SPADs and human factors

Introduction

This document provides information on the human factors issues associated with signals passed at danger and guidance on how these issues can be addressed.

A Signal Passed At Danger (SPAD) refers to any signal that is showing the train driver he or she should not proceed any further but the train still passes the signal. Since 1996 the number of SPADs has been dropping, due to industry awareness and local and national initiatives to bring the numbers down and therefore improve safety on the rail network.

Case study

The SPAD at Chester on 12th June 2003 highlighted some of the key human factors associated with this issue. The SPAD resulted in an overrun of approximately 1.5 miles by a First North Western Service. The seriousness of this overrun was exacerbated by the fact that the train was travelling - incorrectly - in the wrong direction over the Down Main line. HMRI's investigation revealed that the SPAD arose as the result of a combination of circumstances:

- A track circuit failure that prevented a route being set automatically from Chester Station towards the Up Main line
- Poor communication between driver and signaller
- both of whom were relatively inexperienced
- The failure by the signaller to set the correct route manually
- Poor route knowledge of the driver resulting in a failure to locate the Limit of Shunt signal
The SPAD was made worse by the time taken by the signaller to relay an emergency stop message to the driver by means of the National Radio Network (NRN). It was fortunate that no other train was approaching Chester on the Down Main line at the time of the incident.

**Issues**

**Why do SPADs occur?**

Contributing factors to the occurrence of a SPAD can include:

- A lack of infrastructure maintenance
- Poor signal sighting design
- Poor train cab design and layout
- Operational management decisions, for example design of rosters and duty diagrams
- Insufficient or ineffective training design and competence management
- Low track adhesion

A high proportion of SPADs are attributable to human causal factors. This is not surprising as the task of train driving and operation of the railway relies heavily on humans interacting with the equipment and each other. Safety systems and driver vigilance devices such as ATP (Automatic Train Protection), AWS (Automatic Warning System), TPWS (Train Protection and Warning System) and DRA (Driver’s Reminder Appliance) have been introduced to help prevent SPADs or mitigate against the effects of a SPAD. However, the driving task is still essentially a human one. It is difficult for any human to complete the driving task, day in day out, without ever making an error.

Some examples of the many underlying human factors influences on the likelihood of a SPAD occurring are described below:

- Although the driver sees the red signal and correctly identifies that it applies to them they then make the assumption that the signal will change to a less restrictive aspect before they get to it. Assumptions like these are made as a result of the driver's past experience of driving on that line.

  - When starting away from a location (typically a station) the driver forgets to check the signal before moving off, immediately resulting in a SPAD. This may occur due to a number of contributing factors:
    - The driver forgets to check the signal
    - The driver is given conflicting information from other staff
    - The driver is distracted by events happening in the driving cab or outside the train such as a passenger slip at the platform/train interface
    - Environmental conditions such as poor lighting or adverse weather
- When a number of signals are displayed in one location the driver may select a signal that is inappropriate for their track. Contributory factors to this type of
SPAD include the signal's position in relation to the line the driver is travelling on and the drivers' route knowledge.

- The drivers' task has become more monotonous over recent years, partly as a result of limited routes and little variation in the type of rolling stock being used. Other factors include the improvement in driving conditions (more comfortable cabs) and standardisation of cab equipment. The driver's attention may therefore wander away from the task and be diverted for long enough to miss a signal when it is within their potential visual field, for example when a fault occurs on the train.

- Poor communication between the driver and signaller can also cause SPADs, particularly in engineering sites ('possessions'), in railway yards and sidings. The failure of the driver and signaller to come to a clear and complete understanding then results in the driver believing that it is safe to proceed through a red light.

- Environmental conditions including background noise, the thermal conditions inside the cab and the weather. Lighting conditions (fog, sun, rain, snow for example) can distort brightness, contrast and the driver's perception of distance.

- Stress and tiredness can reduce the driver's ability to concentrate. Stress may be caused by events at work or at home, such as a death in the family, coupled with lifestyle factors (sleep patterns, diet, general health).

RSSB have prepared a database of these and many other common factors in SPADs (see Further Information for details).

What can be done to reduce the number of SPADs?

The National SPAD Focus Group (NSFG) has recommended a number of human-centred approaches to minimising the occurrence of SPADs, grouped under the following headings:

**Safety critical communication**

With any safety-critical information it is vital that the message being relayed is clearly understood. This is particularly important for communication between drivers and other railway staff (mainly signallers and hand-signallers) to avoid SPADS - and also for protection of the line when a SPAD has occurred. Practice in this area now includes:

- Keeping the message clear by avoiding the use of jargon, keeping the message short and simple
- Always ensuring that the message is fully understood by the other parties by asking them to repeat back what has been said
- Use of the phonetic alphabet when describing signal numbers, locations etc
- Always confirming who the other party involved in the communication is and ensuring that it this is the right person with the right level of authority
- Only using authorised communication systems - signal post telephones or cab-signalbox radio for example
- Encouraging individuals to always ask for clarification if there is any doubt, to remain calm and to make notes if this would assist with remembering important details later.
Professional train driving

The concept of 'professional driving' is a holistic approach to ensuring that the driver is fully aware of, and manages, all those factors that affect their performance. The approach focuses on establishing clear policies and instructions, providing the driver with the skills to handle the train effectively, the knowledge to make effective decisions and judgments (including SPAD training, lifestyle training, route & traction knowledge and an understanding of the roles of others in the operation of the railway) and finally by providing opportunities for this knowledge to be regularly updated and practised.

- **Defensive driving**
  A defensive driving approach focuses on enabling the driver to anticipate and respond to scenarios in a way that minimises the inherent risk of a SPAD. Defensive driving ensures that safety has priority over punctuality and there are many factors that can promote a defensive driving technique, including the driver’s braking technique and the strict adherence to speed restrictions.

- **Lifestyle**
  Research has shown that lifestyle factors have can have a significant effect on the performance of drivers. The industry has developed policies, training packages and support for drivers and signallers in this area, including:
    - Understanding the impact of shift work
    - Adequate rest between shifts
    - Drug/alcohol abuse

- **Driving cab discipline**
  Cab discipline focuses on the working environment of the driver, including potential distractions. There are many factors that challenge a driver’s cab discipline and again the industry has been working to make improvements in this area including:
    - Not permitting unauthorised people and/or articles in the cab
    - Ensuring that unnecessary tasks and/or communication does not take place whilst driving
    - Having key documents in a convenient location

- **Route and traction knowledge**
  Route knowledge is central to ensuring that drivers are fully aware of, and understand the implications of the general characteristics of the routes over which they will drive, the specific SPAD risks and any other significant risks that may be encountered. A number of aids are available for drivers to gain knowledge about the traction type and of the routes over which they will be operating:
    - Hands on experience of the traction type
    - Full motion driving simulators
    - Desktop computer-based simulation or information packages
    - Company route maps
Further information

- ORR’s HM Railway Inspectorate quarterly SPAD Reports
- SPADWEB
  The website of the rail industry's National SPAD Focus Group
- RSSB SPADs National Initiative
- London Underground SPAD information