SIESO medal

Boksburg LPG tanker blast — a detailed analysis of the tragic chain of events and safety insights

Princess Diana Dube, University of Johannesburg, South Africa

Summary

Liquefied Petroleum Gas (LPG) is a widely used fuel source across different industries and residential applications, making its safe transportation crucial for energy supply chains. However, the risk of LPG explosions during transit poses significant threats to public safety, infrastructure, and the environment. The Boksburg LPG tanker explosion served as a stark reminder of the associated risks, emphasising the importance of operational Hazard Identification (HAZID) measures to prevent similar disasters. The incident which happened on 24 December 2022, in Boksburg, South Africa, resulted in devastating consequences, including fatalities, injuries, and extensive property and infrastructure damage. This study aimed to create a comprehensive loss prevention infographic that identifies potential hazards associated with LPG transportation. The incident highlighted several key lessons: the necessity of assessing infrastructure and ensuring clear road signage, proper route navigation and adherence to regulations, the need for vehicles to be suitable for specific road conditions, and the critical role of regulatory enforcement in preventing accidents. It is hence recommended to use clear signage or height clearance indicators and assign designated routes for hazardous material transportation.

Keywords: Liquefied Petroleum Gas (LPG); explosions; hazardous material transportation; Hazard Identification (HAZID)

Event description

Date: 24 December 2022

Time: Approximately 06:15

Location: Boksburg, Gauteng, South Africa. Under a bridge on the N17 highway, enroute from Richards Bay to Botswana.

Detailed account of the accident

On 24 December 2022, a tanker exploded in the vicinity of Boksburg, South Africa, while transporting 60,000 litres of LPG gas from one of the facilities of Sasolburg in Richards Bay to Botswana[1, 2, 3]. The driver mistakenly took the wrong exit from a truck stop to get onto the N17 highway, which led him under a bridge with illegible height restrictions[2]. After assessing and confirming whether the truck could pass under the bridge, the driver proceeded cautiously; however, an incline at the bottom of the bridge raised the back of the trailer. The truck got stuck under the bridge around 06:15am, and it ignited into a massive boiling liquid expanding vapour explosion approximately 30 minutes later, leaving ten immediately confirmed dead and forty injured[3]. Two smaller explosions followed the blast, drawing onlookers. Then, at around 07:30am, the final massive blast struck, causing many casualties. The explosion impacted buildings within a 400m radius of the epicentre, and people felt the tremor from 4km away[4]. Figure 1 shows the images of the incident from when the truck got stuck under the bridge, during the explosion, the affected area and the aftermath of the accident.

Immediate actions taken

At approximately 06:15am, the truck got stuck under the bridge, causing damage to the gas tanker and releasing liquefied petroleum gas. Upon hearing a metal scraping sound, the driver stopped the vehicle and inspected it, he found that the tanker's cap had been scraped off[2]. The driver immediately contacted his ISS (Innovative Staffing Solutions) controller and the fire department to report the incident and the gas leak[2]. He quickly cordoned off the area and warned the public, motorists, and passersby to evacuate. A security vehicle soon arrived to assist, and together they secured the scene with safety tape.

Investigation and findings

The investigations into the Boksburg LPG explosion revealed critical insights into the events leading up to and following the incident and highlighted several areas for improvement in safety measures and regulatory oversight.

Cause of the explosion

The investigation revealed that the driver had seven years of experience transporting LPG gas and had adhered to all required safety and transit protocols. However, the explosion was caused by damage to the tank, which occurred when the vehicle attempted to pass under the bridge[4]. The driver had assessed the possibility of driving through the bridge; however, he overlooked the incline on the road under the bridge, which raised the trailer, pressing it onto the roof.

Community impact

Casualties

Ten people were immediately killed during the explosion, while others succumbed before the arrival of paramedics, and others died later[6]. An article from the Daily Maverick reported that 37

0260-9576/25/$17.63 + 0.00

Figure 1 – a) LPG tanker stuck under bridge before explosion, b) during the explosion, c) the affected surrounding area, d) after the explosion

a) Image: Supplied[5]

b) Photo via X(Twitter): @TheQuint

c) Estimation of thermal radiation effects due to Explosion. Image: Google Earth

d) Image: smilefm.co.za

people, including 24 patients and 13 hospital employees at OR Tambo Memorial Hospital, sustained severe burns and were diverted to neighbouring hospitals. The eNCA reported that the death toll rose to 41 people as of 18 January 2023.

Impact on infrastructure

The explosion destroyed two nearby houses and several cars, including a fire vehicle that was attempting to extinguish the fire, and most properties in the sphere of influence were severely damaged[5]. The railway bridge underneath which the explosion occurred was also damaged, affecting the Germiston-Springs and the PRASA railway lines.

Lessons learned

Importance of height clearance awareness and infrastructure assessment

The incident underscores the necessity for clear and visible height restriction signage on all bridges, especially in areas frequented by heavy vehicles. The case pointed out the issues with infrastructure, specifically a bridge with illegible height restrictions and an incline that caused the truck to get stuck. Drivers must be notified of the potential hazards related to low-clearance structures[7]. A clearance object, like a wooden, plastic, or rubber bar that won't damage vehicles, could be suspended across the road just before bridges to measure the maximum allowable height, such as the one shown in Figure 2. Regular assessments of infrastructure integrity concerning potential industrial accidents should be conducted[8, 9], and this can be done by assessing the road conditions and putting clear signage especially when there are humps and height restrictions.

Figure 2 – Signage and height clearance.

0260-9576/25/$17.63 + 0.00

Importance of navigation, route planning, and compliance

Drivers should receive training in comprehensive route planning, ensuring they establish contingency plans and strictly follow procedures[10]. The incident highlighted the critical need for meticulous route planning for dangerous goods transportation, especially considering vehicle dimensions and infrastructure limitations, as the driver taking a wrong exit contributed to the truck getting stuck under the bridge. Practitioners of dangerous goods, such as LPG truck drivers, can suffer from a lack of professionalism, improper operation, and an insufficient ability to deal with accidents[11]. The accident highlighted the deadly risks of driver misjudgements or deviations from planned routes, emphasising the critical need for properly qualified drivers who strictly adhere to operating procedures[12]. Authorities are advised to designate specific routes for transporting hazardous goods like LPG to reduce associated risks.

Vehicle suitability and operation

The incline in the road lifted the trailer's back, causing the truck to become stuck, indicating issues with the vehicle's design and its interaction with the road's geometry. This incident underscores the need for vehicles to be both well-maintained and properly suited to the specific routes they will navigate. Therefore, vehicle engineers must account for these technical factors in their designs[11].

Inter-stakeholder communication and coordination, and public safety

Improved communication between legitimate stakeholders can enhance safety. The incident involved multiple stakeholders: the transport company (ISS), the infrastructure authorities, the consignor/consignee, emergency services, and the public. The lack of clear height restriction information, the delay in effective emergency response coordination, leading to onlookers remaining in a danger zone, and the driver's wrong turn point to gaps in information flow and coordination[11]. These incidents advocate for better coordination, as it is possible that multi-departmental management can suffer from a lack of synergy and inability to share information. Additionally, it highlights the need for seamless communication and coordinated action among all relevant parties involved throughout hazardous goods transportation, including emergency response services and the public[11, 12]. Furthermore, the case clearly shows the devastating outcome when rapid containment, area lockdown, and public evacuation protocols are not effectively implemented after an initial incident involving hazardous goods like LPG.

Regulatory oversight

The investigation findings suggest a need for improved regulatory oversight regarding the transportation of hazardous materials. This includes ensuring compliance with safety standards and conducting regular inspections of vehicles and routes used for transporting dangerous goods[13]. Companies must follow the legal framework, authorities to strengthen the improvement and updating of laws and regulations, establish professional enforcement teams and implement stricter law enforcement[11]. The tragedy underscores the real-world consequences when regulatory gaps or enforcement weaknesses allow unsafe practices or conditions to persist.

Conclusion

The Boksburg LPG explosion has provided invaluable insights that can guide the development of more robust safety measures and regulations. By implementing these lessons learned, we can work towards minimising risks and preventing future tragedies related to the transportation of hazardous materials, thereby enhancing public safety and protecting communities.

References

1. *Al Jazeera, 2022. The death toll in the South Africa fuel tanker explosion rises to 15. Al Jazeera. 25 Dec.*
2. *Kgosana, R., 2022. Driver tried 'everything in his power' to prevent casualties in Boksburg explosion: report. Times Live. 29 Dec.*
3. *Mahlangu, I., 2022. Boksburg explosion: tanker driver arrested. Sowetan Live. 25 Dec.*
4. *Eligon, J., 2022. Fuel Tanker Wedged Beneath Overpass Explodes Near Hospital in South Africa. The New York Times. 24 Dec.*
5. *Pheto, B., 2022. Boksburg woman counts her losses from gas tanker explosion. Times Live. 29 Dec.*
6. *Watling, T., 2022. At least 10 dead after explosion destroys South African hospital as chilling screams heard. Daily Express. 24 Dec.*
7. *Maghiar, M., Jackson, M., Maldonado, G. and University, G.S., 2017. Warning systems evaluation for overhead clearance detection : final report. [online] https://doi.org/10.21949/1503647.*
8. *Mensah, E.A., 2021. Assessment of Risk from Liquefied Petroleum Gas (LPG) Filling Stations in the Accra Metropolis and Its Implications for Land Use Planning. [online] Available at: <http://ir.ucc.edu.gh/jspui/handle/123456789/10775> [Accessed 31 October 2024].*
9. *Farouq, A.A. and Al-Obaidi, B.H.K., 2022. Sustainability in the design of liquefied petroleum gas systems used in buildings. Journal of the Mechanical Behaviour of Materials, [online] 31(1), pp.248– 255. https://doi.org/10.1515/JMBM-2022-0027/MACHINEREADABLECITATION/RIS.*
10. *Liao, X., Zhou, T., Wang, X., Dai, R., Chen, X. and Zhu, X., 2022. Driver Route Planning Method Based on Accident Risk Cost Prediction. Journal of Advanced Transportation, [online] 2022(1), p.5023052. https://doi.org/10.1155/2022/5023052.*
11. *Deng, A. and Sun, T. (2023) 'Comparative Study on the Management of Domestic and Foreign Road Transport of Dangerous Goods', World Journal of Research and Review (WJRR), 16(5). Available at: https://doi.org/10.31871/WJIR.16.5.12.*
12. *Vojinovi, N., Sremac, S. and Zlatanovi, D. (2021) 'A Novel Integrated Fuzzy Rough MCDM Model for Evaluation of Companies for Transport of Dangerous Goods', Complexity, 2021(1). Available at: https://doi.org/10.1155/2021/5141611.*
13. *Solanke, B., Onita, F.B., Ochulor, O.J. and Iriogbe, H.O., 2024. The impact of artificial intelligence on regulatory compliance in the oil and gas industry. International Journal of Science and Technology Research Archive, [online] 7(1), pp.061–072. https://doi.org/10.53771/IJSTRA.2024.7.1.0058.*

0260-9576/25/$17.63 + 0.00