LSM TECHNOLOGIES

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Discussion Paper – Draft Vehicle Fire Safety: Part 1 – Bus Standards.

This paper provides an overview of the draft proposal, with particular emphasis on the inclusion of TMSystems, which represents a significant and positive advancement in enhancing fire detection, suppression, evacuation, and maintenance requirements for buses operating under Transport for NSW (TfNSW) contracts.

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1. EXECUTIVE SUMMARY.

The **Draft Vehicle Fire Safety- Part 1: Buses** standard represents a substantial and positive step forward in strengthening fire detection, suppression, evacuation, and maintenance requirements for buses operating under Transport for NSW (TfNSW) contracts.

However, the Draft does **not explicitly recognise Tyre Pressure Monitoring Systems** (including over-temperature alerting) as a **primary fire- prevention control**, despite TMSystems (TMSystems- Tyre Monitoring Systems- incorporates **pressure** and **temperature**) having been:

- Mandated and implemented in TfNSW bus procurement specifications since approximately 2017, and,
- Introduced specifically to mitigate wheel- end, brake, and tyre- origin fires following real incidents, industry advisories and international safety research.

The current low incidence of wheel- end / tyre fires since TMSystem roll- out implementation in 2017, which should be understood as evidence of **successful prevention**, not as evidence that the underlying hazard has disappeared.

The Draft standard risks unintentionally eroding institutional safety knowledge by omitting an effective upstream mitigation control.

This discussion paper is limited to TMSystems as a fire risk mitigation control. Accordingly, fire suppression systems for the engine, battery, and other mitigation measures are not discussed, as they are addressed in the ***Draft Vehicle Fire Safety – Part 1: Buses***.

In addition this discussion paper should be read in conjunction with our ***TB- 0019- Safety Outcomes OTSI 2015- 2024- TfNSW mandate TMS (BC1718562) v1 09012026*** that analyses the OTIS Reporting of the TfNSW **Bus Engine Fire Suppression** and **Tyre Monitoring System** mitigation control implementation.

2. BACKGROUND: REPORTED BUS FIRE EVENTS THAT TRIGGERED ACTION (2012–2016).

Between approximately **2012 and 2016**, NSW and other Australian jurisdictions experienced a series of **publicly reported bus fires**, several of which were identified in media and safety commentary as originating in **wheel- ends, brakes, or tyre assemblies**.

These incidents were characterised by:

- Limited early warning to drivers.
- Rapid escalation once ignition occurred.
- Occurrence during in-service operation (including on motorways) and
- Significant public, operational, and political impact.

3. KEY REPORTED EXAMPLES (INDICATIVE, NOT EXHAUSTIVE).

As already mentioned the following event examples is limited to TMSystems. Accordingly, fire suppression systems for the engine, battery, and other mitigation measures are not discussed.

3.1 Sydney Harbour Bridge Bus Fire.

- Sydney Harbour Bridge, NSW.
- Approx. date: August 2016.
- Reported origin: Wheel / brake / wheel-end area.
  - ABC News (NSW).
  - Sydney Morning Herald.

Significance:

The incident occurred on nationally critical infrastructure, prompted emergency closures, and elevated bus fire risk to a whole- of- government concern.\

3.2 Kiama Region Bus Fire.

- Kiama, NSW.
- Approx. date: Late 2014- early 2015.
- Reported origin: Wheel well / tyre area.
  - 9News Article.

Significance:

Demonstrated that wheel-end fire risk was not limited to metropolitan fleets and featured prominently in industry safety discussions.

3.3 Pacific Highway / M1 Motorway Bus Fires.

- NSW arterial and motorway network.
- Approx. dates: 2012- 2016 (multiple incidents).
- Reported origin: Rear axle / dual tyres / brakes.
  - 9News Article.

Significance:

Reinforced the link between high-speed operation, heat build-up, and wheel-end fire risk.

These and similar incidents created a clear pattern that wheel- end and tyre- origin failures were a **systemic ignition risk**, not isolated maintenance anomalies.

4. INDUSTRY AND INTERNATIONAL SAFETY DRIVERS.

Key industry and international drivers supporting the implementation of TMSystems are outlined below:

4.1 BIC Fire Mitigation Advisory (2014).

The Bus Industry Confederation (BIC) initiated and commissioned the Fire Mitigation Advisory (2014) in response to:

- A rising number of serious bus fires nationally.
- Requests from operators, insurers, and state transport agencies for authoritative guidance.

4.2 Funding and Governance.

- Commissioned and funded by BIC through industry resources.
- Developed with input from operators, OEMs, safety specialists, and state agencies.
- Not vendor- sponsored.

4.3 Key findings Relevant to Submission.

- Wheel- ends, brakes, and tyres were identified as a dominant fire ignition source.
- Prevention required early detection of abnormal conditions (thermal events), not reliance on suppression alone.
- Tyre Monitoring Systems (TMSystems) were identified as an effective mitigation measure, particularly for rear axles, dual- tyre configurations and high- speed operations.

4.4 NHTSA Motorcoach Fire Safety Final Report (November 2015).

The **US National Highway Traffic Safety Administration (NHTSA)** published its *Motorcoach Fire Safety Final Report* (DOT HS 812 213) in November 2015, concluding that:

- A significant proportion of motorcoach fires originate in wheel- well and brake areas.
- Prevention and early detection (thermal events) are critical complements to fire suppression and evacuation strategies.
- This report was influential internationally and provided a strong evidence base for preventative approaches adopted in Australia.

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4.5 International Alignment: UNECE R141 / EU (EU) 2019/2144 now includes buses (M2/M3).

- Internationally, UNECE Regulation No. 141 explicitly applies to M2 and M3 vehicles (buses/coaches) (in addition to other categories).
- The EU's General Safety Regulation (EU) 2019/2144 is the umbrella framework under which mandatory TMS**ystem** fitment has expanded beyond passenger cars, including M2/M3 buses in the current regulatory rollout.

4.6 Australia is actively considering mandating TMSystems (TMSystems) aligned to UNECE R141.

- In Australia, industry consultation has been underway on mandating **TMSystems**, with the Federal Department (vehicle standards) canvassing the prospect of a mandate and industry bodies circulating a **TMSystems** consultation paper focused on UNECE R141 requirements.

4.7 Note on Pressure vs Temperature (and why TfNSW is already ahead).

- UNECE R141 is fundamentally a pressure monitoring regulation (warning on pressure loss / thresholds).
- However, TfNSW's procurement specifications have already gone further by requiring T**MSystems** with over- temperature alarm, which is directly relevant to wheel- well thermal / fire precursors.
- This makes it even more appropriate that the Draft bus fire standard explicitly calls up **TMSystems** as a fire prevention control**-** because TfNSW already requires it, and it targets ignition precursors.

5. NSW GOVERNMENT AND TFNSW RESPONSE (2016–2017).

The NSW Government, through **Transport for NSW (TfNSW)** and its bus delivery agencies, initiated a **centrally directed, fleet- wide fire mitigation program**.

In response to:

- Reported bus fire incidents,
- The BIC Fire Mitigation Advisory (2014) and
- International safety research (including NHTSA 2015),

This program was:

- Supported at Ministerial level (Transport portfolio),
- Implemented by TfNSW and government-contracted operators and,
- Delivered through contracted and mandated requirements, not discretionary operator choice.

6. OTHER TMSYSTEMS DRIVERS.

There are many other such safety drivers in Australia (and internationally) that are calling for (or have already implemented) TMSystems to be mandated- for example:

- Every Passenger vehicle manufactured in **the world** is no**w** manufactured (mandatory) with TMSystem technology.
- ARTSA- I have called for TMSystems to be mandated in Australia on all heavy vehicles and aligned with the UNECE R141
- Various Industries such as the CICA for Cranes, Mining OH+&S Regulators have established standards and guidelines for the use of TMSystems for mitigation controls- see this link to Compliance Standards and Guidelines.

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7. 2017 TFNSW BUS FLEET-WIDE MITIGATION ROLLOUT

From approximately **2017**, TfNSW mandated the fleet-wide fitment of two complementary safety technologies:

- Automatic engine fire suppression systems:
  - Intended to control fires after ignition and support safe evacuation.
- Tyre Monitoring Systems (TMSystems)- including over-temperature alerting:
  - Intended to detect abnormal tyre pressure and thermal conditions.
  - Intended to prevent wheel- end and tyre fires **before ignition occurs**.

These technologies were deliberately implemented as **different layers in the fire- risk causal chain**:

- Suppression = consequence management.
- TMSystem = ignition prevention.

8. TMSYSTEM EMBEDDED IN TFNSW AND NSW FRAMEWORKS.

Since the **2016 / 2017** rollout, TMSystems have been embedded in multiple TfNSW and NSW instruments, including:

- TfNSW Bus Panel **s**pecification No3.
- TfNSW Bus Panel specification**s No4**, which include explicit TMSystem requirements and over-temperature alarm call-ups.
- NfNSW TMSystems Standard- BC17/18562 on Buses to mitigate (rear wheels only) Tyre and Wheel Well Fires.
- TfNSW Bus Thermal Ignition Mitigation Member information / directive for TMSystem roll- out.
- TfNSW publication **Safety Features and Technologies for Heavy Vehicles (2024)**, which:
  - Defines TMSystem and its in- cabin alerting role.
  - Identifies wheel temperature monitoring as relevant to fire risk.
- TfNSW incident reporting frameworks that capture TMS fitment and activation.
- NSW Vehicle Standards Information (VSI) No. 9, which mandates TMSystems for vehicles fitted with run-flat tyres.

This demonstrates that TMSystems are already recognised within TfNSW and NSW as a **safety- critical system**, not an optional or experimental technology.

Please note: Following tyre incidents caused by low tyre pressures, TMSystems were recognised by TfNSW as a proven in-cabin warning solution for tyre pressure loss and its consequences.

As a result, in 2022 TfNSW updated the Bus Panel **s**pecification No3**,** Bus Panel specification**s No4 and BC17/18562** to include TMSystem Sensors for **ALL Wheel / Tyres.**

9. ACTUAL FIRES VS THERMAL EVENTS (OTSI REPORTING- DERIVED).

The following table provides for analysis of the OTSI Bus Fire Safety Report Reports from 2015 to 2023 / 2024, noting reported data indicates that:

- “Fires” = confirmed flame events
- “Thermals” = heat / smoke without flame / fire ignition
- From roll- out implementation of TMSystems in 2017 onward, OTSI reporting consistently records wheel- end events as **thermal only.**
- Engine Fires still seem to be significant.

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Year	Wheel / Brake / Tyre Fires	Engine-Bay Fires	Wheel / Brake / Tyre Thermals
2015	17	16	–
2016	8	18	~40
2017	**~5**	**~10**	**~45**
2018	1	~11	~58
2019	0	~15	~59
2020	0	~12	~43
2021	0	~10	~90
2022	0	~9	~95
2023	0	~12	~102

Table 1- **Wheel / Brake / Tyre Events – Thermals Vs Fires (2015–2023)**

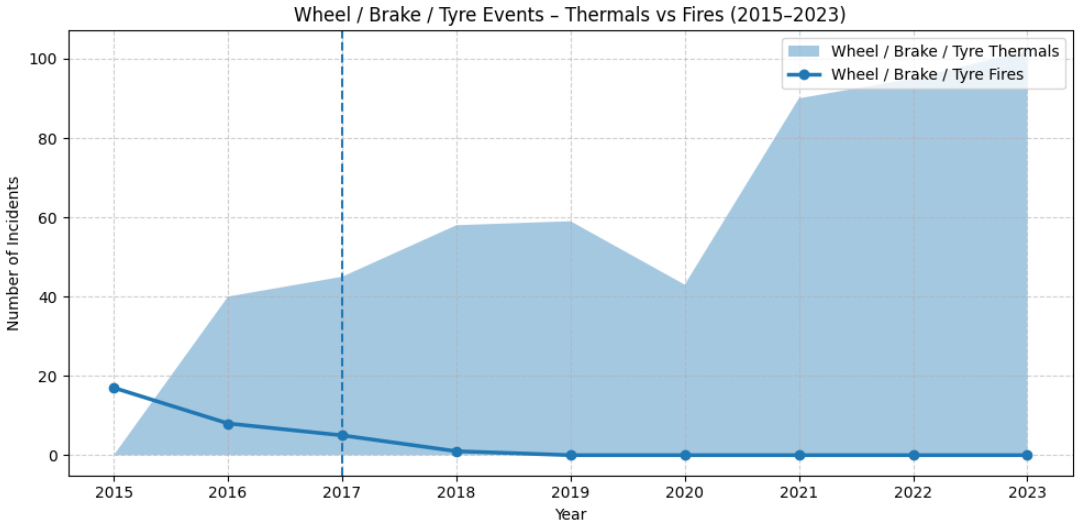

Figure 1: Wheel / Brake / Tyre Events – Thermals Vs Fires (2015–2023)

10. ISSUE IDENTIFIED IN THE DRAFT VEHICLE FIRE SAFETY- PART 1: BUSES.

The Draft standard:

- Provides strong coverage of detection, suppression, evacuation, and maintenance, but
- Does not explicitly reference TMSystems as a fire-prevention control.

This omission is likely the result of **success bias**:

- Wheel- end / tyre fires are now rare (have been eliminated).
- Many incidents are captured as thermal anomalies rather than fires.

This outcome aligns with the original intent of the 2017 mitigation program and should be recognised as evidence of effectiveness, not as justification for omission.

11. ADDITIONAL CONCERN - OMISSION AND THE RISK OF COMPLACENCY.

A further concern we wish to highlight is that TMSystems activations and performance are not being consistently captured in mandated incident reporting, and that TMSystems is not being explicitly recognised in some emerging safety documentation and consultation material.

The current OTSI Bus Fire / Thermal Incident Information Collection Form captures whether an incident is classified as a fire or thermal event, the attributed cause category (e.g. brakes, tyre) and includes a specific question regarding whether the engine bay fire suppression system worked effectively (if activated).

However, it does not include structured fields to record TMSystems fitment, alarm type (e.g. over-temperature, pressure loss / increase, fast leak), alarm acknowledgement or silencing, wheel position, or whether TMSystems event data was preserved or downloaded for analysis.

This creates a systemic visibility gap: the industry risks losing sight of the upstream prevention layer precisely because it is effective, while downstream suppression systems remain explicitly reported and analysed.

11.1 Thornton (2017) Remains the Clearest Case Study.

The OTSI Bus Fire Investigation – Thornton, NSW (16 October 2017) provides a clear and well-documented example of the consequences that can arise when TMSystems alarms are not treated with urgency or when drivers are not adequately trained in their operation.

In that event, OTSI recorded that an audible alarm from the dash- mounted TMSystems sounded, the driver continued driving and manually silenced the alarm, and the fire subsequently initiated within the offside rear wheel well.

OTSI also found that the driver had not received training in the function and operation of the TMSystems (or EBFS), despite the system performing as designed and providing adequate warning.

OTSI's recommendations following this investigation emphasised the need to reinforce the urgency of responding to alarms and to ensure initial and recurrent driver training incorporates the correct response to all safety systems fitted to the bus.

11.2 Why Explicit Recognition in Standards Matters.

If TMSystems is not explicitly addressed in standards and mandated reporting- particularly for wheel- end, brake and tyre thermal incidents- there is a risk that institutional knowledge erodes, training focus diminishes and a form of success- bias complacency develops over time.

This creates the conditions for preventable wheel- end fire events to occur or reoccur, not because the technology has failed, but because its importance has been implicitly downgraded through omission.

Recognising TMSystems as a primary fire- prevention control in standards and reporting frameworks is therefore not optional- it is a necessary safeguard against regression.

12. RISK CREATED BY OMISSION.

If TMSystems are not explicitly recognised in the Draft standard, there is a risk of:

- Loss of institutional knowledge regarding why TMSystems was mandated.
- Misalignment between TfNSW procurement requirements and fire safety standards.
- Over- reliance on post- ignition controls.
- Gradual erosion of a proven preventative layer as standards evolve.
- Recurrence of Wheel end/ Tyre related fires.

13. REQUESTED AMENDMENT (MINIMUM).

It is recommended that the Draft **Vehicle Fire Safety- Part 1: Buses** standard explicitly recognise TMSystems as a primary fire-prevention control.

13.1 Suggested Clause Text.

Tyre and wheel-end fire prevention (TMSystems):

"*Buses shall be fitted with a Tyre Monitoring System (TMSystems), consistent with TfNSW bus procurement specifications, incorporating over- temperature / low (and high) pressure alarm capability where specified.*

The system shall provide in- cabin warnings for abnormal pressure and temperature conditions, support event recording for maintenance and incident analysis, and be inspected, tested, and maintained in accordance with TfNSW requirements and manufacturer instructions."

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14. CLOSING STATEMENT.

TMSystems was introduced into TfNSW bus fleets deliberately, following real fire events, independent industry analysis, and government-level safety decisions.

Its effectiveness has reduced the visibility of wheel- end and tyre- origin fires.

The **Draft Vehicle Fire Safety- Part 1:** Buses standard should preserve this preventative intent by explicitly recognising TMSystems, ensuring continuity of safety outcomes and alignment with existing TfNSW, other Industries and national practice.

Much more evidentiary documentation can be provided to support the implementation of TMSystems.

More information and links to compliance guidelines, news articles, etc, can be found at these references to our web site sections.

- LSM TyreGuard® **TMSystems.**
- Links and References.