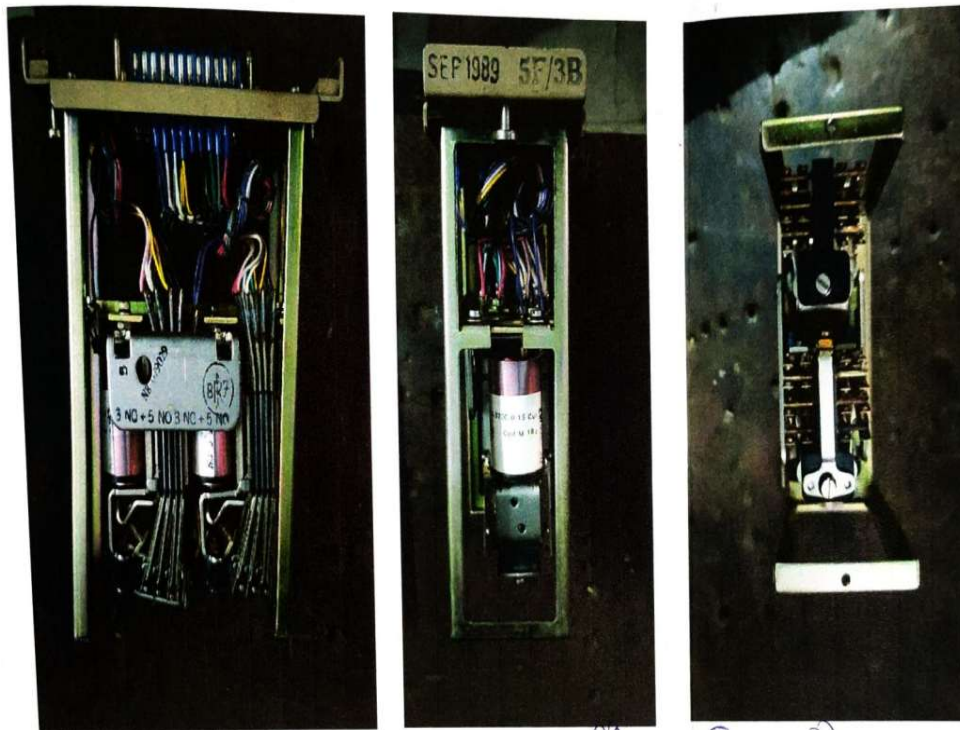


2. Root cause analysis of the accident –

- (i) As per Data Logger report, engine of the train hits track No. 2T, just beyond home Signal S2 at 05:31:44 hours and passes over it in 7 Seconds to hit next track circuit 26BT at 05:31:51 hours while train was still in motion. ***In the meantime, at 05:31:48 hours, 26WRR got picked up, thereby giving command to operate Point No. 26B from Normal to Reverse and it moved immediately thereby creating two route condition and the derailment happened.***
- (ii) The relay room of Nalpur was opened by night signal Maintainer at 04:58:07 Hours on 9/11/2024 following the due procedure to locate the cause of an ongoing failure of S-10 (Dn loop line starter) ***.It was in open condition, when operation of Point No. 26B was initiated i.e. at 05:31:48 hours.*** The relay room was closed at 05:48:13 hours nearly 15 min after the incident.
- (iii) This station was having ***Panel interlocking (commissioned in the year 1999) with Q series relay and point operation circuit was provided with k-50 relays.*** The analysis of the completion circuit of Nalpur for Point No. 26B, shows that under wheel operation of Point No. 26B, with route lock condition is not possible in ordinary circumstances. But the clinch of this circuit was that ***if latch relay K-50 (Siemens mechanical latch relay) is picked up for reverse operation of point automatically without the desired electrical feed for reverse operation, command will go for operation of Point No. 26, bypassing all interlocking and it will operate the point.*** On that fateful day, this exactly had happened as evident from records of data logger as well as on site position of Point No. 26B, which was found set in reverse condition after passage of Loco of the train leading to derailment of the accident.
- (iv) During enquiry, the night signal maintainer confessed that during his attempt to fix the failure of S-10, he stooped down to see the condition of 10 NNR relay (Q series) on relay rack #2 and ***while standing up, he casually rubbed the K-50 Siemens latch relay for point no. 26 installed on relay rack #1.*** The relay rack #2 and relay rack #1 are facing each other hardly 84.5 cm apart.
- (v) On inspection of relay room at Nalpur, it was discovered that ***out of two screw provided for holding such relay on relay rack, only one top screw was tightened up and no bottom screw was provided which was required to fix it firmly and hold the relay tightly.*** This missing provision of bottom screw have ***led to this original relay swinging and while hitting when restores to its position led to detaching of the relay K50 for point no. 26B from its normal to reverse position.*** The details of culprit relay K-50 for point no. 26B was- SI no- 8070909, Configuration – 5F/3B, ***Manufactured in the year – Sep'1989.***



26 WRR K-50 Relay

- (vi) In order to study the behaviour of such type of Siemens K-50 relay, the Inquiry ***Committee tried to simulate the situation at the same type of installation and similar kind of work at Satragachi PI installation.*** The same type of relay was located in relay room of Santragachi in similar fashion, with bottom screw not located and top screw was kept in loose connection. The relay was put in normal latch position and similar kind of rubbing by human back was simulated. It was found that most of the cases when such jerk was given to the said relay, detaching took place within the relay. It was repeated several times and similar result followed. This simulation was repeated with other similar healthy K-50 relay and result was the same.
- (vii) The possibility of ***deliberate action of operating the point no. 26B by the night maintainer has been ruled out because when the attempt was made to open the top cover of the relay after derailment, it was found that the top cover was in badly jammed condition*** and could not be opened easily. This shows that the top cover was not opened earlier.
- (viii) The ***possibility of this detaching due to accidental shorting in the linking or giving feed to point no. 26B to operate from CTR during checking of circuit for signal S-10 is also ruled out as the circuits are physically far apart*** and situated in different CT racks.
- (ix) Thus it was concluded that the derailment of Train No.22850 at Nalpur on 09.11.2024 has taken place due to under-wheel operation of point no. 26B while the train was passing over the said point. The ***under-wheel operation of point no. 26B has taken place due to unintentional***

shaking of the K-50 type Siemens relay by the night signal maintainer while he was attending the failure of Down Common Loop Starter Signal S-10 in the relay room.

3. **Systematic failures leading to the accident & Recommendations -**

- (i) In this case, it is pertinent to highlight the “essentials of interlocking” as per IRSEM 7.6.1, which is reproduced as below -

Essentials of Interlocking: Equipments provided for the operation and control of signals, points, etc., shall be so interlocked and arranged as to comply with the following essentials-

(a) It shall not be possible to take 'OFF' a Main stop signal or a Subsidiary signal, unless all points in the route, including overlap and isolation (as applicable), are correctly set and locked and all interlocked level crossing are closed and locked against public road, and relevant tracks are unoccupied by vehicles and clear for the line on which the train will travel.

(b) After such signal has been taken “OFF”, it shall neither be possible to move any points nor unlock the route, including overlap and isolation, nor to open any interlocked gates until the concerned signal is replaced to 'ON' position.

Again, IRSEM 7.6.10 directs for fail safe feature of signaling circuit which is reproduced as below-

Fail safe Features: Signal and interlocking circuits (including hardware and software as applicable), shall be so designed and equipment so installed and maintained with its connections, that the ***relevant signal shall remain at or return to its most restrictive aspect and Points shall remain locked in their last operated positions in the event of failure of any part of its connections and circuits.***

Further, IRSEM 21.1.12(c) guides for possible condition for point operation, which is reproduced as below-

Operation of points shall be possible only when the interlocking is free and relevant point track circuit is clear. Emergency operations, where provided when point zone track circuit fails, it shall be possible to operate the concerned point provided interlocking is free by releasing an emergency control. Each such operation shall be recorded on a counter.

It is clear that the cause of this incident is violation of these essential principals of signaling.

- (ii) During the inquiry, it has come to light that the ***Point Control Circuit was not designed to prevent unwarranted operation of a point in case of its K50 (Siemens Make)*** mechanical relays malfunctioning and making way for other operations of the point. ***Thus there was some short coming in the design of such mixed type of relay system which existed at Nalpur (i.e., mixture***

of mechanical metal to metal relays along with Q type relay). In a sound design of the circuit, **failure of one signal component should not result in a major unsafe incident. A second layer of design, and hence its interlocking, providing fail-safe route of the moving train over a critical component should have been there.** Thus, this circuit design defect has not only undone the interlocking provisions but also led to driving the point no 26B contrary to the route of moving train and hence to cause the accident.

- (iii) Being panel interlocking of Q-series relays, K-50 mini group and minor group have been used for point operations at this station. **So at all such stations, the existing point operation circuits using K-50 mechanically latched relay should be replaced using QL1 magnetically latched relays.**
- (iv) The K-50 relay used for point no. 26B was of manufacture in the year Sep/1989, whereas PI at Nalpur was commissioned in March/1999. So, this relay has already outlived considerable period of its life (around 10 yrs) at the time of the commissioning of the system. **So, It should be ensured that equipment being installed should not be much older (not more than 2 years) at the time of commissioning.**
- (v) **Further , Metal-to-metal plug-in relays, like the K-50, are assigned a codal life of 1,500,000 operations or 25 to 30 years** (depending on the route category -Route A: 25 years , Route B: 28 years ,Routes C/D & special: 25–28 years, Route E/E Special: 30 years) whichever is earlier. So its codal life was already expired. Several such overaged relays were available at site, but nothing was done for their replacement. **Thus, the maintenance staff should maintain proper documentation of drawings & registers at station (which includes Signal equipment history book) as per IRSEM annexure 3-A5.** They should have knowledge of codal life of equipments installed at site, identify & demand materials for replacement and division should ensure procurement & replacement of such materials timely.
- (vi) The PI system was installed in March'1999 **had also completed its codal life. Sanction of work for replacement of such installation should be planned well in advance.**
- (vii) The **S&T sectional maintainer had been posted there since last 21 years but he failed to notice that the K-50 relay for Point No. 26B was on loose condition though this is a part of his duty(as per IRSEM 3.8) to check it once in a month.** He also failed to notice that neither bottom screw nor holes for fixing this screw on relay rack was available which **led this relay to swing while hitting.**
- (viii) The SSE/S&T/Sectional and SSE/S&T/In-charge were equally slack in their duty of inspection on monthly and quarterly basis respectively as per IRSEM chapter 3. **Their due diligence and timely action could have easily**

prevented the accident. Thus, ***the routine transfer of S&T maintenance staff including JE/SSEs should be done in the span of 4 years to avoid slackness in their working.***

- (ix) Slackness is also indicative on part of sectional ADSTE as he cannot escape his responsibility of proper controlling of Signal Maintainer, SSE (Section)/S&T and SSE (In charge)/S&T under him . The method of auditing the schedule of inspections of JE/SSE/S at division level and that of ADSTE at HQ level should be followed properly. The quality of inspection is also to be monitored at HQ level .***The safety audits should be conducted by divisional and HQ team regularly to identify lapses in the field in view of latest guidelines and policies of Railway board and RDSO and timely compliance of deficiencies to be ensured.***
- (x) The ***failure memo for ongoing failure of S-10 (Dn loop line starter) was not issued by on duty ASM.*** Disconnection for S-10 was also not demanded. It was also noticed that one tower has passed this failed signal S-10 at ON without any proper written authority issued by ASM. Thus, the due procedure for attending failures and train operation were not followed at site. ***Issue of failure memo, demand for disconnection (if required) and procedures for train operation during such failures need strict implementation.***
- (xi) ***CCTV with adequate nos. of cameras are to be provided in Relay Room and Panel/VDU room*** to capture all the activities of signalling staff working in the relay room with proper storage facility.

(Manish Kumar)

Dy. Chief Safety Officer(S&T)
ECR/Hajipur

Copy:-

- (i) Sec to GM – for kind information to GM/ECR please.
- (ii) AGM, PCSO, PCSTE, PCOM, PCEE, PCE, PCME/ECR/HJP - for kind information please.
- (iii) CSE, CPTM, CTE, CEE, CME, CELE/ ECR/ HJP- for kind information please.
- (iv) DRM/ DHN, DDU, DNR, SEE, SPJ- - for kind information please.
- (v) Sr. DSO, Sr. DSTE, Sr. DOM, Sr. DEE(TRD), Sr. DEE (Op), Sr. DEE(G), Sr. DEN(Cord), Sr. DEN / DHN, DDU, DNR, SEE,SPJ-for information please.
- (vi) Principal STTS/DNR-for information please.
- (vii) All concerned Supervisors & Railway staffs.