

**PERFORMANCE TESTING OF A FAIL-SAFE (SAHR) BRAKING SYSTEM
ON ISUZU NPS81 FOR UNDERGROUND MINING OPERATIONS**

By

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STATEMENT BY THE AUTHOR

I hereby declare that this submission is my own work and to the best of my knowledge, it contains no material previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at any educational institution, except where due acknowledgement is made in the thesis.



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ABSTRACT

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The operation of Isuzu NPS81 trucks in the underground mining environment of PT ABC requires a braking system with a high level of reliability, given the extreme field conditions and the critical safety risks involved. Operational data and on-site observations revealed several instances of delayed braking response, particularly when the engine was turned off, hydraulic pressure was low, or operators encountered emergency situations. Such conditions may lead to uncontrolled vehicle movement, posing significant danger to the operator and disrupting production flow and operational continuity at PT ABC.

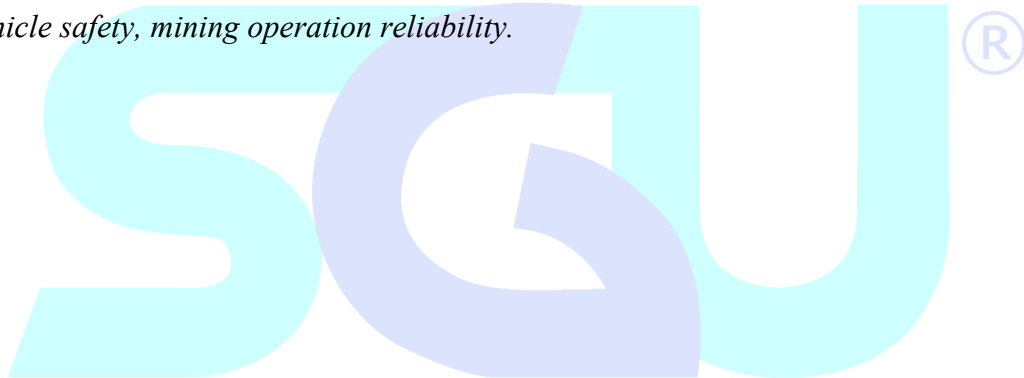
To address these issues, this study focuses on the development of a *fail-safe braking concept* as an additional safety feature designed to enhance the reliability of the existing braking system. The concept operates on the principle of automatic brake engagement when hydraulic pressure is lost or when the vehicle is in a high-risk condition, ensuring that the braking mechanism remains active without relying solely on operator input.

The research method includes a technical review of the existing braking system, mechanical and electrical installation processes, and a series of field tests comprising flat-ground tests, ramp tests, stall tests, and brake-dyno assessments. The test results demonstrate a significant improvement over the OEM system, particularly on gradients of approximately 30°, where the vehicle was able to stop and maintain its position

without brake-pedal input. Additionally, stopping distances under operational-speed tests remained below one meter and exhibited consistent performance throughout a monitoring period of more than three months.

These findings indicate that the implementation of a fail-safe braking system can strengthen the safety layers of the existing configuration, reduce the likelihood of human error, and support the business continuity of PT XYZ in sustaining mining operations at PT ABC. For further development, this study recommends integrating the system with interlock sensors (door, seat belt, and hydraulic-warning sensors) and conducting long-term evaluations related to maintenance and durability to enhance overall system reliability.

Keywords: Fail-safe brake, emergency braking concept, uncontrolled movement, vehicle safety, mining operation reliability.





DEDICATION

This thesis is dedicated to:

My beloved family,

for their endless prayers, patience, encouragement, and unconditional support throughout my academic journey.

My supervisors and lecturers,

for their invaluable guidance, knowledge, and motivation that have shaped my academic and professional growth.

And to myself,

for the perseverance, discipline, and resilience in completing this Master of Management Engineering program.

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I would like to express my sincere appreciation to my thesis advisor, whose guidance, direction, and constructive feedback have been instrumental from the proposal stage through to the completion of the final report. His insights and evaluations greatly assisted me in developing a comprehensive understanding of the technical issues encountered in the field.

My heartfelt thanks also go to the management teams of PT United Tractors Site Timika and PT Freeport Indonesia for granting permission to conduct field testing and for providing the data necessary to support this research. I am equally grateful to colleagues from BP, IAMI, as well as the technicians and field operators, for their time, knowledge, and operational experience shared throughout the monitoring activities and technical discussions related to the braking system of underground mining vehicles.

I extend my deepest gratitude to my family and my wife for their prayers, patience, and constant encouragement throughout this academic journey, particularly during the challenges of maintaining a long-distance relationship. Their support has been a crucial source of strength in completing this thesis.

Finally, I wish to acknowledge all parties whose contributions could not be mentioned individually but were nonetheless significant to the success of this research. May this thesis provide meaningful insights for improving operational safety in mining environments and serve as a useful reference for future studies.

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