Reliability Issues of Brake Systems of 3 Phase Locomotives
Review of Reliability Related issues of Computer Controlled Brake (CCB) system of M/s KBIL:
1. Failure of Unloader Valve (M/s. KBIL)

(a) **Problem:**

- Failures of Unloader Valve causing heavy air leakage and MR pressure drop

(b) **Investigation:**

(i) Failure of sealing rubber in the unloader valve.
(ii) Less Cap hex head size causes difficulty in opening the valve.

Cap hex height increased for proper grip
(c) **Action Taken:**

• KBIL was procuring Unloader Valve from a sub-vendor. They developed modified ULV’s. However, extent of the problem reduced but persisted.

• Hence KBIL designed New ULV in line with their competitor i.e. FTRTIL, which has improved stem rubber seal, spring, mating seat edge and increased the height of the cap hex for proper grip.

• Same was provided on loco no 31548 /ELS/TKD on 20.05.2017.

• Performance of this Unloader Valve was reported satisfactory.

• KBIL has provided modified Unloader Valve to all sheds. Till date 409 out 544 locos with CCB have been provided with new ULV’s as per availability of the Locos.
2. Moisture drainage arrangement in Panto reservoir

a) **Problem:**
No provision for moisture draining from Panto reservoir
Ingress of moisture causes malfunctioning of pneumatic valves.

(b) **Action taken:**
(i) Drain pipe provided at the test point loco no. 30409/ WAP-7 of ELS/RPM as shown below:-

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Drain pipe connected in place of test point (TP) of panto connect pipe
• Till date 470 locos out of 544 Locos have been provided with this arrangement as per availability of locos.

• ELS/RPM has reported that this modification has shown improvement but does not ensure complete draining of moisture. Moisture ingress was seen in the loco 30409 even after this modification. However, the KBIL has continued the arrangement of drain pipe from the test point of the panel as an improvement measure.

• M/s KBIL has developed drain arrangement at the bottom location of Aux. reservoir. Same has been provisionally approved for providing in new 50 no. of Locos by CLW. After satisfactory performance, this arrangement will be regularized.
3. Higher brake application time in locomotive fitted with CCB Brake system.

(a) **Problem:**
Eastern Railway reported that there is a delay in brake application time through SA-9 in improved version of CCB system of 3-phase locomotives resulting in unsafe conditions.

(b) **Action Taken:**
- Firm modified the software to reduce the timings of brake application with SA9.
- Trial with new software in one loco (WAP-7 & WAG-9 each) was done and found successful.
- Till date, new software in 522 out of 523 locos (WAP-7 & WAG-9) having CCB have been completed.
4. Provision of wire mesh filter in BP circuit of CCB.

(a) Problem:
Foreign particles go via Train BP Pipe line and enter into BPCP during Emergency Brake application causing air leakage.

(b) Investigation:
The cases were investigated and found that the solid particles like coal or stone pieces of size 1 mm – 10 mm are found inside the BPCP causing sticking up of the exhaust seat and creating leakage from the valves resulting BP pressure not building up.

A Mesh Filter was provided on loco no 31679/Tata on 19.04.16 and after fitment during inspection on date 24.01.17, a foreign particle (Stone) got arrested inside the Mesh Filter
Mesh Strainer Provided on loco no 31679/Tata on 19.04.16

After Fitment, in Fifth inspection on dt 24/01/17, foreign particle (Stone) got arrested inside Mesh Filter.
To address the issue of foreign particles entry inside BPCP (PVEM) Strainer Mesh is provided which traps them.

The strainer mesh has to be cleaned once in three months to remove the trapped particles.
(c) Action taken:

Till date wire mesh strainer has been provided in 531 locos out of 544 locos as per availability of Locos.
5. Failure of Emergency Exhaust Valve (NB-11)

(a) Problem:
Railways reported heavy air leakage from NB-11 due to entry of foreign particles during emergency application of brakes.

(b) Action Taken:
RDSO issued MS 0465 Rev ‘0’ dated 18.10.17 wherein:
1. Trap Chambers are to be provided in BP pipeline both side.
2. Existing NB-11 are to be replaced by EBV of FTIL make or of similar design. M/s KBIL has also developed EBV similar to FTIL make design.

Dust/Coal particles entrapping arrangement
6. Failure of MPIO electronic cards

(a) **Problem:** Failures were reported by Railways on account of MPIO electronic card

(b) **Investigation:** M/s KBIL submitted root cause analysis of MPIO cards failures as burning of a Resistor in the card when Driver keeps PVEF pressed for longer durations.

(c) **Action Taken:**

- M/s KBIL recommended to disconnect the resistor from MPIO cards.
- Trial of this modification was done in 2 locos each of ELS/GZB,LGD,AQ,BRC&TATA for a period of three months.
- After satisfactory performance from railways, approval accorded for disconnection of resistor in all existing locos as well as in new supplies to CLW. This modification is completed in 292 locos out 544 Locos.
Other improvements:-

• Use of borosilicate filters in place of existing paper type filters. However Railways are requested to monitor the performance and send feedback for any abnormality.

• Change in BC pressure setting to resolve the issue of SR interlock Loco brake. The BC pressure setting from 0.2 to 0.65 kg/cm² has been changed to 0.3 to 0.65 kg/cm² with tolerance of ± 0.05 kg/cm².
Reliability issues pending with M/s KBIL

1. **Reduction in BC pressure for WAP7 locos:-**

   In view of use of composite brake block it is desirable to reduce BC pressure in WAP7 locos as per MOM 19.12.2016. Firm stated that software of CCB need to be modified by 30th June’ 2017. Firm was advised to implement modified software in 2 locos in ELS/GZB & TKD.

   Firm vide letter dated 20.04.18 requested to nominate a loco to upload the modified software got from NYAB. RDSO issued letter to WCR in this regard on 26th April for trial in a loco of ELS/TKD.

   Firm has to give PDC.

2. **Speed enhancement during PTDC mode:-**

   RDSO advised to firm to implement the scheme proposed by ELS/LGD for speed enhancement in PTDC mode with safety features in case of failures of brake electronics. Firm is requested to provide the status.
Reliability issues pending with M/s KBIL

3. Pneumatic supply to ULVS from MR1 in place of existing Aux panel of CCB.

4. Pneumatic supply to SR1,2 & HF contactor to be taken before over flow valve.

5. Failure of Feed valve leading to FP pressure more than 6 Kg/cm²:

   - Firm reported that they have improved the rubber seal of check valve provided inside the feed valve and replaced the check valve nylon body to aluminum body material. In the new design check valve aluminum body vulcanized with improved rubber material. Firm fitted this improved feed valve in ELS/RPM-01Loco & ELS/KYN-02 Locos on 12/13.03.18 for field trial period of 03 months.

6. Solution regarding PVEF/Bail-off should be de-activated during emergency brake application.

7. Problem of moisture in Aux reservoir.
Other issues pending with M/s KBIL

1. Validation and cut in date for Computer Control brake system with New RDSO’s Specification no. 0126.

2. Status of implementation of EP assisted brake system as per RDSO’s Specification no.0138.

3. Training programs at various sheds and loco pilot lobbies.

4. Simplification of fault codes including display in Electronic Brake Valve.
Review of Reliability Related issues of E-70 Brake System M/s FTRTIL:
1. Failure of metal seated Non Return Valve:

(a) Problem:
Railways were reporting the problem of metal seated NRV’s (Disk Valve type) getting stuck up in E70 brake system leading to air leakage.

Fig A. Non Return Valve (NRV)
(b) Investigation:

The reason for stuck up of NRV had been attributed to breakage of studs/spring seats and ingress of foreign particles. Carbon deposits were also causing NRV’s to stuck-up.

(c) Action Taken:

Metal seated type NRV was replaced by rubber seated type (Polyurethane seated). The Polyurethane rubber has excellent tear and abrasion resistant with high hardness and a low resilience. After the provision of the Polyurethane seated NRV, the problem of NRV getting stuck-up reduced substantially.
2. Failure of Air flow Gauge (AFI):

(a) Problem:
Zonal Railways have reported the cases of breakage of air flow indicator gauge glass. AFI gauge is shown in fig.
(b) Action Taken:

- Design modifications were carried out as under:
  (i) Thickness of polycarbonate glass increased from 8mm to 12mm.
  (ii) Inside chamber size reduced from 39-49 mm to 19-20mm
  (iii) The space between needle and glass is increased from 4.2mm to 5.5mm.

- After this modification, no failure of modified AFI gauge has been reported by Railways. This modification has been done in E-70 as well as CCB brake system.

- M/s FTRTIL was advised to include all the good quality suppliers of AFI gauge in addition to other approved sources to ensure wide vendor base as well as to create competitive environment in quality and price.

- M/s FTRTIL has requested approval for procurement from M/s Top Grip also in addition to M/s Midland. They will modify their QAP and add the M/s Top Grip as sub vendor.
3. Failure of FD1 (SA-9) and D2 Relay Valve

(a) Problem:
ELS/LGD and ELS/GMO reported failures of Valve stem of D2 Relay Valve/SA-9. This was causing heavy air leakage in valves.

Fig: Shifted rubber insert found in D2 relay valve
(b) Investigation:
(i) Stem rubber insert found shifted as shown in figure B.
(ii) A gap of up to 0.7 mm was observed as indicated in figure A & B.
(iii) Seating of insert found only at outer periphery of internal diameter with partial seating at the face.
(iv) Clearance between the Rubber insert and the valve stem seating surface is more, which leads to poor bonding between the rubber insert and Valve stem.

Fig A. Gap up to 0.7mm between outer seating and rubber.

Fig B. Improper seating of insert at Periphery
(c) Action Plan:

- Drawing of valve seating was modified and step design is removed as shown in fig B. All the D2 relay valves were modified.

Fig C. Valve with modified design where step in seating is removed.
4. Provision of Modified push rod in DBC

(a) Problem:

Air leakage cases were reported from Auto Brake Controller (DBC or A9) when LP try to release after emergency brake application due to continuous supply of pilot pressure to EBV. Firm investigated and found root cause of failure was due to malfunctioning of Release valve spindle of DBC.

(b) Action:

– M/s FTRTIL stated that they have redesigned release valve spindle(modified push rod) to address this issue.

– They have supplied modified push rod to ELS/AQ-75nos., ELS/RPM-75nos., ELS/LGD-75 nos., ELS/SRC-50nos, ELS/BIA-60, ELS/BSL-22, ELS/GZB-60, ELS/TKD-50, ELS/BRC-50 & E.Rly -50 as up to 09.04.18.
4. Pending issue of Non application brakes through DBC (A-9)

(a) **Problem:** SER reported non application of brakes through A-9 (except emergency position) during initial/full service positions.

(b) **Investigation:**
- M/s FTRTIL investigated and reported various reasons of failure related to bad workmanship during manufacturing of electronics cards like wiring/soldering, loose connection, breakage of strands of a wire etc.

(c) **Action Taken:**
- M/s FTRTIL has taken improvement measures in their existing vendor M/s Triphase and also they are trying to develop another source (M/s Avlon) for making of Electronic cards.
- M/s FTRTIL is carrying one round of field check of all E-70 brake panels’ electronic cards for any loose connection, breakage of strands in wires, setting of card in rack etc.
- M/s FTRTIL has developed SOAEB as fail safe measure wherein if BP is not dropped by A-9 in service zone then penalty brake will be applied. They have installed one SOAEB unit each in ELS/TATA in Loco no. 31658 WAG-9 and in ELS/RPM in Loco no. 30366 WAP-7 as a trial.
5. Pending issue of Reduction in BC pressure for WAP7 locos.

• As per MOM 19.12.16 M/s FTIL has to submit the detailed technical design for reducing BC pressure to RDSO by 30th Dec 2016 in view of use of composite brake block. Clearance will be given by RDSO thereafter. Consequently firm will carry out modification in 2 locos, one each at ELS/LGD and ELS/RPM on trial basis by 21st March 2017. On completion of modification, braking distance trials will be conducted to examine the adequacy of braking effort on reduced BC pressure.

• The proposal submitted by M/s FTRTIL was discussed and it was advised to resubmit the proposal with the pressure adjustable arrangement.
6. Pending issue of Air leakage from Panels

• CR and WCR reported failure cases of panel on account of air leakage before reaching the overhauling period (9 years).

• Investigation report submitted by firm revealed that premature leakage are due to ingress of moisture & dust.

• Firm has to clarify the action plan in this regard.
Other issues pending with M/s FTRTIL

• Firm has to offer new version of ILS brake system as per RDSO’s specification -126 for prototype inspection.
• Status of implementation of EP assisted brake system as per new spec-0138.
• Supply of spares to ZR’s.