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

REPORT
ON
OUTBREAK OF FIRE

IN
BADNERA OIL CHIEF GOODS TRAIN
AT
MALKAPUR STATION YARD
ON BHUSAVAL-BADNERA BROAD GAUGE DOUBLE LINE
SECTION OF CENTRAL RAILWAY'S BHUSAVAL DIVISION
AT ABOUT 16.50 HOURS
ON
20th AUGUST, 1980
AND
SUBSEQUENT OUTBREAK OF FIRE
IN
WAGON NO. ER 65925
DURING CLEARANCE OPERATIONS
ON
21st AUGUST, 1980
AT ABOUT 15.30 HOURS

SUMMARY

1. Date		(i) 20-8-1980 (ii) 21-8-1980
2. Time		(i) 16.50 hours (ii) 15.30 hours
3. Railway		Central
4. Gauge		Broad (1676 mm)
5. Location		Malkapur Station Yard.
6. Nature of Accident		(i) Outbreak of fire in 'Oil Chief' Goods train. (ii) Fire in wagon No. ER 65925 during breakdown clearance operations.
7. (a) Train involved		Down Trombay Badnera Oil Chief Special Goods train.
(b) Consisting of		45 four-wheelers, including 41 loaded tank-wagons, hauled by WDM-2 Diesel Electric Locomotive No. 17531.
8. Speed		Well in excess of 75 Km/h.
9. System of Operation		Absolute Block System.
10. No. of tracks		Non-electrified double track Main Line with a Loop Line on the outside of each Main Line.
11. Gradient		1 in 624 falling.
12. Alignment		Straight.
13. Weather		Clear.
14. Visibility		Good.
15. Cost of damage	Rolling Stock —Rs.	8.00 lakhs
	Permanent Way —Rs.	5.12 „
	Signalling —Rs.	0.52 „
	Net loss to fuel oil cargo—Rs.	13.26 „
	Total Rs.	26.90 lakhs
16. Casualties		Killed—5 (2 on 20th & 3 on 21st). Injured—10 on 21st (3 grievous & 7 simple).
17. Cause		(i) *Accident on* 20-10-80 Eruption of fire was the result of derailment of a tank-wagon and its immediate capsizing and puncturing caused by a combination of "excessive over-speeding" and "failure of equipment" causing some component to drop off on the run.

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SUMMARY—*contd.*

(ii) *Accident on* 21-10-80

Eruption of fire was the combined result of spillage of oil during manipulation of this tank-wagon and the release of some still very hot substance whilst the partially buried undergear of this tank-wagon got prised off the ground.

18. Important recommendations in brief

(a) To improve the resistance of tank-wagons to derailment by stipulation of more rigorous maintenance standards in respect of "rejectable" defects.

(b) To set up a special "Task Force" to undertake :—

(i) the development of safety procedures to combat the dangers associated with wreckage clearance operations involving the leakage of hazardous materials.

(ii) To also set up appropriate safety precautions, including the use of safety equipment, to meet the health-hazards, to which wreckage-clearance personnel might be exposed.

(c) To equip, as a first step, the break-down set-up on each Division with explosimeters and related instrumentation.

(d) To set up an adequate machinery to detect and prevent over-speeding by goods trains.

(e) To improve and strengthen the on-track fire-fighting capabilities.

(f) To ensure the accuracy of train-timings as recorded by Station Masters in the Train Registers.

(g) To effect improvements in the design of tank-wagons to better cope with sudden surge loadings and in general to become less derailment-prone relative to other types of 4-wheeler rolling stock.

(h) To upgrade the safety of existing tank-wagons against penetration and puncturing in a post-derailment situation, by the appropriate fitment of specially designed elements, such as "Head Shields" and "Shelf-type couplers".

(i) To upgrade the insulation property of the barrel by the provision of thermal insulation to safe-guard tank-wagons against explosion through BLEVE effect.

(j) To establish a procedure for the prompt updating of the safety procedures consistent with the experience gained, the development of newer products and /or techniques, etc.

(k) To develop a simple on-board computer for installation in a Diesel locomotive, so as to control its "road-speed" by cutting off the power as and when the speed exceeds a pre-set limit.

(l) To progressively replace steam-cranes by diesel-cranes for break-down operations, in view of the hazards posed by coal-fired furnaces in situations involving the release of inflammable oil/vapour.

CONFIDENTIAL.

NO. C-10 (INQ)/44

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 Goevrnment of India,
Ministry of Tourism & Civil Aviation,
Sardar Patel Bhavan,
Parliament Street,
New Delhi-110 001.

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 Inquiry into the outbreak of fire in Down Trombay Badnera Oil Chief Special Goods train at Malkapur on the Bhusaval-Badnera Section of the Central Railway's Bhusaval Division at about 16.50 hours on 20-8-1980 and into the subsequent outbreak of fire in wagon No. ER. 65925 during the breakdown clearance operations on 21-8-80 at about 15.30 hours.

2. *Inspection and Inquiry*

(a) Although it is not obligatory for such an accident as this to be inquired into by the Commission of Railway Safety, taking into cognizance the consequential fatality to 2 persons who were walking on the cess in Malkapur yard on 20-8-80 and to 3 more persons due to outbreak of fire on 21-8-80 during the restoration operations and also bearing in mind the tremendous tragedy that could have occurred, had an Up passenger-carrying train been arriving Malkapur at that critical juncture, this particular accident was reckoned to be sufficiently serious as to merit an Inquiry by the Commission.

(b) On the 25th, 26th and 27th August 1980, I inspected the site of the accident in the company of the Chief Transportation Safety Superintendent, Bombay, the Divisional Railway Manager (DRM), Bhusaval and other railway officers of Bhusaval Division. By that time, the wreckage had already been cleared off the tracks. Having consulted the Senior Railway Officials (who were the first to arrive at the accident site and who either recorded or observed the disposition of the various rolling stock) and the crew in overall charge of the Break-down operations, I then caused a plan of the accident site to be prepared, which appears at Annexure IV in the Report.

(c) The Railway Hospital in Bhusaval was also visited on 25-8-1980 and several times subsequently in the company of the DRM, Bhusaval and the Medical Superintendent of the Railway Hospital. The care and attention bestowed on the patient(s) was considered quite satisfactory, albeit that 3 of the 4 cases with serious burns succumbed despite the best medical attention provided at the Railway Hospital.

(d) A Press Notification was issued on 25-8-80 in the local Marathi Dailies "Matrubhumi" and "Shiv Shakti" (both issued from Akola) and "Gavkari" (issued from Jalgaon), as also the English daily "Indian Express" (issued from Bombay), inviting members of the Public having knowledge relating to this accident to give evidence at the Inquiry, which I commenced at Malkapur on 26-8-80, or to communicate with me by post. The District Collector and the Superintendent of Police, Buldhana, were also duly notified.

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(e) The Officers present at the Inquiry were : —

Railway :—

Shri Y. N. Trehan	:	Chief Transportation Safety Superintendent, Bombay.
Shri S. Abuzar	:	Divisional Railway Manager, Bhusaval.

Ministry of Industry & Civil Supplies :—

Shri . K. T. Lokhande	:	Deputy Controller of Explosives, Bombay, who was present throughout the conduct of the Inquiry Proceedings on the 26th and 27th August, 1980.

Indian Oil Company :—

Shri P. J. Tikekar	:	Assistant Divisional Manager (Operation), Nagpur was present during the site inspection on 25-8-1980

Civil Authorities :—

*Shri O. P. Behrotra	:	District Collector, Buldhana.
*Shri R. B. Pawar	:	Superintendent of Police, Buldhana.
@Shri R.V. Kumbhare	:	S. D. O. Malkapur.
@Shri P. R. Pudke	:	Tehsildar, Malkapur.

Shri Kishan Lal Sancheti (MLA) and Sri Arjun Rao Wankhede (Ex MLA), both from Malkapur Constituency, also extended their courtesies by making a brief appearance from 9 to 9.30 A.M. on 26-8-1980, before the commencement of the Inquiry proceedings.

(f) A subsequent development was the receipt of a registered communication from the Central Railway Mazdoor Sangh (Bhusaval Main Branch) enclosing a hand-out aimed at drawing the specific attention of the Railway Minister as well as the undersigned, alleging that it was carelessness on the part of Railway Officers that caused the break-out of fire in the wagon during clearance operations on 21-8-80 and further that, under pressure from the concerned Officers, certain evidence was being suppressed. Keeping in view both the gravity of the allegations and the tremendous loss sustained by the Railway as a result of this accident, it was considered not only prudent but also desirable to further extend the scope of interrogation by examining as many additional witnesses as appeared pertinent to the context, so as to be able to ensure, in regard to the conduct of this Inquiry, that justice and fairplay were not only observed but also overtly seen to be observed in the eyes of the public.

(g) The deposition of evidence thus concluded only on 11-9-80 with 106 witnesses examined in all, comprising 94 Railway employees and 12 outsiders, including some government officials.

(h) 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 the Badnera Oil Chief Goods Train.

3. *The Accident, a brief description of*

(a) At about 18.50 hours on 20-8-80, as Badnera Oil Chief Goods Train (hereinafter called simply as the 'Oil Chief'), carrying 41 loaded oil tank wagons marshalled centrally within its trailing load of 45 vehicles was running through Malkapur Station, situated at Km. 494.26 on Bhusaval—Badnera Broad Gauge Double-line section of Central Railway's Bhusaval Division, 28 oil tankers derailed, marshalled the 8th to 35th and /or capsized, blocking both the Up and Down Main Lines. With as many as 12 wagons piled up within a space of hardly 40 metres just ahead of Malkapur 'B' Cabin, one or more wagons got punctured/ ruptured in the resulting impact, which caused a sudden outbreak of fire and its rapid spread through the BLEVE (an acronym for 'Boiling Liquid Expanding Vapour Explosion') effect, which enveloped all, save just one single wagon of these affected and destroyed, besides the fire-affected rolling stock and their inflammable contents, considerable length of track as well as Signalling and Tele-communication assets.

(*) Witnessed the Inquiry Proceedings from 15.45 hours to 18.30 hours on 26-8-1980.

(@) Present at the time of site inspection on 25-8-1980.

(b) Providentially, 384 Up Nagpur-Bhusaval Passenger train had arrived Malkapur and already left at 16.44 hours, with 84 Up Maharashtra Express not yet due. Had the former been late by some 10 minutes further, the catastrophe could have been too terrible by far even to imagine.

(c) During the subsequent wreckage clearance operation, on the next day (i.e. 21-8-80), as the steam-operated Bhusaval Breakdown crane was engaged at about 15.30 hours in handling the fire-damaged tank wagon No. ER. 65925, the latter suddenly caught fire, leading, to casualties as well as temporary hold-up in the restoration of through communications on the Bhusaval-Badnera Section.

(d) The weather at the time of both these mishaps was clear, bright and not windy.

4. *Casualties*

(a) I have to report with much regret that as a result of the accident on 20-8-80, 2 innocent persons (one a Railway employee and the other an aged woman) who were walking on the cess next to the Up road near the Malkapur 'B' Cabin got caught in the conflagration and their bodies got charred on the spot.

(b) As a result of the accident on 21-8-80, besides 7 persons who sustained simple injuries, 6 others suffered grievous injuries, of whom 3 succumbed later due to the severity of burns.

II. RELIEF MEASURES.

5. *Intimation*

(a) On 20-8-80, within minutes of the outbreak of fire, the Bhusaval Control Office was informed of the mishap by the ASM on duty at Malkapur, whereupon the Bhusaval Fire Fighting Unit and the Breakdown train were immediately ordered. Immediately as the magnitude of the fire was known, assistance was also sought of the Fire-Fighting services available with the Reserve Petroleum Depot at Bhusaval, the Ordnance Factory at Varangaon, the Railway's Fire-fighting unit from Akola as well as the Municipalities of Malkapur and Khamgaon. Subsequently, the Ajni-based Breakdown train of Nagpur Division was also ordered.

(b) On 21-8-80, within minutes of the outbreak of fire, the Bhusaval Accident Relief Medical Equipment Van was ordered to proceed with as many doctors as possible and all concerned also suitably advised.

6. *Medical Attention*

(a) On 20-8-80, when it became clear that no one else received injuries other than the 2 persons who expired in the flare-up, the ARME Van already on the move was stopped en route and returned to Bhusaval.

(b) On 21-8-80, immediate medical attention was provided by the doctors of Malkapur Municipal Hospital as well as private medical practitioners, who all rushed to the site within minutes of the accident. The ARME Van, ordered at 15.40 hours, arrived at the site at 17.00 hours, whereupon the Railway's District Medical Officer and his colleagues took charge of the cases of grievous and simple injuries and brought them to Bhusaval for admission to the Railway Hospital, whereafter continuous medical superintendence was provided.

7. *Clearance and Restoration*

(a) The rear string of 10 wagons (marshalled the 36th to 45th, which included 8 Oil Tankers) were safe on the track and unaffected by the fire. However, the spectacular dimension of the conflagration was so scary that simply no one dared to uncouple the rear portion of the train, as the 36th wagon happened to be still coupled to the 35th (which had derailed but not caught fire, though quite close to the area under devastation). Thus, it was only when the first contingent from Bhusaval, headed by the DME (C & W) (late Shri B. L. Pali) arrived Malkapur at 18.50 hours that this rear string of 10 wagons could be unhooked under the said DME's personal supervision and pulled away to a safe distance.

(b) Having parted from the rest of the load, the front portion of the 'Oil Chief', comprising the engine and 7 wagons, came to a halt approximately 30 m. in rear of the road overbridge located at Km. 495/8-9. Subsequently, the train drew ahead reaching the next station, Biswa Bridge, at 22.35 hours.

(c) Through the combined efforts of the various fire fighting units, the fire was finally put out and the entire affected area flooded all over both by foam and by water by 01.00 hours of 21-8-80. Nevertheless, because of the presence of disconcerting quantities of inflammable vapour, the entire area was kept under close and continuous observation for some time to exclude any possibility of re-ignition and the outside fire fighting units finally left the scene at about 07.00 hours.

(d) Although the Bhusaval breakdown train had arrived at 21.10 hours on 20-8-80, its steam crane could commence its operations only at 03.15 hours on 21-8-80. The 35th wagon (which was not affected by fire) was rerailed 2 minutes later, but clearance of further wagons (upon all of which the fire had wrought devastating havoc) had to be very very carefully organised by taking into consideration, inter alia, how hot the wagon bodies felt at that stage.

(e) The Ajni-based breakdown train arrived at 09.30 hours on 21-8-80 to provide assistance in restoration work from the Opposite end. Most of the track underlying these wagons having been destroyed 'in toto', linking of track had to closely follow wreckage clearance to enable the breakdown cranes gain closer access into the affected area. With restoration works progressing from both ends, it was possible to achieve good progress and by about 15.00 hours on 21-8-80 only 2 wagons remained to be cleared away, one each to be tackled by the 2 cranes.

(f) The 19th and the last tank wagon No. ER 65925 to be cleared by the Bhusaval Breakdown crane was lying on the Up main line just beyond the crossing of the emergency cross-over. At about 15.30 hours on 21-8-80, this Breakdown crane was brought right upto the end of the newly laid track and clearance operations on this wagon were in progress with several Senior Officers of Bhusaval Division, including the Divisional Railway Manager, witnessing this manoeuvre, when fire broke out all of a sudden after some residual oil from this tank wagon spilt out of the open man-hole.

(g) This crisis caused not only casualties [para 4 (a)] but also held up the restoration operations [para 3 (c)]. Eventually, the Up Main line was cleared for traffic at 20.45 hours on 21-8-80 and the Down Main line at 18.30 hours on 22-8-80.

(h) As a result, further to 4 Goods trains cancelled and 6 more stabled, 2 Mail/Express trains and 4 Passenger trains had to be cancelled, with 6 Mail/Express trains diverted via other routes, while 3 Mail Express trains and 4 Passenger trains had to be terminated short of their destinations.

III. COMPOSITION OF TRAIN AND DAMAGE.

8. *The Train-consist*

(a) The 'Oil Chief' was carrying petroleum products from the Bharat Petroleum Corporation's siding in Bombay to Badnera and ex : Bhusaval it was hauled by the Jhansi-based WDM-2 Diesel Electric Locomotive No. 17531, with its short hood leading. As in the case of most of this Railway's locomotives of this type, it is regretted that this particular locomotive, too, had its Vigilence Control Device dummied and the conjunction valve for proportionate braking isolated. However, all the safety items were stated to be in good working order. It underwent its last triennial overhaul on 1-11-1979 and its last trip inspection on 15-8-1980. This being a goods train, a speed recorder was not fitted on the loco, the speedometer of which was functioning.*

(b) The trailing load comprised 45 four-wheelers, including 41 loaded tank wagons with 2 dummies at either end. The total length of the load was 370 m., with 1400 t. of gross weight and 396t. brake force. Wagon particulars are given in Annexure IV.

(c) The extensive heat damage suffered by almost all the capsized wagons virtually obliterated the PRO particulars. Still, reference to the PRO particulars barely decipherable on the odd wagon involved in the fire and also to the data read out from the wagons not involved in this accident showed that none of them was overdue its POH at the time of the accident.

(d) Of the 41 tank wagons, 22 were type TK and the balance 19 of type TP. In regard to lading, 22 wagons contained high speed diesel whereas 15 contained superior kerosene oil, with petrol in the balance 4.

(e) The 'Oil Chief' had its last "safe-to-run" examination at Bhusaval, where nothing abnormal nor untoward was discovered. The brake-power certificate showed that, in all, 6 wagons (marshalled the 5th, 6th, 26th, 34th, 42nd and 43rd from the front) had defective cylinders, leading to an over-all effective brake power of 87%.

9. *Damage to Rolling Stock*

(a) The locomotive suffered no damage whatsoever and likewise the 7 wagons which comprised the front part of the train that had separated in the accident. However, both the screw coupling as well as the swan-neck with its flexible hose pipe connection got snapped off the rear end of the 7th wagon, with the fractured ends fresh and bright, without any evidence of corrosion.

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*Only on the Assistant's side.

(b) There was also no damage to the rear string of 10 wagons (comprising the brakevan, a dummy and 8 tank wagons) which had not derailed. Indeed, the 35th wagon (which was the last wagon to derail),having had only its left leading wheel derail *inside* with its 3 other wheels on rail, showed no damage excepting for discoloration due to exposure to intense heat.

(c) The extensive damage caused to the other 27 wagons, 20 of which had totally capsized, is briefly summarised now. As regards the barrels, 18 had burst in the resulting explosion and 3 punctured due to impacting with one another, with the balance 6 dented/deformed. The man-hole covers of the 21 wagons that had either punctured or burst were all in position but with the holding down bolts bent and the threading damaged through over-heating on 5 barrels, the man-hole covers were missing (with evidence of some damage at the socket-mouth locations), whereas the man-hole cover was in position on the remaining barrel (although its top portion sustained damage). Of these. 27 wagons, 15 were type TK while the remaining 12 were type TP. The contents-wise distribution was diesel in 14 barrels, with kerosene in 10 barrels and petrol in the remaining 3. As a result of the fire, 15 barrels were rendered empty, with the balance 12 yielding some residual contents, which were later on carefully decanted for possible salvage/reclamation.

(d) As regards the underframes of these 27 wagons, 25 were found very badly smashed up and twisted with 2 others sustaining but moderate damage. The magnitude of the forces involved in this accident can, be gauged from the fact that no less than 3 wagons lost both the axles and 8 further wagons were found without one wheel-set. It was only to be expected under such circumstances that most of the brake cylinders got wrenched off their moorings, the braking gear distorted out of shape, the various springing components spewed out and a majority of brake-blocks dislodged. This most of the mechanical gear (comprising the multifarious components pertaining to the draw/braking buffing/springing gear) was destroyed beyond repair, both as a result of physical forces experienced during capsizing, etc., and through exposure to extremely high levels of temperature. For instance, buffers had either been uprooted or badly drooping due to deformed plunger rods.

(e) The disposition of the various wagons involved in the accident may be seen in Annexure IV. The tremendous power of the blast pressures released by exploding tank wagons may be gauged from the fact that, as the wagons marshalled the 9th and 10th burst, the 9th wagon was tossed forward as also to the right to land on the Up road, whereas the 8th wagon was tossed no less than 14 m. to the left and slightly backwards, where it was found lying in a ditch of water. Whereas the 12 wagons (marshalled the 10th to the 21st had capsized more or less sequentially one behind the other, the next 12 wagons (which should have ordinarily occupied 100 m. of linear space) where found piled up helter-skelter within a short distance of just 40 m., beyond the 'B' Cabin and fouling both the Main Lines.

10. *Damage to infra-structure*

(a) As regards the Permanent Way, 220 m. of plain track, mostly on the Down Main Line, was totally destroyed, including the Badnera-end cross-over with its 1 in 8 1/2 turnouts. The 1 in 12 turn-out negotiated by the 'Oil Chief' in the trailing direction near 'B' Cabin was also totally demolished in spite of its steel through sleepers. Further, due to the impact of the capsized wagons falling upon it, the switch portion only of the 1 in 16 turn-out located near 'B' Cabin on the Up Main line got damaged.

(b) Smashed up in this accident were the double wire facing point assemblies for the 4 switches mentioned in sub-para(a) above, besides 200 m. of double-wire transmission. Communications paraphernalia like overhead aerial alignment of "control wiring" (some 500 m of it) and 12-core underground cable (about 300 m of it) were also damaged.

(c) Ploughed through by the capsized wagons, the formation, too, was badly broken up particularly on the Down Main line and especially at 2 locations where 2 pits were found, into which inflammable products collected. The first pit (measuring 11 m. along the track 4m. across and 1 m. deep) was found 17 m. forward of Telegraph Pole (TP) No. 494/10 and the second (measuring 8 m. along the track, 2.5 m. across and .5 m. deep) was found 20 m. in rear of TP No. 494/11. Channels had to be excavated to drain out these 2 pits before commencing earth-works preparatory to laying of new track.

(d) As an aftermath of the outbreak of fire in Wagon No. ER 65925 during the afternoon of 21-8-80, while the Ajni-based breakdown crane was scampering away to safety, the Up Home Bracketeed Signal got hit/damaged, requiring replacement of the entirec struture.

11. *Cost of Damage—*

As estimated by the Railway, the total cost of damage had come to Rs. 26.90 lakhs, with component cost as below :—

Rolling Stock	.. ..	Rs. 8.00 lakhs
Permanent Way	.. ..	Rs. 5.12 ,,
Signalling	.. ..	Rs. 0.52 ,,
Net loss to fuel oil cargo	.. .. ..	Rs. 13.26 ,,
	Total :	Rs. 26.90 lakhs.

IV. LOCAL FEATURES.

12. *The Section and the Site*

(a) Malkapur is the 5th station from Bhusaval on the Bhusaval-Badnera double-line Broad Gauge Section, which is a part of the Bombay-Howrah route via Nagpur. The kilometrages reckoned from Bombay VT are as under :—

Bhusaval (BSL)	.. .. ..	Km. 444.12
Varangaon (VNA)	.. .. ..	Km. 456.88
Achegaon (ACG)	.. .. ..	Km. 462.53
Bodwad (BDWD)	.. .. ..	Km. 474.45
Khamkhed (KMKD)	.. .. ..	Km. 485.27
Malkapur (MKU)	.. .. ..	Km. 494.26 (*Accident Site*)
Biswa Bridge (BIS)	.. .. ..	Km. 508.28

(b) To serve the Up and Down passenger platforms, Malkapur Station has one loop line on the outside of each main line. The station building is on the right; likewise, the 'B' Cabin (situated towards Badnera end of the yard), while 'A' Cabin (situated towards Bhusaval end of the yard) is to the left. On the right side, too, is located a Goods Shed at the Bhusaval end of the yard, where a steam engine happened to be performing shunting operations at the time of the accident. Emergency cross-overs are provided between the Up and Down Main lines at each end of the yard.

(c) Trains are worked on the Absolute Block System and Malkapur is a 'B' Class Station with Standard III Interlocking. Orthodox 2-aspect lower-quadrant double-wire operated semaphore signalling with lock-and-block facility, adequate inter-slotting for inter-cabin control and SGE 3 position Double-Line Block Instruments form the essential equipment for working trains in either direction.

(d) Post-Type Reversers are provided in both directions on Outers/Warners/Home Signals/Advanced Starters/Main Line Starters. When a train passes the last stop signal to enter the block section, an audible bell starts ringing at the Block Instrument and continues ringing until the Station Master gives the "Train-Entering-Section" indication to the Station ahead, whereupon the Station Master turns the commutator of his Block Instrument to the "Train-on-Line" position.

(e) The direction of track at Malkapur is roughly Easterly and, as can be seen from Annexure IV, from Bodwad onwards there is generally a falling grade continuously upto Khamkhed whereas, just short of Malkapur, there are also 2 stretches of rising grade interspersed between falling grades or level regions.

(f) Malkapur Yard is situated on a low embankment under 2 metres high and founded on "good" soil. The track structure, which is well ballasted throughout, is adequate for 110 Km/h. the maximum sanctioned speed here. For information on sleepers in use on the Down Main Line, reference may be made to the top of Annexure IV. For instance, because of track circuits provided on the CSR portion, wooden sleepers had to be used in this region, whereas elsewhere CST-9 sleepers have been provided with wooden sleepers at joints only. With wooden sleepers, 4-holed bearing plates are used, with 4 spikes per rail-seat on intermediate sleepers. On CST-9 sleepers, keys are driven in the direction of the traffic and no anti-sabotage measures exist on the wooden-sleepered track.

(g) As a Down train approaches 'B' Cabin and passes it on the Down Main line, it encounters a right hand turn-out in the trailing direction (joining from the Down passenger loop) before negotiating a matched (first a right-hand and then a left-hand curve) pair of short (only 132 m. long each) reverse curves of a very flat (0.7°) degree of curvature with a straight reach in between (which accommodates on the Down Main Line, as a part of the emergency cross-over, a left-hand turn-out in the trailing direction). The reverse curves were provided decades back at the stage of "doubling" the erstwhile single line.

(h) The curved lead rails of these 2 turn-outs traversed in the trailing direction would necessarily form an obstruction to the path of any derailed wheel-set causing the affected wagon to veer further across the track, with the imminent danger, unless the train itself be on the verge of halting, of its inevitable capsizing as well as parting from the train at its front end at least, if not at both ends.

13. *Features relating to the movement of the 'Oil Chief'*

(a) Having arrived at Bhusaval on by-pass line No. 1 at 13.10 hours, the Oil Chief was blocked for 1 hour from 13.25 hours to 14.25 hours for "safe-to-turn" train examination, which did not reveal anything so untoward or unsafe as to cause any wagon to be marked sick. Only minor attention like repairs to bearing spring cotters, adjustment of brake power, replacement of worn-out brake blocks, etc. had to be carried out. Neither leakage nor spillage was noticed off any barrel during this examination. The Vacuum Certificate showed 50 cm in the loco and 40 cm in the brake-van.

(b) *Crew Member Information—*

(i) *Driver 'C' : Shri L. J. Edwards.*

Born	..	..	..	..	: in 1938
Appointed	..	..	..	..	: in 1958, as Cleaner Boy
As Fireman 'C'	..	..	..	..	: in 1962
Passed Main Line Drivers Course				..	: in 1964
As Shunter 'A'	..	..	..	..	: in 1976
As Driver 'C'..	..	..	..	..	: in 1978 (18th April)
Passed Diesel Drivers Course		..	..	..	: in 1979
Last PME* done	..	..	..	..	: on 19-1-79
Next PME due	..	..	..	..	: on 19-1-82
Accident Index (AI)	..	..	..	..	: 100

*PME=Periodical Medical Examination.

He had signed off at 18.00 hours on 18-8-80 and, after availing 44 hours of rest at his headquarters, he was detailed out at 14.30 hours on 20-8-80 for working the 'Oil Chief'.

(ii) *Diesel Assistant : Shri Limbaji Martand.*

Born	..	..	..	..	: in 1931
Appointed	..	..	..	..	: in 1947
Diesel Assistant's Course passed				..	: in 1978
Last PME done	..	..	..	..	: on 27-9-79
Next PME due	..	..	..	..	: on 27-9-80.

He had signed off at 06.20 hours on 19-9-80 and, after availing 32 hours and 25 minutes of rest at his headquarters, he was detailed out at 14.45 hours on 20-8-80.

(iii) *Guard 'C' : Shri M. D. Patil.*

Born	..	..	..	..	: in 1927
Appointed	..	..	..	..	: in 1954
As Shunting Master	..	..	..	..	: in 1963
As Guard 'C'	..	..	..	..	: in 1965
Passed his last Refresher Course				..	: on 14-12-71*
Passed his Last First Aid Course				..	: on 6-12-71**
Last PME done	..	..	..	..	: on 25-9-79.
Next PME due	..	..	..	..	: on 25-9-80.

*He was very much overdue his Refresher Training, which is expected to be imparted quinquennially. Although booked for Refresher Course that started on 21-7-80 and the Safety Camp that started on 17-8-80, he did not attend either.

**He was very much overdue his First Aid training, which is expected to be imparted triennially.

He was punished only twice so far for lapses pertaining to train working.

(c) The Oil Chief had a through run ex: Bhusaval upto Bodwal, at which Station the Advanced Starter could not be taken off. Ordinarily, the train would have had to stop first in order to receive the necessary authorisation to proceed further, but, in this instance, the ASM on duty at Bodwad (who happend to be proceeding towards the Advanced Starter so as to find out what exactly was wrong) handed over the authority to the Driver just as the train was slowing down to a halt, with the result that the train was able to pick up speed again without stopping as such. The Driver's note book showed, however, a 2 minute halt at Bodwad (which was also attested to in the Assistant Driver's evidence) but the real fact was reflected in the Guard's journal. Thereafter, the Oil Chief continued to have a clear run, including past Malkapur station.

(d) Following are the timings recorded by the train crew on the progress of 'Oil Chief' :—

		Driver's Note Book	*Guard's Journal*
Dep.:	BSL	15.40	15.50
Thro'	VNA	15.56	16.05
Thro'	ACQ	16.04	16.15
Arr :	BDWD	16.21	16.30*
Dep :	,,	16.23	
Thro'	KMKD	16.34	16.40*
Thro'	mku	16.47	16.50

It would, thus appear clear that, contrary to the provision of GR 87, the Driver had not set his watch by the Guard's watch. On further enquiry, it appears that setting watches between the Guard and the Driver is not possible, if these 2 do not have an opportunity to meet face to face, as often happens whenever it is the Shunter who brings the outgoing engine on to the load, and the "Driver proper" takes charge of the loco subsequently, with the Guard having already commenced, in the meantime, his examination of the load from the engine away towards his brakevan.

(e) Inasmuch as the Oil Chief left Bodwad after having almost halted there, it would suffice to particularly scrutinize its progress thereafter. According to the Train Register of Bodwad, the Oil Chief left Bodwad at 16.30 hours and ran through Khamkhed at 16.40 hours. As per the Train Register of Khamkhed, however, this train left Bodwad at 16.35 hours and ran through Khamkhed at 16.45 hours. The Register of Malkapur showed that it left Khamkhed at 16.44 hours and ran through Malkapur at 16.50 hours. The differences in the timings to reveal slackness on the part of station staff in not being accurate and, on the premise that such slackness tends to be accentuated when dealing with goods trains rather than Mail/Express/Passenger trains, the timings recorded at Badwad, Khamkhed and Malkapur in respect of key events relating to the passage of all the Down Goods Trains on 20-8-80 were collated as reproduced in Annexure I (a).

(f) According to Appendix I at page 54 of Bhusaval Division's Working Time Table No. 55 valid for the period from 1-4-80 to 31-10-80, the running times in minutes for WDM-2 hauled goods trains are as given below, for the critical block section Bodwad-Khamkhed-Malkapur :—

	Through Trains	*Stopping Train*
Bodwad—Khamkhed	10	14
Khamkhed—Malkapur	10	12

It might be inferred from this data that the running time for the Oil Chief should have been (10+14)/2= 12 minutes and 10 minutes respectively from Bodwad to Khamkhed and Khamkhed to Malkapur. The Working Time Table does not however, provide information on the *minimum* running time for goods trains.

*Although all the remaining entries bore the appearance of having been scrawled in a moving vehicle, these 2 figures were neat and tidy : also, in the timing 16.40 the zero as written could easily be mistaken for "6", in which case the time would read as 16.46.

(g) Amazingly, the 'Control Chart' of the Bhusaval-Badnera Board for the relevant period could not be traced after the accident. A duplicate chart (which could not and did not reflect the actual timings pertaining to Khamkhed and Malkapur because the concerned Train Registers had been seized and sealed immediately after the accident) was produced for this Inquiry, ostensibly purporting to be the original document. Because of the discrepancies between the timings recorded in the said Train Registers and those read off the 'Control Chart' submitted, the truth could not remain hidden for long, however. For a 'Control Chart' to be missing seemed most unusual, but the Bhusaval Division, which subsequently enquired into this affairs at my behest, advised under letter No. BSL. T. 106/F.100/RB 5 of 7-2-81 that neither could the original chart be located nor any responsibility be pin-pointed on any individual as several officials had access to 'Control Charts' generally. A later development has been that instructions were issued by this Division that 'Control Charts' involving accidents must be kept under the custody of a nominated Deputy Controller.

(h) Throughout its run ex : Bhusaval through Malkapur, nothing abnormal nor dangerous (such as, hot bearings, binding of brake-clocks, spillage and/or leakage from barrels, etc.) was noticed by any railway staff responsible for train-passing duties, who, trained as they are to pick up any such symptom that looks/sounds the least bit suspicious, would otherwise have at once raised an alarm.

(i) Immediately prior to the accident, the Oil Chief had first crossed, between Khamkhed and Malkapur stations, 384 Up Nagpur-Bhusaval Passenger hauled by steam engine No. 8757 WG and then, towards the Bhusaval end of Malkapur yard itself, steam engine No. 8447 WG of 728 Up Goods, which happened to be performing shunting near the Goods Shed. With emission of sparks by steam engines not being uncommon, both these engines had already been throughly examined on 22-8-80—lest there be any doubt as to whether this accident could have been caused by the outbreak of fire, the origins of which could possibly be traced to this factor—jointly by the Boiler Mechanical Loco Inspector and the Loco Foreman (all from Bhusaval), who found that the spark arresters as also the dampers on both these engines were of the standard type and in good working order.

14. *Features relating to track at the accident site*

(a) With reference to provision of berthing track-circuit on the CSR portion of the Down Main Line at Malkapur Station, the work of through sleeper renewal of CST-9 plates by wooden sleepers had commenced on 1-5-80 and continued uptil the middle of June. In order not to contain the speed restriction to below 30 Km/h, re-sleepering was undertaken by tackling every 4th sleeper, rather than doing this work in continuous stretches. After the entire renewals were completed, the speed was successively raised to 50 Km/h after the first packing, to 70 Km/h after the second packing, and to 90 Km/h after the third packing, with the speed restriction finally removed on 23-7-80 after the fifth packing. As the wooden sleepers were received with holes pre-drilled, the accuracy in regard to the setting of which was not perfect, it was inevitable that there were certain variations in track gauge. For this and other reasons, as warranted by site conditions, spot renewals were continued into the first week of August.

(b) In regard to maintenance of Permanent Way, the accident site falls under the jurisdiction of the following :—

*DTM (Directed Track Maintenance) Gang Unit No. 8 located at Malkapur under the control of a Permanent Way Mistry who reports to the—

*Permanent Way Inspector (PWI), Grade III, headquartered at Bodwad and who reports to the—

*Permanent Way Inspector (PWI), Grade II, also headquartered at Bodwad and who reports to the—

*Assistant Engineer (West), with headquarters at Akola and who reports to the—

*Sr. Divisional Engineer (South), with headquarters at Bhusaval.

(c) As already mentioned in para 12(f), a variety of sleepers were provided on the Down Main Line as indicated at the top of Annexure IV. This region of track had its last track recording run by the Amsler Car on 6-7-80 [on which date, vide para (a), the speed had not yet been relaxed fully on the CSR portion] which showed the following results for Km. 494, within which kilometer the accident took place :—

	Unevenness Right/Left		Twist	Gauge
Classification :	B3	B4	B10	B3

95-M/P(N)47MofAviation—2(a)

(d) The Assistant Engineer had inspected the track in this region by the foot-plate of the engine of 59 Down Gitanjali Express on 1-8-80, when he noted loose packing near 'B' Cabin and his inspection note was forwarded on 4-8-80 to the PWI for action. Subsequently, he repeated the foot-plate inspection by the same train on 6-8-80 and his remarks that the entire Down Main Line at Malkapur had loose packing was forwarded to the PWI on 12-8-80 for action. On 16-8-80, he had commenced push-trolly inspection of this stretch at 08.00 hours ex: Malkarpur, when he found that the Temporary Gang was getting ready to do through packing near 'B' Cabin at Km. 494/8-9.

(e) It was in response to these 2 inspection notes of the Assistant Engineer that through packing was carried out on 16-8-80 on the newly re-sleepered portion near 'B' Cabin by the Temporary Gang and this fact was reflected in this Gang's Gang Chart. On that day, the DTM gang had its rest day and the PWI (Grade III) was himself busy elsewhere attending to scattered rail renewal; furthermore, of the 2 Permanent Way Mistries, as one was sick with the other on leave, the Head Trollyman of the PWI (Grade II) was also detailed to strengthen the supervision over this task, although the Temporary Gang's own Mate was himself present to supervise. Indeed, faint but legible evidence was available even on 26-8-80 of the result of pre-maintenance measurements of track marked in white chalk on the sleepers, which are presented in Annexure II(a).

(f) On 18-8-80, both the PWIs had separately inspected the track in Malkapur yard, but found no major defect.

(g) After the withdrawal of the rear string of 10 wagons [para 7(a)], the exposed track was carefully examined by Railway Officials and an apparent "point of drop" was noticed at a disance of 1.3 m. [Annexure IV] ahead of the Down Main Starter; however, there were no corresponding mounting marks visible on the rail-table immediately in rear. From about 30 m. ahead of this "point of drop", the track showed evidence of sufficient damage that was so obviously a post-accident phenomenon that measurements of track were carried forward for only 10 stations at the standard spacing of 3 m. In rear of the observed "Point of drop", however, the measurements extended to the usual 30 stations. All these details are presented in Annexure II(a). As the alignment of the tangent track at this location was good, versines were not taken by the Sr. Subordinates,

(h) With reference to these joint measurements, 2 curious features emerged as below :—

(i) It was on their own initiative that the Sr. Subordinates conducted these measurements at around 4 A.M. on 21-8-80, using a 5-cell torch and a 'Petromax' to provide the lighting needed for this exercise. Evidently, the object behind this unusual timing was to ensure that restoration operations were neither held back now interrupted on this account.

(ii) Blissfully ignorant of the danger posed by the presence of enormous quantities of inflammable vapour in this region, a steam locomotive was brought to the site to enable measurements of cross-levels under loaded condition, and slowely taken back, while measurements were read out by Khalasis operating under the locomotive. The P.W.I. (Grade II), who was a signatory to this record, did not himself participate in taking the measurements, but contented himself, like the other 3 Inspectors by making the necessary entries in his note-book.

(i) At the "point of drop" and beyond, the dent marks showed that one wheel-set had derailed to the right, whereas beyond Station 4, 3 flange-marks were clearly visible and later 4 of them. The position of dent marks exhibited on 27-8-80 (by such a sleepers which did not need renewal) is also presented in Annexure IV.

(j) In rear of the "point of drop," canted bearing plates were in use upto Station 10 and Anti-Creep Bearing (ACB) plates further in the rear. The Joint Observations recorded on the track condition revealed some loose dog-spikes in the portion of track fitted with canted bearing plates, whereas an occasional key was found deficient or slack in the region where ACB plates were used.

(k) As is evident from Annexure IV, the rear string of 10 wagons had in fact successfully negotiated even the damaged track, with the brakevan halting 7 m. ahead of the Down Main Starter (or, in other words a distance of 5.7 m. ahead of this "point of drop").

(l) Uptil the time of my arrival at the site and even thereafter for a few days, the entire Engineering labour force was kept busily tied down to firstly restoring the damaged portion of track lines, with furtoer inputs of effort devoted to progressively raising the speed-limit. Thus, it may be taken for granted that the track in rear of Station 1 behind the "point of drop" was not touched by anybody and, on that premise, measurements of track were taken in my presence, which are also reflected in Annexure II(a).

15. *Other features relevant to the accident on* 20-8-80

(a) The last 2 Down trains to pass Malkapur prior to the Oil Chief' were 59 Down Gitanjali Expres (which ran through at about 15.40 hours) and OJA Special Goods train (which ran through at 16.07 hours). According to the Drivers of both these trains, nothing unusual was felt by them while passing through Malkapur.

(b) No miscreants or malingerers were seen in Malkapur yard tampering with the track (Down Main line) in the vicinity of 'B' Cabin nor was anything even remotely suspicious observed by anybody after the passage of OJA Special, thus ruling out any possibility of sabotage.

(c) Evidence of independent public witnesses, albeit only a few of them turned up at the Inquiry, was enabled by the following circumstances :—

(i) With 84 Up Maharashtra Express due to arrive at 17.17 hours, the presence of large number of passengers and others who had already arrived on the Up platform at Malkapur; and

(ii) The existence of a factory bordering the Railway premises and due South of 'B' Cabin.

Similarly, the circumstance that preparation of pay-sheets was in progress in one of the rooms on the Up platform did provide a source for further accountal of what happened from Railway staff, not directly engaged at that time in train-passing duties.

(d) The ASM on duty at Biswa Bridge had, when the front portion of 'Oil Chief' finally pulled into the Station, an opportunity to interrogate its Driver and found him quite normal and not under the influence of alcohol/liquor.

16. *Features relevant to the accident on* 21-8-80

(a) It was at about 15.30 hours that the 19th and the last wagon No. ER 65925 to be tackled by the Bhusaval Breakdown crane was found in a prone position lying on its side having capsized in clockwise manner and fouling both the emergency cross-over and the Up road, as may be seen from position No. 1 of Annexure III. As already mentioned in para 7(e), track-linking had to closely follow wreckage-clearance and, in this case, because of the emergency cross-over, track could be laid only upto the stock-rail joint but not any closer to this wagon, which had also partially dug itself into the formation. Before this wagon could be thrown clean clear of the Up track , it was necessary to firstly release it clear of the ground, then bring it closer to the crane (position No. 2) to reduce the working radius and swing it gradually across the track (postion No. 3).

(b) With reference to information provided in para 9(c) supra, as this particular wagon was not one of those that had burst or punctured, its man-hole cover was off; also it was one of the wagons which was still laden with flammable contents in the post-fire situation.

(c) The emergence of the hitherto buried parts naturally lossened the sub-surface elements and, while the wagon was still in position No. 1, some "strange substance" was thrown up from underneath, that looked more like ashes rather than embers or live fire and which lay until then hidden and dormant under the surface. Some near-by workers immediately took the initiative of playing safe by dumping local earth on this substance, but apparently no one felt sufficiently apprehensive of anything suspicious or dangerous that neighter was any general alarm raised nor the attention of any senior officer present close by drawn to this development. Thus, the manoeuvres went ahead as shown in Annexure III, which also indicates the position of personnel who happened to be the closest to the wagon at this juncture.

(d) Either because most of the barrels on the wagons cleared uptil then were empty or because no wagon had thus far got its undergear firmly tangled up under the formation, wreckage clearance operations went off smoothly and without the occurence of any unanticipated tilting of any wagon barrel during its handling. In the case of wagon No. ER (65925, however, the extrication of its undergear off the earth was followed by its sudden titling, understandably caused by the imbalance in the hitherto balanced tensions in the parts of its slinging chain due to the experiencing of an abrupt disequilibriating jerk at the very instant of its release off the earth.

(e) This tilt caused a few spurts of spillage off the open-man-hole to fall, incidently some distance away from the location where the strange substance referred to in sub-para (c) appeared and got smothered. Immediately, white fumes shot off the ground, followed almost instantaneously by the bursting out of a ball of fire from the mouth of the man-hole with an explosive sound. The direction in which the flames happened to shoot off, causing eventually 3 fatalities, may also be seen in Annexure III, whence a moment's reflection would reveal that, had the alignment of this wagon (and hence its barrel) at the moment of fire-outbreak been any different, it might easily have been the DRM and/or the Sr. DEN and/or the DME (Power) to succumb in this tragedy.

(f) There was pandemonium all-around, as the fire caught the oil-slicks in the side-drains and many suffered injuries while rushing blindly. As mentioned in para 10(d); it was at this stage that a singal post got damaged while the other breakdown crane rushed back. Wagon No. ER 65925 was on hook in position No. 3. as the Crane-Driver had the presence of mind to drop the wagon (thereby not causing more spillage) but swing it away from position No. 2 (to keep the wagon away from the major concentration of labour-force) and, as the contents burned themselves off, the Bhusaval Breakdown team commendably made their way back to the accident scene to disengage the crane and withdraw it back to a safe distance.

(g) As mentioned in para 7(d), all the outside help, which constituted the major fire-fighting units, left the site by 07.00 hours of 21-8-80. Moreover, the Railway's Bhusaval-based fire-fighting unit, which was the only remaining plant at the site, ran short of water. As this equipment had anyhow to go to Bodwad (the nearest watering station), it was decided, not anticipating any fire hazard particularly after the successful and eventless clearance of a number of wagons earlier in the day and with the possibility of any such danger sharply declining with further elapse of time, to send it away from Malkapur at 12.15 hours back to Bhusaval. Thus, aside of portable fire-extinguishers, nothing else was available at the time of this fire out-break.

(h) Para 317.3 of 'Red Tariff', reproduced below, seems to have given the impression to the Senior Officers in charge of the Breakdown operations that greater danger was associated with handling empty or nearly empty tank wagons loaded with petroleum products :—

> "317.3. Empty tank wagons—All empty tank wagons which have contained petroleum and other inflammable liquids shall, except when they are opened for the purpose of cleaning them and rendering them free from vapour, be kept securely closed unless they have already been thoroughly cleaned and free from vapour.
>
> NOTE :—A very small proportion about 1½% of petroleum vapour is sufficient to render the atmosphere explosive. The risk of explosion from a vessel containing the quantity of petroleum that remains after it is nominally empty is greater than that from a full or nearly full vessel in which the atmosphere is too rich to be explosive.
>
> The aforesaid statement is applicable even to petroleum Class B in bulk, because vessels in the open, exposed to the sun, may easily reach the flashing point temperature of the liquid which will under these conditions give off an inflammable and explosive forming vapour."

(i) In any case, the organisation and deployment of facilities for decanting and for the proper storage of decanted products would take up some valuable time, the loss of which could not be even contemplated in the context of the paramount urgency to restore rail communications as speedily as possible on this trunk route. Rule 199(2) of Petroleum Rules 1976, which is reproduced below, does permit wreckage clearance if required for this purpose of restoring rail communications :—

> "CHAPTER XI—NOTICE OF ACCIDENT.
>
> 199. *Notice of accident*—(1) The notice of an accident required to be given under section 27 of the Act shall be given forthwith—
>
> (a) to the Chief Controller by telegram (Telegraphic address—EXPLOSIVES, Nagpur) followed within 24 hours by a letter giving particular of the occurrence, and
>
> (b) to the Officer-in-Charge of the nearest police station by the quickest means of communication.
>
> (2) Pending the visit of the Chief Controller, or his representative, or until instruction is received from the Chief Controller that he does not wish any further investigation or inquiry to be made, all wreckage and debris shall be left untouched except in so far as its removal may be necessary for the rescue of persons injured and recovery of the bodies of any persons killed by the accident or, in the case of railways, for the restoration of through communication."

(j) The Railway's Accident Manual does not cover the handling of petroleum products sufficiently thoroughly, as may be seen from the relevant extract reproduced below :—

> "5.15. *Petrol and other inflammable goods, handling of*—Petrol, explosives and other dangerous goods in full wagon loads must only be loaded, unloaded or transhipped, during daylight and on no account after dark, necessitating the use of lamps.....Oil or gas lamps must on no account be taken inside the wagons or near the petrol tins, whether full or empty. No person shall smoke or take any naked light or unprotected lamp near any vehicle containing explosives or other dangerous goods, or near any place were such goods are stored or handled."

(k) With reference to the allegations made [para 2(f)], any data collected before the critically injured succumbed to this accident would be particularly relevant. Accordingly the following information was obtained from the Police, vide Bhusaval Division's letters No. BSL. T. 106/F/100/RB.5 dated 1-10-80 and 10-12-1980 :

(i) The dying declarations of the late Amarjeet Singh (Train Examiner) and the late Sk. Jabbar (Breakdown Fitter) recorded at the Malkapur Municipal Hospital at about 17.10 hours on 21-8-80 by Shri B.B. Jain (Executive Magistrate of Malkapur) refer to the sudden explosion which engulfed them but deny any foul play.

(ii) Subsequently, at the Railway Hospital, whereas the latter was unable to state anything coherently, the late Amarjeet Singh gave a statement to the Head Constable of Bhusaval Police, an English translation of which is provided below :

"I was detailed for duty at Malkapur to lift wagons that had capsized. I left at 09.00 hours on 21-8-80 by the 'Labour Special' train and, upon reaching Malkapur at 12.00 hours I joined the lifting operations. At 3.30 p.m., while the last wagon was being lifted by the crane, suddenly the wagon exploded. All people got frightened and began to run away. I also ran but at that time oil-fire from the wagon flashed on some people and I too got burnt. There was no particular cause for the fire. I am now told that I am in Bhusaval Railway Hospital. I dont' know how many others got burnt."

V. SUMMARY OF EVIDENCE

17. *Eye Witness Accounts on the speed of the Oil Chief*

(a) Shri Abdul Majeed Qureshi, who was on the Up Platform at Malkapur [para 15(c)(i)] awaiting the arrival of Maharashtra Express, stated that while the Oil Chief was running through at a fast speed—faster than normally expected of a Goods train, as could be gauged not only by the sound made by it but also by the flying bits and pieces of paper—it caught fire. He was not aware of the numerical value of the speed-limit for the Oil Chief; yet, being a keen observer, he was quite familiar with the speeds at which Goods trains ran. He could hence affirm that this particular train was certainly going much too fast—as fast as the Gitanjali Express, if not possibly even faster. He did not notice anything otherwise abnormal with this train.

(b) Shri Abdul Rahoof, a businessman of Malkapur, stated that he too was awaiting the Maharashtra Express when he saw the 'Oil Chief' rush by surprisingly fast, causing bits of loose paper to fly all over the yard and on the platform also. He also saw one of the axles smoking and pandemonium soon broke out on the platform as flames rose into the sky from Nagpur-side, Cross-examined about the train-speed, he reiterated that it was going much faster than goods trains were wont to, and probably even faster than the Gitanjali Express.

(c) Shri B.B. Chandak, Owner of the Factory located just behind 'B' Cabin [para 15 (c) (ii)] was able to recall that the 'Oil Chief' sounded as if it was going as fast as the Gitanjali Express. As the Gitanjali had already passed earlier, his curiousity was aroused, making him stand up in his office and look out to discover that actually it was the 'Oil Chief' passing by. In moments, he heard an explosion.

(d) Shri S.L. Rawat, Assistant Public Prosecutor (Railway Protection Force), Bhusaval, stated that he happened to be at Malkapur on 20-8-80 in connection with the Court* being held by the Railway Magistrate. It was at 16.50 hours that the Oil Chief passed by as fast as the Gitanjali Express, if not slightly faster. Being a frequent traveller by trains, he attested to being quite familiar with train-speeds generally. Recalling a whistling sound coming from the 11th or 12th wagon from the rear, he also referred to a distinct impression gained by him of smoke emanating near this wagon and seconds later a man-hole cover (quite possibly of that very wagon) popped up quickly followed by an explosion and flash, as wagons piled up beyond the Cabin. Although unable to elaborate upon these observations any further, he nevertheless stood by them and opined that, precedent to this accident, there was no derailment.

(e) Shri P.G. Palwe@, an ASM of Malkapur, was preparing pay-sheets in the SM's office when, at about 16.50 hours, the heard the Oil Chief go by so fast that he simply felt compelled to stop the work on hand and rush out onto the platform just in time to see that some wagons had capsized blocking even the Up road, followed at once by fire and explosion. Queried further regarding the speed of 'Oil Chief' he clarified that his heart started pounding fast, with his spontaneous reaction one of awe and wonder as to

*However, when interrogated, neither Shri Vinod Kumar Verma, Judicial Magistrate (First Class), who was holding the Court, nor Shri S. S. Vyavahare, the Public Prosecutor, nor Shri S. S. More, the TTI Prosecution, committed himself about overspeeding by the 'Oil Chief'.

@Each affirmed that he held no reservations about the overspeeding, that there was no bias and that there was no question also of his having any enemity towards the Driver of this train.

how a mere goods train could go so fast. Clarifying that he had also in act expressed his grave misgivings to Shri Sarode* as to whether the Oil Chief would reach its destination intact, he added that he did not find anything else unusual with it.

(f) Shri Laxman Nimba (Mate of Gang Unit No. 8, Malkapur) stated that he, alongwith his gang and the Permanent Way Maistry, were returning from work when the Oil Chief rushed towards them from the opposite direction as fast as the Gitanjali. He noticed smoke coming of one of the wagons towards the rare of the train and,just as he took his whistle out to attract the Guard's attention, a big explosion occurred near the 'B' Cabin and a number of wagons were piling up. He and his gangmen managed to run away to safety but the Permanent Way Maistry could not be found. He clarified that he was just alerted by the smoke and he could not say if a wagon had already derailed by that time or if the train had already parted.

(g) Shri Soma Mana, Keyman of Gang Unit No. 8 and whose beat covered both the roads from Km. 494 to Km. 497 besides Malkapur yard, deposed that at about 16.45 hours he was in the yard near TP 494/5 when he saw the Oil Chief rushing through at a speed faster than even an Express, and a derailment had taken place near about TP 494/8. Immediately, there was fire. He felt that the position of the derailed wagon could be about the 10th to 15th from the rear. He denied any further knowledge, because tremondous quantities of smoke and fire obstructed the view of the accident site and the Police prevented him from getting any closer.

(h) Shri Shantaram Zandoo, Pointsman of Malkapur, who was busy with shunting duties near the Goods Shed, deposed that Diesel-hauled goods trains ran faster than the Steam-hauled ones. He was quite certain that this train was not travelling faster than the normal Diesel-hauled goods train.

(i) Shri V.R. Badgujar, ASM on duty at Malkapur, stated that he was in fact returning to his office after having correctly exchanged signals with the Oil Chief's train crew, when he saw a wagon capsizing to its right and catching fire. The front part of the train having already cleared the Down Advanced Starter, thus activating [para 12(d)] the bell, the first action he took was to give the 'Train Entering Section' signal to Biswa Bridge, the Station ahead. He then immediately advised all concerned. Observing the fact that, in contrast to the usual running time of 9 to 10 minutes for 'through goods trains', the Oil Chief took only 6 minutes to clear the Block Section in rear was a sufficient comment on its speed, he also refuted the suggestion made by eye witnesses [para 18(a) infra] that the train had already parted when this accident occurred not did he find anything else unusual with it.

(j) Shri P.K. Chakravorty, the ASO (Fire) from Bombay, deposed that the Bhusaval Divisional Inspector (Fire), Shri Ajab Singh**, told him on 21-8-80 of a youth who happened to be an eye witness to the passage of Oil Chief at Malkapur and who saw an axle spitting fire. This 16 years old youth, when later interrogated by Shri P.K. Chakravorty on 21-8-80, identified himself as Arun Kadam of Shiva ji Nagar, Malkapur, and admitted that, being unemployed, he used to frequent the Malkapur Yard to pick up the odd lumps of coal which dropped off running trains. He was standing on the Up track when the Oil Chief passed by *at a very great speed*; he also observed some smoke emitted by an axle-box, which was giving out sound like a 'bus horn.'

(k) Shri D.G. Narkhede (Station Master, Malkapur) confirmed that the Assistant public prosecutor as well as Mr. More (the TTI Prosecution) [para 17(d)] were both commenting that Oil Chief was proceeding fast as the Gitanjali. As regards the timings entered for the Oil Chief in the Train Register at Khamkhed and Malkapur, he saw no reason to doubt their accuracy. However, he opined that it was certainly going faster than the normal Goods train although not as fast as the Gitanjali or so fast as to end up in his disaster.

18. *Other Evidence from Eye Witnesses*

(a) As the Oil Chief was running through Malkapur from the opposite direction, Smt. Draupadibai Shripat Girde and Shrimati Sarubai Raghunath Mahajar, both labourers working in the nearby farm, were walking, alongside of the latter's mother, on the path by the side of the Up line. Quite suddenly, when they were just a few metres away from 'B' Cabin, they saw stone ballast flying off the track and one of the wagons had capsized towards them. Immediately, there was a tremendous burst of fire, causing all the 3 women to run away, but the mother of Smt. Sarubai could not escape in time to save herself. Both the surviving women felt that the train had already parted, with the fire breaking out in the rear portion off a wagon that had capsized.

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*Shri R. D. Sarode—@(Leave Reserve Foreman at Malkapur, who also was preparing pay-sheets in the SM's office at Malkapur) while fully corroborated Shri Palwe's evidence, added that, with some 15 years of experience on the Railways, he considered himself quite competent to judge the train-speed by the passage of axles over fish-plated rail-joints. In this instance, his heart, too, started pounding fast as the Oil Chief went by so fast that he also rushed out onto the platform to find that a calamity had just taken place.

**This was wholly corroborated by Shri Ajab Singh.

(b) Shri M.N. Patil, Cabinman 'B' of Malkapur, stated that, as he stood in the gallery of the 'B' Cabin to exchange signals with Oil Chief's train crew, he saw that, after the passage of some 10 or 15 wagons in front of his Cabin, one tanker—probably the 20th from the engine—derailed. He immediately showed his red flag but, within second, 2 or 3 other wagons in rear of the derailed wagon caught fire with an explosion (causing a pile-up of many wagons from the rear), which was quickly followed by a few more explosions. During a demonstration, he indicated the position of the derailed wagon which, when measured at the site, was about 40 metres from the Main line Starter towards the 'B' Cabin. He, too, confirmed that the train was moving in one string without any gap, when the derailment occurred.

19. *Evidence of Shri L.J. Edwards, the Driver.**

(a) Claiming to have had no difficulty in controlling his train at any stage, he stated that, whilst running through Malkapur, he chanced to look back to notice a heavy flash like a cracker bursting, followed by a big report and billowing smoke. Recovering from the shock, he decided to stop, as depicted in Annexure IV, a safe distance away from the explosion. Realising that 84 Up was almost due to pass, he immediately deputed his Assistant* to protect the Up track and, upon hearing a second report, he drew further ahead to stop 2 to 3 furlongs ahead of the road-over-bridge, in order to Keep farther away from the accident site.

(b) During the cross-examination, he confirmed that he looked back at his train from time to time but found nothing wrong. Also, it was not any "jerk" that promted him look back as he ran through Malkapur. Asked if this was because of the high speed at which he was travelling, he replied that he was in a positon to affirm, inspite of the circumstance that only the speedometer on his Assistants side was in working order that his speed was around 60Km/because from time to time his Assistant used to repeat '55-65 Km/h as the speed. When confronted with the timings entered in the Train Registers at Khamkhed and Malkapur, he argued that the timing entered at Khamkhed was probably inaccurate, because station staff were often—times so busy with their other multifarious duties that they could enter the timings only much later on. His own timings did not tally with those of the Guard [para 13(d)] because his watch could not be adjusted to the Guard's watch, both of them never having actually met.

(c) He, too, never received any Refresher Training after he passed the Driver's Course in 1964.

20. *Evidence of Shri M.D. Patel, Guard—*

(a) He had checked the load at Bhusaval for any signs of leakage, intact seals, tight couplings, etc. and found nothing unusual, nor did he find anything wrong on the run as he frequently kept a sharp look-out ahead. While running through Malkapur, just after he had correctly exchanged signals with 'A' Cabin and the ASM, he fell down as the Brake Van received a violent jerk. He found that some wagons had capsized and some had caught fire.

(b) During cross-examination, he stated that it did not appear to him that the Driver was over-speeding, as the train ran through Khamkhed at 16.40 hrs, thus taking 10 minutes for traversing the Block Section immediately in rear of Malkapur. He maintained that the entry was in fact 16.40 and not 16.46. He could not also satisfactorily explain as to how only the timings 16.30 and 16.40 were neatly entered wheras the rest of the figures appeared scrawled whilst in motion [see para 13(d)* supra] on this as well as the preceding pages even when confronted with oral evidence to the contrary, he maintained that the train was doing 60-65 Km/h. Confronted with the fact that, for the Sector Achegaon-Bodwad-Khamkhed, the Oil Chief took less time than what was given in the Working Time Table for a run-through WDM-2 hauled goods train, he conceeded the possibility of over speeding although he himself was at no stage alarmed by any sensation of over speeding as such; hence, there was no question of attracting the Driver's attention in terms of GR 126.

21. *Evidence pertaining to Track Maintenance*

(a) As he filed to detect any such adverse features during his push-trolly inspection on 18-8-80 when the crosslevels were probably within ± 5 mm, Shri M.L. Pachoriya * PWI (Grade II), sought to explain away the sub-standard crosslevels recorded on 21-8-80 [Annexure II(a)] as a consequential effect of this accident.

(b) According to Shri S. Venugopal, Assistant Engineer, as the "slack" (noted by him on the Down Main Line near Malkapur 'B' Cabin on 1-8-80 and again on 6-8-80) was not bad or dangerous from the safety view-point, the fact that it was not "packed up" until 16-8-80 did not constitute an unsatisfactory state of affairs. Particularly bad spots were advised straightaway to PWI for immediate attention and not by routine 'line notes'.

(c) Shri O.P. Agarwal, the Senior Divisional Engineer, stated that, with the track having been 'through-packed' on 16-8-80 in the very region of the accident site and with both the PWIs not having detected any

*All the above was substantially confirmed by the Diesel Assistant, Shri L. Martand, according to whom the speed was only 50 to 55 Km/h.

major defect during their separate push-trolly inspections of this stretch of track on 18-8-80, it could hardly be expected to deteriorate so badly within a matter of mere 2 days (i.e. upto 20-8-80) as to cause a derailment. As regard the joint measurements of 21-8-80 [Annexure II(a)], he had reservations of any such work conducted in the dark, even if some lighting was used. He also drew attention to the wide disparity between these readings and those recorded on 27-8-80, although during the intervening period no maintenance was or could be done at that reach, with the labour force as yet busy on the more important restoration works.

22. *Other Evidence as to the Likely Cause for the Accident*

(a) Shri A.K. Gupta, Assistant Commercial Superintendent, Bhusaval, stated that he examined the track in rear of the "point of drop" at 19.15 hours on 20-8-80, but found nothing that could have caused a derailment.

(b) Referring to wagon No. ER. 61876 (marshalled the 33rd) one barrel-end of which not only bore a round stamp mark of about 1 ft. diameter (which corresponded accurately to the size of a buffer end) but was also pressed inside with bottom edge entirely torn, Shri P.K. Chakraworty, the Assistant Security Officer (Fire) felt that this was probably the culprit wagon which capsized after first derailing and into which a buffer of an adjacent wagon impacted with such force as to cause its rupture and explosion.

(c) Shri P.E. Kharve,* Train Examiner, Bhusaval, stated that his first supposition after studying the overall situation was that the entire accident was caused by an explosion that occurred at the place where deep pit was later on found. He also felt that, because no point of mount could be dicerned in the rear of the "point of drop," the derailment, if any, must have first occurred in the distorted region of track. However, in the absence of any reason that might have caused a fire, he later on felt that it could well be a derailment, followed by capsizing of that wagon and the piling up of wagons in rear, that caused an explosion. Upon assessing the extent of damage to rolling stock, he opined that the derailment first took place of some wagon between the 20th and the 32nd.

23. *Evidence relating to the Outbreak of fire in Wagon No. ER* 65925 *on* 21-8-80

(a) Shri K. Kelappan (Supervisor Grade I of No. 1 Fire Fighting Unit of the Reserve Petroleum Depot, Bhusaval) maintained that the fire which was raging on 20-8-80 was completely put out and the affected area throughly dowsed, using foam wherever fuel could be seen and by water at other places and surrounds. The Fire Fighting teams personally checked the insides of each tanker to ensure that there was no residual fire anywhere and, well before their departure on the morning of 21-8-80, the fire had keen totally extinguished. When he was recalled to Malkapur again in the afternoon of 21-8-80, he was amazed that fire could break out again. He had no personal knowledge of how this latter accident did occur.

(b) Shri P.K. Chakraworty, the railway's ASO (Fire) from Bombay, while substantiating the above elaborated upon the fire fighting measures in good detail. He added that, after the fire was completely put out by 01.00 hrs. of 21-8-81, there was actually only one incident of fire outbreak; that happened at about 04.30 hours at a location where a number of tankers were piled up, when the still-very-hot steel-wheels re-ignited an oil slick and it was at once dowsed in foam. As wheels and axles of wagons were thereafter constantly jetted with water to cool them down, there was no recurrence of fire, which was why it was most surprising that a fire could erupt as late as at 15.30 hrs. He himself was some 75 metres away from the spot, when he noticed a flash of flame, a whooshing sound, a mushroom of dark cloud and another flame of dark yellowish colour, all in that order. Immediately, there was total confusion, as people rushed out blindly causing many to suffer injuries by burns and otherwise. Pending the re-orgnisation of fire-fighting measures (since this major fire was quite beyond the capacity of the portable extinguishers to tackle/control) the immediate concern was to rush medical aid to the injured. His on-the-spot enquiries revealed the sequence of events mentioned in paras 16(a) to (f) supra. He felt that, even after the elapse of 16 hours after the fire was put out, a hot piece of buried metal managed to retain sufficient of its heat that some oily substance, which could not so far catch fire for want of oxygen in the buried state, immediately set off white fumes the very moment it got exposed to air via its emergence alongwith the undergear of that wagon. Under this condition, any oil spillage off an open man-hole could but lead to the inevitable flash-fire.

(c) Shri S. Abuzar, the Divisional Railway Manager of Bhusaval Division, stated that fumes came off the ground only after oil spilled out of its open man-hole and even as the crane operator reacted instantaneously to swing the wagon away, fire broke out. Queried about the alleged fire noticed under this wagon [para 16(c) 1], he replied that, as neither did he observe anything like it although he was close by, not did any one bring any such to his attention, and as it was apparently put out by merely smothering with earth without recourse to the readily available portable fire extinguisher, it would be quite right to surmise that

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*At the instance of the TXR [para 22(c) infra], he collected a bag-ful of ballast, as a sample extracted.

*At his instance, samples of ballast were collected by the PWI [para 21(a)] from Stations 8, 9 & 10 *ahead* of the "point of drop" and produced at my Inquiry.

whatever was seen must have been so trivially insignificant as not deserving any comment, let alone alarm. He added that he ensured that his personnel had adequate spells of rest between the strenuous periods of restoration activities, thereby implying that there was no question of personnel getting careless through fatigue.

(d) Shri V.T.G. Nair, Sr. Divisional Mechanical Engineer (Power) of Bhusaval Division, stated that since he* was in charge of the Bhusaval Crane, he checked the propping and wedging of the crane@, the drop-chain, etc. While the wagon was being prised out of the ground, it veered to the left and, almost immediately, he saw fumes coming off the ground with a hissing sound on the far side of the wagon. As the wagon was swung further, the entire area was suddenly ablaze and everyone ran off to safety. Queried about the alleged fire discovered under this wagon and soon put out, he denied any direct knowledge of it, nor was he advised of this development, which was most unusual because, had any fire been truly sighted, there ought to have been at least some commotion.

(e) Shri O.P. Agarwal, Senior Divisional Engineer, who got injured in the virtual stampede that followed, the out break of fire, admitted to being witness from a distance of some 4.5 metres to the incident described in paras 16(c) to (f) and affirmed that, had the least bit of danger been suspected by anyone, all the Senior Officers positioned around the wagon [Annexure III] would have put an immediate stop to the work and evolved revised strategy.

(f) Shri Khemchand Kishan, Breakdown Khalasi, stated that he was amongst those* who climed upon this wagon to hook it to the crane. As the wagon rose a few inches above the ground, a little bit of fire was revealed, looking somewhat like burnt sleepers, which was at once put out by him and those nearby dumping earth over it. Then, as the wagon was further moved, oil unexpectedly spurted out 4 times in quick succession and the flames that shot off the ground enveloped the wagon also. Queried as to why no alarm was raised when the fire (no matter how small it might have been) was discovered, he replied that it was really so insignificant that there did not seem to be any cause for alarm. Adding that no one felt concerned about this incident, most probably because all their thoughts were concentrated upon the restoration work on hand, he clarified that, during the entire course of restoration work, there were no hassles, nor arguments nor any imposed "pressure" at any time.

(g) Shri Abdul Hamid Rahimat (Breakdown Fitter) deposed that, as he was looking towards the crane, he was entirely unaware of any fire having been noticed or put out by throwing earth upon it. He also argued that when the wagon body was itself cold, the oil spilt could not also have been otherwise than cold. When confronted with the substance of this evidence, 35 more witnesses, all of whom were at that point of time present very near to this tank-wagon, attested to it, with nothing further to add.

(h) Shri K.T. Lokhande, Dy. Controller of Explosives, Bombay, mentioned that unless barrels were first devanted, there was always the danger of spillage and the associated phenomenon of static electric charges; that was why a tanker was always required to be electrically earthed during filling/empting. In the subject case, if the wagon was off the ground and in the air as the spilage occurred, the electric charges jumping from the oil surface to the man-hole in the barrel might have caused the ignition. Such charged were invisible in daylight and that there was vapour present in abundance was proved by the wide-spread injury to workers around. Alluding the Rule 78 of Petroleum Rules 1976 (which dealt with "Precaution against Static Charge " and elaborated upon the action to be taken in this respect) he illustrated the need for the exercise of utmost caution by quoting the restriction imposed on even the rate of loading petroleum products.

24. *Evidence relating to the Precautions taken during the Restoration Work* —

(a) Shri P.K. Chakraworty, the Railway's Assistant Security Officer (Fire) from Bombay, stated that it would be simply unacceptable for the Railway to await until all tanks were emptied of their contents, then all the drained off oil salvaged and the atmosphere thereafter freed of petrol vapour. Indeed, the Breakdown Crane started operating right from 03.15 hours of 21-8-80. He was not himself directly associated with the restoration operations until after the accident of 21-8-80, whereafter he was told to take overall charge. That

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*This evidence was entirely corroborated by Shri B. P. Pali, Divisional Mechanical Engineer (Carriage & Wagon) who, being in charge of the Nagpur Crane on the afternoon of 21-8-80, was some distance away.

@This evidence was corroborated by Shri Ramaswami Pochatti (the Breakdown Crane Driver), who, apprehending danger to the crane itself, returned with others later on to disengage the wagon and move the crane away to safety. Disclaiming any awareness of the alleged discovery of fire as the wagon got freed off the earth, he clarified that, inspite of his ventage position in the cab of the steam crane, the oil spillage from the open man-hole on the far-side was unsighted from himself by the barrel body itself.

*Whereas similar evidence was deposed by Shri Bhaurao Shamrao (another Breakdown Khalasi) and Shri Laxman Waman (C&W Fitter), the latter added that the fire could not have been caused by external sources because, under strict instructions and supervision, no one smoked or did anything that could give rise to any spark. Shri Waman also cited Shri V.P. Chary (Breakdown Chargeman) as a witness to the so-called fire being put out, but Shri Chary refuted this.

nothing untoward happened until the very end was proof enough of the sufficiency of the steps taken and, in any case, had there been the slightest reservation on this account, so many officers and staff would not kept themselves so very close to the wagons being tackled.

(b) Shri V.T.G. Nair, Senior Divisional Mechanical Engineer (Power) of Bhusaval Division, deposed that in the vicinity of any tank-wagon, the fire on the Steam Crane was never allowed to be raked or hooked and special care was invariably taken to position its boiler-side as far away as possible from any tank-wagon. Whereas oxygenated or torch-based operations were absolutely barred, not even heavy hammering or any such act likely to cause sparks was permitted. All available portable fire extinguishers were kept on hand as a stand-by precaution against the foreseeable contingencies. Initially, the barrel metal of a tank-wagon was felt and, if it was too warm to the touch, its handling was put off for the time being, but this step became redundant afterwards as the barrels* cooled down. While expressing his opinion that empty barrels posed a greater danger relative to those partially full, he clarified that the barrels could not be emptied straightaway for want of decanting equipment and containers for storage of the decanted stuff. As a result of this accident, he had the following suggestions :—

(i) In order to avoid the wastage of time needless movements for the sake of replenishing of water, a TWT (Travelling Water Tank)@ should be separately earmarked as an essential part of each water-based fire fighting equipment;

(ii) Fire fighting capacity $ should be augmented with modernised equipment operating with foam and chemicals;

(iii) Diesel Driven Cranes £ should replace steam-operated cranes;

(iv) Fire fighting staff* should be provided with special fire-proof clothing; and

(v) If decanting* and de-vapourising is deemed essential, then it becomes necessary to explore the alternative of providing a "diversion" clear of the affected area in order to pass traffic as quickly as possible.

(c) Shri V.P. Chary, Breakdown Chargeman, Bhusaval, mentioned that staff were forbidden from smoking bidi/cigarettes and exhorted not to bring petromax light or open flames near any tank-wagon, nor to use heavy metal on metal, or open the dampers of the steam crane. Only the barest minimum personnel required for the tasks on hand were allowed access to the work-spot and others were made to keep their distance.

(d) Shri K.T. Lokhande, Dy. Controller of Explosives, Bombay, stated that he was at the site to advise Railway Officials in freeing the tank-wagons of petrol vapour. The decanting of fuel and subsequent de-vapourisation took about 3 days, during which period it was also essential to keep on hand adequate fire fighting equipment as a precautionary step. Similarly, within 9 or 10 metres of decanting operations, no activity, such as hammering metal, was allowed that could conceivably give rise to sparks. As regards the clearance operations, he was certain that any coal-fired machinery (like the steam crane) constituted a potential hazard. It was also essential to de-gas the barrels by firstly decanting the fuel, then filling with water and let it overflow for a specified length of time before its evacuation with compressed air; the total duration could well exceed 2 hours depending upon the facilities organised for this purpose. In any case, it was essential for the Railways to use 'Explosimeters' to ascertain whether the vapour-concentration in the air within the prescribed safe limits; precisely because this was not so during the first few days of the accident, he advised that a steam traction be banned and passenger trains stopped short of the affected area to caution passengers to refrain from smoking etc. while the train negotiated the 'dangerous stretch.'

(e) Shri U. Nagnath, Divisional Safety Officer, Bhusaval stated that all passenger-carrying trains in the Down direction were stopped at Malkapur and all passenger-carrying trains in the Up direction were stopped at the Outer Signal of Malkapur, in order to facilitate the entry of GRP Constables, RPF Sainiks and Station Porters into each and every coach so as to explain the hazard to those inside and also caution them

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@This particular suggestion was also made by Shri Sakhiram, Assistant Security Officer, Bhusaval.

$Strengthening of rail-mounted fire fighting capability was essential, according to Shri S. Abuzar, the Divisional Railway Manager, because road-mounted units cannot always gain cacess into Railway yards and full benefit of the letter could not be realised if they were to operate from very long reaches or leads.

£This accorded with the general consensus.

*Shri B. L. Pali, Divisional Mechanical Engineer (C&W), Bhusaval clarified that after the fire was completely put out in and arround a wagon, a minimum of 3 hours margin was allowed for the barrel metal to cool down. He additionally felt that fire fighting personnel should be given specialist training in the use of modern equipment and particularly in fighting fires of petro-chemical origin. He also opined that no wagon with any residual fuel contents should be tackled without clearance from experts knowledgeable in such matters and stressed that the need for earthing of cranes against static electrical charges should be properly understood by Breakdown staff.

to desist from smoking, lighting matches, etc. until the crisis area was passed. Similarly, because of the presence of oil slick in the sidedrains, into which the oil had collected in the 2 craters [para 10(c)] was channelled out, and also due to prevailing undesirable levels of concentration of petrol vapour in the atmosphere, the Block Section ahead of Malkapur (i.e. up to Biswa Bridge) was declared unsafe for the plying of steam locomotives, which were accordingly banned for a period of almost a week.

(f) Shri P.R. Thakur, Special Grade Guard, Bhusaval, deposed that the fact that the Bhusaval Fire Fighting Unit was returned to Bhusaval while the restoration measures were still in progress showed that the full import and implication of working in such explosive situations was beyond the comprehension of the Officers-in-Charge. There was thus a strong need for setting up proper procedures for tackling such situations, rather than depend upon individual judgement of Senior Officers, which others might hesitate to protest about.

VI. TESTS AND OBSERVATIONS.

25. *Inspection of the Accident Site*

(a) I had visited the accident site [para 2(b)] on the 25th, 26th and 27th of August, 1980, whereas firstly the Up and then the Down Main Line was resotred for traffic by 22-8-80 [para 7(g)] after getting cleared of all fouling wagon-bodies. Although the capsized wagons had thus already been distrubed, it could nevertheless be regarded that the rolling stock was not subjected to any further damage of a serious nature during the breakdown operations, which were themselves conducted throughout with great caution. A survey of the condition of the rolling stock confirmed the summary presented in paras 9(c) and (d) supra.

(b) As may be gathered from para 9(c), there were no less than 14 Wheel-sets lying loose, and the axles were so badly 'cooked up' in the fire that substantial blistering and scale-formation developed, which precluded any likelihood of determining if at all there was a hot-axle amongst them in their pre-fire condition. Similarly, such a large number of broken-off components, which were scattered in the devastated area, were also found subjected to long exposure intense heat that no evidence of rusted/flawed condition, if any, could be expected to survive the fire.

(c) One wheel (possibly the leading, left-hand) of Wagon No. WR 36452 (one of the 3, which had *both* its axles separated) was found to have shifted by about 25mm on the axle; allthe axle-box guards were smashed and sole plates out-of-position. On Wagon No.WR 43370, which had roller bearings on both is axles, the same side (possibly, the right-hand) wheels had slipped off their seating by at least 300mm. Whilst the shifting of wheels on the run due to wheels getting slack is not entirely unknown, the probability of this rarity occuring simultaneously on *both* the axles of a wagon is admittedly very very remote. However, on the consideration that an accident is in itself quite a remote occurrence, it was decided to have the axles sent for metallurgical and chemical examination at the Railway's Workshops located at Parel.

(d) Wagon No. ER 61876, marshalled the 33rd as per the "vehicle guidance," was inspected to reveal that the "buffer-stamp-mark" [see para 22(a)] was slightly off-centre "vertically," but 700 mm clear from the bottom of the barrel, where almost 2/3rds of the end-shell (i.e. excepting the 'top' 1/3rds) had got torn off and pressed inwards. This damage could have been typically caused only by the ramming at a very great force of a buffer of another wagon into the dished-out barrel-end and its location clearly proved that the wagons concerned were not in their customary position on rail when this happened; obviously, this could have occurred only during the overriding of ER 61876 by another (or, vice versa) in the pile-up created in this accident. The axle-boxes of this particular wagon were got opened up in my presence, but no evidence of "hot running" was noticed.

(e) Thus, the severity of damage caused by the explosion, the blast pressures and the intense heat caused so many components to burn/break off or separate out, besides so much twisting of the wagon-bodies, that it was prima facie impossible to determine—even by the most meticulously comprehensive visual inspecion carried out without, however, disturbing any wagon from whatever the position in which it was found at the end of theclearance operations—if at all even a single of the multitudinous serious defects noticed did exist in the pre-accident situation as well. As there was not one conspicuously abnormal condition that stuck out as an obvious defect that could have caused a derailment, a more detailed *joint* examination of the wagon bodies was requested of the Railway, in order to uncover any curious feature that was simply not visibly in the particular positions taken up by the wagons.

(f) As regards track-works, it was found that the Main Lines were restored without installing the Nagpur-end emergency cross-over, the arrangement of the requisite materials for which would take as yet much longer. Besides packing the restored part of the Main Lines, the track gangs were deployed mostly

in cutting channels to lead away the spilt oil from the side-drains to the railway culvert and well beyond, in order to decrease the concentration of oil vapour in the vicinity of track sufficiently enough to permit the re-introduction [see para 24(e)] of steam traction. With even the important track works on the Up and Down platform loops relegated to a lower priority, it became clear that the track in the rear of the so-called "point of drop" had been left untouched*. Accordingly, I caused a fresh set of joint mesurements to be recorded [para 14(e)] by the Additional Chief Engineer, Bhusaval, and the Divisional Safety Officer. Also, as a close inspection of the wooden sleepers in the region covered by the earlier measurements revealed fading chalk-marks, a record of this evidence [para 14(e)] was also got produced.

26. *Further Investigations on damaged rolling stock—*

(a) On 31-8-80, the Railway carried out a detailed examination of all axle-boxes (which were not obviously in a badly damaged state) and alsothe journals of all axles which had not separated out. This examination, jointly conducted by Senior Subordinates, failed to reveal any indication of a "hot box" all the journals appeared smooth/polished.

(b) Under my direction, the draw gear of all the derailed/capsized wagons was got examined in detail and, upon a study of the report submitted by the Division under letter No. BSL T. 106/F-100/RB.5 of 29-10-80, I caused 5 broken metallic pieces (4 screw couplings and 1 draw bar) to be sent for metallurgical and chemical analysis.

27. *Results of Tests*

(a) The only speedometer that was functioning on WDM-2 locomotive No. 17531 was got calibrated at the Diesel Loco Shed, Jhansi, and the results showed satisfactory accuracy as below :—

Speedometer Reading	*Actual Speed*
100 Km/h..	98 Km/h
46 Km/h.	48 Km/h.

(b) The M&C Report on the 2 axles [para 25(c)] concluded that, as scaling and decarburization of the surface as well as the grain-growth in the matrix were indicative of exposure to enormous heat, the shifting of the wheels must have been caused by differential expansion between the wheel and the axle and not due to any material defect. I had earlier witnessed in the Parel Workshops the pressing-out test on the wheel-discs which had *not* shifted and found that the forcing-out pressure was in excess of what was stipulated.

(c) The M&C Report on the 5 specimens [para 26(b)] concluded that all the breakages were due to sudden shock, no flaw defect having being detected through micro-etching. The formation of a coarse crystalline structure observed on all the fracture surfaces could be due to either insufficient heat treatment of these components during their manufacture or possibly their post-accident exposure to abnormal levels of heat.

(d) *Computer simulation of train-timings*

Before giving credance to the train-timings as clocked and entered in the registers at Bodwad, Khamkhed and Malkapur, it was considered essential to establish their feasibility by simultaing the performance of the 'Oil Chief' on RDSO's Amsler Train Schedule Computer, utilising the information available below as inputs :—

Accleration	:	A WDM-2 loco, hauling 1400 tonnes of trailing load [paras 8(a) & (b)]
Gradients	:	As given in Annexure IV, but with compensation for curvature adjusted uniformly over the affected grade-lengths.
Distances	:	Inter-station distances from para 12(a).
Speed	:	5 Km/h through Bodwad [para 13(d)] and in all, 4 alternatives were run, the speed-distance plots for which are presented in Annexure (b).

*One further reason for this circumstances was that the Railway had all along treated this only as a fire accident, with the derailment in the rear reckoned rather as an after-effect.

The results are summarised hereunder :—

Simulation Run No.	Assumption on Maximum speed	Running time in Minutes		
		BDWD-KMKD	KMKD-MKP	Total
1	Upto 65 Km/h throughou	10.58	7.74	18.32
2	65 Km/h upto KMKD, but unrestricted beyond	10.58	7.07	17.65
3	Unrestricted* throughout	8.82	5.22	14.04
4	Limited to about 80 km/h throughout	9.57	6.38	15.95

28. *Observations on train timings maintained*

(a) As the Motive Power hauling a Goods train is not provided with a speed-recorder, there is no source-document that would provide proof as to the speeds attained on the run by a Goods train. In such a situation, the train-timings entered at stations constitute the only reliable "outside" evidence, whence to reasonably infer the speed attained by a Goods train. It is in this context that the accuracy and dependability of the said train timings gains its paramount value, as may be gathered also from the "Handlbook for Station Inspections" issued by the Railway Board, the relevant extracts from which are reproduced below :—

"Para 7(7) (page 22) : *Time Clocks*—It is of particular importance that correct time is shown by the clocks in the Assistant Station Master's and other offices, on platforms and in cabins. Time is an important factor in reconstructing the events preceding an accident, in ascertaining its cause and in unearthing the unsafe acts and procedures that may be in vogue at a station.

Para 7(8)(1) (Page 24) : (v).....(that) the timings entered are the actual timings.....
.....
The accuracy of timings @ shown in the book can be ascertained by cross-checking them with the timings recorded :

(a) at adjacent back stations,

....."

(b) For a reasons of rounding off, an error of one minute might be regarded as reasonable and, therefore, although such errors are likely to cancel each other, a discrepancy of ± 2 minutes may thus arise, but rather rarely. Accordingly, only errors in excess of 2 minutes should merit attention. Reference to Annexure I(a) would show that excessive discrepancies in the timings (as entered in the Train Registers of adjacent stations) for the same event are quite frequent. That the situation depicted on 20-8-80 was not an isolated instance was noted by myself during the course of a rather protracted study of timings for events taken at random; I do not include these figures in this Report, however, for the sake of brevity.

(c) SGE 3—position Lock-and-Block Instruments having been provided at Malkapur [para 12(c)] for working trains in both the directions, the same type of Block Instrument existed also at Khamkhed (the station immediately in its rear) for train-movements to and from Malkapur. Khamkhed is a 'C' Class Station with only a Warner and a Home (but without a Starter) in either direction. Thus, the Down Home (the lowering of which is naturally controlled by the 'Line Clear' position of the Block Instrument 'towards' Malkapur) at Khamkhed also happens to be the 'Last Stop Signal'. The audible bell facility of the SGE Block Instrument [para 12(d)] exists also at Khamkhed; in other works, once a Down train actuates the "Down XT", the bell starts ringing and continue to do so until, in response to the appropriate code-beat from Khamkhed, the concerned SGE Block Instrument at Malkapur is set to the 'Train-on-Line' position. Thus, firstly the bell not only draws the attention for the need to operate the Block Instrument but also does the nuisance-value of its continuous ringing form truly an effective safe-guard against delays. Secondly, at this relatively unimportant station, there is little likelihood, if any, of any other "pressing" matters arising, which could delay the Khamkhed Station Master (SM) from taking prompt action in giving the apposite code-beat to Malkapur. For these 2 reasons, it would seem unlikely that there should be any delay or tradiness on the part of the Khamkhed SM.

*It was possible to attain 100 Km/h speed between KMKD and MKP.

@Item 2(b) of the Railway's Form T 297-F calls for a check on the correctness of timings recorded at a Station with those ascertained from the adjacent stations.

(d) On the other hand, staff quarters are located right close behind the Station Building at Khamkhed, which might make it quite an easy matter for the SM to periodically pop into and out of his house within a few minutes and possibly without attracting attention. Moreover, it could be argued that, Malkapur being a very busy station, its ASM might delay in attending to his Block Instrument and the entries might not reflect the actual departure (or, rather, the run-through) time of a Down train ex. Khamkhed.

29. *Observations relating to the design of tank wagons*

(a) The enquiry held by Colonel W.P. Reed into the fire that occurred on a train of 100 ton oil tank wagon on 1-1-1969 at Crich Junction in U.K. concluded that it was caused clearly by brake-block sparks during braking, which ignited the vapourised spilt oil from unsecured hatches. Whilst the frequency of a hatch-lid leaking was admittedly low, its origins were traced primarily to out-of-plane lids and small distortions in the hatch-coaming rim, rather than any oversight in the fastening operation as such. Arising out of this accident, the British Railway Board had severally arranged with wagon-owners for a comprehensive check of all wagon-hatches, for the introduction of sealing rings of improved quality and of torque-wrenches for tightening the fastenings, and also for the review of the frequency as well as the standard of examination of hatches and associated components.

(b) Whereas the Red Tariff's Rule 317.2(3) stipulates that all inlets and outlets shall be securely closed, *it is quite a common enough occuurrence on the Central Railway (as amply proved by even a casual inspection of any rake of *loaded* tank-wagons) for at least 2 bolts on almost *all* the wagons to be lyinfi prone (*i.e.*, not *even* turned up into the matching slots/recesses of the man-hole covers, let alone their not being tightened). And there is sufficient visual evidence of spilt oil (congealed with dirt) exhibited on the outside of *all* the barrels (which cannot wholly be ascribed just to carelessness at the loading stage), although the draft induced around a moving tank-wagon often tends to vapourise oil as it spills out in trickless (cousing evidence to vanish almost as it forms, thereby leaving not even a temporary trace of wetness).

(c) Vide its para 2.1.14, R.D.S.O's Pamphlet W-M-73010 stipulates the proper sealing of the dome cover by tightening the eye bolt nuts at loading points; para 2.2.5 indicates a similar injunction after unloading as well. That, despite the steep rise in the cost of fuel(s), laxity has overtaken even the relatively simple task of bolt-tightening and, that, too, at an "open" and clearly visible location, clearly shows the deterioration that is besetting that out-turn of TXR staff. There can be no scope nor hope for any improvement in such a situation, unless and until the higher supervisory officials/Officers take a serious cognisance of lapses and pull up the concerned defaulting staff.

(d) Transient but violent blast loads of tremendous pressure are released by an explosion and, as the shock-front gets reflected by near-by obstructions, the resultant instantaneous value of pressure exerted on any such structure can well be even thrice the incident pressure, thus setting the stage for a chain-reaction of explosions. Obviously, whilst it is economically inconcievable to design a tank-wagon for blast-resistance, the optimal course to adopt would then be to render such wagons less derailment-prone, particularly as the severity of losses incurred through an accident to such a wagon transporting hazardous materials is often unaccpetably high, from the manifold considerations of direct costs (such as the damage to rolling stock and infrastructure, the settlement of claims pertaining to destroyed contents and the delays caused, the cost of restoration measures including the stocks and consumables used up, etc.) as well as the indirect costs (the actual cancellation of and hold-up to trains, their actual termination short-of-destination, the loss of available line capacity, etc.).

(e) Inadequate vertical suspension parameters (*i.e.*, high bounce frequency and insufficient damping) are known to cause not only large dynamic excursions of wheel-load on all but the smoothest of track but also dynamic instability with a high probability of derailment, particularly at the higher speed-rangers and with specific reference to a 2 axled wagon, the pin-joint (which provides articulation having only vertical but not horizontal/transverse stabilization) is another feature that renders it derailment-prone. Whereas the introduction of a double-link suspension system or an oil-damper in the lateral direction (for effective stabilizing articulation possessing horizontal alignment control) may be construed as a luxary that the Indian Railways, cannot afford to incorporate in 4-wheeler "flats',' an optimal way is still available to increase its running stability by improving its frequency response characteristics (such as the damping force on rolling).

(f) Out of the 16 leading tank wagons that had completely derailed in the Collision (that occurred on 6-8-75 at Weaver Junction in U.K. between a Freightliner Train and a Tank Wagon Special), no less than 6

*There are 12 bolts for the fitment of the man-hole cover at the top of a tank-wagon barrel.

tank wagons had their barrels both badly crushed and pierced, with 2 further wagons pierced only and yet another crushed only. Para 93 of the Report of the Enquiry made by Major P.M. Olver into this accident mentions the following aspects of the British practice with regard to tank wagon design :—

> "The barrel and its attachment to the wagon under-frame must, in the fully laden condition, be capable of absorbing the following external forces :—
>
> (*a*) a minimum of *four* times the total weight in the direction of travel,
>
> (*b*) the total weight, *both* transverse to the direction of travel and vertically *upwards*,
>
> (*c*) *twice the total weight* vertically downwards.
>
> The design allows for a deceleration surge pressure of 7g."

Concluding that the circumstance that many wagon-barrels got so badly damaged in that accident was clearly a pointer to the severity of the collision rather than any specific design inadequacy, this Report recommend any steps towards the design improvement of tank wagons.

(g) In view of the loading parameters specified in sub-para (f) above for the design of barrel-to-wagon fixtures, it would be reasonable to hypothesis that the British practice must have prescribed similar criteria for assessing the stability of the wagon under-frame under surge-effects. On the Indian Railways, however, a tank wagon is simplistically conceived as merely the simple fitment of a barrel on any of the existing standard so-called "flat-wagons" of varying wheel-base; in other words, designs are not especially evolved for 2-axled tank-wagons, inclusive of their underframes and suspension mechanisms. This is not to cavil at the traditional concept of the so-called IRS flat wagon, the design of which—evolved decades back on predominantly empirical basis in accordance with the state of art obtaining in that era—was meant to satisfy a variety of situations including the transport of surge-causing fluids in barrels. On the contrary, not only was the fitment of baffle-plates as an effective measure to minimise or contain within limits the longitudinal surge-effects discontinued, but also was the removal of even the existing baffle plates ordered vide Railway Board's letter No. 63/951/16/M (WP) dated 20-9-66, possibly after giving consideration to some tests conducted by the RDSO.

(h) As, despite the best precautions, derailments can't be avoided altogether, it would be rational to think in terms installing such devices on tank-wagons as may improve their resistance against penetration. In the USA, for instance, research conducted by the Federal Railroad Authority (FRA) concluded (as mentioned at p. 13 of National Transportation Safety Board's Report No. NTSB-SEE-78-2, entitled Safety Effectiveness Evaluation" relating to "Derailments and Hazardous Materials") that "shelf-type" couplers alone would protect in 60% accident situations, while "head shields" alone would protect in 85%* cases and the use of both these measures would suffice in as many as 90% of accident casets

(i) As some of the BG tank-wagons in India are fitted with CBC (Centre Buffer Couplers), it would be of topical interest to note that the so-called "shelf-type coupler" has a shelf at the top as well as the bottom, which minimises the possibility of an over-ride (and, hence, separation) in the vertical mode; if coupler disengagement is contained, there can hardly be any risk then of its penetrating the barrel of the next wagon.

(j) A "Head Shield", as the term itself indicates, comprises a shield (usually going upto half the height of the barrel) fitted at its bottom to the end of the headstock and at the top by 2 struts (one at each side) connected to the sole-bars. Basically, its configuration is that of a "bulwork", with the sole purpose of absorbing the energy of impact and serve as a "first defence" against the end penetration by the buffer of an adjacent wagon. Such head-shields are provided, of course, at both ends of a tank-wagon to protect its barrel from impact at ends.

30. *Observations on the guidance available in tackling damaged wagons containing inflammable/toxic/corrosive and such other hazardous materials.*

(a) Shri K. T. Lokhande, Deputy Director of Explosives, advised later on that a nylon rope must not be used to lift a tank-wagon for 2 reasons : firstly, nylon being non-conductive it would vitiate the very purpose of earthing the crane and, secondly, it would easily give way under fire. With particular reference to the accident of 21-8-80, he also expressed the desirability of ensuring that, whenever possible, any open man-hole is closed before handling it by a crane. Pursuing this line of reasoning further, it must appear essential to innovate at the site suitable 'ad hoc' plugging meausres to render a tank wagon reasonably leak-proof, unless it were previously decanted, flooded and rendered vapour-free.

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*The Association of American Railroads (AAR) estimated this figure conservatively at 50%.

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(*b*) Besides inflammable products, the Railway carries in tank-wagons toxic substances also (such as, liquid ammonia and liquid chlorine) and, because of the very low survivability associated with inhaling the fumes released by these 2, the salvage personnel themselves form the primary target. Yet, astonishingly enough, no guide-lines are explicitly or otherwise provided in the Railways' Accident Manual for tackling a situation when a wagon carrying liquid chlorine or anhydrous/ammonia gets punctured after a derailment. The rather naive precaution indicated under Notes Nos. 4 and 10 of Red Tariff s Appendix II/2 simply calls for a leaky wagon to be moved as quickly as possible to an open area, where the effect of the escaping gas is expected to be less hazardous. But, more importantly, what if that wagon is in no condition to be moved in a post-derailm ent situation ? The provisions of para 5.18 of the said Accident Manual with regard to Acid Wagons are both delightfully vague and wholly inadequate, somewhat akin to the meagre guidance expressed [para 16(j)] in its para 5.15 in respect of handling inflammable goods.

(c) As regards Workshop Practices, however, instruction No. 6 of R.D.S.O's Pamphlet W-M-73010 (Revision I of June 1974), the relevant extracts of which are reproduced below, details certain precautions including steam cleaning, to be taken before repairing of a tank barrel by welding :—

"6. *Welding of the Tank Barrel —Precautions to be observedl :—*

6.1 Repairs by welding shall be undertaken only after the tank is properly steam cleaned and the complete absence of petroleum vapour inside is confirmed.

6.4 The barrel of the tank wagon fitted with roller bearings shall also be properly earthed and roller bearings short circuited as shown at page 13 Fig. 4 before conducting any repair to the barrel by welding.

6.5 Flame-proof torches only should be used for internal examination. The tools shall be lowered into the tank in canvas bags to avoid their being dropped.

6.6 Only non-sparking shovels, scoops or hammers shall be used for removing scale, sludge etc."

As regards the steam cleaning operation, the procedure outlined vide instruction No. 5 (*ibid*) takes no less than 26 hours at the very least to complete; the relevant portions are extracted below :—

" 5. *Producdure for Steam Cleaning* :

5.1 After unloading, the tank wagon shall be placed in an open space for *6* hours and interior thereof shall be exposed to atmosphere. A red painted board with suitable warning against entry of the men inside the tank and the use of naked light and not substances near it shall be hand on both sides of the tank.

5.2 Steam pipe with copper or brass nozzle shall be inserted through the man-hole and a free flow of steam shall be allowed for *12* hours and condensate removed after every 2 hours through the bottom discharge out-let.

5.3 The barrel shall then be completely filled up with water and later drained out. It must be ensured by a responsible supervisor that the tank is free from petroleum vapour. This may be done with the help of an explosimeter or by applying a lighted watch on the mouth of a bottle filled up with sample of vapour collected from the tank. In the event of the barrel still showing the presence of the vapour, the barrel shall again be steam cleaned for 8 hours and the above test *repeated.*"

(d) As regards an accident, however, the prevailing practice is by and large to advise the nearest representative of the Controller of Explosives and, should the havoc wreaked be very great, to set up at the Railway Headquarters a so-called "emergency control", with the latter functioning merely as a "clearing house" for information-retrieval/distribution. For the evaluation of the hazardousness of any given situation, an adequate methodology does not at present exist for linking all the available diagnostic expertise with the field staff who, working in a frenzy of activity (on a war-footing, as it were) have neither the time nor the inclination to weigh the lurking hazards from angles unknown to them. In the subject instance, unbeaknownst to themselves, not only the break-down personnel but also the track workers as well as the Officers present at the site were all exposing themselves continuously to a potentially dangerous situation. By way of illustrating the extent of hidden and unsuspected danger, I would draw attention to a case quoted in Report No. NTSB-SEE-78-2 of USA's National Transportation Safety Board, mentioning a LPG loaded tank-car, which had got damaged in a derailment on 24-2-1978 in Waverly (Tennessee, USA) and exploded thereafter after the elapse of as much time as 2 days, killing 16 and injuring 45 others.

(e) It thus becomes abundantly clear that the Railway Administration has not at present provided any criteria whatsoever towards the rational assessment of the risk-proneness of undertaking salvage/restoration operations around damaged tank-wagons in such delicate/tricky situations involving spilt inflammable fluids, explosions, escaping poisonous fumes, etc. Handicapped by the absence of guide-lines and by the lack of specialist know-how, enterprising Officers and break-down staff working in the field have had necessarily to "blindly" fend for themselves and rely largely on their own subjective judgement, which is neither a desirable nor an acceptable feature from the safety view-point.

(f) In contrast to other systems, which are non-guided, rail-transport has a peculiarity in that it is conceptually predioated upon a fairly sophisticated infrastructure by way of track which, if damaged or destroyed, takes considerable expenditure of time, effort and materials (of these 3, 'time' being undeniably the most critical parameter) to repair or renew before rail-traffic can resume. In this context, it is not altogether surprising that emphasis is of necessity essentially oriented towards the speed of wreckage clearance operations, with the attendant risk that safety-aspects might be relegated into the back ground particularly if there is a lack of awareness of the danger(s) inherent in tackling, for instance, situations involving hazardous materials.

(g) On the other hand, with time-factor forming really the crux of restoration measures, any situation, where delays of the type envisaged in a steam-cleaning operations [Sub-para (c) above] are just simply unacceptable, would form one of those rare strange-but-true real-life situations, when an undesirable feature becomes a practical necessity. A pragmatic approach would then be to, rather than await until idealised conditions obtain over the entire area affected by a serious accident, organise the parallel progress of restoration operations at one or more spots simultaneously with the rendering of the remainder area danger-free to the desired degree.

31. *Observations on Track Geometry*

(a) The Amsler Track Recording results presented in para 14(c) supra can be interpreted as under, with regard to 'twist' and 'gauge', the parameters subsequently measured at the site :—

Twist (B 10) : The classification 'B' meant that more than 10 peaks occurred exceeding 5.0 mm (= 1.39 mm/m), the outer limit for 'A' category; the suffix 10 meant that there were 10 peaks exceeding 7.5 mm(=2.08 mm/m), the outer limit for 'B' category.

Gauge (B 3) : The classification 'B' meant that more than 10 peaks occurred exceeding a variation of 3 mm, the outer limit for 'A' category; the suffix '3' meant that there were 3 peaks exceeding a variation of 6 mm, the outer limit for 'B' category.

(b) Derailments due to track twist occur only at low travelling speeds, a finding confirmed by the "dynamic tests" discussed in ORE (Office for Research and Experiments of the International Union of Railways) Report No. B 55/RP 4. Consequently, right from the outset, ORE's B 55 Committee (which examined the question of "Prevention of Derailment of Goods Wagons on Distorted Tracks") was able to address itself to the investigation only of quasi-static guiding forces due to curvature conditions, disregarding thus the dynamic components of the guiding forces occurring at higher speeds. The value of the quasi-static guiding force is, of course, governed by the characteristics of both the track (alignment defects; gauge variations) and the vehicle (wheel-profile defects; anti-phase complexity in spring-stiffnesses, spring-camber variations, and under-frame distortion; excessive play between the bearing and the journal and excessive horn-check clearances). For the design and testing of non-bogie (*i.e.*, 4-wheeler or 2-axled) vehicles, a limiting non-dimensional value for track-twist on a base of '2a' (in m) was propounded by the B-55 Committee as follows : —

$$\text{glim} = \left(\frac{20+3)}{2a} \right) \leqslant 10\ [°/00]$$

The tank wagons involved in this accident had a wheel-base of 4.57 m (= 15 ft), which yields a value of 7.3°/00 for limiting track-twist.

32. *Observation as to the utilization of Traffic Inspectors (TIs)*

(a) During the course of my Inquiry the TI of the Section submitted (duly supported by records of his movements) that, what with so many enquiries into minor accidents and with having to accopmany so many Heads of the Operating Department (HODs) and others on their tour movements over his section, he had scarcely any time to undertake the periodic inspection of the requisite number of Stations.

(b) During my own several tours of routine inspection also, I have gained the distinct impression that, whereas this was a substantially wide-spread phenomenon, amazingly enough the TI was hardly ever required to perform any official task as such during such "escort duties". In other words, his 'formal' accompanying of HODs would be tantamount to an avoidable wastage of supervisory personnel. (Lest there be any misunderstanding on this issue, I myself never ask for a TI or, for that matter, any Railway Official, to accompany me, unless the presence of that official was really necessary to the context of my inspection). Prima facie, such escort-duty by the TI is either explicitly so ordered by either the HOD himself or on his behalf by the Railway Headquarters or the Division, although the TI may occasionally use his own initiative in "respecting the tradition". Needless to say, however, that such duties must necessarily tell upon the TI's performance in a more vital aspect.

VII. DISCUSSION

33. *As to the Time of the Accident*

According to all available records and evidence, the accident did occur at 16.50 hours.

34. *As to whether this accident arose out of any tank-wagon catching fire*

(a) One witness did come forward with this hypothesis [para 17(d)], stating that the man-hole cover of a wagon popped up, followed by an explosion.

(b) The first requirement to this supposition is the presence of an inflammable substance which, in this case, can come about only via either spillage at the top or leakage at the bottom. As pointed out in para 29(b), such leakages (which vapourise instantaneously while the wagons are on the run) are beyond detection by track-side personnel. Whereas commonsense tells us that no one will incriminate himself there is no reason to doubt the version that the safe-to-run examination [para 13(a)] at Bhusaval did not reveal any leakage/spillage off any tank-wagon.

(c) The second requirement, of course, is the source for causing the fire, either exogenous or endogenous to the 'Oil Chief'. Exogenous factors are ruled out from para 13(i). As regards endogenous factors, while paras 13(*h*), 17(*a*), 17(*e*) and 17(*g*) rule out this possibility, paras 17(*b*), 17(*d*) and 17(*j*) are on the contrary clearly in support of this surmise. There is thus considerable disparity in the evidence on this score; however, on the premise that sparks off binding brake-blocks or a hot-axle could not have conceivably escaped the notice of railway officials [paras 17(*e*), 17(*g*), 17(*h*), 17(*i*) and 17(*k*)] who are specially trained to be on the look-out for just these features, I accept the version of the other eye-witness accounts [paras 17(*e*), 17(*g*), 17(*i*) and 18(*b*)] that at first a derailment had occurred.

(d) The final disposition of tank-wagon [Annexure IV] is quite consistent with this hypothesis. However, on the basis of sub-paras (b) & (c) above, I do not hold that this accident was caused by a tank-wagon catching fire.

35. *As to the effect of train-parting*

(a) The combination of the sudden imbalance in the longitudinal forces imposed on a wagon caused by 'parting', and the sudden application of brakes at the parted vehicle (while the destroyal of vacuum is yet to be transmitted/propogated along the train-pipe) causes instantaneous off-loading of wheel-loads of the leading wagon of the rear string. While it is true that derailments almost never take place through partings that occur at moderate speeds (while, for instance, trains negotiate a long ascending grade), the derailment-potential is known to be particularly great when the parting takes place at such higher speed ranges that the dynamic stability of the wagon under consideration is itself suspect.

(b) 2 lay eye-witnesses did depose [para 18(a)] that the train had already parted when a wagon in the rear string capsized.

(c) Having regard to the very acute and progressively narrowing visual gradient provided by the receding train, the occurrence of any parting is quite beyond the perception via the visual receptive fields of witnesses standing on the platform at Malkapur. But the same is not the case with either an observer positioned in an elevated cabin in front of which the train is passing by or another witness from the same region as the 2 ladies.

(d) Whilst the Gang Mate [para 17(*f*)] was unable to clarify this matter one way or the other, I give due weightage to the evidence [para 18(*b*)] of the Cabinman (who, of all the people, had really the best view of this accident and who affirmed that the train was moving in one string at that time), to conclude that parting as such (which did take place, after all, but rather as a consequential effect) had not caused this accident.

36. *As to the condition of track in rear of the so-called "Point of Drop"*

(a) The circumstance that this stretch of track was apparently attended to on 16-8-80 (*i.e.* just 4 days prior to the accident) by a temporary gang (and, *not* the regular DTM gang) and, that, too, under the supervision of, besides the gangmate, amazingly the PWI's head trollyman [para 14(*e*)] does look, prima facie, suspicious. Nevertheless, the evidence of chalk marks (representing the pre-maintenance imperfections in track geometry) that was still faintly visible would tend to substantiate the submission that that portion of track had actually been maintained recently. I accordingly hold that this reach of track had indeed been maintained just a few days prior to the accident.

(b) Whilst the Assistant Engineer's contention [para 21(*b*)] is acceptable, the feature mentioned in para 14(*f*) runs contrary to any supposition that the condition of track was sufficiently bad to have caused the derailment on 20-8-80, because its geometry is unlikely to have deteriorated to that extent within a matter of 2 days. Likewise, the feature mentioned in para 15(*a*) also attests to the circumstance that there was nothing commen-worthy about any deficiency in the condition of track even immediately prior to the accident.

(c) Notwithstanding what has been stated in the foregoing 2 sub-paras, there is scant doubt that the cross-levels, as measured under "free" as well as "loaded" conditions, did reflect a condition of track that was quite incompatible with a speed potential [para 12(*f*)] of 110 Km/h maximum. This aspect is herefore considered in further detail as below.

(d) Whereas cross-levels contribute to "rolling" action, what is relevant in the context of a derailment [para 31(*b*)] is in fact the "twist" parameter. Accordingly, the values given under column 5 of Annexure II(*a*) have been plotted in Annexure II(*b*) and, having regard to the wheel-base of 4.57 m for tank wagons, the maximum value of twist is found to be 7.9‰.* The pre-maintenance measurements [vide column 2 of Annexure II(*a*)] are also plotted on Annexure II(*b*) between station 0 and 14 only (*i.e.*, corresponding to where the track geometry is allegedly particularly bad), wherefrom it is observed that the maximum value of twist is 3.5‰.@ As per the Final Report of ORE's B-55 Committee, however, the limit for track twist in this case would be [para 31(*b*)] 7.3‰.

(e) While expressing reservations on the accuracy of track measurements recorded at night time [para 21(*c*)], the Senior Divisional Engineer also drew attention to the wide disparity between the measurements so recorded and those observed later on 27-8-80. With reference to paras 14(1), 21(*c*) and 25(*f*), I hold that stretch of track, the geometry of which was measured on 27-8-80, remained in all probability untouched by track gangs at least till that date.

(f) As the input of any maintenance effort must necessarily lead to improvements in track geometry, the condition of track after 16-8-80 must have been vastly superior to what has been revealed by the chalk marks made prior to commencement of attention. All things considered, therefore, I am unable to place credence on the accuracy of measurements recorded during the night of 20/21-8-80.

(g) At this juncture, it would be highly pertinent to note that neither was a "point of mount" observed [para 14(*g*)] corresponding to the "point of drop" (which shows that the derailment was almost certainly caused through excessive buffing action, rather than due to any track defect as such), nor did any of the 10 rear-most wagons detail, albeit that these wagons (which were, in the context of a portion of train coming to a halt, obiviously proceeding at comparatively lesser speed than those ahead of them) were indeed more susceptible to derailment [para 31(*b*)] on account of track "twist".

(h) Accordingly, I hold that the geometry of track in rear of the so-called "point of drop" had no part to play in the derailment of a tank-wagon at the "point of drop". Apropos the joint measurements [para 14(*g*)], the P.W. I's role in becoming a signatory to these measurements does cast a reflection both on his competence and knowledge. That he could be so inane as to get directed by a mere colleague into collecting samples of ballast [see foot-note under para 22(*c*)] as a measure of preservation of (vital) clues is a further pointer to his incompetence.

37. *As to the significance of the "Point of Drop" found* 1.3 *m ahead, beyond Down Main Starter*

(a) From the evidence supplied by the position and the number of dent marks found on sleepers ahead of the point of drop (see bottom of Annexure IV), it is clear that no more than a single wagon derailed in that region. There are 2 possibilities to consider : whether it was this derailment that initiated a chain of events culminating in this disaster, or whether it was caused instead by a back-lash in consequence of another mishap.

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*Under loaded condition.

@Under no-loaded condition.

95-M/P(N)47 MofAvations—4(a)

(b) Let us now assume that the event chain commenced with the derailment of a wagon at the so-called "point of drop", with that wagon travelling along the Down Main line in a derailed condition before its left hand wheels fouled with the curved lead-rail of the 1 in 12 trailing turnout linking the Down platform loop, causing the wagon to capsize near about the toe of its switch and to part at its front-end from the rest of the train. As is to too far-fetched to surmise that this capsizing wagon parted at its rear-end as well while conveniently clearing the moving dimensions but without damaging the track beneath (thus permitting the rear wagons to roll ahead), this hypothesis would necessarily entail the piling up of several wagons immediately in rear of the derailed wagon over and around it (*i.e.*, in the reach well in *rear* of 'B' Cabin). On the contrary, reference to Annexure IV shows, however, that the said piling-up in fact took place within a distance of 40 m *ahead* of the 'B' Cabin, which is contra-indicative of the above postulate.

(c) The alternative supposition would be that the accident had *already* happened ahead of the 'B' Cabin and that the derailment of one of the wagons in the rear at the observed "point of drop" was one of the consequential effects. Supporting this possibility are the following features :—

(*i*) The absence of any flange mark on the rail table to indicate the "point of mount" [para 14(*g*)], strongly suggesting that the vehicle had in effect "jumped" the rails, most probably because of abnormally high buffing forces; and

(ii) The circumstance that, in spite of the derailment of one of the wagons ahead, none of the rearmost 10 wagons derailed while completely and successfully traversing over and clearing the track both just in rear as well as ahead of the "point of drop".

(d) For the same reasons, the 'B' Cabin's observation—that the derailment of a wagon was first observed by him at a location [para 18(*b*)] about 40 m ahead of the Down Main Starter, which roughly corresponded, vide Annexure IV, to just in rear of the 1 in 12 trailing turn-out—cannot merely be taken at its face value. The logical interpretation of this evidence would instead be that he himself was understandably looking towards the Guard (with whom he was due to exchange Signals) and that, in that direction, the first wagon did really derail at the location pointed out by him. This is not to conclude, however, that some mishap had not in fact already occurred a few meters ahead of the 'B' Cabin; rather that the Cabinman could not be aware of this other development, simply because he happened to be looking in another direction.

(e) It thus becomes clear that this "point of drop", being merely a by-product of this accident, bore no relation to its cause. Viewed in this light, the entire discussion contained in the preceding para 36 might appear prima facie somewhat redundant, but it is all the same considered important to include that material not only to demonstrate its rationale but also because its omission would render the presentation incomplete in what might be construed as a key area.

38. *As to the course of the accident of* 20-8-80

(a) Paras 3 (a) and 29(d) allude to the chain reaction set in motion by an exploding tank wagon and in the subject case, the most post-accident disposition of the rolling stock forms the most decisive clue wherefrom to reconstruct the event-chain.

(b) The rearmost 10 wagons were all on rail, with the 11th wagon from rear (or, the 35th behind the engine) derailing by just its leading left wheel [para 9(*b*)], whereas the dent marks on sleepers [Annexure IV, bottom] clearly showed that a wagon had derailed on all its wheels. This provides us a threshold in that the derailed wagon, which caused those dent marks, must have been the 12th or further away from the rear (=the 34th from the engine or nearer to it).

(c) If a wagon had not caught fire spontaneously [para 34(*d*)], then it must have derailed and then exploded because the very process of capsizing must have generated both sparks as well as leakage past either the bottom outlet or the top dome. Any such phenomenon would cause the wagons in rear to plough into the capsized wagon and cause a build-up of smashed wagons *behind* it. This provides us another threshold and the disposition of rolling stock as depicted in Annexure IV leads to the supposition that it was in all probability the 22nd wagon from the engine that first derailed and then exploded to trigger off the chain-reaction of explosions.

(d) It is not surprising that nothing particular was found [para 22(*a*)] behind the so-called "point of drop", as it represented, as already reasoned out in para 37(*g*), the effect of derailment caused by the excessive buffing forces transmitted towards the rear of the train by the shock created by the mishap that occurred elsewhere ahead. It is thus logical to reckon that the rear derailment of a wagon (the 34th from the engine or nearer) occurred hardly within moments of the capsizing/explosion of the 22nd wagon. The location of the "point of drop" being known, the next step in this analysis would be to determine the location of the mishap that led to this disaster.

(e) The string of wagons between the 22nd and the 34th would number in all 13, both inclusive, or 11, if both were excluded. Without much loss of precision in the reconstruction of events surrounding this accident we, may reasonably postulate that a distance of 12 wagon-lengths separated the "point of drop" and the actual derailment-cum-capsizing-cum-explosion. The overall length from buffer to buffer of the TP-type as well as the TK-type tank-wagon is 8.28 m (27'—2)" and, making due allowance for some gap/clearance between the buffers of adjacent wagons in the context of a speeding train, it may be taken that these 12 wagon-lengths would cover a distance of about 100 m, which accords very well with the position of the larger crater [Annexure IV] found just to the east of 'B' Cabin, but not with the final position of the 22nd wagon which was lying somewhat athwart the destroyed track roughly 40 m east of 'B' Cabin. The explanation for the eventual position of the 22nd wagon is clearly that several wagons in its rear launched themselves in quick suecession into it and, in consequence of their combined forward momentum as well as its own, it must have moved some 30 meters before coming to rest.

(f) It thus transpired that no less than 12 wagons had piled themselves up in pell-mell disorder, with further explosions creating, besides the enlargemnt of the crater already formed just ahead of 'B' Cabin, yet another crater some 20m. further eastwards, as may be seen from Annexure IV. By this time, the Wagon-string still in the rear was considerably slowing down through the application of brakes and finally came to halt [para 14 (k)] clearing the "point of drop" by 5.7 m.

(g) As will be shown in para 39 infra, the train was travelling well in excess of its maximun permissible speed and its rate of progress would accordingly be over 20 m/sec. After it parted at the front, the 22nd wagon exploded most probably a second or so, within which brief interval of time the Oil chief (now with a trailing load of only 21 wagons) would have already drawn forward by about 30m or thereabouts, when the 21st wagon must have also exploded affected by the intense blast pressure* released by the explosion of the 22nd wagon, which was also being pushed forward by the forward momentum of the wagons piling up into it. The bursting of the 21st wagon must doubtless have sent a tremendous shock wave to the front of the train causing not only severe damage to the buffing/draw gear but also the derailment and consequent capsizing of the wagons up to and including the tank-wagon marshalled the 8th from the engine, all of which explains the position in which the 21st wagon and others ahead of it were found.

(h) Much in the same manner as the 21st tank-wagon*, the 20th and then the 19th had burst in rapid succession, whereas wagons marshalled the 9th or 10th and the 17th must have burst for the same reason as the 22nd wagon. The blast pressures released were so great that some wagons (the 11th, 15th and 18th from engine) which had not burst got penetrated by the adjacent wagons and eventually the fire engulfed them all. The tossing away of the 8th wagon by no less than 14m while the 9th wagon burst and leaped forward by about the same distance constituted by far the most spectacular display of the severity of the blast-power.

(i) Having regard to the fore-going exposition, I hold that the origins of this accident lay in the derailment of most probably the 22nd wagon. In order to eschew dogmatism, the possibility that it could have perhaps been the 21st or the 23rd will also be explored in para 40 infra.

39. *As to the Speed of the Oil Chief*

(a) As to eye-witness accounts, evidence to the effect that the Oil Chief was proceeding considerably faster than ordinary goods trains was deposed by all the 3 independent public witnesses [para 17 (a) to 17 (c)] who came forward, as well as the one who didn't [para 17 (j)], besides no less than 6 Railwaymen [paras 17 (d) to 17 (g) and 17 (i)]. Whilst the train crew themselves [para 19 (b) and 20 (b)] as also another Railwayman (para 17 (h)] denied this allegation, 4 others [paras 17 (d) and 17 (k)] were non-committal. Thus, according to the preponderance or majority of evidence, the 'Oil Chief' did proceed much faster than a Goods train (the maximum speed of which is 75 Km/h), even if did not proceed as fast as the Gitanjali Express (the maximum speed of which is 110 Km/h).

(b) Unforunately, with a speed-recorder not fitted on its locomotive as it hauled but a goods train [end of para 8 (a)], no direct evidence is avaiable on the speed attained by it ex: Bhusaval.

(c) Nevertheless, a fairly accurate idea of the speed can be obtained via a rational consideration of inter-station running times actually achieved. It is of great help to know in this contest [para 13 (c)] that the Oil Chief almost halted at Bodwad, which feature gives us a "fix" on its speed through Bodwad at about 5 Km/h. Annexure I (b) clues us in with regard to the range of inter-station running times [para 27 (d)] that are theoratically possible, given certain assumptions.

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*BLEVE effect [para 3(a)].

(d) Not unexpectedly there is some disparity in the evidence deposed in respect of these timings, as can be deduced from Annexure I (a) and paras 13 (d) and 13 (e), which should also be compared with the running times given in para 13 (f).

As per	*Running Time in Minutes*	
	BDWD-KMKD Section	*KMKD-MKP Section*
Guard's Memo Book	10	10
Driver's log	11	13
BDWD Station	10	—
KMKD Station	10*	5
MKP Station	—	6

(e) For reasons brought out in para 28(c), it may be taken that the 'TOS' Signal was given promptly by KMKD to MKP. Whereas any error in the Train Timings (due to delay, say, on the part of KMKD station in recording the 'TES' Signal towards Malkapur) might cause, as contended by the Driver [para 19 (b)] or as mooted out in para 28 (d), a reduction in the recorded running time for the Block Section ahead, it should simultaneously cause a corresponding *increase* in the recorded running time for Block Section in rear, thus leaving unaffected the *total* running time through both the adjacent Block Sections. In other words, 15 minutes would still be a fairly accurate estimate of the time taken by the Oil Chief to cover the distance from Bodwad to Malkapur.

(f) Within the range of speed-profiles for Simulation Runs Nos. 1 and 3 [Table in para 27 (d) and Annexure I(b)], a large spectrum of possibilities is feasible, depending upon the tractive effort actually exerted. Yet, it is easy to observe that, for resons of track gradients, the running time of the order of 5 to 6 minutes between Khamkhed and Malkapur could not be achieved, unless a speed of at least 80Km/h was already attained by the time the Oil Chief ran through Khamkhed.

(g) It would not be out of place to consider at this stage the amazing development [para 13 (g)] of the "missing control chart". After all, there has got to be a reason, even behind such a strange happening. Once it is realised that the control chart shows little else other than train-timings and that these timings are of little use excepting the derivation of train-speeds therefrom, it would but be logical to conclude that the reason behind the disappearance of the 'control chart' could hardly be anything other than to suppress any indication of excessive train speed(s).

(h) The driver had clarified [para 19(b)] that it was not any 'jerk' that prompted him to look back as he ran through Malkapur. However, the reconstruction of the event-chain [para 37 (g) & (h)] relating to this accident, does bring to light 2 separate events which should have been sensed by an alert Driver: firstly, the parting of the train behind the 21st wagon and secondly, the shock wave transmitted by the explosion of the 21st wagon itself, which tossed off the track all but 7 wagons behind the engine. The Driver ought to have sensed the first event by the perceptible forward surge of the locomotive caused by a substantial loss in the trailing load and hence in the overall train-resistance and the second event by a forward jolt. As regards the second event, any argument that the effect of the shock would have been dissipated by the introduction of slack in the draw gear of the trailing load comprising 7 wagons must also contend with the factor of the latter parting at the rear of the 7th wagon must have by itself caused a further appreciable reduction in the train-resistance, leading to the experiencing of the the inevitale for ward surge. The Driver's admission that he did not feel any 'jerk' would only serve to lend further support to the theory that the tain was going so fast that he was unable to sense these surges and jolt over and above the severity of parasitic movements/vibrations that he was already experiencing within the locomotive proceeding at a high speed. Incidentally, as the WDN-2 locomotive has already been cleared for a maximum speed of 110 Km/h, it is a matter for conjecture if the Oil Chief attained a speed nearing 100 Km/h for the Driver not to have become aware of the locomotive's responses to the sudden curtailments in the trailing load.

(i) Thus, notwithstanding the tardiness generally exhibited in failing to record accurate timings in the Train Registers maintained at stations [Annexure I (a) and para 28 (b)], I hold, without being at all influenced by what has been stated in sub-paras (g) and (h) above, that it has been sufficiently established in sub-paras (a), (e) and (f) above that the Oil Chief exceeded by far the maximum permissible speed for it while it sped through Malkapur. In view of para 27 (a), this substantial over-speeding cannot be attributed in any way to any malfunctioning on the part of the locomotive's single speedometer, the accuracy of which was found upon calibration to be satisfactory.

*For KMKD Station, this is the interval between the 'TOS' from the preceding Block Sections and the 'TES' into the next Block Section.

40. *As to what had caused the accident on* 20-8-80

(a) From paras 25 (d), 26(a) and 27 (b) and (c), it will be noted that in-depth investigations into certain abnormal features noticed in the post-accident situation ascribed these defects to long exposure to intense heat. In any case. these features did not relate to either the 22nd wagon (or the adjacent ones on either side of it), which was established as the "culprit" wagon in para 38(i).

(b) Whilst over-speeding has been reasoned out [para 39 (i)] and whereas over-speeding per se is known to cause dynamic instability of rolling stock (the principal purpose of conducting oscillation trials being to establish the safe speeds for rolling stock on a given track), it remains to examine if any other adverse factor was co-existing at the critical judcture. It is worthwhile now to recount what factors might be relevant to the contest of a derailment on a speeding train on a straight reach of track, which rules out inter-locking between the buffers of adjacent wagons; these are :

(i) Track imperfections;

(ii) rolling stock suspension defects (springing gear, axle-box clearances and components); and

(iii) sudden breakage of any of the multitudinous parts (which make up the mechanical undergear; buffers and relatied components, etc.) fouling a moving vehicle.

(c) Track in the vicinity of 'B' Cabin having been totally destroyed, nothing is known of its pre-accident condition. However, going by para 15(a), track is not considered blame-worthy. Nevertheless, a vital clue is provided by the fact that there was no turnout, either trailing or facing, on the Down Main Line in this critical region opposite of 'B' Cabin, as may be seen from the undisturbed state of track, shown at bottom left of Annexure IV.

(d) As pointed out in paras 9(d) and 25(b) & (e), so many fittings got spewed out or broke away from tank-wagons and then for exposed to severe heat that an examination of their post-accident condition did not lead to any logical inference as to their contribution, via the premises (ii) & (iii) of sub-para (b) above, to the derailment of the 22nd tank wagon (or one of its adjacent ones) either in combination with over-speeding or otherwise. Indeed for that matter, it is equally difficult to completely rule out the possibility that one or the other of these 2 factors may not have been the the primary cause for the drailment in the first place.

(e) Deralied wagons are known to have travelled over considerable distances in the deraliled condition withour capsizing and, in exceptional cases, before getting re-railed (authomatically, as it were) on the run. In the subject accident, however, as set forth in para 38(c) supra, capsizing had immediately followed the derailment and, for this to have happened, there has to be a reason which, in the absence of any obstruction on the part of track-structure vide sub-para (c) above, must in all probability be the on-the-run dropping off of a large-sized part, such as, the vacumm cylinder or buffer. This may be taken as a satisfactory explanation for the quick capsizing of the derailed wagon, as the examination of the rolling stock did reveal a number of buffers and few vacumm cylinders knocked off the tank-wagons marshalled closer to the engine than the 22nd, which lost one buffer also.

(f) As to the extent of damage suffered by the 21st, 22nd and 23rd tank-wagons, all of them had their barrels burst and badly smashed, their underframes twisted and all mechanical fittings destroyed. In addition, the 21st (WR W6244 TK) as well as the 22nd (ER 99661 TP) had one wheel-set missing. The circumstance that the 21st and the 23rd (CR 42298 TP) had their screw coupling and draw bar missing at one end, while the draw gear of the 22nd seemed intact, lends support of the supposition that it was the 22nd wagon that derailed first and parted at either end, with coupling of adjacent wagons torn-off in this process.

(g) With the other causative factors rejected through the earlier part of "Discussion" and with sabotage ruled out vide para 15(b) supra, I hold that, in all probability, this accident was the outcome of a combination of excessive over-speeding on the part of Oil Chief's Driver and the failure of material in respect of rolling stock, the latter causing the on-the-run falling off of a component. I also hold that, in all probability tank-wagonNo. ER 99661 TP, marshalled the 22nd from the engine, was the "culprit", the derailment of which was the "causa causans" of this accident. Furthermore, on the basis of the available evidence, it has not been possible to arrive at any definite conclusion as to whether any deficiency in rolling stock maintenance contributed in any measure, by rendering a tank-wagon particularly unsafe at the higher speed ranges over 75 Km/h.

41. *As to the need to improve vigilance against leakage/spillage off tank-wagons*

(a) True, the possibility of this accident originating from the out-break of fire in a tank-wagon was ruled out [para 34 (d)] as improbably far-fetched, but it cannot be rejected out-right with absolute certainty for the following reasons :—

(i) Any such escaping liquid gets instantaneously vapourised on the run, thus escaping detection; and

(ii) Any Railwaymen noticing a hot-axle or binding brake-blocks, being rule-bound to take some positive action to have the train stopped the soonest as possible, will not incriminate himself by owning up to such an observation, if he didn't do anything about it. The Oil Cbief did, after all, apply brakes in order to slow down while passing through Bodwad and it is within the realms of possibility that the brakes on one of the wagons perhaps failed to get released; the speeding train could then cause those brake blocks to become red-hot and emit sparks.

(b) Such leakages/spillages off tank-wagons transporting inflammable materials constitute a potential fire-hazard. The importance given to this subject on the British Railways has been alluded to in para 29 (a). But as shown in paras 29 (b) & (c), the laxity observed in tightening the man-hole cover is disconcerting and the Railway should exercise greater vigil in this regard and take such deterrent action as it deems fit to improve the situation. For instance, the Railway should not hesitate to discipline the TXR staff of the originating station, if a few bolts on the man-hole cover atop of tank-wagons are not even in their place.

42. *As to the Accuracy of Timings recorded in Train Registers*

(a) The Spot-light invariably falls on these 'timings' at but rare occasions when accidents occur, because a consideration of these timings leads to a cleaner appreciation of the key events in their proper chronological sequence as well as a rational assessment of the train-speed. Yet, under normal circumstances and for most of the time, because these timings are seen to be serving no particular purpose, it is perhaps not altogether surprising that a Station Master should grow progressively indifferent to the accuracy of timings recorded by him in his Train Register.

(b) In the days of yore, it was almost an article of faith with Railwaymen to be meticulous and rule-minded in all the aspects of their work and possibly there was scarcely any occasion for a Station Master to be found wanting in the matter of accurate record of actual train-timings. That the situation has by now vastly deteriorated in this respect is exposed in paras 28 (b) and Annexure 1 (a). Such proclivity towards laxity can be curbed only by checks exercised by Senior Supervisors and Officers.

(c) The importance of this subject is accepted [para 28 (a)] by the Management; alas, what is sadly lacking is the implementation of existing instructions. In this context, whilst the non-use of TIs [para 32] needs the urgent attention of the Railway, it must also be made widely known that the "highers up" are also really interested in this otherwise mundane task of keeping accurate train-timings, so that Station Masters may pay greater need to it, at least as a gesture of "pleasing the boss" rather than just abiding by the extant instructions.

43. *As to the Adequacy of the Existing Machinery to check over-sepeeding by Goods Trains*

(a) On the one hand, over-speeding—long recognised as a major factor contributing to derailments—by a Goods Train is easily possible whenever it negotiates a long down-grade and/or hauls "short" loads (i.e. running under-load); gravity assists the speed in the former case, while the "reserve" power of the locomotive enables the attainment of high speeds in the latter case. On the other hand, more the speed of freight trains, the better the rolling stock ultilization, the shorter the turn-round and the greater the throughput, upon which heavy emphasis had been consistently laid, as throughput is reckoned as one of the foremost officiency-indicators. Inherent in the combination of these 2 features is the grave danger that no serious effort may be made by the Railway Management to concern itself adequately about over-speeding Goods trains. Sadly, such is bound to be the case particularly if the extant practice does not admit of a direct recording of the speed(s) attained by a Goods train.

(b) Now, in the absence of speed-recorder, train-speed can only be indirectly estimated from a train's progress past stations. Whilst the essential pre-requisite for any such exercise is reliable information on train-timings, overspeeding can be inferred only if a comparator exists by way of a complete data-base on the minimum running times for stopping as well as through Goods trains, i.e. without exceeding the maximum sectional speed permissible for the type of the loco and for the trailing load. Surely, this task ought not to pose much difficulty, particularly as each Railway system has its own Computer and further as the algorithm for computer aided calculations is not really complex (inasmuch as it would suffice to consider for inputs the parameters of distance, maximum speed, and maximum acceleration/deacceleration).

(c) I sincerely believe that it is the bounden responsibility of any safety-minded Administration (which is, hopefully, alive to the dangers inherent in overspeeding) to institute and promulgate meaningful steps to curb this hazardous practice by detecting it, whenever possible, in the real-time environment almost as soon as it occurs or, failing this, by imposing deterrent penalties or such other stringent measures when overspeeding is discovered from the evidence of timings extracted from Control Charts. Accordingly, certain recommendations were made in the context of another Inquiry*, but the Railway remained unmoved@ as may be gathered from the relevant extracts summarised below :—

Recommendations	*Railway's Comments*
Railway to compute and publish the minimum running times for Goods trains hauled by WDM-2 locos and other engines of equivalent horse-power.	Presently, a check is exercised by frequent monitoring by Officers and Supervisors in day to day working. Inclusion of the minimum running time in the Working time Table would not, therefore, serve much useful purpose.
Railway to designate a suitable Official to watch the speed of trains in the real-time and take steps to pull up overspeeding Drivers.	Section Controller is fully occupied with train movements. In any case, overspeeding is not reflected on the Control Charts in corresponding reduction in the running time. For instance, against the present maximum speed of 100 Km/h, overspeeding by 10% would result in a negligible reduction of only 3 seconds per Km.

(d) If the Railway's agrument is that marginal overspeeding by, say, 10% is hardly susceptible to detection, there can be no two opinions about it, nor is overspeeding by such trivial measure always dangerous, although some situations might be so "sensitive" that even slight over-speeding could become critical. But, it would not at all be correct to maintain that gross overspeeding, which truely bristles with danger, cannot be gauged from a reference to the Control Chart, as the very essence of arranging "precedences" and "crossings" lies in a thorough knowledge of the running times of the various trains. An alert 'Control' is expected to and is also able to figure out whenever a goods train is taking longer time than usual in the Section and then responds appropriately to this development by making suitable adjustments in precedences/crossings. The very same alertness ought to engage its attention when a goods train takes sensibly less than the normal time to cover a Section or a number of Sections; it is not clear as to what is so very impractical or difficult about this.

(e) It is agreed that Officers and Subordinates do often make use of goods trains as a convenient mode of transport to go from one station to another and also that they take every opportunuty to travel on the locomotive. Surely, no one seriously expects Drivers to resort to any overspeeding at such times, nor is there an element of surprise associated with such so-called "monitoring".

(f) The present situation in regard to the speeds of Goods trains can thus be summed up as follows:—

(i) A direct review of the speeds is ruled out, as speed-recorders are not fitted on engines hauling goods trains;

(ii) According to the Railway, gauging of overspeeding is in any case not feasible in the Control Office, the only place where information on actual train-timings past the various Stations is recorded/plotted; so, even the indirect approach is also out;

(iii) For the duration actually covered by the said "monitoring" of goods trains, hopefully no overspeeding may be expected whereas for the remainder, which truely comprises the very major proportion of the total period that the Goods trains are on the run, there exists just no machinery to detect overspeeding, not to speak of curbing this unsafe tendency; and

(iv) The offending Drivers can neither be caught nor be punished for overspeeding—a circumstance that is bound to lead to proliferation of this undersirable feature.

(g) The questions that naturally arise from the foregoing are :—

(i) Does the Railway seriously believe that a Goods train does not exceed its maximum permissible speed and, if so, what would be the purpose behind the overt measure of "monitoring" ?

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*Head-on Collision of a Goods train with a Mixed train at Madha on Central Railway's Solapur Division at 12.22 hours on 22-10-80.

@Central Railway's letter No. T. 102.P/4/80-81 of 12-8-81.

(ii) If not (and, provided that "monitoring" is a deliberate steps taken as, inter alia, a deteterent measure in this respect), what other steps has the Railway taken or, proposes to take now, to prevent overspeeding by goods trains ?

Indeed, if "monitoring" is the sole measure taken by the Railway it is truely amazing that the Railway appear so complacent about this subject as is implicit in its comments vide sub-para (c) above.

(h) As is well known, the first step towards problem-solving is the recognition of the existence of the problem. Hence, unless the Railway is convinced that overspeeding is rarely, if ever, resorted to by Goods trains, it is considered imperative that it should establish meaningful deterrent action for, otherwise, the menace of overspeeding can only flourish with ruinous consequences. There is no question but that the cost any additional inputs necessitated in this context will be amply repaid several times over by the savings via reduced incidence of accidents to Goods trains.

(i) There is one innovative way that over-speeding can be effectively prevented; instal a "Governor" that automatically cuts off the power to the "drive" whenever a given speed is exceeded and, so long as this mechanism is kept in working trim, the speed-limit cannot but be observed. Wheras diesel engine power-packs are fitted with built-in govornors to regulate, inter alia, the engine speed under varying load conditions, it seems a great pity that no gadget seems to have as yet been devised to control the "road-speed" of a diesel locomotive. The time-tried principles of servo-mechanisms and negative feed-back loops as also the known technology in regard to electronic circuitry will thus remove the dual responsibility for "decision and control" off the Driver with reference to over-speeding.

(j) Conceptually, the projected device could be, for example, a simple on-board mini/micro-computer with a tie-up between the axle generator on the one hand (which provides the input for speed recording) and, on the other hand, the excitation system of the tractor-motors, in order to achieve the stated objective of power cut-off as and when the "road-speed" over-shoots a pre-set limit. Two further inovations would serve to greatly enhance this gadget's value :—

Firstly, as the same loco (say, a WDM-2, for instance) may be severally utilised to haul either a Super-fast or mail/Express or a Goods train, it is important that this system should incorporate a facility for the variable setting of the speed-limit; and

Secondly, a sealed digital display/counter in the cab, to record the number of times that the maximum permissible speed has been exceeded, would provide a ready reckoner whereby to monitor the performance-index of a Driver.

It would be eminently desirable to entrust this interesting task to the Diesel Development Directorate which has been especially set up in the RDSO recently.

44. *As to cause for the accident of* 21-8-80

(a) From paras 16(c) & (d) and 23 (e) & (f), it becomes quite clear that the very operation of extricating tank-wagon No. ER 65925, the undergear of which got partially burried in the earth beneath, chanced to dislodge some elements of very hot stuff which was until then underlying the super-incumbent layer of earth-crust, the lower part of which had previously got admixed with the oil spilt earlier. Obviously, the simultaneous exposure of the still hot stuff and the oil-laden earth to the oxygen-containing atmosphere caused evanescent fumes. Most unfortunately, however, the tempo of restoration works was such that no one took any heed of this warning, which definitely proved the unforeseen presence of pyrophorous substance in the work-area.

(*b*) All evidence [paras 23(a) & (b)] pointed to the fact that the blazing fire was thoroughly extinguished and the effected area completely flooded by foam/water. It has also been established that the precautions [paras 24(b) & (c)] already enforced proved both effective as well as satisfactory even during those initial hours of breakdown activity, at which time not only the concentration of inflammable vapour in the surrounding atmosphere but also the metallic temperature of the wagons handled was the highest during the entire duration of these operations. Hence, and in view of the very meagre guidance provided to breakdown staff [paras 16(h) & (j) and 30(b) & (e)], I hold that this situation was not the result of either any "mala fide" intention or even incompetence on the part of the various senior Officers (including the Divisional Railway Manager) who supervised the breakdown operations from extremely close quarters; there is no doubt in my mind that this was instead due to the prevailing ignorance [para 30(d)] as to the hazard-proneness inherent in the situation obtaining.

(*c*) It was doubly unfortunate, under these circumstances, that some inflammable oil should have spurted [paras 16(e) and 23(e) & (f)] out of an open man-hole during crane-working. With all the 3 necessary ngredients (*viz.* fuel, heat and air) now present, it was inevitable that fire should break out, taking all those around completely unawares.

(*d*) That no further fire-hazard was anticipated by the Railway is clear from the fact [para 16(g)] tha t the sole remaining fire fighting unit was despatched to Bhusaval at 12.15 hours, rather than organise its watering at Bodwad and return to Malkapur. This circumstance only strengthens the conclusion as to the prevailing ignorance about the hidden hazards and I am unable to hold any Railway Official blame-worthy for either careless or care-free working.

(*e*) All things considered, therefore, I do not find any "Act of God" or natural causes involved in this accident, which must accordingly be ascribed to "Failure of Railway Staff", albeit unbeknownst to themselves.

45. *As to the adequacy of Relief Measures*

(*a*) On 21-8-80, thanks to the prompt attendance by the doctors of the Malkapur Municipal Hospital as well as private medical practitioners [para 6(b)], first aid was speedily rendered, whereafter the Railway's medical department took charge. The local doctors of Malkapur deserve commendation.

(*b*) One tragic development was the death, despite the best medical care and attention by the Railway's medical department, of 3 Railwaymen, who finally succumbed to the severe burns contracted in this accident. The mortality rate amongst cases of serious burns being known to be high, this misfortune does not constitute any reflection on the competence of the Railway's medical staff at Bhusaval or the treatment given to these 3.

46. *On improvements of the tank-wagons*

(*a*) Paras 29(h) to (j) explain the 2 measures already completed to a tight-time-schedule in the USA to safe-guard tank-wagon barrels against puncture/penetration by adjacent wagons further to a derailments "Head shields" of the type mentioned in para 29(i) have universal (i.e. to all types of tank-wagons and for all gauges) application. "Shelf-type" couplers mentioned in para 29(j) can replace existing CBCs, on the Metre Gauge and on Broad Gauge to the limited extent that BG tank-wagons have already been fitted with CBCs. Indeed, future conversion of BG tank-wagons to the CBC concept can straightaway incorporate the "Shelf type" couplers that possess in-built resistance against separation vertically.

(*b*) The American stategy of providing insulation and thermal coatings within a stated dead-line (but rather as a long-time correction) is meant to afford protection [page 17 of National Transportation Safety Board's Report No. NTSB-SEE-78-2] against rupture through BLEVE effect in case of fire and the Indian Railways would do well to emulate this American practice.

(*c*) Whereas the installation of "Shelf-type" couplers ought not to pose any problem effort-wise or cost-wise, "Head shields" and "Thermal insulation" are comparatively capital-intensive but, if the American experiences are anything to go by, thes measures will definitely more than repay themselves handsomely. Still, the RDSO may undertake, if necessary, a cost-benefit analysis to determine the worth of the latter 2 measures.

(*d*) As stated in para 29(d) supra, it is not a feasible proposition to design a tank wagon for blast-resistance. But, in view of the abnormally high losses associated with derailments involving tank-wagons, the only logical and sensible step for the Railways to take would be to progressively render the fleet of existing tank-wagons less sensitive to deviations in track-geometry and to evolve suitable designs with reduced derailment probability for new rolling stock. It might be this very rationale that caused the Railway Board to always scrupulously eschew, while notifying from time to time their clearance to overload certain classes of both 2-axled and 4-axled goods stock by a stipulated tonnage over and above their designed carrying capacities, a similar relaxation in respect of tank-wagon.

(*e*) Whereas certain ideas to improve the stability and safety of tank wagons against derailment were outlined in paras 29(e) and (g), it is also felt that, as the first step in this direction, the springing characteristics as also axle-box clearances etc. should be studied by the RDSO with a view to effecting design improvements and/or stipulating more rigorous maintenance standards in respect of "rejectable" defects.

47. *On the guidance to be provided to wreckage clearance personnel*

(*a*) An explosion/fire in a tank wagon is potentially dangerous, but Railway personnel happen to be blissfully unaware of this potential, simply because such accidents occured possibly so infrequently as not to have so far warranted the collation of related documentation, followed by the preparation and dissemination of a set of instructions to cover the various contingencies. For instance, because petrol vapour is heavier than air *by* approximately 1½ times, it tends to remain on the scene for a surprisingly long duration [end of para 30(d)].

(*b*) Whilst an atmosphere charged with 1.5% inflammable vapour becomes potentially explosive, Safety Rules usually prescribe a lower explosive limit of 0.015% for the affected air to be declared as safe. A variety of fail-safe portable battery-operated electronic explometers and gas alarm models are available (and, some are marketed in India) to detect and continuously monitor the presence of combustible gases/vapours. In the UK, a specialist organisation exists (The BASEEFA, an acronym for British Approval Service for Electrical Equipment for Flammable Atmosphere) just to serve this very purpose, whereas the Directorate of Explosives, the Central Mining Research Station, the Oil & Natural Gas Commission are among the Specialist Organisations over here in this field.

(*c*) Yet, the paramount importance of assessing rationally the hazard-proneness of a given situation by using an explosimeter (or, vapour-detector) to measure the atmospheric concentration of vapour was beyond the ken of site personnel. Similarly, no Railwayman seemed to know anything [para 30(a)] about the likely existence of static electric charges and hence it occurred to none at the site to plug man-holes or any other openings in the barrel before lifting a tank-wagon and much less to electrically earth the crane.

(*d*) The extreme dearth of guide-lines available field personnel has been summed up in para 44(b) and there is absolutely no doubt that, if future accidents of this type are to be better addressed in regard to safe work-environment and risk minimisation, the emergency response system should be properly geared to assess all the related sensitive/risk-prone features. It is also equally imperative that post-restoration feed-back from such accidents is properly collated and carefully documented to enable the periodical review/updating of the guide-lines already framed.

(*e*) In the various organizations connected with the production, the handling and the transport of petrol and other inflammable/hazardous products, there no doubt exists indigenous in-house expertise and know-how of a very high calibre on the precautions to be taken in precisely such situations. Most regrettably, however, the sum total of this wealth of knowledge is not readily available to the Railway personnel involved in wreck-clearance in the context of accidents releasing such hazardous substances.

(*f*) That the imposition of stringent restrictions would hamper the restoration measures by an unacceptable degree has already been alluded to paras 30(f) and (g). As a variety of post accident situations can develop, it would be impracticable to set up, each time that such an accident occurs, an emergency response system (that, too, quickly enough in a real-time environment) which has ready access to an identified nucleus of expertise so as to be able to determine not only the overall strategy but also the changes in tactics so as to be able to dynamically respond to the situation as it progressively unfolds itself from the accident site.

(*g*) It would also seem impractical to legislate precise methodologies for each such situation but the logical and sensible course would lie in the establishment of a systematic methodology for, say, the following, which is intended to be indicative but not exhaustive :—

(*i*) identification of the risks involved;

(ii) rational assessment of those risks;

(iii) listing of the necessary precautions to be taken in given situations;

(iv) nominafion of the authorities to be contacted in case of doubt(s); and, finally

(v) nomination of those authorities whose approval thereto shall be a pre-condition, should any deviation be planned from (iii) and/or (iv) above.

VIII. CONCLUSIONS

48. *Cause*

(*a*) Upon a full and careful consideration of all the factual, material and circumstantial evidence at my disposal, I conclude as follows :—

(*i*) In respect of the accident to Down Trombay Bandera Oil Chief Special Goods train at Malkapur on the Bhusaval-Bandera Broad Gauge non-electrified double-line Section of Central Railway's Bhusaval Division at 16.50 hours on 20-8-1980, when 27 out of the 28 derailed tank-wagons were engulfed in the fire that caused also the on-the-spot death of 2 passers by :

That the eruption of fire, which rapidly set up a chain reaction of explosions of some other tank-wagons, was the result of the derailment of a tank-wagon most probably the 22nd behind the engine, and its immediate capsizing and puncturing, caused by a *combination* of

—Excessive over-speeding on the part of its Driver and

—Failure of equipment in respect of rolling stoc causing some component to drop off on the run

(*ii*) In respect of the accident at about 15.30 hours on 21-8-1980 when, during the wreckage clearance operations, fire broke out once again in tank-wagon No. ER 65925, killing 3 and injuring a total of 10 others including 3 grievously. — That the eruption of fire was the combined result of spillage of oil via an open man-hole during the manipulation of this tank-wagon by the break-down crane and the release of some still very hot substance whilst the partially buried undergear of this tank-wagon got prised off the ground.

(*b*) Both these accidents are accordingly attributed to "Failure of Staff", although "Failure of Equipment" relating to Rolling stock also contributed to the accident of 20-8-1980.

49. *Responsibility*

(*a*) For the said contribution of "Failure of Equipment" in respect of rolling stock, no one is held responsible.

(*b*) For contributing to this accident by working the "Oil Chief" at a speed considerably in excess of its maximum permissible speed, the following are held *jointly* responsible :—

(*i*) Shri L.J. Edwards , the Oil Chief's Driver; and — For violating General Rule 89, which enjoins a Driver to so regulate and control the running of his train as to avoid excessive speed.

(*ii*) Shri Limbaji Martand : the Assistant Driver, on whose side (in the Driving Cab of Oil Chief's enging) was fitted the sole speedometer that was in working order who was from time to time repeating the speed attained for the Driver's information. — For violating General Rule 163(a), which enjoins every Railwayman to make every exertion for ensuring the safety of the public and of General Rule 163(b)(iv), which enjoins every Railwayman, who observes any unusual circumstance(s) likely to interfere with the safe running of trains, to take such immediate steps as the circumstances may demand.

(*c*) The Oil Chief's Guard, Shri M.D. Patil, is also held responsible to a secondary degree for violating besides General Rule 163(b)(iv), General Rule 126(a) in failing to attract the Driver's attention, in spite of the considerable over-speeding of his train, which he could hardly remain unaware on.

(*d*) For the accident of 21-8-1980, no railway staff is held responsible, either individually or collectively.

(*e*) Infractions and other deficiencies noted in paras 32, 36(h) and 41 have been separately referred to the Railway Administration for appropriate action.

50. *Relief Measures*

With reference to para 45, I was entirely satisfied with the care and medical attention provided to those who contracted burn injuries at the accident of 21-8-1980.

IX. REMARKS AND RECOMMENDATIONS

51. *Short-term Corrections*

(*a*) In the context of the extremely high-cost damages scenario consequential to the derailment of loaded tank-wagons, to improve, as a first step, the resistance of 2 axled tank-wagons to derailment by stipulation of more rigorous maintenance standards in respect of "rejectable" defects, pursuant upon a review of its springing characteristics, axle-box clearances, etc. [Para 46(e)].

(*b*) To set up a special multi-discipline "Task Force" to eclectically undertake :—

(*i*) the assessment of dangers associated with wreckage clearance operations involving the leakage of hazardous materials and then the development and dissemination of adequate safety procedures to effectively combat the indentified dangers. [para 47(d)]; and,

(*ii*) To simultaneously analyse the risks to which wreckage-clearance personnel might be exposed to, so as to be able to set up appropriate safety precautions, including the use of safety equipment, to meet the identified health-hazards. [paras 47(g)(i) & (iii)].

(*c*) Pending the completion of (b)(i) above, to equip, as a first step, the break-down set-up on each Division with explosimeters, (or similar vapour detectors, gas monitors) and related instrumentation. [paras 47(b) & (c)].

(*d*) To set up an adequate machinery to detect and prevent over-speeding by goods trains. [paras 47(a) to (h)].

(*e*) To improve and strengthen the on-track fire-fighting capabilities by the allocation of an assigned travelling water tank (TWT) to each water-based fire-fighting unit, by modernising its equipment to operate with foam, by providing fire-fighting personnel with special fire- proof over-alls, etc. [paras 24(b)(i), (ii) & (iv)].

(*f*) To take such steps (like a 'special drive', etc.) that the Railway may consider as appropriate to ensure the accuracy of train-timings as recorded by Station Masters in the Train Registers. [para 42].

52. *Long-term Corrections*

(*a*) In view of the excessively heavy losses commonly associated with derailments involving loaded tank-wagons, to effect improvements in the design of tank-wagons to better cope with sudden surge loadings and in general to become less derailment-prone relative to other types of 4-wheeler rolling stock. [paras 29(e) to (g)].

(*b*) To upgrade the safety of existing tank-wagons against penetration and puncturing in a post-derailment situation, by the appropriate fitment of specially designed elements, such as "Head Shields" and "Shelf-type couplers", which proved highly successful in the U.S.A. [para 46(a)].

(*c*) To upgrade the insulation property of the barrel by the provision of thermal insulation, similar to the type developed 'ad hoc' in U.S.A., to safe-guard tank-wagons against explosion through BLEVE effect. [para 46(b)].

(*d*) To establish a procedure for the regular review of the safety procedures set up by the Task Force [vide para 51(b) supra] and their prompt updating, consistent with the experience gained, the development of newer products and or techniques as also the broadening of the related know-how. [para 47(d)].

(*e*) To develop a simple on-board mini/micro computer for installation in a Diesel-electric locomotive, with the objective of controlling its "road-speed" by cutting off the power, as and when the speed exceeds a pre-set limit. [paras 43(i) & (j)].

(*f*) To progressively replace steam-cranes by diesel cranes for break-down operations, in view of the hazards posed by coal-fired furnaces in situations involving the release of inflammable oil/vapour. [para 24(b)(iii)]

Yours faithfully,

(N.P. VITHAL)
Commissioner of Railway Safety,
Central Circle, Bombay

BOMBAY
Dated 13-11-1981

ANNEXURE-1(a)

Extract of timings recorded on 20-8-80 *in the Train Register maintained at Bodwad, Khamkhed and Malkapur in respect of the passage of the Goods train*

Train No.	BDWD-KMKD Section			KMKD-MKU Section		
	Grant of L.C.	T.E.S. Signal	T.O.S. Signal	Grant of L.C.	T.E.S. Signal	T.O.S. Signal
BD Spl	1-13 (1-13)	1-43 (1-45)	2-00 (2-02)	1-45 (1-46)	2-02 (2-01)	2-16 (2-15)
BIA Spl.	2-17 (2-18)	2-48 (2-50)	3-00 (3-01	2-50 (2-51)	3-00 (3-00)	3-10 (3-12)
SHM Spl.	7-13 (7-20)$	7-33 (7-34)	7-45 (7-45)	7-35 (7-35)	7-44 (7-44)	7-53 (7-54)
MZR Gds.	11-16 (11-18)	11-18@ (11-22)	11-31@ (11-34)	11-20@ (11-23)	11-30 (11-32)	11-39 (11-40)
Lt. Eng.	12-35 (12-53)$	13-13 (13-22)$	13-32 (13-34)	13-17 (13-22)$	13-31 (13-32)	13-44@ (13-48)
OJA Spl.	15-16@ (15-19)	15-44$ (15-47)	16-00 (15-58)	15-49 (15-47)	15-58 (15-56)	16-08@ (16-12)
Oil Chief	16-13@ (16-16)	16-30$ (16-35)	16-40$ (16-47)	16-35 (16-35)	16-44 (16-45)	16-50£ (16-57)
F.F. Unit	18-23 (18-25)	18-27$ (18-33)	18-42 (18-44)	18-27 (18-26)	19-42 (18-41)	10-00£ (20-20)

NOTES : *L.C. means 'Line Clear'.

*T.E.S. means 'Train Entering Section'.

*T.O.S. means 'Train Out of Section'.

*For the BDWD-KMKD Section, figures at the top are extracted from the Train Register maintained at BDWD (Bodwad).

*For the KMKD-MKU Section, figures at the top are extracted from the Train Register maintained at MKU (Malkapur).

*All figures in parentheses are extracted from the Train Register maintained at KMKD (Khamkhed).

@Time difference in excess of 2 but less than 5 minutes.

$Time-difference in excess of 5 minutes.

£Obviously, a post-accident communication gap.

ANNEXURE-II(a)

Track Measuremants Record in mm.

(Para 1408 of the Indian Railways Way and Works Manual)

Station	Cross Levels 'Free'		Cross Levels Under load		Gauge
—30	(—5)—6	(—3)	—8	—2	(—1)
—29	(+3)—4	(—3)	L	+2	(+1)
—28	(+4)—4	(+1)	—2	—2	(—2)
—27	(+3)—2	(+3)	+2	—4	(—4)
—26	—2	(+3)	—2	—1	(—2)
—25	+2	(+4)	L	—2	(—3)
—24	+4	(+5)	+4	—2	(—4)
—23	(+10)+4	(+3)	—4	(—1)	(—1)
—22	(+8)+2	(+3)	+2	OK	(OK)
—21	(+5) L	(+5)	+1	—1	(—1)
—20	(—2)—6	(+1)	—1	—7	(—5)
—19	(—2)—6 (+6)	(—2)	—6	—6	(—5)
—18	(+8)—6	(+7)	+6	—5	(—6)
—17	(+10)+5	(+7)	+8	—4	(—6)
—16	(+6)—2 (+3)	(+2)	L	—2	(—3)
—15	(L)—2	(+1)	L	—2	(—4)
—14	(—10)—9	(L)	—6	—8	(—9)
—13	(—16)—5	(—5)	—24	—6	(—10)
—12	(—24)—32	(—4)	—34	—4	(—8)
—11	(—8)—30	(—5)	—30	—5	(—11)
—10	—10	(+1)	—6	—6	(—8)
—9	(—8)—2	(+6)	+10	—6	(—7)
—8	(—9)—5	(+5)	—2	OK	(—1)
—7	(—12)—20	(—4)	—24	+3	(+1)
—6	—32	(—4)	—28	+2	(+1)
—5	(—8)—36	(—6)	—36	OK	(—2)
—4	—27	(—2)	—24	+2	(+2)
—3	(—10)—20	(+2)	—21	+1	(—2)
—2	(—10)—11	(—2)	—10	OK	(—4)
—1	(—8)—9	(—2)	—9	+5	(—1)
0	—9	(—2)	—8	OK	(—2)
+1	—10			+2	
+2	—8			+1	
+3	+2			+8	
+4	+7			+12	
+5	+6			+8	
+6	+10			+4	
+7	+11			+4	
+8	+10			+2	
+9	+9			+5	
+10	+18			+10	

NOTES :

(*i*) '0' Station represents the "Point of Drop" (See Annexure VI).

(*ii*) All non-bracketted figures were recorded on 21-8-80 at about 04.00 hrs. on the basis of measurements taken by TXR staff in the presence of the PWI (Grade II).

(iii) Because of damage to track, it was not considered safe to take the measurements under load of WG Engine beyond Station '0'.

(*iv*) Adverting to Cross Levels under 'Free' condition and to Gauge, the bracketted figures appearing on the *right* reflect the measurements taken on 27-8-80 in my presence.

(*v*) Adverting to Cross Levels under 'Free' condition, the bracketted figures on the *left* pertain to chalk-marks (observed in my presence on 27-8-80) which purport to signify the defects noted by the Gang on 16-8-80 doing the pre-maintenance examination of track.

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