which were, as mentioned in para 1 of Annexure III (a), found to be complied with—such was not the case in the subject accident ;

(iii) And, had Signal No. RVJ-5 truly been normalised in defiance of the said Circular, any CASM of ordinary prudence must be expected to be very alertly on the look-out for any possible overshooting of this Signal by B-90, with the result that firstly, he ought to have become quickly aware of TC 205 T 'dropping' and secondly, he should have taken steps to immediately put back Signal No. RVJ-1 to Danger † ; but, such was not also the case in the subject accident.

(e) Having no grounds whatsoever to postulate any collusion between the concerned staff (the CASM and SI) and as sub-paras (a), (b) and (d) above are contra-indicative of this possibility, I accordingly conclude that Signal No. RVJ-5 could not have been taken 'Off' for B-90.

39. As to whether Signal No. RVJ-5 could have been seen in its 'Off' aspect by B-90's Motorman for any other reason

(a) If credence is to be placed on the Motorman's version [para 15 (a)], then this Signal could have assumed its 'Off' aspect only due to an unsafe failure in the Signalling System or due to a deliberate short-cut and unsafe method employed by S&T staff or due to miscreant activity.

(b) With the satisfactory cable insulation [para 4 (b) of Annexure II (a)] and further with the most comprehensive series of tests [paras 13(d) (ii), 27 (a) and 28 (a)] demonstrating the structural integrity of the installed PI, there can be *no* doubt whatsoever that the Signalling System was performing as desired.

(c) As regards interference by outsiders, the possibility of anyone tinkering with the Signal Unit of this Signal is ruled out, as explained in para 2 (e) of Annexure II (a). Similarly, para 3 (d) of the same Annexure ruled out miscreant activity at the Apparatus Case at Location H-1022. Broadly speaking, behind any such anti-social behaviour there has to be an underlying motive which most commonly, happens to be theft; in the subject accident, however, nothing was reported stolen and, inasmuch as nothing was also found amiss with the functioning of either this Signal or the entire system, miscreant activity can be ruled out.

(d) When, for any reason, a Signal@ does not come 'OFF' and provided that it has been established (albeit of ten heuristically) that the conditions for clearing the Signal have been satisfied, it is quite true (even if the Railway Administration may not concede this situation officially) that short-cut methods like bridging of relays [para 35 (b)] have had to be resorted to, with the sole object of minimising detention to traffic. Coming to the specific case under Inquiry, a point would arise whether there was any particular fault on the day of the accident which might have necessitated recourse to any short-cut method and, in this context, it would be pertinent to note that, due to the bobbing of TC 207T, CH-21 [para 20(a)] was detained at Signal No. RVJ-1 until the giving of 'Calling-on' Signal. According to evidence [para 20 (b)], this problem with TC 207T did not persist, which was the reason stated for not entering this fault in the Signal Failure Register. However, it might well have been that the problem did persist, requiring the

\* Vide para 30 (b) the hood on at least some of the Driving Cabs of EMUs can screen the Signal Unit of this Signal from the Motorman after an Up Local has halted at KCE.

\*The resulting situation would be similar to what might be achieved by the so-called "Flank Protection" referred to in para 3 (a) of Annexure II (a) wherein it was shown that CM-14 could then be easily brought to a halt well short of the diamond crossing without any possibility of colliding with B-90.

@ Without a ° Calling-Only facility.

use of the 'UYN' [para 5 (b) (ii) of Annexure II (a)] to release the sub-routes; but, as even then the concerned Signals affected by TC 207 T could not be taken 'OFF', the SI might have resorted to bridging the relevant contacts and providing a "false feed" to Signals No. RVJ-1 and RVJ-5, and thus clearly creating an unsafe situation, as conflicting movements could occur simultaneously on purportedly "proper" Signals.

(e) A careful consideration of all available evidence would, however, show that 3 factors do go against any supposition regarding short-cut methods :

- (i) With regard to a persistent fault in TC 207T, which is an essential ingredient to the hypothesis made in sub-para (d) above, the fact that nothing adverse was discovered during the joint tests\* [para 13 (d) (ii)] would serve to prove that nothing was probably wrong with this TC at the time of the accident.
- (ii) With particular reference to Signal No. RVJ-5, it is noteworthy that it has got a 'Calling On' facility which virtually rules out the need to resort to any short-cuts for taking off the Main Signal; and
- (iii) From the traffic point of view also, no situation developed, immediately prior to this accident which could act as a motive to justify any unsafe procedure.

(f) All things considered, therefore, I am of the opinion that this Signal could not have been actually perceived in its 'OFF' aspect by B-90's Motorman.

#### 40. As to the situation at RVJ at the time of the accident

(a) The disposition of Points has been mentioned in para 13 (a) (vii). That Points No. 104 were in the 'normal' position (which was also borne out by the path taken by CM-15) is not, in view of para 33 (a) (ii), in itself sufficient proof that the route was not set for B-90. Yet, the fact that Points No. 107 were in the 'normal' position† is proof enough that route was not initiated for B-90.

(b) The situation at the time of the accident may thus be summed up as below :

- (i) Track Layout at RVJ did not accord with the route for B-90 but agreed with the route having been set for CM-15; and
- (ii) CM-15 was signalled, whereas Signal No. RVJ-5 for B-90 was not taken 'OFF'.

#### 1. As to the Role of B-90's Motorman

(a) On the basis of what has already been established in the foregoing in respect of the speed-profile of B-90 after it passed Signal No. RVJ-5, at 'Danger' no reliance can be placed on the Motorman's evidence.

(b) My own personal inspection of the accident site on 25-4-81 [para 27 (d)] and subsequent trial by the same Local (i.e. B-90) on 28-4-81 [concluding part of para 30 (b)] established that there was just no way that the Motorman could have mistaken the 'Red' aspect for 'Yellow' at about the time that B-90 arrived at KCE on 24-4-81.

(c) The assessment of the likely speeds attained by B-90 ex: KCE vide Annexure I (b) and the validated reconstruction of its movements vide Annexure II (b) clearly show that the Motorman had arrived at the collision point at a speed very much in excess of 15 Km/h which was the governing speed. That the train was probably out of control was also corroborated [para 14 (a)] by an independent witness. The basic premise here is that the 15 Km/h speed restriction is by and large being truly observed by Motorman, so much so that a satisfactory rationalisation has to be sought to explain a gross infraction.

(d) Due cognizance must be accorded to the above feature while postulating any possible explanations as to why the Motorman did not heed the KCE Starter which was at 'Danger'. Thus, any argument that he was handicapped from sighting the KCE Starter No. RVJ-5 by the constraints—comprising a combination of the proximity of the said Starter and the obstruction formed by the sun-shade (or, hood)

\* Certainly no one would have failed to observe them, if any S&T personnel had been working on TC 207T or anywhere in the vicinity of the accident site (which was buzzing with hectic activity right until the time of restoration of suburban services.)

†Vide para 28 (a) (iv), it was established that the lie of any Points could not be altered, once a route was set. Hence, Points No. 107 could no longer be operated after the accident because of the occupation [paras 13 (a) (iv) & (vi)] of the affected TCs.

over the wind-screen of the Driving Cab [Annexure I (b) and paras 25 (b) & 30 (b)]—would not bear much scrutiny for two reasons : firstly, it is a Motorman's cardinal responsibility to observe Signals and go by their aspects and, secondly, the said handicap could have in no way influenced him to overspeed as he did.

(e) Indeed, no matter how-so-ever he might have been lulled into believing that the Signal was 'OFF' when it was actually 'ON' (whether or not such a misunderstanding could have been either triggered off by the exchange of 'beats' with his Guard, or otherwise occasioned by a lapse of concentration on his part, or the possible outcome of a sub-conscious retention in his memory of the 'Yellow' aspect of the Guard's Repeater No. RVJ-5 PG), there was no reason to overspeed because this Local was on time.

(f) The only explanation that fits with passing the Signal at 'Danger' and subsequent loss of control over the train-speed would be that, finally succumbing to the extremely strenuous as well as monotonously repetitive nature of his duties [note under para 25 and paras 36(a) to (e)], the Motorman had been so overcome by sheer fatigue that he was no longer fit to operate an EMU, whether or not he had actually dropped off to sleep. As the Motorman had adequate rest [para 36(h)] prior to starting his 'Detail' on 24-4-81, with the collision having occurred on his very last trip for that day, and further in the absence of any evidence of something unusually tiring or wearisome having adversely affected him on any trip on his 'Detail' or that day, the root cause for the Motorman's severe fatigue (that had most probably incapacitated him from about the stage that he halted at KCE) can be ascribed only to the very nature of his duties, which are mentally exhausting. Surely, unless he was overcome by a compulsive death-wish he could not have been deliberately planning wanton destruction, because any such act would be actually tantamount to a suicidal attempt.

(g) The fact that the Joint Observation of the Driving Cab revealed that the Master Controller [para 12(c)(iv)] was *not* in the 'off' position\* and that the Brake Controller [para 12(c)(v)] showed practically too little application to be any effective lends further support to the conclusion that the Motorman had not taken the proper steps to brake his train (with a view to controlling its speed within the imposed limit), which was simply because he was unfit, with respect to his mental acuity, to have been in charge of an EMU at the time of the collision.

(h) Given these circumstances, that a collision was unavoidable has been brought out in para 4(d) of Annexure II(b). Nevertheless, this observation does in no way absolve the Motorman of the gravity of his offence of continuing to man the EMU while he was in all probability far too tired to do so with safety. Even if GR 98(c) provides no guidance in this respect as to what ought to be done when a Motorman becomes or feels incapacitated, it surely is a matter of ordinary prudence and commonsense for him to have desisted from operating an EMU any further and sent a suitable message to the Suburban Loco Power Controller.

(i) It is true that Shri Krishna Kumar, the offending Motorman, was originally recruited as Assistant Driver, who then got promoted successively as Shunter 'A', Driver 'C' and Driver 'B' before becoming a Motorman. In other words, he is not one of those Motorman directly recruited from the Railway Service Commission. However, on the basis of available evidence, I do not consider that this particular factor had any bearing on the cause for this accident.

#### 42. As to the Role of B-90's Guard

(a) As mentioned in para 2.4 of Annexure III, the provisions of the Railway's SR 115-1(b) (ii) about starting of Suburban trains, as duly amended in 1970, absolve the Guard from any and all responsibility to see that the correct Signal had been taken 'OFF'. Accordingly, despite the existence of Guard's Repeaters at several stations on the Suburban section, ever since 1970 the Guard of a Local is not duty-bound to observe its aspect. In any case, B-90's Guard [para 16(b)(ii)] that he was unable to sight the Guard's Repeater No. RVJ-5PG provided on the Up platform at KCE.

(b) With regard to the overspeeding of B-90 relative to the speed limit of 15 Km/h, it is inconceivable that the Guard could have been unaware of the same. Accordingly and particularly in view of the Joint Observation made of the Guard's Cab [para 12(d)(i)] the Guard is deemed to have not complied with the provisions of GR 121 (which required him to ensure that the train was proceeding in a safe and proper manner) as amplified by the Directorate of Safety, Railways Board, at page 118 of the "Handbook for Guards", the relevant extract of which is reproduced below :—

"(vi) *Train running at excessive speed*—Speed of the train is to be within the permissible limits and permanent and temporary restrictions on speed on certain parts of the run are to be observed".

\*In Chapter III on "Jessop Stock" of Central Railway "EMU Operating Manual", Section III at page 119 on "Stopping" commences as follows

"Before applying the brake, the Master Controller handle must be at the OFF position".

#### 43. As to the role of CM-15's crew

(a) The preponderance of evidence shows that CM-15 was travelling on proper signals exc : Vadala Road. According to the Motorman's evidence [para 17(b)], his application of brakes and the actual impact had occurred simultaneously. Based on the reconstruction of the progress of the 2 Locals on their collision path, this accident was assessed from the view point of CM-15's Motorman in para 5 of Annexure II(b), whence it would be seen that, by the time that he could have become aware of B-90, it was far too late for him to be able to stop CM-15 short of the crucial diamond crossing. Although the implication is that a collision of probably different type (involving certain damage to his Driving Cab and himself as well) would nevertheless have taken place\*, no blame can be attached to CM-15's Motorman.

(b) Even though CM-15's Guard was not primarily involved in this accident, as may be seen from para 12(f)(i), he, too, took prompt action to control his Local, once he felt the jerk.

#### 44. As to the role of the CASM on duty at RVJ

(a) The Joint Observation of the 'Panel' [para 13(a)] having wholly corroborated the evidence [paras 19(a) & (c)] of the CASM on duty at RVJ, he is deemed to have acted correctly and properly in signalling CM-15 while detaining B-90 at KCE.

(b) However, there is no doubt that this accident could have been averted had he been concentrating on his 'Panel' for, in that event, he could not have failed to perceive the de-energisation of TC 205T (and, had he further been alert to the possibility that TC 205 T had 'dropped' because of track-occupation by B-90, as opposed to the "allegedly ubiquitous bobbing") to restore Signal No. RVJ-1 back to 'Danger'. As explained in the note under para 38 (d) (iii), in such a case CM-15 would have had ample time to heed the 'Red' aspect of Signal No. RVJ-1 and stop quite short of any danger of collision.

(c) It is, therefore, a great pity that the CASM could not [para 19 (a)] detect in time the strip lights [para 11 (e)] glowing red beyond Signal No. RVJ-5. But, he cannot in all fairness be held blame-worthy on this account, because his attention could indeed have been directed elsewhere [para 19 (d)] and also because he is not duty-bound to concentrate non-stop on his 'Panel'.

#### 45. As to whether this accident could have been averted

(a) Movements at RVJ are as it is inhibited by a speed restriction of 15 Km/h [note at page 28] for trains going to (or, coming from) the Mahim Chord. That even this restrictive speed limit does not by itself constitute an inhibitor of collisions at this running junction as explained in paras 1 (c) and (d) of Annexure II (c). Indeed, this speed limit, which was imposed on account of trains having to negotiate turnouts, bears conceptually no relation whatsoever to the notion of protecting a running junction. In other words, any increase or decrease in this speed limit has no direct effect on safety at RVJ, excepting for its indirect effect on the related braking distances.

(b) The PI at RVJ is characterised by the availability of only the minimum "flank protection" as illustrated in para 33 (a). The desiderata in regard to flank protection having also been emphasised [para 33(c)] in the British Railways practice, the effect of such flank protection on the safety of movements at RVJ has been examined in detail in para 3 of Annexure III (c), whence it can be concluded that such flank protection is foolproof against overruns past conflicting Entrance Signals, excepting when a Down Local also chooses to disregard the restoration of Signal No. RVJ-1 consequent upon the overrunning by an Up Local past Signal No. RVJ-5 at 'Danger'. Whilst it is quite impossible to legislate for in-built safety against such a fantastic improbability of 2 Locals simultaneously ignoring their respective Signals at Danger, the principle of extending the flank protection up to the conflicting Entrance Signals would be adequate to avert a collision at RVJ.

(c) The infrastructure at RVJ does not include physical isolation (by way of trap point, snag dead end, etc.) of the Mahim Chord, which should be regarded as a Branch Line for all practical purposes. The implications of isolation are detailed in para 32(a) and para 2 of Annexure II(c). It is an accepted maxim that special circumstances merit special considerations and, in this case, the terrain characteristics at RVJ (such as 1 in 91 steep gradient and a 2-1/2° moderately sharp curve) are peculiar features which, prima facie, justify the incorporation of physical isolation of the Kurla Chord at this running junction from the Mahim Chord, which would have averted an accident of this type.

(d) As regards B-90's crew, it is self-evident that this accident would not have taken place had—

(i) the Motorman obeyed KCE Starter No. RVJ-5 which was at 'ON'; or

(ii) the Guard taken pains to observe and obey the aspect of the Guard's Repeater No. RVJ-5PG because Guards do nevertheless pay heed to the said Repeaters [later part of para 2.7 of Annexure III], even though they may no longer expected to do so.

\*i.e., had he applied brakes even earlier.....40

(e) Lastly, no such accident would take place, had AWS been installed here, for such a system was entirely free from the effects of human error.

#### 46. As to the need for further protective measures at RVJ

(a) There is no question but that the Driver of a train has to obey the aspect displayed by a line-side Signal and whilst it is certainly impossible to provide for protection against any serious errors on his part in this respect which cannot be "accommodated" within the designed in-built safety-margins (such as, the 'Adequate Distance' or 'Block Overlap' and 'Signal Overlap'), the Railway Administration must nevertheless be ever vigilant to pin-point the areas which become particularly hazardous on account of some particular circumstances peculiar to these locations and then take special measures to provide at the sensitive spots so identified some suitably adequate safe-guards against the effects of human error. For, it would become tantamount to ascribing divinity to a train Driver if all safety-consciousness stems from only the serendipity that Driver will never commit the error of disobeying a Signal.

(b) The adequacy of the existing system to cope with any inadvertent starting of an Up Local ex : KCE against a Starter at 'Danger' has been discussed in Annexure II (c) and having regard also to para 45 (b) the proposed extension of "flank protection" becomes a matter of imperative necessity in the interest of observing abundant caution.

(c) With regard to physical isolation of the Up Mahim Chord, however, shows terrain constraints which would necessitate the positioning the trap-point or snag dead-end so close to the Kurla Chord that any Up Local approaching at a speed of about 40 Km/h (as was most probably the case in the subject accident) could very likely overshoot the physical isolation provided and go on to foul the Kurla Chord's Down Line to form a collision-risk. At speeds of the order of 40 Km/h, there would also most certainly be considerable damage to the errant Up Local due to derailment past the trap point (or, snag dead end, as the case may be), even if the dreaded collision were avoided. In other words, a careful consideration of the effect of providing a physical isolation on the Up Mahim Chord would show that the real trade-off would be a "certain derailment and possible collision of milder consequence" in order to prevent the "possibility of a more serious collision". Such, regrettably, is the case here because of spatial constraints which exclude the introduction of a longer siding to catch that errant Local and keep it away from fouling any other running line(s).

(d) Contrariwise, it is essential to protect the Kurla Chord [para 32(c)] from any "parted load" that may run back down the 1 in 91 grade of the Dn Mahim Chord. Although the contingency visualised herein bears no relation to the subject accident, it is surely a matter of prudent commonsense to improve the safety of railway installations as and when any short-fall comes to light, rather than await until an accident occurs before remedying the situation.

#### 47. As to the need for a proper re-assessment of a Motorman's Work-Load

(a) As elucidated in paras 41(f) & (g) and 45(d) (i) supra, this accident might well have been averted had the Motorman's duties been not so fatiguing. As explained at some length in para 36, whereas there has been no increase in the quantum of the Motormen's workload as gauged from the index of the average daily distance covered, the externalities have through the years certainly aggravated the situation to such an extent that the Motorman has to display a highly strenuous level of concentration continuously, with not even any brief spells of relaxation in between.

(b) A similar observation was made by the then ACRS who had conducted a Statutory Inquiry into the rear-end collision between 2 Locals near Matunga Station on 14-11-79. Elaborating on the circumstances that effectively imposed additional stresses and strains on Motormen, a recommendation was made in para 9.1 of his Report that Motormen should be brought under the category of 'intensive', workers. Non of the circumstances brought out therein were a secret, being public knowledge and known to everybody; yet, under their Office Memorandum No. 79/Safety (A & R1)/28 of 26-6-80, the Railway Board, while seeing no justification for reclassification of Motormen as 'intensive' under the HOER, cited also the Report of the "High Powered" 'Committee on Running Allowances, 1980' as not having recommended any change of classification of any category of running staff from "continuous" to "intensive".

(c) As the facts of the matter are as elaborated in paras 36(a) to (e), it would be worthwhile to ascertain as to precisely what this "High Powered" Committee studied in the context of Motormen's job evaluation. This issue has been dealt with in paras 1521 to 1526 (pp 161—163) of the said Report, a perusal of which would clearly show that the workload of Motormen as such was never examined but rather that of the running staff manning certain "Superfast" trains subjected to a job analysis on 2 Zonal Railways. It would accordingly be erroneous to draw any conclusions from this Report as to the current level of Motormen's actual workload or the adverse effect of the work-surroundings as obtaining at present.

(d) Briefly, the implication of reclassifying the Motormen from 'continuous' to 'intensive' category would be an increase in this cadre of employees, because the total hours of work over a 2-week period (from 'sign-on' to 'sign-off' and inclusive of preparatory as well as complementary times) would reduce from 104 to 90, with a corresponding increase in the rest-period between successive spells of duty from 10 hours to 12 hours. Against the background that a Steward of Rajdhani Express is also classified as a 'continuous' worker, one cannot fail to realise that the Administration has been blind to the 'tiring' nature of duties as currently being performed by Motormen.

(e) As any reduction in the working hours will have a corresponding reduction in the mileage allowance and consequently the pay-packet, it would be impractical to expect Motormen to come forward (either individually or collectively) to press for their reclassification into 'intensive' category. But it is surely for the Administration to recognise the realities of the situation and organise a proper real-world job-analysis of Motormen's duties for, had it not been that his duties were indeed so fatiguing, Shri Krishna Kumar might not have suffered any lapse in his concentration that eventually led to this tragic accident.

#### 48. As to the urgency for introducing AWS

(a) AWS is neither a new nor a revolutionary development ; in fact, a variety of AWS and similar systems have been in operation for decades with considerably success on foreign railways covering the whole range of climatic conditions. Hence, there is truly no cause to soft-pedal its progressive introduction on the Indian Railways on any plea of peculiar considerations.

(b) Admittedly, financial constraints are very real and can't be simply wished away; nevertheless, each adversity like the subject accident under Inquiry does constitute an opportunity to press home the point to all and sundry that more funds are required for investing in safety, because any sane person and/or Administrator would rather wisely support any reasonable expenditure to ensure safer travel, rather than knowingly involve himself and others in a risky situation. Following this rationale, it would certainly appear that any failure on the part of Railway Management to cite each such major accident to forcefully argue and reiterate the demand for extra funds would imply a lost opportunity and indicates lack of deep concern for safety.

(c) The manner in which the introduction of AWS on Central Railway's Suburban System was frozen and the concerned tender cancelled under Railway Board's letter No. 79/W3/SG/26-Part of 3-9-1981 can only lead to the surmise that "concern for safety" is not perhaps accorded high enough a priority by the Apex body in the Ministry of Railways, in spite of the views [para 34(a)] emphasised by the successive Railway Accidents Inquiry Committees.

(d) If reliance can be placed on Press Reports, a view has been ascribed to the Railway Board that theft of line-side equipment acts as a main deterrent against faster introduction of AWS. A little reflection would, however, show that, whereas the nuisance of theft seems to be all-pervasive, the said deterioration in law-and-order situation is obviously not hampering the progress of inputs and investments in other key areas related to rail transport. Hence, it seems amazingly paradoxical that this particular "excuse" should now be cited as an argument against a safety-oriented project. Incidentally, it was in recognition of this very menace of theft that the Sikri Committee exhorted as follows under Recommendation 155(ii) of Part II of their Report :

"Pilfer-proof housings should be provided for all field equipment of AWS system and the circuitry should incorporate earlier warning to the driver if track equipment is stolen".

(e) It being self-evident that the subject accident could have undoubtedly been averted [para 45(e)] had AWS been installed, the urgency as well as the paramount importance of this work cannot be over-emphasised.

#### 49. As to the functioning of the S & T Department

(a) As summed up in para 39(b), nothing amiss was found with the Signalling System and the PI at RVJ. On the other hand, the Motorman had alleged a crisis of confidence [para 35(a)] in the S & T Department's performance on the Railway's Suburban sector.

(b) Since the conditions seem to be such that "bridging of relays" is 'de facto' inescapable [para 35(b)], the Railway has really no option but to accept the inevitable and act as follows :

- (i) Identify those relays, which shall *never* be bridged, no matter what the circumstance(s);
- (ii) Spell out the circumstance(s), under which bridging of certain other relays is admissible and the level and manner of authorisation thereto;
- (iii) Specify an upper limit for the duration within which the fault should be (located and) rectified and normal operation Signals restored, exceeding which a further authorisation would become necessary at a higher level; and

- (iv) Promulgate a system of record-keeping which would enable, through a periodic review, the pinpointing of critical areas requiring an in-depth investigation as also the type-wise classification of problems, besides the identification of repetitive faults for technical study, etc.

It is understood that an initiative has been taken by the S & T Department, which has subsequently got logged down in the administrative imbroglio.

(c) Comparisons are odious but, unfortunately, they can't always be avoided. In this case, whilst the Western Railway was able to create and operate the position of a Signal Controller [para 35(c)] at Bombay Central, the Central Railway seems to have got stuck in this respect, even though the Committee of S & T Directors (constituted under Railway Board's letter No. 78/W3/SG/M/4 of 14-6-78) specifically exhorted the Central Railway under its Recommendation 17 to provide a "Fault Controller" similar to the practice adopted by the Western Railway. This lapse might be due either to a lack of proper appreciation by the Central Railway of the necessity for this post and its immense potential or else to its inability to convincingly justify the same to the satisfaction of the sanctioning authority. The Central Railway would now do well to successfully emulate the Western Railway in this matter.

(d) With reference to Annexure II (a), the circumstances noted below do not also serve to inspire much confidence in the S & T Department's functioning on Bombay Division :

- (i) Absence of locking of Singal Units [para 2 (c)];
- (ii) Absence of locking of Apparatus Cases and Locations [para 3(d)];
- (iii) Non-compliance with the Station Working Orders of RVJ, in respect of the details to be made available in the "UYN" Register [para 5 (b)]; and
- (iv) The increase with age in cable insulation values revealed in the Meggering Register [para 4 (b)];
- (v) Non-compliance with Railway Board's instructions relating to the security/custody of Relay Rooms [para 7(b)].

(e) That the Central Railway had evolved its own practice of *not* preparing "Route Control Charts" while undertaking Panel Interlocking works [para 27(b)] seems most odd and inexplicable, because there must be some basis (as distinct from the numerous and complex circuit/wiring diagrams) for the annual testing of the installed interlocking by supervisory staff.

#### 50. As to the Recommendations made to the Railway during the course of this Inquiry

(a) Where as the results of a series of extended personal discussions with Railway's General Manager(s) and HODs on the above presented in Annexure IV, 2 key areas drawn therefrom (which have strong safety connotations) remain to be explored further as below :

(b) *What to do with the so-called Gaurd's Repeaters, which already exist—*

- (i) As stated in para 3(b) of Annexure III, standards for the "Starter Indicator", which can be meant for reference by Guards only, have already been 'OK'ed by the Railway Board. Hence, it would be logical to conclude that the Railway Board have accepted in principle not only the need for such a Starter Indicator but also the paramount importance safetywise for its observance by Guards. What now remains is to see to its enforcement, because there should never be any question of a compromise in dealing with any matter relating to safety of train operations.
- (ii) Ideally, therefore, the existing Repeaters should be modified (if possible) or replaced by the approved types of Starter Indicators, making the most use of the existing cabling, wiring/circuiting.

(c) *Protection of Double Running Junctions in quadruple-line Suburban Sector—*

- (i) The case visualised\* occurs frequently (whenever a cross-over provided between fast and slow lines, crosses via a 'diamond crossing' a running line meant for traffic in the opposite direction) and physical isolation is, of course, ruled out. Although this situation has nothing to do with the subject accident, it is nevertheless safety-wise serious enough to merit a discussion here.
- (ii) Even the projected flank protection only succeeds in trading off a more serious collision to a less serious one, because "diversion" of an 'out-of-control' train does not necessarily imply that the line to which that train is being diverted is always unoccupied.
- (iii) It accordingly becomes very essential to inject a new discipline into Suburban Train Control to ensure that such diversions from 'fast' to 'slow' lines or vice versa are rigorously restricted down to the barest minimum and in principle never resorted to excepting under emergencies or operational exigencies. The need for enforcing such a discipline at the very initial stage of planning train-paths becomes all the more imperative at a time when the Section is being operated at anything over 75% of its rated line capacity. In other words, in the interest of safety, all such cross-overs should hereafter be construed to function as "emergency cross-overs" which are provided at way-side stations to permit TSL (Temporary Single Line) working under exceptional circumstances on Double Line Sections.

\*[Para 24(a)].



## VIII. CONCLUSIONS

### 51. Cause

(a) Upon full consideration of the factual, material and circumstantial evidence at my disposal, I conclude that the Side-Collision of B-90 Up Local with another Local train on the run at Raoli Junction on the Harbour Branch of 1500V DC Electrified Broad Gauge Double Line Suburban Section of Central Railway's Bombay Division at 16.19 hours of 24-4-1981 was the result primarily of B-90's Motorman passing the Colour Light Starting Signal No. RVJ-5 on King's Circle Up Platform at 'Danger'. The fact that B-90 arrived at RVJ at a speed much in excess of the permissible limit of 15 Km/h had also undoubtedly contributed to the seriousness of the accident if not as well to the cause itself.

(b) As B-90's errant Motorman was, in fact, on the very last trip for the day and thus short by just 10 Km or hardly some 21 minutes of completing his duty, it is quite possible that he was actually so overcome by fatigue, a circumstance which prompted him to start from King's Circle in an apparently automatic reflex action to which Motormen are wont to be conditioned in response to receiving a certain code of "beats" from the Guard which signifies that it is OK for the 'Local' to start. That, at the time of causing this accident, he was in all probability in no fit state to be working an EMU is also demonstrated by a consideration of the speed-profile of B-90 after it passed the Up Starter of King's Circle at 'ON' as well as of the position in which the various controls in the Driving Cab were found subsequent to the accident.

(c) As normally associated with such Inquiries, several infractions—such as, or instance, those reflected in para 49(d), which had no bearing, either directly or indirectly, on the cause of this Accident—came to light and these have been separately referred to the Railway Administration for appropriate action.

### 52. Responsibility

(a) Even though his mental acuity may well have been weakened by fatigue at the crucial time, primary responsibility for this accident devolves on Shri Krishna Kumar\*, the Motorman of B-90 Up Local, for having violated the provisions of GR 79 (which prohibit a Driver from passing, without the necessary written authorisation, a Starter Signal at ('ON') and GR 89†.

(b) Through the non-observance of the provisions of GR 121 by his failure to ensure that the train was proceeding in a safe and proper manner and not at excessive speed, B-90's Guard (Shri H.S. Saini@) contributed at least to the magnitude of this accident, if not also to its cause.

### 53. Relief Measures

With regard to what has already been stated in paras 2(f) and 6, I am quite satisfied with the relief measures (which came into effect almost within minutes off the occurrence of this accident mainly through volunteer effort) as well as the subsequent "medicare".

## IX. REMARKS AND RECOMMENDATIONS

### 54. Recommendations aimed at improving safety at RVJ

(a) *Extension of Flank Protection at RVJ [Annexure IV]*—It was recommended to the Railway during the course of this Inquiry that the flank protection at RVJ should provide for overruns past Entrance Signal controlling conflicting routes, besides ensuring that such of the points which, by virtue of their location, are able to trap conflicting movements, are set, locked and detected in the correct position. This recommendation was accepted by the Railway under its letter No. T. 102. P. 2/81-82 of 14-5-82 and action is afoot to modify the circuitry.

\*Shri Krishna Kumar. 41 years of age, joined railway service over 19 years ago as an Assistant Driver. He was promoted as Shunter 'A' in April 1970 and Driver 'C' in July, 1972. He became a Motor-man in July, 1978. He passed his last PME (Periodical Medical Examination) on 14-3-80. As on 24-4-81, his "Accident Index" was zero.

@Shri H. S. Saini. 49 years of age, joined railway service 31 years ago as a 'Cabin Candidate'. He was promoted as Guard 'C' (Lower Grade) in April, 1963 and as Grade C (Higher Grade) in June, 1977. He passed his last PME on 17-5-80 and the last time that he attended a Refresher Course was on 16-8-1974. His increment was withheld for 6 months in January 1975 for causing derailment of Wagon No. 22276 C during Shunting Operations.

†R 89 cautions a Driver to regulate and control the running of his train as accurately as possible within the limits speeds specified.

(b) *Protection of RVJ against run-away vehicles [Annexure IV]*—As the Mahim Chord is on a 1 in 91 gradient falling towards RVJ, it is essential to protect the Kurla Chord against being fouled by a run-away load (of a parted down goods train on its way from the BPT to the Western Railway) by physically isolating the Down (Mahim) Line suitably. Under its Letter No. T. 102.P.2/81-82 of 14-5-82, the Railway has accepted the provisions of a sand-hump siding to isolate the Down (Mahim) Line just beyond RVJ.

(c) *Visibility of Signal No. RVJ-5 at KCE to be improved [Annexure IV]*—The Division having intimated under its letter No. BB.T/106/A/IC/1981-82 of 28-7-82 that re-siting this Signal entailed several problems, the alternative of extending the Up platform at KCE towards Mahim end by about 20 metres and then, shifting the “9-car Marker” rearwards suitably is commended for the Railway’s consideration, with a view to affording improved visibility of this Signal to the Motorman of an Up Local that has halted at KCE and also to provide a greater margin of distance from the said Marker.

## 55. Measures to improve safety generally on the Suburban Section

(a) *Reassessment of Motormen’s workload [para 47]*—As, contrary to what seems to have been implied in Railway Board’s office Memorandum No. 79/Safety/(A & R)/1/29 dated 26-6-80, the High Powered Committee did never really study the work-load of Motormen as such and with sufficient evidence having been adduced regarding the extremely fatiguing nature of Motormen’s duties, it is recommended that a proper exercise of ‘Job Evaluation’ should now be undertaken in order to review the need for reclassifying Motormen from “continuous” to “intensive” category.

(b) *Expediting the introduction of AWS on Central Railways’ Suburban System [para 48]*—Safety is not entirely an abstract concept; on the contrary, it can be meaningfully invested in. And, foreign railways have long since opted for AWS and similar systems aimed at eliminating the danger arising from ‘human failure’ on the part of Drivers. It being axiomatic that any system working to almost its full capacity virtually loses its capacity to absorb the outcome of failures, the introduction of AWS on the Central Railway’s Suburban System cannot brook any further delays. It is accordingly recommended that the Railway Board should review its earlier decision to freeze this project particularly as there exists at present no safeguard at all if a Motorman of a Local gets incapacitated in such a manner that the DMH is not released.

(c) *Improvement of the visibility of Platform “Starters” on the Suburban Section [Annexure IV]*—Apropos an Immediate Recommendation made in this context, the Railway has advised under its letter No. T. 102, P. 2/81-82 of 4-1-82 that, pursuant upon a joint survey, 2 Signals were directed to be shifted, the hood of 2 other Signals to be modified and one further Signal to be re-focussed.

(d) *Advantage to be availed of the existing Guard’s or Platform Repeaters [para 50(b)]*—By their capacity to enhance safety to train operation, such Repeaters to do undoubtedly constitute an asset to the Railway. Now that standard designs have been approved by the Railway Board for a “Starter Indicator” which serves the same purpose, it is urgently essential that the Central Railway reverts to the ‘status quo ante 1970’ with reference to its SR115—1(b) (ii), by making Guards responsible once again to observe the aspect of ‘Starter Indicators’ wherever they have been provided and, elsewhere, the “Starter” Signal ahead unless, of course, the latter is patently impracticable at any given location. Since this matter could involve a dialogue with the Union, it is recommended that a ‘policy directive’ should emanate from the Railway Board so as to easily facilitate its implementation by the Railway.

(e) *Safety at double-line running junctions in quadruple line territory [para 50(c)]*—It being rather obvious that, on a Suburban Section operating at near-saturation level of its line capacity, any switch-over from the ‘fast’ to a ‘slow’ line is fraught with a collision—hazard in the face of movements from the opposite direction on the line crossed in between, it becomes imperative that the Railway Administration must now review the train-paths afresh. For, after all, neither can such lay-outs be protected by physical isolation nor is any ‘flank protection’ (by diverting an errant train from the opposite direction that has overshot a Stop Signal at the time of such a ‘switch-over’ in operation) entirely free from hazards. Under these circumstances, the safer operating strategy of decongesting the accident-prone ‘diamond crossing’ through deliberate segregation of traffic-streams on the fast and slow lines and strictly restricting the use of the available cross-overs to only emergencies is highly commended for the Railway’s serious consideration and adoption.

## 56. Measures aimed at improving the level of confidence in the functioning of the S & T Department on the Suburban Sector

(a) *Railway to restrictedly regularise the recourse to short-cut methods under specified exceptional circumstances*—There is not much sense in escaping from facts and, since experience does reveal a not infrequent tendency, in order to minimise detention to traffic, to ‘bridge certain relays’ for the purpose of taking of

especially those Signals which are not provided with 'Calling-On' facility, the time has come to regularise the restricted use of such 'ad hoc' measures by the issue of a suitable Joint Operating and S & T Circular somewhat on the lines outlined in para 49(b) and with the prior concurrence of the Commission of Railway Safety.

(b) *Creation of the post of Signal Fault Controller [para 49(c)]*—It is essential that the Railway creates this position at Bombay VT, as its inability to do so hitherto—particularly in the face of a similar position having been in operation for over a decade at Western Railway's Bombay Central—does create an adverse image. It is recommended that the Railway Board should issue a suitable directive in this regard, along with any special dispensation that may be necessary for the creation of this post.

(c) *Display of Route Control Charts at Cabins provided with Panel Interlocking [para 49(e)]*—In order to facilitate the proper testing of the structural integrity of the Panel Interlocking (or, Route Relay Interlocking) system as installed, it is recommended that Route Control Charts similar to Locking or Control Table should be invariably prepared and made available in the Cabins as well as Relay Rooms.

#### 57. Maintenance of Counters provided with emergency buttons on Control Panels

The very purpose of providing such counters and maintaining detailed records on counter readings is to inhibit the misuse of the related emergency devices through the accountability of staff. The crux of this whole issue is based on the tacit assumption that, each time that the particular emergency button is operated, its corresponding counter will move forward by one step or digit. Yet, [para 23(b)] on the day of the accident the 'COGN' counter got stuck for the reason that "its mechanical pawl did not get engaged with the ratchet due to inadequate tension". In as much as constructional features of all counters are very much the same and any doubts on the functioning of a counter can render this exercise of maintaining proper record and the 'raison de etre' of the counters virtually meaningless, it is recommended that the Railway should review the existing policy regarding the inspection and upkeep of these counters and take such action as necessary.

Yours faithfully,

Sd/-

(N. P. VITHAL)

COMMISSIONER OF RAILWAY SAFETY,  
CENTRAL CIRCLE, BOMBAY.

BOMBAY,  
DATED 29TH JULY, 1982.

## Brief Report on Inspection of and Tests on the Undamaged Stock of B-90

## 1. Joint Inspection and testing done in Central Railway EMU Siding at Bandra during the night of 24-4-81 [para 12(g)]—

(a) No "bogie isolations" were noticed; in other words, the braking system was fully effective on all the bogies.

(b) During the "static test", all the brake blocks were found to be holding well upon the application of either the 'EP' or the 'Auto' brakes. In the absence of the Motorman's Cab (which was damaged in the accident), air-pressure readings were measured in the Guard's Cab (or, the Driving Cab of the last coach No. 76185) as follows :

|  |                             |
|--|-----------------------------|
| Main Reservoir                         | 6 to 7.5 Kg/cm <sup>2</sup> |
| Brake pipe                             | 4.5 Kg/cm <sup>2</sup>      |
| Brake pipe on DMH application          | 1.5 Kg/cm <sup>2</sup>      |
| Brake cylinder (full 'EP' application) | 1.8 Kg/cm <sup>2</sup>      |

(c) The condemning size for 'Ferodo' brake blocks is 16 mm. Out of all the 112\* brake blocks examined for thickness, only one was found 12 mm thick (and hence below the minimum acceptable limit) while 2 others had also worn down to just this limit of 16 mm.

(d) As regards piston stroke/travel, all the 36@ brake cylinders were tested while the rake remained stationary, whence it was noticed that the length of the piston stroke varied between a minimum of 10 mm and a maximum of 60mm, which range is within acceptable limits.

## 2. Braking Tests conducted on 27-4-81 [para 29]

(a) Deceleration trials were conducted with a "scratch rake" (composed of the 7 rear coaches of B-90 duly tagged on behind the Driving Trailer Coach and Motor Coach of a Service Rake as below) on line No. 26 (which is on a level and straight reach) in Kurla Car Shed between 22.30 hours and 23.45 hours in my presence and witnessed by several Railway Officials including Bombay Division's Additional Divisional Railway Manager (Technical) and Divisional Safety Officer.

—76178, 70178; both from a Service Rake, followed by—

—72187, 72186, 70186, 76186, 72185, 70185 and 76185;

comprising the undamaged stock of B-90.

(b) The results were as below for DMH release as well as emergency application of brakes :

| Test No. | Speed† in Km/h | Braking distance (m) | Braking‡ time (Sec) | Declaration§ Km/h per second |
|----------|----------------|----------------------|---------------------|------------------------------|
| (1)      | (2)            | (3)                  | (4)                 | (5)                          |
| 1†       | 15             | 21.5                 | 7                   | 2.1                          |
| 2†       | 20             | 33.3                 | 8                   | 2.5                          |
| 3†       | 20             | 33                   | 7.2                 | 2.8                          |
| 4†       | 25             | 30                   | 8                   | 3.1                          |
| 5†       | 25             | 31.8                 | 7.5                 | 3.3                          |
| 6†       | 40             | 49                   | 11.2                | 3.6                          |
| 7†       | 15             | 23.7                 | 6.5                 | 2.3                          |
| 8†       | 20             | 30                   | 7                   | 2.9                          |
| 9†       | 25             | 40                   | 8                   | 3.1                          |
| 10†      | 40             | 73.3                 | 10.5                | 3.8                          |

\*Each coach has 4 Wheel-set (axels) and 16 brake blocks/shoes and thus this 7-coach formation had  $16 \times 7 = 112$  blocks (i.e. none were missing).

@The motor coach, being much heavier than the others, has 8 brake cylinders, whilst the rest are fitted with only 4 brake cylinders. As the undamaged stock included only 2 Motor coaches the number of brake cylinder would work out to  $(2 \times 8) + (5 \times 4) = 36$ .

## NOTES—

‡ With DMH release.

†† With emergency application of brakes.

† In actual practice, it was not possible to ensure with absolute accuracy the desired speed while passing the post whence the braking was to be applied. Thus, in some cases, the train was under acceleration to pick up speed to the desired level and in other cases it was already decelerating under normal train resistance from a slightly higher speed-range.

£ Average of 2 stop-watch readings taken by independent observers positioned in the Driving Cab.

§ The average rate of deceleration was simply derived by dividing the figures in column (2) by the corresponding figures in column (4).

(c) Although these trials did reveal substantial variation in deceleration rates actually obtained from test to test (the explanation for which lay in the remarks given against the "Speed" under the tabulated data), the averages approximated to the predicted value; viz. the overall average deceleration with DMH release over the 6 tests conducted was 2.9 Km/h per second, while this figure was 3.0 Km/h per second for emergency application.

## Likely speeds of B-90 and CM-15, as deduced from Braking Distance Calculations—

## 1. CM-15 : on a level, straight reach—

(a) Braking tests conducted by the Railway in December 1974, with full EP (Electro-Pneumatic) brake application as well as DMH (Dead Man's Handle) release showed a deceleration value of the order of 3 Km/h per second\* with indigenous stock and a brake propagation time of approximately 4 seconds in the case of DMH release. Thus, while computing braking distances under DMH release, due allowance would have to be made for the distance covered within a 2-second interval, which is the average delay, as reckoned over the entire 9-car train, that occurs before the brakes become effective.† The EP brakes, of course, apply almost instantaneously throughout the train formation.

(b) The simple equations relating to a body in motion and subjected to a uniform retardation are noted below, provided that all parameters are expressed in mutually consistent units of measurement :

(i)  $V_t = V_o - ft$ ; and

(ii)  $D_t = (V_t + V_o) \times t/2$

Where  $V_o$  is the initial speed :

$V_t$  is the speed after a time lapse of 't'; and

$D_t$  is the distance traversed within 't'.

(c) In the special case where the terminal speed is zero then the following relationships obtain :

(iii)  $D = V^2/2f$ ; and

(iv)  $t_o = V/f$

Where  $V$  is the starting speed;

$D$  is the braking distance;

$f$  is the retardation/deceleration; and

$t_o$  is the braking time.

(d) Should, for the sake of convenience, speeds be designated in Km/h and the deceleration likewise in "Km/h per second", while the other 2 variables specified differently (namely, distances in meters and time-intervals in seconds), certain correction factors need to be introduced then into some of the above formula as below :

(v)  $D_t = (V_t + V_o) \times t/7.2$ ;

(vi)  $D = V^2/7.2f$ ; and

(vii)  $f = V^2/7.2 D$

(e) Since CM-15 was proceeding on a level and straight track, no correction need be effected to the accepted deceleration value of 3 Km/h per second on account of either grade or curvature compensation. However, as 2 out of the total 48 brake cylinders were known to be ineffective on this train, it would be appropriate to correspondingly increase the braking distance estimate. Thus, the following expression would emerge for the braking distance of CM-15, using formula (vi) :—

$D = (V^2/7.2 \times 3) \times 48/46 = V^2/20.7$ , which yields in turn the following braking distances for various values of  $V$  :

|            |      |       |       |       |       |
|------------|------|-------|-------|-------|-------|
| $V$ (Km/h) | 45   | 50    | 60    | 70*   | 80@   |
| $D$ (m)    | 97.8 | 120.7 | 173.9 | 236.8 | 309.2 |

(f) The Motorman stated that his application of EP brakes and the side collision occurred simultaneously. Since DMH release was not involved "in solo", no further refinements need be made in the braking distance estimates. Annexure I(c) shows that CM-15 travelled 105 m from the moment of impact

\*This was also generally borne out by the tests conducted on 27-4-81, vide para 2 of Annexure II (a)

†The "booked speed" is 72 Km/h.

@The Maximum Permissible speed is 80 Km/h.

before coming to halt. From a consideration of the distances tabulated in sub-para (e) above, it would, however, be hasty to conclude straightaway that the speed of CM-15 at the moment of impact was just over 45 Km/h.

(g) In other words, one must duly reckon with the crucial significance of the additional retarding effect via the jack-hammer-like knocks that B-90 subjected CM-15 to. Considering the extent of damage caused, it would be reasonable to hypothesise that CM-15 must have been considerably slowed down by this hammer-blow action of B-90. While this behaviour is conceptually easy to appreciate, the quantification of braking effort generated by this side-collision is a difficult process, which can be attempted only by a consideration of the speed of CM-15 and its braking distance as actually observed at site.

(h) Even in the absence of direct proof as to the speed of CM-15 at the moment of impact, it is nevertheless permissible to ratiocinate it as below :

- (i) It could hardly be less than 60 Km/h, particularly when the Local was already running 3 minutes late;
- (ii) It could hardly be expected likewise, to exceed 80 Km/h, its maximum permissible speed; and
- (iii) Within this range, it might be prudently reckoned at 70 Km/h (a 'via media' approach, as it were) which is just about the "booked speed".

(i) The implication of these 3 possibilities on the reciprocal (following the Law "Action and reaction are equal and opposite") retarding influence mutually exercised by the 2 colliding 'Locals' is now worked out by inserting the known braking distance of 105 m for CM-15 in formula (vii) and having due regard to the weights\* of the 2 trains involved.

|   |         |             |             |             |               |
|---|---------|-------------|-------------|-------------|---------------|
| V of CM-15                                | .. .. . | 60          | 70          | 80          | Km/h          |
| Overall retardation experienced by CM-15† | ..      | 4.73        | 6.44        | 8.42        | Km/h per sec. |
| The retarding effect of B-90 on CM-15‡    | ..      | 1.85        | 3.56        | 5.54        | " " "         |
| The retarding effect of CM-15 on B-90@    | ..      | 2.02<br>(2) | 3.88<br>(4) | 6.04<br>(6) | " " "         |

## 2. B-90 : on a falling gradient of 1 in 91 and negotiating a $2\frac{1}{2}^\circ$ curve—

(a) As per para 818 of the Indian Railways Way and Works Manual, grade compensation for curve on BG is at the rate of 0.04% per degree of curvature which, in the subject case, would mean 0.1% for a  $2\frac{1}{2}^\circ$  curve. Hence the net downward draw exerted by terrain characteristics would be  $(100/91) \times 0.1 = 1\%$ . The resulting acceleration would be 0.01 g, where g (the gravitational constant) is 9.81 m/sec<sup>2</sup>. Expressed in Km/h per second, this downward pull is equivalent to 0.35 units, which acts opposite to the braking deceleration [see para 1(a)] of 3 Km/h per second. Thus, the nett braking effect would be  $(3 - 0.35) = 2.65$  Km/h per second for B-90 traversing a falling grade situated on a curve. As all brake cylinders were effective on B-90, no correction factor need be applied in this case.

(b) A further complication was the clockwise tilting of B-90's leading 2 coaches, which caused the 'left' wheels on these 2 coaches to rise in the air and float to become totally ineffective in so far as braking action on these wheels is concerned. On the other hand, the corresponding 'right' wheels on these 2 coaches derailed and ploughed through the 'formation', eventually pushing out of alignment of any track that happened to come in their way. The peculiar situation obtaining under the first 2 coaches during the time that B-90 came to halt was thus that, whereas the left wheels met with no resistance whatsoever, the right wheels encountered tremendous resistance, so that it would not be an unfair assessment to regard that the latter effect more than compensated for the former effect. The imponderables that arose out of this phenomenon will be ignored in the following summing up for the sake of simplicity, and this has the overall effect

\* As it just so happened that that relatively lighter B-90 (tare weight = 366.75t against 400.41t tare weight of CM-15) also carried comparatively less passenger load, it would be quite in order to consider, instead of ratios of gross weights, the ratios of the tare-weights for the purposes of this exercise.

†  $F = V^2/7.2 \times 105 = V^2/756$ .

‡ By subtracting the EP braking deceleration of  $3(46/48) = 2.88$  Km/h per second from the estimated value of overall combined retardation.

@ Since force is the product of mass and acceleration, the lighter B-90 will experience a higher retardation by a factor equivalent to  $400.41/366.75 = 1.09$ . In other words, the additional deceleration experienced by B-90 is obtained by multiplying the corresponding deceleration of CM-15 by 1.09, with figures in parentheses duly rounded off for application in para 2(b) *infra*.

of actually under-estimating the braking forces which were truly brought into play (and consequently under-estimating the speed of B-90 as well as arriving thus somewhat in the Motorman's favour in respect of any conclusions as to overspeeding).

(c) As elucidated in para 1(i) above, B-90 was additionally subjected to considerable retarding influence by the side-collision, the numerical value of which was determined indirectly. However, as the braking of B-90 seemed only to arise from DMH release, which would attract the 2-second delay, within this interval only the retarding effect of the side-collision could be expected to act. 3 sets of calculations are now given below :-

(i) Retarding effect of 2 Km/h per second

| $V_0$ | $V_2$ | $D_2$ | + | $D_{DMH}$ | = | BD   |
|-------|-------|-------|---|-----------|---|------|
| (1)   | (2)   | (3)   |   | (4)       |   | (5)  |
| 15    | 11    | 7.2   |   | 3.6       |   | 10.8 |
| 20    | 16    | 10.0  |   | 7.6       |   | 17.6 |
| 25    | 21    | 12.8  |   | 13.2      |   | 26.0 |
| 30    | 26    | 15.6  |   | 20.2      |   | 35.8 |
| 35    | 31    | 18.3  |   | 28.7      |   | 47.0 |
| 40    | 36    | 21.1  |   | 38.7      |   | 59.8 |
| 45    | 41    | 23.9  |   | 50.2      |   | 74.1 |
| 50    | 46    | 26.7  |   | 63.2      |   | 89.8 |

NOTES : Column (2) by using Formula (i) and  $t=2$ ;

.. (3) by using Formula (v) and  $t=2$ ; for distance travelled in 2 seconds;

.. (4) by using Formula (vi), with  $V$  read from column (2) and  $f=(2.65+2)=4.65$  Km/h per second, such that  $D$  becomes  $V^2/33.5$  for distance travelled after DMH release became effective.

.. (5) BD (Braking Distance) = Sum of columns (3) and (4).

(ii) Retarding effect of 4 Km/h per second

| $V_0$ | $V_2$ | $D_2$ | + | $DDMH$ | = | BD   |
|-------|-------|-------|---|--------|---|------|
| (1)   | (2)   | (3)   |   | (4)    |   | (5)  |
| 15    | 7     | 6.1   |   | 1      |   | 7.1  |
| 20    | 12    | 8.9   |   | 3      |   | 11.9 |
| 25    | 17    | 11.7  |   | 6      |   | 17.7 |
| 30    | 22    | 14.4  |   | 10.1   |   | 24.5 |
| 35    | 27    | 17.2  |   | 15.2   |   | 32.4 |
| 40    | 32    | 20.0  |   | 21.4   |   | 41.4 |
| 45    | 37    | 22.8  |   | 28.6   |   | 51.4 |
| 50    | 42    | 25.6  |   | 36.8   |   | 62.4 |

NOTES :—Columns (1) to (3) and (5) computed as before.

Column (4) from  $D = V^2/7.2 (2.65 + 4) = V^2/47.9$ .



## (iii) Retarding effect of 6 Km/h per second

| $V_0$ | $V_2$ | $D_2$ | $D_{DMH}$ | = | BD   |
|-------|-------|-------|-----------|---|------|
| (1)   | (2)   | (3)   | (4)       |   | (5)  |
| 15    | 3     | 5     | 0.1       |   | 5.1  |
| 20    | 8     | 7.8   | 1.0       |   | 8.8  |
| 25    | 13    | 10.6  | 2.7       |   | 13.3 |
| 30    | 18    | 13.3  | 5.2       |   | 18.5 |
| 35    | 23    | 16.1  | 8.5       |   | 24.6 |
| 40    | 28    | 18.9  | 12.6      |   | 31.5 |
| 45    | 33    | 21.7  | 17.5      |   | 39.2 |
| 50    | 38    | 24.4  | 23.2      |   | 57.6 |

NOTES—Columns (1) to (3) and 5 computed as before.

Column (4) from  $D = V^2/7.2(2.65 + 6) = V^2/62.3$ .

(d) Considering that B-90 covered a distance of 41.4 m, reckoned from the moment of impact before finally halting, its speed at the time of the collision can be gauged by reference to the data tabulated in subpara (c) above.

| Assumption No. | Speed of CM-15 (Km/h) | Corresponding Speed of B-90 (Km/h) |
|----------------|-----------------------|------------------------------------|
| (i)            | 60                    | Between 30 and 35                  |
| (ii)           | 70                    | 40                                 |
| (iii)          | 80                    | Just over 45                       |

(e) Indeed, had the DMH been released by the Motorman of B-90 earlier than the instant of impact with CM-15 the situation with regard to B-90's speed-profile would be even more adverse or higher. This is so because, had the resulting application of brakes occurred sooner instead of awaiting the elapse of the 2-second interval, the braking distance corresponding to any initial speed-level would then have been even shorter; conversely, for a given braking distance, the assessed speed would be higher at the moment of impact and, of course, by the same logic, yet even higher earlier on because of the said earlier application of brakes.

(f) All things considered, therefore, it would be logical to conclude from the foregoing analysis that B-90 was doing 40 Km/h at the time of colliding with CM-15 (which itself was speeding at 70 Km/h) and that the application of braking on B-90 occurred through DMH release only at the instant of impact. And, overspeeding to this extent cannot be shrugged away as "merely an error on the part of Motorman's judgment in the absence of a speedometer".

**Miscellaneous Observations made at RVJ and KCE :****1. Route Cancellation and putting back Signal No. RVJ-5 to Danger**

(a) Bombay Division's Operating Circular No. 135 of 7-5-73 on "Restoring of Signals to 'ON' in the face of an approaching train" prohibited such an act, excepting to prevent an accident, unless and until the Driver/Motorman had already come to a halt before being advised of the change(s).

(b) It was in compliance with this directive that a practice had developed at RVJ to obtain a 'Private Number' from the SM of KCE (that he had actually cautioned the Driver or Motorman concerned) before normalising Signal No. RVJ-5 via the 'EUUYN' facility. I had checked the records maintained at RVJ and KCE and found as follows in respect of the latest 2 such cases:

- (i) On 28-2-81—B-134 Up was held back at KCE and 'PN' 48 was obtained by RVJ from KCE before cancelling the set route by 'EUUYN' (counter moved from 93918 to 93919) in order to signal CH-43 Dn waiting at Signal No. RVJ-1; and
- (ii) On 15-1-81—No 'PN' was exchanged as Signal No. RVJ-5 for B-74 Up, which (although appearing on the "arrival track" on RVJ Panel) had *not* actually arrived at KCE, having got stuck some distance in the rear, was put back to 'ON' (the 'EUUYN' counter moved from 93874 to 93875), to allow the waiting CH-29 Dn.

**2. Failure of Signal No. RVJ-5 on 16-4-81 and related matters**

(a) The Route/Junction Indicator appeared lit, which was confusing because the Locals were certainly not intended to go on to the BPT line; as a result, 4 Locals had to be passed on Form T. 32-B (the authority to pass a defective Signal). Book No. 1265 in use at KCE was checked to find that S. No. 63219, the last T. 32-B Form to have been used was issued at 08.54 hours on 16-4-81, which tallied with particulars recorded elsewhere.

(b) Subsequent examination by S & T personnel at 09.05 hours on the same day showed no fault as such, but that some miscreant(s) had tampered with the hinged back-cover of the Route Indicator, causing it to hang loose and allow ordinary day-light to filter through the row of Indicator Lenses to make it appear as if the lights were lit when actually they were not. The cover was swung back into position and the "phantom" indication disappeared.

(c) Asked as to why the Signal Unit and its accessories were not secured by locks, the DSTE(S) replied that anti-social elements were robbing these locks, which was a perpetual problem on the Suburban System.

(d) In order to gain access to this Junction Indicator, one had necessarily to climb up the ladder fixed to the Signal Post. Yet, this defect was reported at 08.37 hours (*i.e.*, broad day light) and, amazingly enough, the alleged miscreant activity escaped detection and moreover nothing was apparently stolen.

(e) As it was thus not unusual for unauthorised persons to gain access to the Signal Unit, it becomes germane to this Inquiry to examine if the Signal Unit of RVJ-5 could have been tampered with. The Signal Unit is so constructed that the hood would have to be removed first before the clear-glass outer lens can be unscrewed to provide access to the inner coloured lens. A trial showed that it would take as much as an hour to inter-change the red and yellow lenses of a 2-Aspect Colour Light Signal. As independent observers found nothing adverse with the functioning of this Signal immediately *after* the accident and since anyone working on that Signal at that stage for any length of time would certainly be conspicuous, it would appear that any such supposition that the Signal Unit could have been tampered with and the tampering afterwards undone, too, is ruled out.

**3. Failure of Signal No. RVJ-5 on 26-3-81 and related matters**

(a) At 19.35 hours, the Signal showed both its 'Yellow' and 'Red' aspects; on the Panel, it was simultaneously noticed that TC 204 was "down" and the lights for this Signal were continuously flashing. Upon careful examination of the 19-core cable, it was discovered that someone had driven a nail into it (near the Eastern abutment of the first road underbridge after RVJ), causing multiple cross-feed. The fault was set right at 23.35 hours the same night, by utilizing the spare conductors in the other cable [see para 11(j)].

(b) Subsequently, the damaged control cable was repaired on the next day by carefully insulating the individual conductors and then a length of the whole cable was sealed\* up using the M-Seal Epoxy Resin compound, after which the cable was again meggered carefully to verify that the insulation was satisfactory.

\*This particular location was got unearthed to inspect the repair-job done and it was found that the sealing had indeed been properly executed.

(c) It was not outside the realms of possibility that this Control Cable could have got similarly or otherwise damaged just prior to the accident, but the spurious feed in such an event would have had to be so peculiar that, while the Signal was displaying its 'OFF' aspect, the Panel would ostensibly show that this Signal was instead at 'ON'; and even more peculiar would be the fact that this defect got also rectified automatically. The probability of such an occurrence, particularly in the context of the megger test reflecting satisfactory insulation values between the conductors, must be regarded as indeed extremely remote. The same argument would also apply to any damage of the same type in the "tail cable".

(d) Another possibility could be miscreant activity at the Apparatus Case at Location H 1022, but this is extremely improbable as requiring not only specialist knowledge of a rare kind but also subsequent undoing of the tampering. The Apparatus Cases and other 'Locations' are not locked by the S & T Department for the reason that locks as such are extremely theft-prone.

#### 4. Meggering of Cables

(a) From pp 190-191 of the Cable Meggering Register kept at Byculla, it was noticed that testing of the insulation properties of the 19-core cable No. 118 (or, RVJ-15) yielded the following results :

| Date    | Resistance  |
|---------|-------------|
| 19-4-77 | 20 meg-ohms |
| 11-2-78 | 25 meg-ohms |
| 3-4-80  | 30 meg-ohms |

While no further entries were available, it was stated that meggering done pursuant upon repairs to this cable [para 3(b) supra] also showed an insulation resistance of 30 meg-ohms, all of which was contrary to the normal expectation of fall in insulation resistance with lapse of time and consequent aging of the cable.

(b) Moreover, testing of this Cable in my presence on 12-5-81 showed readings consistently over 50 meg-ohms (and hovering for the most part beyond 75 meg-ohms) which, too, was unexpected. Whereas it is true that all these insulation values were above the minimum acceptable limit, the "reverse" trend of their variation with age as recorded cannot but cast some suspicion as to the genuineness of such data.

(c) The Railway's explanation of this phenomenon, vide its letter No. T. 102/PN/RVJ/66 of 14-6-81, was that while, with the dial-gauge fairly cramped in the range above 20 meg-ohms, the possible use of different megger instruments on different occasion might contribute to some discrepancy in the reading, the principal cause could well be the influence of the ambient temperature ( $T^{\circ}$  Celsius) of the cable on its insulation-resistance, the significance of which could be gauged from the correction factors (CFs) tabulated below :

| $T^{\circ}$ | 20 | 25   | 30   | 35   | 40 | 45 | 50  | 60   |
|-------------|----|------|------|------|----|----|-----|------|
| CF          | 1  | 2.62 | 6.81 | 16.6 | 40 | 91 | 209 | 1000 |

#### 5. Careless entries by CASMs at RVJ

(a) The entry for the '12/18' shift of 24-4-81 made in the "CASM's DIARY" revealed against item 4 the remarks "Passed all Up and Dn traffic safely without any undue detention", while a new item 10 was appended at the last to describe the subject collision as having occurred at about 16.19 hours. This proves that CASMs have got into a habit of writing down their Daily Report in the Diary very much in advance of the actual end of their duty-hours. Obviously, this function is being regarded as routine, trivial and perfunctory and the tragedy is that this could well reflect an apathy in general to the observance of rules and regulations.

(b) The 'UYN' Register was *not* being maintained as stipulated [para 11(e)] in the Station Working Orders. Instead, the Register has 8 columns (for Date, reason, shift, opening or closing Counter Readings and lastly the signatures of CASMs handing/taking over and of S & T official using this device.

Thus, the reason and time for any *individual* operation of the 'UYN' are not necessarily always ascertainable from this Register. Further detailed examination revealed as follows :—

- (i) The closing reading of 97798 (which was the same as the opening reading) on 24-4-81 for the '7/12' shift was struck off and 97807 was written above it. This proves that the first version of the closing reading was entered by the CASM quite in advance of the actual end of his shift-duty, needing it to be subsequently corrected; and
- (ii) Similar readings for the subsequent shift (in which the accident occurred) were 97807 (opening) and 97811 (closing) which were initialled by the team of Officials who conducted the Joint Inspection immediately after the accident. This again proves [see Note "@" under para 13(a) (viii)] that CASMs have got into the habit of completing the entries well before the end of their shift-duty and also establishes that the 'UYN' was in fact used 4 times during this particular shift.

(c) This situation prevailed in respect also of other Registers pertaining to the use of the other Emergency devices [para 11(b)] on the Panel. For instance, during the '7/15' shift of 13-4-81, the 'EUUYN' was stated to have been used once (the opening counter reading of 93985 changing to a closing reading of 93986) with the reason given as "Route Tested Signal 5 to BPT"; yet, the opening reading for the next shift (and, indeed, for several shifts thereafter) remained recorded at 93985. Upon inquiry, it was revealed that, although a testing of the route to the BPT was actually planned via Signal No. RVJ-5 by the CASM concerned (whereupon he promptly made the relevant entry even before anything was performed), in the event the test did not materialise because of pressure of other work. It would thus certainly seem that the seriousness of maintaining accurate Registers is totally lost on the CASMs.

(d) All the CASMs questioned on this matter uniformly replied that each simply carried on with whatever the prevailing practice was. Surprisingly, no higher supervisory officials nor officers found anything amiss and it becomes clear that upkeep of all these multifarious Registers/Diaries is not considered as an important function even by the Administration.

#### 6. Testing of the Routes form/to BPT Railway

(a) Connected with the BPT Railway there can be 4 different types of movements : either way to and from Central Railway or Western Railway. Reference to the Route Section Plan for RVJ (not incorporated in this Report) would show that a total of 6 sub-Routes are involved in these 4 routes as below :

| Route | From        | To          | Sub-Routes    |
|-------|-------------|-------------|---------------|
| 2(2)  | BPT Railway | Kurla (CR)  | 101A          |
| 2(1)  | —do—        | Mahim (WR)  | 101B and 104B |
| 5(2)  | Mahim (WR)  | BPT Railway | 107B and 105B |
| 5(1)  | Kurla (CR)  | —do—        | 105A.         |

(b) Referring to this Route Section Plan, it can also be argued that sub-Routes 101B and 104A can be utilised to set Route 2(2) from BPT Railway to Kurla, but this arrangement is rarely, if ever, attempted.

(c) Since the release of each sub-Route requires the separate initiation of the 'UYN' it may be argued that any series of comprehensive testing of Routes to and fro BPT would involve the use of 'UYN' about 7 times. On the day of the accident, around noon-time, the 'UYN' was used no less than 13 times.

#### 7. Security of Relay Room

(a) There are two doors providing access to the Relay Room underneath the Cabin at RVJ and, whereas keys for both the doors are in the custody of ESM, a duplicate key for only one door (that provided under neath the stair-way) is lodged with the CASM upstairs.

(b) This practice is not in consonance with the directive contained in Railway Board's letter No. 75/W3/SG/GI of 16-2-79 and, although over 2 full years had already elapsed, the Railway seems to be bogged down in decision-making over such a trifling issue as the exact type of lock to be used ;

**Reconstruction of the progress of the 2 Trains on their Collision Path****1. Distances covered by B-90**

(a) The point of side-collision (reckoned as that location where the 3.66 m (12') wide stocks of the 2 concerned Locals would first experience contact, assuming that they were positioned centrally with reference to their respective tracks and assuming ideally the absence of any parasitic motions) is located at a distance of 507.1 m from Signal No. RVJ-1 [see Annexure I (o)], 9.1 m behind which is positioned the "9-Car-Marker" on the track to serve as a guide for the Motorman to halt at. Thus, the total distance covered by B-90 from the moment it started from KCE upto the point of collision with CM-15 may be summed up as 516.2 m.

(b) With the speed at the moment of impact established at 40 Km/h vide para 2 (f) of Annexure II (b), there could have been hardly any braking of this Local. It would accordingly be adequate to consider the distance of 516.2 m in just 2 parts :

- (i) Initial 160 m of acceleration to 40 Km/h ; and
- (ii) The balance 356.2 m at an average speed of 40 Km/h.

(c) The "arrival Indication" on the Control Panel of RVJ of a train approaching Signal No. RVJ-5 extends [see para 11 (a)] to 1,259 m in rear of that Signal and, having due regard to the location of the afore-said "9-Car-Marker", B-90 would first appear on the Control Panel right from the stage that it was 1,250 m in rear of its normal position of stogage at KCE.

(d) Any Up Local arriving at KCE is not able to pick up its maximum speed because of having to ascend the rising grade leading to the High Level Platform. Thus, the distance of 1,250 m (for which this train is visible on the Panel in rear of Signal No. RVJ-5) may be conceptually divided into-2 parts :

- (i) 200 m, to halt from a speed of 60 Km/h ; and
- (ii) The preceding 1,050 m at an average speed of 60 Km/h.

**2. Distances covered by CM-15**

(a) The point of side-collision as enunciated in para 1(a) above is located at a distance of 425 m ahead of [see Annexure I(b)] signal No. RVJ-1, which itself is 765 m from the Automatic Signal No. H-903, the "Starter" of Vadala Road Station. Consideration must now be given to—

- (i) the material evidence that the front part of CM-15 had already escaped damage, which demonstrates that this Local travelled further by a space [equivalent to the overall length (192 m) less the damaged length (146.4 m) [less the undamaged rear (14.9 m)] of 30.7 or, say, 31 m ;
- (ii) the likely position (say, 10 m in rear of the "Starter") of stoppage of CM-15 at Vadala Road whereby the total distance traversed by it after starting from here and before suffering the side-collision may be reckoned as  $31+425+765+10=1,231$  m ; and
- (iii) the extent of visibility of Signal No. RVJ-1 [or, 200 m as per para 31 (b)].

(b) Because of heavy encroachment from the left side by way of unauthorised structures and excessive trespass by people of all ages, a Down Local rarely proceeds at a speed higher than 50 Km/h while approaching RVJ. Hence, this 1,231 m of distance may be divided into 3 reaches :

- (i) Initial 200 m of acceleration, attaining a peak speed of 50 Km/h ;
- (ii) The last stretch of  $(425+200+31)$  656 m when the train picked up a maximum speed of 70 Km/h [see para 2 (f) of Annexure II (b)] ; and
- (iii) The middle length of 375 m at an uniform speed of 50 Km/h.

(c) The "Arrival Track" behind Signal No. RVJ-1 [see para 11 (a)] extends for a distance of 1,188 m, of which  $[765+(say) 10] = 775$  m is already accounted in the foregoing reckoning. This leaves a balance of 413 m to be considered for the train as it arrived into Vadala Road, which may be conveniently split up into 2 parts ;

- (i) 250 m, to halt from a speed of 70 Km/h ; and
- (ii) The balance 163 m at an average speed of 70 Km/h.

### 3. The time-element in the progress of the 2 trains

(a) From the known material evidence that for the side-collision to have occurred as it did, the 2 Locals must have been in a given position at one time, we can now recede backwards in time as tabulated below to determine each Local's location on the basis of the stated distances and speed-profiles :

| Local No. | Distance (m) | Average speed (Km/h) | Time (Minutes) | Cumulative time (minutes) |
|-----------|--------------|----------------------|----------------|---------------------------|
| B-90      | 356.2        | 40                   | 0.53           | 0.53                      |
| "         | 160          | 40/2                 | 0.48           | 1.01                      |
| "         | 0            | 0                    | 0.50*          | 1.51                      |
| "         | 200          | 60/2                 | 0.40           | 1.91                      |
| "         | 1050         | 60                   | 1.05           | 2.96                      |
| CM-15     | 656          | 70                   | 0.56           | 0.56                      |
| "         | 375          | 50                   | 0.45           | 1.01                      |
| "         | 200          | 50.2                 | 0.48           | 1.49                      |
| "         | 0            | 0                    | 0.50*          | 1.99                      |
| "         | 250          | 70/2                 | 0.43           | 2.42                      |
| "         | 163          | 70                   | 0.14           | 2.56                      |

\*Scheduled duration of stoppage as per Para 12 (a).

(b) It becomes clear from the above analysis that at the time when CM-15 first appeared on the Control Panel in the RVJ Cabin (i.e) about 2½ minutes before the collision), B-90 (having first appeared on the Panel at about 3 minutes before the collision) could already be noticed for a full 1/2 minute.

Indeed, if the statement of B-90's Guard [para 16(b)(i)] that the Local may have halted for even more than a minute is to be given any credence, the implications would be as below :

(i) CM-15 was running slightly later than 3 minutes; and

(ii) B-90 had in effect appeared on the Control Panel for over 1 minute before CM-15 could arrive on its "arrival track".

The same 2 implications arise if we believe that CM-15 could have been moving faster than the 50-Km/h speed assumed in Para 2(b) on its approach to Signal No. RVJ-1.

(c) Opposite would be the effect, were B-90 able to approach KCE faster than at 60 Km/h. For instance, were this 70 Km/h, then the time taken to cover the distance of 1,250 m would then be 1.24 minutes (against 1.45 minutes shown in the preceding table), as even in this case B-90 would still appear on the Panel earlier than CM-15, although now by only some 10 or 12 seconds. These possibilities are presented here only to demonstrate that the appraisal that CM-15 must have appeared on the Panel later than B-90 is not "sensitive to" and accordingly unaffected by any marginal error in the assumed speed-profile.

(d) For the accident to have happened at 16.19 hours, reference to the tabulated cumulative times would show that B-90 must have left KCE at 16.18 hours (which tallies with its published right-time departure time and that CM-15 must have left Vadala Road at 16.17 1/2 hours, which precisely agrees with the postulate of its late running by 3 minutes [see para 12 (a)]. This analysis thus stands validated.

### 4. From the view-point of B-90's Motorman

(a) Ordinarily, braking to avert danger (such as an impending collision) would involve either 'Full EP' or Emergency application of the Brake Controller on the Motorman's part and not merely the release of the DMH. In other words, such an act would not attract the 2-second delay that is associated with DMH release. Hence, as worked out in para 2 (b) of Annexure II (b), the retardation 'f' would be 2.65 Km/h

per second, with formula (vi) of Annexure II (b) yielding an expression for the braking distance as  $D = V^2 / (7.2 \times 2.65) = V^2 / 19.1$ , the values for which are tabulated below :

| V.<br>(Km/h) | D<br>(m) | d*<br>(m/sec) |
|--------------|----------|---------------|
| 15           | 11.8     | 4.2           |
| 20           | 21.0     | 5.6           |
| 25           | 32.8     | 6.9           |
| 30           | 47.2     | 8.3           |
| 35           | 64.2     | 9.7           |
| 40           | 83.9     | 11.1          |

\*d\* is the distance travelled in each second of "reaction time", as computed from the expression  $d = V/3.6$ .

(b) From the visibility test conducted [see para 30 (e)], Turn-out No. 104 was distinctly visible from a point 5 m in rear of ES 10/11 which is located 85.1 m @ in rear of the Fouling Mark which itself is 7.7 m in rear of the point of collision vide Annexure I (c). Thus, the total distance involved was 97.8 m for B-90 travelling at 40 Km/h within which duration CM-15, travelling at 70 Km/h, would be 171.2 m in rear of the collision spot. In other words CM-15 had not yet reached the Turnout No. 104 and was in fact  $171.2 - 94.2 = 83$  m still in rear of it vide Annexure I(c).

(c) Coming down a gradient, B-90's Motorman should know at once, had he but been trying to ascertain this factor, when CM-15 had *not* taken the turn-out (because the "left" or West-side stock rail would be visible). Because of the EMU's comparatively wide width, we may allow another 8 m or so of travel by CM 15 for B-90's Motorman to be able to discern this factor unambiguously. In other words, CM-15 would travel  $83 + 8 = 91$  m onwards, within which time B-90 would itself proportionately move forwards by 52 m. At this juncture, (i. e. when it becomes clear to B-90's Motorman that CM-15 is actually proceeding on the straight road) B-90 and CM-15 are respectively 45.8 m and 80.2 m from the location where they could collide.

(d) Having regard to the braking distances mentioned in sub-para (a) above, 45.8 m was just inadequate to halt B-90 moving at 40 Km/h, even if the Motorman acted instantaneously. Further more, a reaction time of 3 to 5 seconds would in effect even mean non-application of brakes, which was most probably what had actually happened. Or, indeed, the Motorman may at that crucial time have been looking at his controls and *not* directly ahead. In short, given the travel-paths of the 2 Locals and given further the circumstance that B-90's Motorman not only started erroneously against the Starter at RED from KCB but also maintained the excessive speed-profile deduced from material evidence, the limited visibility available on the curved approach from the Mahim Chord meant that the collision was in effect unavoidable.

#### 5. From the viewpoint of CM-15's Motorman

(a) His visibility of the Up Mahim Chord was clear and excellent [see para 31 (c)] respectively from 226.9 m and 147.7 m in rear of the Fouling Mark, which distances may be adjusted to 219.2 m and 140 m as reckoned from the point of collision or contact. At these points of time, B-90 may be calculated ("pro rata" on the basis of the relative speeds) to have been 126.8 m and 80 m in rear of the point of collision and was thus available within the view-frame of CM-15's Motorman *only* from the *later* location and *not* from the first position.

(b) In other words, although CM-15's Motorman could see the southern end of the Mahim Chord, B-90 could not be spotted as arriving. It now remains to examine the situation when CM-15 was 140 m in rear of the place of collision. Clearly, this distance was inadequate to bring CM-15 to halt from a speed of 70 Km/h, which required a braking distance of 236.8 m vide para 1 (e) of Annexure II (b), let alone its travel forward within the reaction time of 3 to 5 seconds.

(c) The implication of this observation is that, even if C-M-15's Motorman took action to brake his train, the collision would have occurred, but of a different nature and with differing outcomes. Because of the lower average speed due to the said braking, CM-15 would have arrived slightly later at the critical "diamond crossing" which would have "now" been already occupied, because of this very-delayed time-element, by B-90; the net effect would be that CM-15 would have simply pierced through B-90 or got badly deflected by the latter, causing in either case the derailment of several EMU's on both the Locals leading to heavy casualties.

@ [(para 30 (e))

**Adequacy of the existing system to cater to Errant Motorman of Up Locals from Mahim Chord—**

**1. Could such an accident be averted if the Motorman approached RVJ at no faster than 15 Km/h ?**

(a) Due to 2-1/2° curvature of track the visibility ahead is 150 m [see para 30(d)] and, having regard to the information presented in para 4(a) of Annexure III(b), it becomes clear that an Up Local ex-KCE can stop short of fouling the Down Kurla Chord with more than 30 seconds to spare, if its speed was 15 Km/h and provided further that the Down Local could be espied passing in front of it.

(b) Indeed, with a number of Locals not equipped with speedometers and the fitted speedometers out-of-order on a number of other Locals [for example, see paras 30(a) & 31(a)], it would not be safe to entirely rely on a Motorman's personal judgement of speed. Hence, the following discussion will consider an actual speed of 20 Km/h, the braking distance for which speed is 21 m as per para 4(a) of Annexure III(b), with 5.6 m covered in each second prior to the application of brakes. Thus, plenty of time [(150-21)/5.6=23 seconds] is available even in this case, for the Motorman to react and respond.

(c) However, if the Down Local towards Kurla has not yet arrived at the diamond crossing of RVJ, an entirely different picture emerges because, even if the Up Local sights the other train, its Motorman can always assume that this other train is Bandra-bound. Thus, if an Up Local ex-KCE happens to have arrived close enough to the diamond crossing, it would be too late to avert an accident; that the other Local, travelling at its full speed (which is entirely permissible) is unable to be brought to a halt has been expounded in para 5(c) of Annexure III(b).

(d) The question then arises whether a signalled Down Local ought to be arriving at RVJ later than the "truant" unsignalled Up Local. The timings for the Down Local as worked out at para 3(a) of Annexure III(b) show that it arrives at the diamond crossing within 1.49 minutes of leaving Vadala Road, whilst the following run may be reckoned as normal for the Up Local :

| Distance (m) | Average Speed (Km/h) | Time (minutes) | Cumulative Time (Minutes) |
|--------------|----------------------|----------------|---------------------------|
| 160          | $(0+40)/2=20$        | 0.48           | —                         |
| 220          | 40                   | 0.33           | 0.81                      |
| 50           | $(40+20)/2=30$       | 0.10           | 0.91                      |
| 86.2         | 20                   | 0.26           | 1.17                      |

Thus, the Up Local would arrive at the diamond crossing in 1.17 minutes, with the repercussion that the Junction being situated closer to KCE, the Down Local would always take longer to arrive at RVJ. The relative times of their appearance at RVJ will, of course, depend precisely upon the departure times of the 2 Locals from KCE and Vadala Road. Because of the uncertainty of this variant imponderable, the peculiar situation obtaining at RVJ (with the curved approach of the Mahim Chord imposing limited visibility) renders this Junction hazardous, even in spite of the stringent speed restriction of 15 Km/h.

**2. Absence of Physical Isolation of the Mahim Harbour Branch**

(a) Positioning of a trap points leading to a snag dead-end (sand hump) on the Up Mahim Chord short of the diamond crossing would be an effective safe-guard against such collisions. Moreover, such a physical isolation at such "running junctions" is covered by GR-90(c), which stipulates that no train shall run through a Station at a speed exceeding 50 Km/h, unless that run-through line is isolated from all other lines by the setting of points or other approved means and unless this condition is maintained during its passage by appropriate interlocking.

(b) Chapter VIII, Section III of the "Rules for the Opening of a Railway for the Public Carriage of Passengers", which deals with the 'Rules covering the provision of Isolation at Stations', also states in its para 1(a) that the speed of trains running through Stations shall be governed by General Rules. However, whilst para 2 of the same Rules cautions against the insertion of points for trap sidings on Main or Through Lines in order merely to maintain safety for such through running, the "Note" underneath it provides



for certain exceptions (such as the reception of trains from opposite directions at the same time, which is very similar to the situation obtaining at RVJ) with the prior sanction of the Commission of Railway Safety. In any case, the Mahim Chord does *not* come under the purview of the expression "Main or Through Lines".

(c) On the other hand, the said physical isolation of a running junction is not prescribed in para 147(c) (i) of Signal Engineering Manual, when "the full complement of Signals" are provided. Having considered this matter in depth, the Railway Board had also decided, vide para 4 of their letter No. 76/W3/SG/G/10 of 27-5-81 that, even when the run through speed of a train exceeded 50 Km/h, isolation was not necessary when the layout included the full complement of Signals placed at a distance of 300 m minimum from the fouling mark. This figure of 300 m seems to be composed of 'Block Overlap, (100 m) and 'Signal Overlap' (120 m).

### 3. Absence of flank protection against overruns past conflicting Entrance Signals

(a) The implication of such cross-protection between conflicting routes is that, in such a case illustrated by the subject accident, Signal No. RVJ-1 would automatically go to 'ON' once Signal No. RVJ-5 was overshot. Referring to the tabulated data of para 3(a) of Annexure III(b), B-90 took 1.01 minutes to reach the collision spot, at which time CM-15 was 1,131 m in rear of that spot or  $1,131 - 425 = 706$  m still in rear of Signal No. RVJ-1. Even allowing CM-15 to travel, say, 100 m within the time taken for this Signal to be restored to its 'Red' aspect, CM-15 would as yet be some 606 m behind it to have become aware of its 'Danger' aspect and to be accordingly brought to halt quite short of the diamond. It is an altogether different matter that, in the meantime, B-90 would have continued its onward journey to trail through and damage the Point No. 107, which was set for the straight [see para 13(a)(vii)].

(b) The efficacy of such an extension of flank protection upto the "Entrance Signal" of any conflicting route will now be analysed in depth. When Signal No. RVJ-5 is overshot, there can be three possibilities with regard to the position of a Down Kurla-bound Local on the move :—

(i) It is well in rear of Signal No. RVJ-1. This case is similar to that discussed in sub-para (a) above and the outcome would be that the Down Local would easily stop short of any collision; or

(ii) It is *just* in rear of Signal No. RVJ-1 to be able to take note of its restoration to 'ON' aspect. The distance of 330.8 metres [see Annexure I(b)] available from this Signal to the Stock Rail Joint (SRJ) of Point No. 104 would allow for a certain reaction time over and above the braking distance of 236.8 metres [see para 1(e) of Annexure II(b)] for a Local speeding at 70 Km/h with two defective cylinders. This allowance for reaction time would work out to  $(330.8 - 236.8) \div (70/3.6) = 4.8$  seconds, which is certainly adequate. Thus, the Down Local would come to halt and allow the errant Up Local to arrive past RVJ without any danger of collision; or

(iii) Its cab has just cleared Signal No. RVJ-1. In this case, the Down Local, totally unaware of any new development, proceeds at 70 Km/h covering the distance of 425 metres in 0.36 minutes to arrive at the collision point and to completely clear the same in another 0.18 minutes, assuming a train length of 200 metres. In other words, by the time the Up Local ex : KCE would arrive in 1.17 minutes [see para 1(d) above] the other Local would have already run past the critical location without any danger of collision.

(c) From the foregoing, it is clear that there is, *prima facie*, no danger of any accident, if the suggested flank protection is provided. Nevertheless, one doubt would yet persist : what if the Motorman of the Down Kurla-bound Local ignores Signal No. RVJ-1 going back to 'Red' ? As regards case (ii) above, the scenario would be just the same as in case (iii) above *i.e.*, the Down Local would have sped onward to clear well past the crucial diamond crossing before the Up Local could arrive there. However, in case (i) when the Motorman of the Down Local would continue to ignore the 'Red' aspect for any length of time, a collision of the type that occurred in the subject accident might become inevitable. But then, it would be difficult to design an infrastructure-based protection system that caters for the simultaneous overshooting of two Locals past two Signals at 'Danger'.

**A Note on the "Guard's Repeater Signal" or "Starter Indicator".**

**1. Introduction to the Guard's Repeater Signal**

1.1 At such stations where site-constraints (like platform on a curve) prevent the Guard's verification of the Starter's aspect by his own direct observation, different practices had evolved on the individual Zonal Railways to provide a special Signal, usually suspended from the platform roof, for the benefit of a Guard in order that he is able to establish for himself the aspect displayed by the "Starter" Signal meant for his train. Installed at the following 9 stations on the Central Railway's suburban system in Bombay, this special Colour Light Signal is known as a "Guard's Repeater", which is of a 2-aspect configuration (with 'Green' aspect underneath implying that the "Starter" has been taken 'OFF' and 'Yellow' aspect above it indicating that the "Starter" is at 'ON') :—

*Main Line :—*

- (i) Sandhurst Road\*
- (ii) Dadar@
- (iii) Vidyavihar@
- (iv) Kanjur Marg@
- (v) Ambernath@

*Harbour Branch :—*

- (vi) Sandhurst Road\*
- (vii) Dockyard Road\*
- (viii) Cotton Green\*
- (ix) King's Circle\*

\*On both Up and Down platforms.

@On Down platform only.

1.2 Neither its conceptual design nor its actual installation was covered by the Railway's G & SR (General & Subsidiary Rules) or by the Signal Engineering Manual or any specific sanction of the GIR/ACRS/CRS under "Approved Special Instructions". Enquiries made reveal that a similar situation obtains on the other Railways as well.

1.3 As mentioned at the outset, different practices prevail on different Zonal Railways with regard to the characteristics of this special Signal to this extent that the Deputy Commissioner of Railway Safety, Calcutta, had concluded, upon his inspection of KCE, that the aspects as displayed by the Repeaters provided on the CR were positively misleading and conceivably hazardous if acted upon by the Driver/Motorman, who is not expected to pay heed to them.

**2. Present situation on CR as to its utility**

2.1 Uptil 1970, the Railway's SR 115-1(b)(ii) used to read as follows :—

"On the suburban section, Bombay to Kalyan, including Harbour Branch and Kurla-Mankhurd Section, where it is not possible for the Station Master on duty to give permission for individual electric suburban trains to start, the Guard of the electric suburban train may authorise the train to start provided he has satisfied himself that the starting signal has been taken 'OFF' for the train and all the conditions for the train to start are complied with."

2.2 This SR came to be reviewed in 1969 at the instance of the Central Railway Mazdoor Sangh (CRMS) which pleaded via a PNM (Permanent Negotiation Machinery) item that a Guard was in no position to fulfil this requirement for reasons beyond his control, such as :

- (i) Non-provision of "Repeaters" in all such cases that a "Starter" was not visible from the position of the Guard's Cab either due to curvature of platform or due to length of load;
- (ii) Defective "Repeaters", when provided; and
- (iii) Withdrawal of "Platform Pointsmen".

2.3 In the processing of this PNM item, while seeking the Railway Board's approval under its letter No. T. 361.P/III dated 15-10-69 for deleting the liability of a Guard of a Suburban train to verify the aspect of the "Starter", the Central Railway made the following points :

- (a) That the Western Railway does not have a similar provision in its G & SR; and
- (b) That the then GIR, who conducted the Statutory Inquiry into the "Following Collision of a Bandra Down Local and a Down BPT Shunting Train at King's Circle Station on 4-6-1954" contended, while holding also the Guard of the "Local" responsible for non-compliance with the provisions of the said SR 115-1(b)(ii) even though the Starter could not be seen from the Guard's cab, that the Guard ought to have gone out of his cab to sight the Starter Signal.

2.4 To this overture, the Railway Board responded under their letter No. 69/Safety/79/19 of 20-11-69 that they had no objection to the amendment of SR 115-1(b) (ii), the revised version of which became effective in 1970 as follows and this latter version holds good now :

"On the suburban section, Bombay to Kalyan, including Harbour Branch and Kurla-Mankhurd Section, where it is not possible for the Station Master on duty to give permission for individual electric suburban trains to start, the Guard of the electric suburban train should authorise the train to start, provided he has satisfied himself that conditions for the train to start are complied with except that the responsibility to see that the correct signal has been taken 'OFF' for the train will be that of the Motorman only."

2.5 It was rather astonishing that, in its letter No. T 361. P/III of 15-10-69, the Railway should have misrepresented the facts relating to the then GIR's Report (ibid) and even more amazing that the Railway Board failed to detect this inaccuracy, for the GIR had actually alluded to the Guard's responsibility only in his *Draft* Report, whereas in his Final Report (which was intimated to the Railway via a set of alterations to the Draft under the GIR's letter No. Inquiry/75/1171 of 27-7-54) the GIR had indeed quite categorically absolved the Guard of the Local.

2.6 As this particular Report was actually printed and published (in its final and corrected version as early as in 1955, there should really have been no cause for any confusion on the Railway's part in this context. Even if an observation contained in a Report of a Statutory Inquiry were to form the basis of a plea for the revision of a SR, the very least that the Railway should have done was to consult the GIR/ACRS/CRS in the matter; it was thus a pity that the Railway possibly felt that the requirements of safety could be better served rather by simply according to the Union's demands.

2.7 It was no less astounding that, in spite of the revision in 1970 to SR 115-1 (b) (ii) that had virtually rendered redundant the Guard's Repeaters already provided, no action was taken at all in the ensuing decade to remove this superfluous signalling equipment. While the Railway Administration had clearly no answer to the question as to the precise purpose served by the retention of the said Repeaters, the situation now obtaining in actual practice does appear that, wherever Guard's Repeaters have been provided on platforms, Guards do take note of their aspect, according to the evidence of the following:

—Shri Z.A. Khan (Guard of B-88 Up on 24-4-81).

—Shri B.S. Mali (Guard of B-92 Up on 24-4-81).

### 3. Genesis of the Starter Indicator—

3.1 At this stage, it is pertinent to draw attention to Railway Board's letter No. 64/W-3/SG/G/15/1 of 26-12-75 under which, further to the inconclusive discussions between the Eastern Railway and the Commission of Railway Safety on this particular subject, the RDSO (Research Designs and Standards Organisation) was directed to develop a suitable design for a "Starter Repeater" in order to rationalise its design.

3.2 The design of this special Signal, now renamed "Starter Indicator", was the subject of discussion at the 51st and 52nd Signal Standards Committees, vide item Nos. 829 and 836 respectively. The present position is that the Railway Board have approved an Indicator of the following features :

- (i) A hooded Single Aspect Colour Light Indicator that shall remain unlit when the Starter is a 'ON', but display, when the Starter is taken 'OFF', a stencilled legend 'R' illuminated in yellow.
- (ii) A double-filament lamp with a reflector or screen ; and
- (iii) The whole device, with the casing either fabricated or cast, to be suspended from the roof.

#### 4. The present position regarding CR's Guard's Repeaters—

4.1 In view of Railway Board's orders that the Starter Indicator should remain unlit in the event that the Starter is at 'ON', the Central Railway was asked as to why no action had been taken to comply with this particular requirement by blanking off the 'Yellow' aspect of the Guard's Repeaters existing on the Railway. The Railway's reaction to this overture was rather peculiar in that, rather than respond to the query, the Railway advised under its letter No. TECN. 34/SPL/4/471/182 of 17-7-81 that the existing Guard's Repeaters were being removed immediately.

4.2 Keeping in view firstly the separate development of the 'Starter Indicator' under the Railway Board's auspices, secondly the undoubted usefulness of this device towards accident-prevention and thirdly the picture that emerged during the course of the Inquiry that Guards do pay attention to such Repeaters wherever provided, the planned action on the Railway's part to dismantle these Repeaters was promptly prevented by invoking the provisions of para 304 (a) of the Signal Engineering Manual and Section 20 (2) of the Indian Railways Act, which stipulate the prior sanction of the Commission as a condition precedent to, inter alia, any alteration to existing signalling installations.

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## Result of discussions with the Railway further to the Recommendations made during the course of this Inquiry

| Deficiency  | Recommendation  | Remarks  |
|---|---|--|
| <b>A. (Immediate Recommendations under Enclosure 2 to the Brief Preliminary Narrative Report.)</b>  |   |  |
| Poor visibility of Starting Signal [Para 30 (b)] and its location too close for a Motorman to pull up, had he started inadvertently [para 25(b)].           | 1 (a). Signal No. RVJ-5 to be relocated farther away to provide better visibility to Motorman from normal position of the stoppage of his EMU.<br><br>1(b). A thorough survey to be made of all platform "Starters" on the Suburban Section from these 2 angles and, arising from this, to develop an action plan to remedy the situation as necessary. | The Division intimated under letter No. BB. T/105/A/JC/1981-82/dated 28-7-82 that shifting this Signal would not be advisable as it would reduce its visibility to run-through goods trains from WR to BPT. Vide its letter No. T 102/P2/81-82 of 4-1-82, the Railway advised that, pursuant upon a joint survey, 2 Signals were directed to be shifted, the hood of 2 other Signals to be modified and one further Signal to be re-focused.   |
| Lost opportunity in <i>not</i> making use of the Platform (or, Guard's) Repeaters (which exists at some Stations) [para 45(d) (ii)].                        | 2. Guards of Locals to be directed to observe the aspect of Platform Repeaters wherever they are provided, without attracting any onus in the event of an accident, in view of the Revised SR 115-1(b) (ii).  | The Railway maintains that, having once acceded to the Union's demand, it would now be delicate as well as indelicate to try to revert to the "Status quo ante 1970" The Railway also wishes to dismantle all these non-standard Repeaters.  |
| Lack of isolation, especially in the absence of flank protection against over-runs past conflicting Signals. [Para 32 (a), and Para 2 of Annexure III (c)]. | 3. Up Mahim Line to be physically isolated at RVJ from the Kurla Chord by a Sand Hump and, if special constraints preclude its provision, the diamond crossing should then be protected by another Stop Signal in its rear.   | After a series of discussions with the Railway, and particularly with such physical isolation attracting its own hazards as expounded in para 46 (c), it was decided not to press for it, provided that adequate flank protection was agreed to be provided.   |
| Absence of Safeguard against a run-away load (off a parted Down Goods to WR) fouling the Kurla Chord [para 32 (b) & 46 (d)].                                | 4. Down Mahim Line to be physically isolated at RVJ from the Kurla Chord by trap points or slip siding.   | The Railway has advised, vide its letter No. T. 102. P.2/81-82 of 14-5-82, that a sand-hump siding would be provided here.   |
| <b>B. (Recommendation made to the GM under letter No. C-10 (INQ)/50-1318 of 12-10-1981).</b>  |   |  |
| Absence of flank protection against over-runs past conflicting "Entry Signals" [paras 33 (a) & 45 (b)].   | Flank protection as spelt out in para 33(c) to be provided at RVJ.  | Initially, the Railway argued that, as such flank protection could not be provided at all similar locations (wherever, for instance, a cross over from a 'slow' to 'fast' line or vice versa cuts across another line meant for movement in the opposite direction), there was little points in improving safety at just one isolated location. Pursuant upon extended discussions, however, this recommendation was accepted by the Railway under its letter No. T. 102. P. 2/81-82 of 14-5-82. |

## RAILWAY BOARD'S COMMENTS ON VARIOUS PARAS OF THE REPORT

*Para 54 : (a) Extension of Flank protection at Raoli Junction :*  
Necessary work has been completed on 4-11-1982.

*(b) Protection of Raoli Junction against run-away vehicles :*

Suitable safeguards in this respect have been provided in conformity with CRS's suggestion and this has been noted by CCRS.

*(c) Visibility of signal No. RVJ-5 at KCE be improved :*

Action has already been initiated by the Railway Administration to improve the visibility of this signal and they are being advised to expedite the work.

*Para 55 : (a) Re-assessment of Motorman's workload :*

The suggestion for change in clarification of 'motorman' from 'continuous' to 'intensive' on Bombay Suburban Section in coordination with RDSO is under consideration.

*(b) Introduction of AWS on Central Railway's suburban system :*

The automatic warning system introduced on Gaya-Mughalsarai and Howrah-Burdwan Chord line section of Eastern Railway has not proved satisfactory due to heavy thefts of aluminium bodied magnets from the track. It is, therefore, proposed to try track magnets with fibre glass body to obviate thefts. The installation of A.W.S. system is also in progress in Churchgate-Virar Section of Western Railway. Extension of the automatic warning system to other sections will depend upon the successful functioning of the system in these sections.

*(c) Necessary work to improve the visibility of the platform "starters" on the suburban section has already been completed by the railway administration.*

*(d) The Railway Administration has been asked to ensure that staff concerned strictly follow the provisions of the Subsidiary Rule 115-1 (B)/ii. As dual responsibility on both the Motorman and the Guard for sighting the Starters is attended with greater risk, it is not considered advisable to make the Guard responsible at par with the Motorman in this respect.*

*(e) The Working Table of the trains of Central Railway adopts safer operating strategy of de-congesting the accident prone Diamond crossing through deliberate segregation of traffic streams on the fast and slow-lines and strictly restricting the use of available cross-overs in only emergencies. The necessity of switching of some trains from one corridor to another cannot be entirely eliminated for operational reasons.*

*Para 56 (a) :* The need to avoid short-cut methods while dealing with signalling failures, has been impressed upon the Railways from time to time. Such short-cut methods like "Bridging of certain Relays" cannot be permitted even to a restricted extent, as suggested by CRS. CCRS has rightly pointed out that such a recourse can be fraught with danger and therefore, cannot be permitted.

CCRS has opined that "Calling-on" facility appears to be the only safe recourse. It means perhaps provision of a "Calling-on" signal. This will not also provide an entirely satisfactory solution to the problem of over-coming detentions in case of failures, as some of the controlling functions are proved in the calling-on signal circuit also; and failure of any of these functions will result in the failure of "Calling-on" signal circuit. However, the Railways are free to provide "Calling-on" signal to meet operational demands depending upon the local conditions available.

*Para 56 (b) :* The recommendations of CRS to provide signal fault controllers is acceptable in principle. However, it may not be possible to meet with this requirement in the near future in view of the ban on creation of new posts. However, C. Rlys. proposal has been received in the Board's office and is under consideration.

*Para 56 (c) :* Necessary action in this regard is being taken by the Railway.

*Para 57 :* A policy directive as regard to effective functioning of counters has been issued by Railway Administration to construction and maintenance officers.

GOVERNMENT OF INDIA  
MINISTRY OF TRANSPORT  
DEPARTMENT OF RAILWAYS  
(RAILWAY BOARD)

No. 81/Safety (A&R)/1/9

New Delhi, dated Nov., 85

OFFICE MEMORANDUM

SUBJECT:—*Side Collision of B-90 Up Local with CM-15 Down Local at Raoli Jn. of Central Railway on 24-4-81.*

The undersigned is directed to refer to the Commission's O.M. No. RS. 21-T(5)/81 dated 30-8-85 on the above noted subject.

The suggestion of CRS contained in para 55(a) regarding reclassification of motorman from 'continuous' to 'intensive' category has been considered by the Work Study Team set up for the purpose. The team came to the conclusion that the motorman cannot be classified as 'intensive' on the basis of their present work load under the existing hours of Employment Regulations.

Sd/-  
(T.A. SUBRAMANIAN)  
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