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ROOT CAUSE ANALYSIS OF DIESEL GENERATOR BLACKOUT DUE TO FUEL RACK MALFUNCTION ON MV SINAR SORONG

*** Didik Dwi Suharso [1], Riyandini Utari [2], Muhammad Rafi Syarifuddin Abdullah [3], Angga Dwi Mulyanto [4]**
[1,2,3]Politeknik Ilmu Pelayaran Semarang
[4]Universitas Islam Negeri Maulana Malik Ibrahim Malang

ABSTRACT

The electricity of a ship greatly depends on diesel generators, which depend on the fuel system to be effectively combusted. This study examines a ship blackout incident that was occasioned by a huge disparity in exhaust gas temperature in a diesel generator. Data were collected by observing, interviewing, documenting and reviewing the literature using a qualitative descriptive design and Fishbone diagram as a tool of analysis. The root cause of the study has been cited as failure in combustion in one of the cylinders brought about by mechanical slip in the fuel rack system. Results show that problems in the delivery of fuel, including leakages in the pipes, corrosion, stuck fuel racks, and poor monitoring cause imbalances during combustion. Such imbalances increase the exhaust temperatures causing extreme degradation of performance and resultant blackouts. To avoid the occurrence in future, ensure the stability of the generators, and minimize the loss of the economy, this paper can recommend planned preventive maintenance, stringent monitoring schedule, and thorough documentation, so that the fuel system has the best safety.

Keywords: *Diesel Generator, Fuel System, Exhaust Gas Temperature, Blackout, Preventive Maintenance.*

ABSTRAK

Listrik kapal sangat bergantung pada generator diesel, yang bergantung pada sistem bahan bakar untuk dibakar secara efektif. Studi ini meneliti insiden pemadaman kapal yang disebabkan oleh perbedaan besar suhu gas buang pada generator diesel. Data dikumpulkan dengan mengamati, mewawancarai, mendokumentasikan dan meninjau literatur menggunakan desain deskriptif kualitatif dan diagram Fishbone sebagai alat analisis. Akar penyebab penelitian ini telah dikutip sebagai kegagalan pembakaran di salah satu silinder yang disebabkan oleh slip mekanis pada sistem rak bahan bakar. Hasil penelitian menunjukkan bahwa masalah dalam pengiriman BBM, termasuk kebocoran pada pipa, korosi, rak bahan bakar yang macet, dan pemantauan yang buruk menyebabkan ketidakseimbangan selama pembakaran. Ketidakseimbangan seperti itu meningkatkan suhu knalpot yang menyebabkan penurunan kinerja yang ekstrem dan pemadaman listrik yang diakibatkan. Untuk menghindari terjadinya di masa depan, memastikan stabilitas genset, dan meminimalisir hilangnya ekonomi, makalah ini dapat merekomendasikan pemeliharaan preventif terencana, jadwal pemantauan yang ketat, dan dokumentasi menyeluruh, sehingga sistem bahan bakar memiliki keamanan terbaik.

Kata kunci: *Generator Diesel, Sistem Bahan Bakar, Suhu Gas Buang, Pemadaman, Pemeliharaan Preventif.*

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Corresponding Author:
Didik Dwi Suharso
Diploma IV in Marine Engineering, Politeknik Ilmu Pelayaran Semarang, Semarang, Indonesia
Jl. Singosari Raya No.2A, Kota Semarang, Jawa Tengah 50242, Indonesia
Email: didikdwisuharso@gmail.com

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1. INTRODUCTION

In approximately 80% of ship power systems, the primary source of electricity is a diesel-synchronous generator set that supplies the entire ship's electrical network (Tarnapowicz et al., 2023). On large passenger ships and commercial vessels, several diesel generators are located in different engine rooms and connected to a main switchboard that distributes power to all consumers on board (Ruvio et al., 2025). Many ships have several generators operating in parallel to meet power requirements and fulfill operational reliability and safety requirements (redundancy in case one unit fails) (German-Galkin et al., 2020; Michalopoulos et al., 2022). The reliability of these generators relies heavily on the optimal functioning of their supporting subsystems, particularly the fuel (Koyama & Arimoto, 2022; Onishchenko et al., 2023; Piana, 2022; Serbin, 2023), cooling (Mohammed et al., 2020; Moussa Nahim et al., 2016; Nahim et al., 2015; Rajendr Prasad, 2018; Sellers & Hawkins, 2017; Stanivuk et al., 2021), and lubrication ("Going with the Flow," 2006; Onishchenko et al., 2023; Piana, 2022; Stoliaryk, 2022; Vrolijk, 2008) systems. Among these, the fuel system plays a critical role in delivering clean and pressurized fuel to the combustion chamber, where the governor regulates the supply to maintain stable engine rotation under varying electrical loads. Any imbalance or mechanical failure within this fuel delivery mechanism can lead to incomplete combustion, severe efficiency degradation, and ultimately, a complete shutdown or blackout of the vessel's electrical grid.

Previous studies have consistently highlighted the importance of specific components within the fuel system to maintain generator stability. Fuel Oil Settling Tanks and Service Tanks are essential for storing and preparing fuel before it is used in the engine (Anantharaman et al., 2015). Purifiers and filters are critical for removing impurities from the fuel. This prevents clogging and damage to the engine components, thereby maintaining the reliability and efficiency of the fuel system (Anantharaman et al., 2015; Islam et al., 2019). Fuel pumps, including diaphragm, gear, piston, vane, and centrifugal types, are responsible for delivering fuel at the correct pressure and flow rate to the engine. Their reliability and compatibility with the fuel type are vital for the consistent operation of the engine (Islam et al., 2019; Roychoudhury & Mastanduno, 2011). These components ensure that the fuel is at the optimal temperature and viscosity for combustion. Proper temperature control is essential for efficient fuel combustion and engine performance (Anantharaman et al., 2015; Yang & Sun, 2022). Although not part of the fuel system, exhaust valves are closely related to the fuel system's performance. They need to be of high quality and well-maintained to prevent failures that can impact the engine's operation 5. They help in removing water and sediments from the fuel, ensuring that only clean fuel reaches the engine. However, while the theoretical functions of these regulatory components are well-documented in existing literature, the cascading operational effects of minor mechanical anomalies within the pump itself remain a persistent challenge in maritime engineering.

Figure 1. Diesel Generator

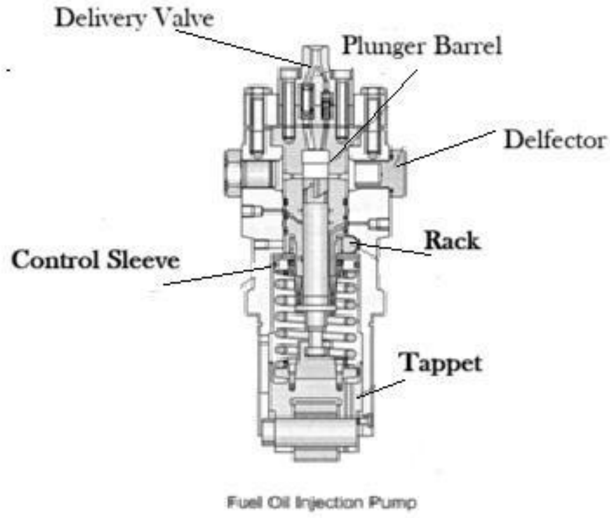

Figure 2. Fuel oil pump

Despite the large amount of literature available relating to diesel generator maintenance, there is a clear lack of comprehensive and field based case studies of the specific processes by which the failure of a single cylinder's fuel rack can result in a vessel wide blackout. This gap becomes very apparent when we look at real-life events such as the sudden blackout that took place on the MV. Sinar Sorong. In this particular case, a high exhaust gas temperature deviation in one of the cylinders was an indication of incomplete combustion; this was later found to be the result of a mechanical slip affecting the fuel supply. The inability to restart the generator was indicative of the massive effects on the entire system caused by this localized component failure showing a critical need for a deeper technical investigation to close the gap between the theory of prevention and the actual failure during operation.

To solve this particular operational problem, this research intends to investigate the blackout incident on MV systematically. Sinar Sorong. The main goal is to detect the root factors of the failure of the fuel rack in cylinder number three of the diesel generator. Furthermore, this research aims to analyze the exact effect of this localized mechanical failure on the general engine performance especially related to exhaust gas temperature deviation and overspeed condition. Finally, the study aims to develop viable preventive measures and maintenance techniques that can be implemented to prevent the recurrence of similar incidences.

The novelty of this research is focused, component-level forensic analysis of a real world maritime blackout, providing a direct link between a specific fuel rack malfunction and a disastrous systemic failure. By breaking down the series of events leading from a simple slip to a full outage of power, this study offers actionable insights that are seldom replicated in controlled laboratory environments. Ultimately, this research is expected to make significant theoretical and practical contributions as a highly relevant technical reference both for educational institutions and for ship operators who wish to improve the reliability of their diesel generator systems.

2. LITERATURE REVIEW

The reliability of these generators depends heavily on the optimal functioning of their supporting subsystems, especially the fuel (Koyama & Arimoto, 2022; Onishchenko et al., 2023; Piana, 2022; Serbin, 2023), cooling (Mohammed et al., 2020; Moussa Nahim et al., 2016; Nahim et al., 2015; Rajendr Prasad, 2018; Sellers & Hawkins, 2017; Stanivuk et al., 2021), and lubrication (Onishchenko et al., 2023; Piana, 2022; Stoliaryk, 2022; Vrolijk, 2008) systems. Fuel systems are critical for improving fuel economy and reducing greenhouse gas emissions. Efficient fuel combustion is necessary to meet stringent environmental regulations and reduce operational costs (Koyama & Arimoto, 2022; Serbin, 2023). Fuel purification techniques such as sedimentation, filtration, and centrifugation are vital to remove contaminants that can adversely affect engine performance and longevity (Onishchenko et al., 2023). Effective fuel treatment helps maintain the engine's reliability and reduces the need for unplanned maintenance (Piana, 2022). Cooling systems are essential to prevent engine overheating, which can lead to severe damage. Marine engines typically use fresh water or seawater cooling systems to maintain optimal operating temperatures (Rajendr Prasad, 2018; Stanivuk et al., 2021). Advanced cooling system models help in diagnosing and predicting faults, ensuring that engines operate within safe temperature ranges and preventing potential failures (Moussa Nahim et al., 2016; Nahim et al., 2015). Innovative cooling systems, such as those integrated with Organic Rankine Cycles (ORC), can recover waste heat from engines to generate additional power, thereby improving overall efficiency and reducing fuel consumption (Mohammed et al., 2020; Sellers & Hawkins, 2017). Lubrication systems are crucial for reducing wear and corrosion in engine components. Lubricants provide a protective layer that minimizes friction and wear, ensuring smooth operation (Stoliaryk, 2022; Vrolijk, 2008). Regular oil filtration and purification are necessary to remove contaminants that can degrade lubricant quality and engine performance. Clean oil extends the lifespan of engine components and reduces the frequency of oil changes (Onishchenko et al., 2023; Piana, 2022). Modern lubrication systems incorporate electronic control to optimize lubricant distribution and minimize consumption without compromising protection.

This helps in managing the corrosive effects of high sulfur content in marine fuels. The reliability of these generators depends heavily on the optimal functioning of their supporting subsystems, especially the fuel. Regular monitoring and maintenance of these systems are essential for preventing faults and ensuring the engine's reliability. Advanced diagnostic tools and machine learning algorithms can predict potential failures, allowing for proactive maintenance (Chin & Nazli, 2021; Kocak et al., 2023). The fuel, cooling, and lubrication systems are integral to the optimal functioning of marine generators. They collectively ensure efficient fuel use, prevent overheating, and reduce wear and corrosion, thereby enhancing the reliability and longevity of marine diesel engines. Regular maintenance and the adoption of advanced technologies in these systems are crucial for achieving sustainable and cost-effective marine operations.

3. METHODS

This research combines the use of descriptive qualitative research which seeks to describe in detail the technical phenomenon of a fuel system failure on a ship's diesel generator. This method was selected in order to reach the factual conditions that take place in the field in more detail, particularly on the basis of the experience of researchers during the implementation of the sea practice. The qualitative approach focuses on the interpretative process of data in a natural context where the researcher is the primary tool in seeking the meaning of the processes being studied. The research was undertaken on board MV. Sinar Sorong, container ship, operating both on domestic and international routes, period October 16, 2022 until October 17, 2023. The choice of this spot was due to a blackout event which is caused by damage to the fuel rack of one of the diesel generator cylinders, when the ship was loading and unloading at the port of Singapore.

The sources of research data are included primary data and secondary data. Primary data was collected from direct interviews among engine technicians and operators of the generators involved in the accident who have experienced the accident first-hand, as well as field observations of the actual condition of the fuel system and damaged components. Secondary data was gathered from technical documentation such as damage reports, photos of components and engine log records which was used to reinforce the findings in the field. Data collection techniques were carried out in the form of semi-structured interviews that were conducted to find out the technical information and experiences of operators related to the causes and impacts of damage, participatory observation of the condition of the fuel rack and diesel generator control system, and documentation in the form of photos, damage reports, and relevant engine operational data. To analyze the data, Fishbone Diagram method or cause and effect diagram was used, which is a visual tool to systematize the root causes of problems. This method was created by Ishikawa and is extensively used in engineering quality analysis to assess the correlation between the symptoms and causal factors.

In this study, diagrams have been used to classify factors causing damage into categories like man, machine, method, material and environment. This approach enables the researchers to develop a technical diagnosis and offer more focused improvement recommendations on the diesel generator fuel system on board.

4. RESULT AND DISCUSSION

1. RESULT

This research was carried out by gathering extensive data through direct observation, interviews with ship engine technicians, visual documentation and the recording of the logs of the alarm system on the diesel generators during sea practice. These combined methods gave a detailed timeline of the events leading up to the blackout. The major results of these systematic observations and field inspections are presented in the following subsections.

Figure 3. Fuel oil pump

The first signs of the fault had taken place, as the exhaust temperature increased above the normal operating range of about 370°C to a high temperature range of 420°C. This drastic increase in temperature instantly sounded a High Exhaust Gas Temperature alarm in the engine control room. Additional inspection of the visual and physical nature showed that there was a serious malfunction of the Bosch-type fuel oil pump, but it was located in the area of the fuel delivery control system. It was found that the fuel rack failed to go back to idle position after actuation, which was the direct cause of dire overfueling in the third cylinder.

After the first temperature alarm, another alarm was the console monitor showing an overspeed alarm. According to direct observations, as well as the registration of operational logs in the engine control room, diesel generator No. 2 had gone through this urgent over speed alarm and then performed an automatic shut down of the system. The information accessed in the engine monitoring system indicated that the rate of engine rotation came to a standstill of that of its nominal rate of 900 RPM and rose to about 960 RPM in less than 10 seconds. This accelerated faster than the preset overspeed trip set at 105% of the nominal speed by the manufacturer so the force on the safety system was to stop the generator entirely.

The engineering technicians carried out a process of thorough physical inspection of the affected unit after the automatic shutdown. The examination was a clear indication that the fuel rack had been mecianically stuck in the full-open position. This particular component is expected to be automatically actuated by the governor when the electrical load changes so as to increase or decrease the supply of fuel during normal operations. Nevertheless, the jammed fuel rack was not responding to the fuel shutdown commands given by the speed control system fully during the incident.

Figure 4. Fuel oil pump

To get to the bottom of the jammed rack, in-depth investigation work was carried out on the Bosch pump that was attached to the cylinder in question. This further investigation indicated as significant mechanical wear and internal failure to the Bosch injection pump itself. Specifically, technicians discovered extensively worn plunger-barrel and a severely clogged delivery valve. Ultimately, these compounding mechanical problems limited movement of the component, which resulted in incomplete combustion, and the highly localized exhaust gas temperature elevation observed in cylinder number three.

2. Discussion

The empirical findings from this case study strongly suggest that apparent minor disruptions in the fuel system components may grow rapidly into serious systemic failures if they are not dealt with in due time. To systematically visualize the root causes of this Blackout Incident based on the field inspections, a Fishbone Diagram was developed and is shown in Figure 5. This diagram identifies the particular mechanical and operational failures that led to the shutdown of the generator and some of the important aspects based on these field data are discussed in the following subsections.

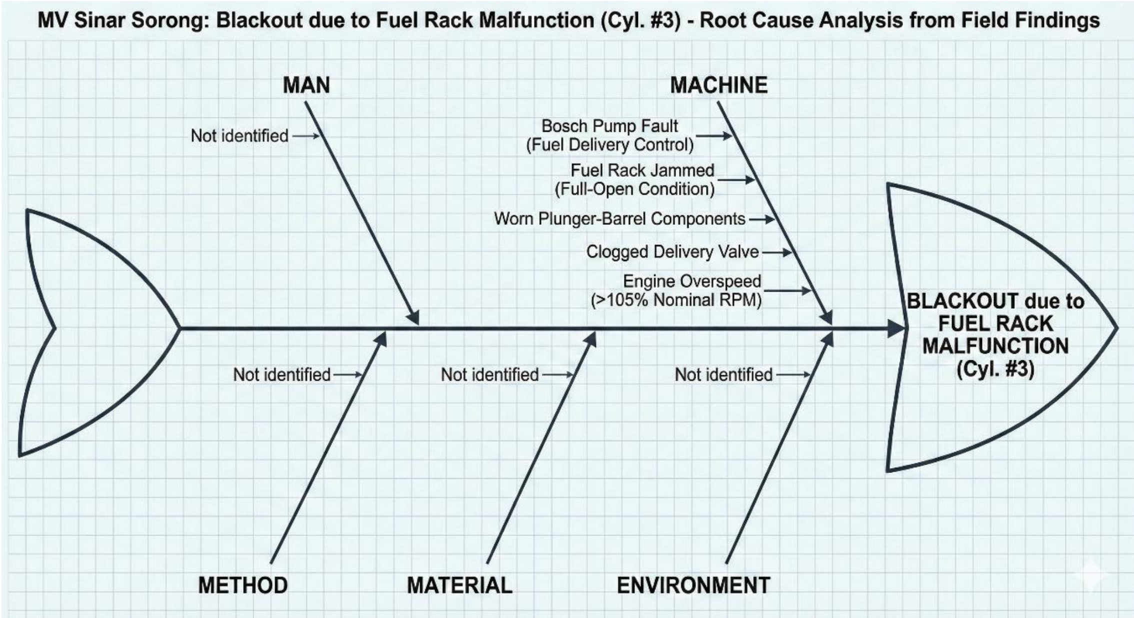

Figure 5. Fishbone
Source: Illustration using Gemini (Nano Banana Pro)

a. Correlation Between Fuel Rack and Exhaust Gas Temperature Increase
The high exhaust gas temperature that is particularly experienced in the cylinder number three is directly attributed to the mechanical failure of the fuel rack that got stuck and was unable to move to its intended idle position. Functionally, the fuel rack has the role of controlling the amount of fuel injected into the combustion chamber at any given time to the exact level as required during any given cycle of operation. In the situation when the rack is stuck in the open position, persistent overfueling takes place and the combustion process becomes overly rich and essentially incomplete. As a result, the possible chemical energy is not properly transferred to mechanical energy, but instead displays as hazardous surplus heat that causes a significant increase in the exhaust gas temperature.

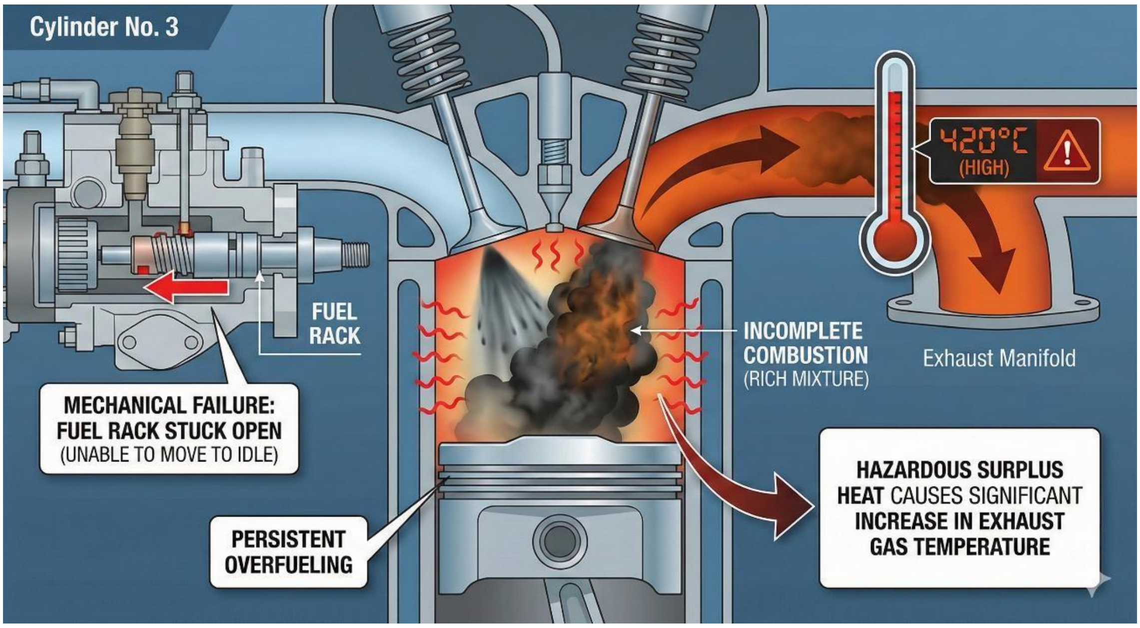

Figure 6. The Effect of a Stuck Fuel Rack on Combustion Efficiency and Exhaust Gas Temperature

Source: Illustration using Gemini (Nano Banana Pro)

b. The Role of Bosch Pump in Thermal Imbalance

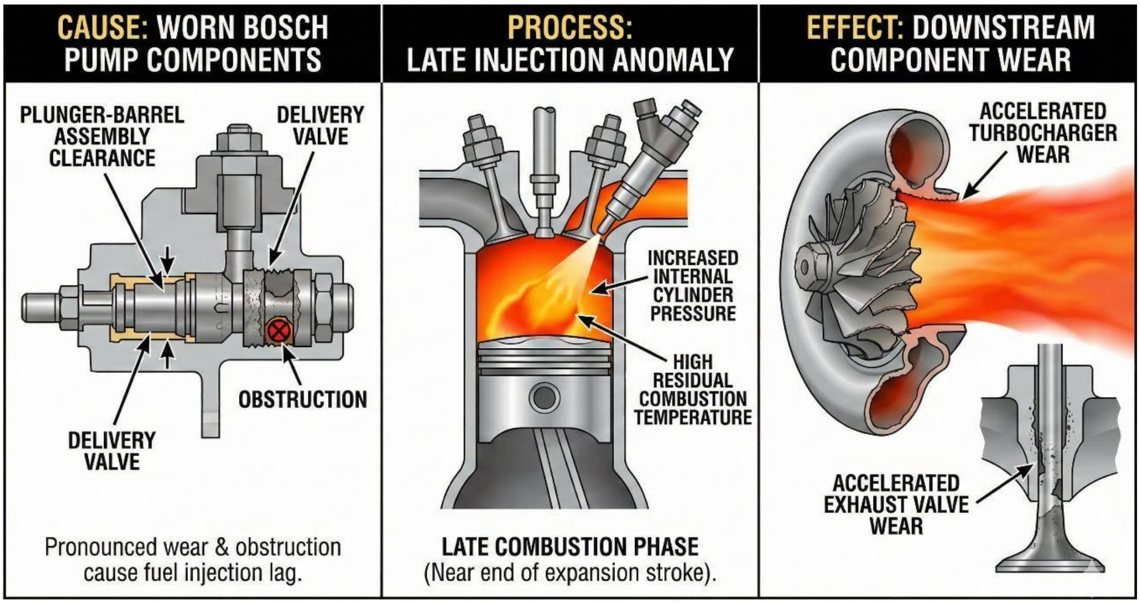

Figure 7. Mechanism of Late Injection and Downsteam Wear duet o Bosch Pump Mulfuction Source: Illustration using Gemini (Nano Banana Pro)

Furthermore, the local thermal imbalance can be explained by very pronounced wear and obstruction in the Bosch injection pump itself. Specifically, the breakdown of the delivery valve and of the plunger-barrel parts caused a serious lag in the fuel injection timing. This late injection anomaly forces the combustion phase to occur much closer to the end of the expansion stroke, which unnaturally increases both the internal cylinder pressure and residual combustion temperature. Ultimately, this disturbed timing mechanism not only leads to exhaust gas temperatures which are way above normal working range but has the additional significant effect of accelerating component wear in the downstream components such as the turbocharger and the exhaust valves.

c. Overspeed as a Consequence of Fuel Rack Malfunction and Governor Failure

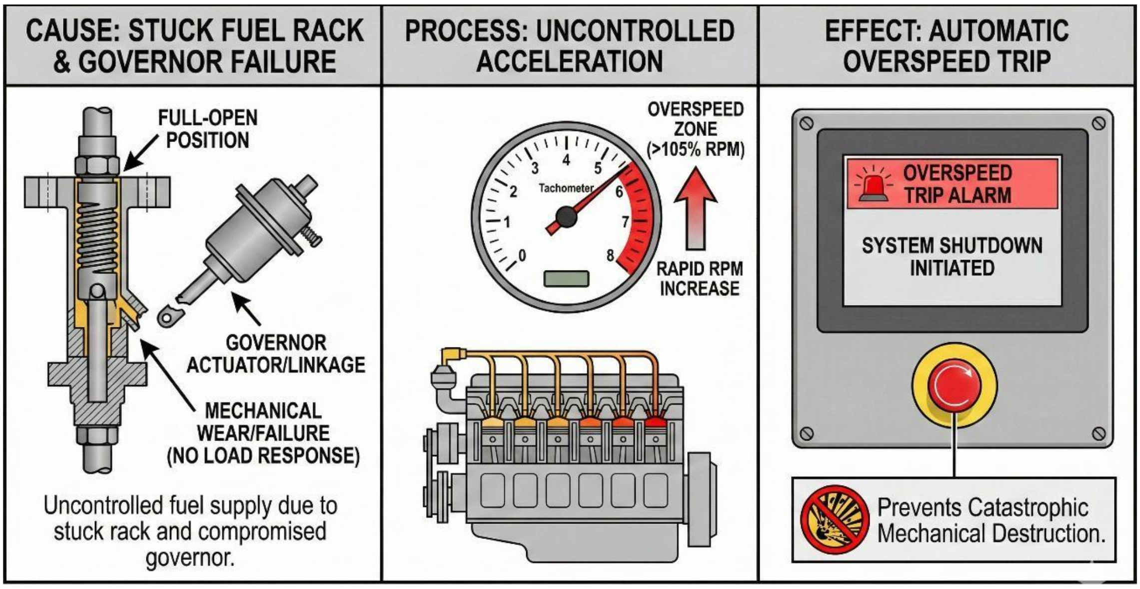

Figure 8. Sequence of Overspeed Trip duet o Fuel Rack and Governor Malfunction Source: Illustration using Gemini (Nano Banana Pro)

Beyond thermal problems, a fuel rack that gets hung up in the fully-open position is a direct catalyst for dangerous engine overspeed conditions. Under normal conditions, the governor would compensate for this risk, but in this case the mechanical governor was not able to react to the changes of electrical loads as it ought, most likely due to compounded wear in the internal actuator or mechanical linkages. This critical combination of an out-of-control continuous fuel supply with a compromised regulatory governor meant that the engine's rotational speed very quickly went beyond its safe operational limits. As a final safety measure this uncontrolled acceleration caused the system to conduct an automatic overspeed trip to avoid catastrophic mechanical destruction.

5. CONCLUSION

This paper finds that the MV blackout case. The main reason of Sinan Sorong was the critical mechanical failures in the diesel generator fuel system (stuck fuel rack and extreme wear on the plunger and delivery valve of the Bosch injection pump). These localized mechanical failures caused a potentially hazardous cascade of operating failures, such as too rich and incomplete combustion, too high exhaust gas temperatures, and a failed governor response that eventually caused an automatic overspeed trip. In order to prevent the occurrence of comparable systemic failures and sustained viability of the shipboard electrical grids, marine engineers have to adopt stringent preventive maintenance measures. Operators of ships should strictly conduct routine calibration of the fuel injection system, conduct strong routinely meticulous schedules of temperature fluctuations on exhausts and make proper recording of component wear in the process of routine visual and physical check ups.

6. REFERENCES

Anantharaman, M., Khan, F., Garaniya, V., & Lewam, B. (2015). Reliability of fuel oil system components versus main propulsion engine: An impact assessment study. In Safety of Marine Transport: Marine Navigation and Safety of Sea Transportation (pp. 167–172). https://doi.org/10.1201/b18515

Chin, C. S., & Nazli, N. B. (2021). Fault Exploratory Data Analysis of Real-Time Marine Diesel Engine Data Using R Programming. Advances in Intelligent Systems and Computing, 1270, 185–197. https://doi.org/10.1007/978-981-15-8289-9_18

German-Galkin, S., Tarnapowicz, D., Matuszak, Z., & Jaskiewicz, M. (2020). Optimization to limit the effects of underloaded generator sets in stand-alone hybrid ship grids. Energies, 13(3). https://doi.org/10.3390/en13030708

Going with the flow. (2006). MER - Marine Engineers Review, (DEC./JAN.), 14–19. https://www.scopus.com/inward/record.uri?eid=2s2.033846398119&partnerID=40&md5=c2b4a77c78545d84dd092119d6b47a94

Islam, R., Anantharaman, M., Khan, F., & Garaniya, V. (2019). Reliability assessment of a main propulsion engine fuel oil system-what are the failure-prone components? TransNav, 13(2), 415–420. https://doi.org/10.12716/1001.13.02.20

Kocak, G., Gokcek, V., & Genc, Y. (2023). Condition monitoring and fault diagnosis of a marine diesel engine with machine learning techniques. Pomorstvo, 37(1), 32–46. https://doi.org/10.31217/p.37.1.4

Koyama, A., & Arimoto, N. (2022). Development of Fuel-Efficient Marine Engine Oils. Toraibarojisuto/Journal of Japanese Society of Tribologists, 67(8), 535–540. https://doi.org/10.18914/tribologist.67.08_535

Michalopoulos, P., Tsekouras, G. J., Kanellos, F. D., & Prousalidis, J. M. (2022). Optimal Selection of the Diesel Generators Supplying a Ship Electric Power System. Applied Sciences (Switzerland), 12(20). https://doi.org/10.3390/app122010463

Mohammed, A. G., Mosleh, M., El-Maghlany, W. M., & Ammar, N. R. (2020). Performance analysis of supercritical ORC utilizing marine diesel engine waste heat recovery. Alexandria Engineering Journal, 59(2), 893–904. https://doi.org/10.1016/j.aej.2020.03.021

Moussa Nahim, H., Younes, R., Shraim, H., & Ouladsine, M. (2016). Modeling with Fault Integration of the Cooling and the Lubricating Systems in Marine Diesel Engine: Experimental validation. IFAC-PapersOnLine, 49(11), 570–575. https://doi.org/10.1016/j.ifacol.2016.08.083

Nahim, H. M., Younes, R., Nohra, C., & Ouladsine, M. (2015). Complete modeling for systems of a marine diesel engine. Journal of Marine Science and Application, 14(1), 93–104. https://doi.org/10.1007/s11804-015-1285-y

Onishchenko, O. A., Melnyk, O. M., Yarovenko, V. A., Aleksandrovska, N. I., Kurdiuk, S. V, Parmenova, D. G., & Storchak, O. O. (2023). STUDY OF EFFICIENCY AND ADVANCEMENT OF MARINE ENGINE OIL PURIFICATION AND FILTRATION TECHNOLOGIES. Journal of Chemistry and Technologies, 31(4), 762–774. https://doi.org/10.15421/jchemtech.v31i4.285643

Piana, E. (2022). Surfing Green, Saving Money. Progress in Marine Science and Technology, 6, 295–304. https://doi.org/10.3233/PMST220037

Rajendr Prasad, R. (2018). Cooling system for marine ship fuel engines. International Journal of Mechanical and Production Engineering Research and Development, 8(1), 873–878. https://doi.org/10.24247/ijmperdfeb2018104

Roychoudhury, S., & Mastanduno, R. (2011). Balance of Plant. In Fuel Cells: Technologies for Fuel Processing (pp. 517–526). https://doi.org/10.1016/B978-0-444-53563-4.10015-X

Ruvio, A., Elia, S., Pasquali, M., Pibiri, R., McPhail, S., & Fontanella, M. (2025). Innovative Power Generation System for Large Ships Based on Fuel Cells: A Technical–Economic Comparison with a Traditional System. Energies, 18(6). https://doi.org/10.3390/en18061456

Sellers, C., & Hawkins, L. (2017). Development of a 350kw marine Organic Rankine power module for ship waste steam. Proceedings of the ASME Turbo Expo, 3. https://doi.org/10.1115/GT2017-63026

Serbin, S. (2023). Development of Plasma-Chemical Combustion Intensification Systems for Hydrocarbon Fuels in Marine Power Engineering. IET Conference Proceedings, 2023(31), 537–540. https://doi.org/10.1049/icp.2024.0272

Stanivuk, T., Lalić, B., Mikuličić, J. Ž., & Šundov, M. (2021). Simulation modelling of marine diesel engine cooling system. Transactions on Maritime Science, 10(1), 112–125. https://doi.org/10.7225/toms.v10.n01.008

Stoliaryk, T. (2022). ANALYSIS OF THE OPERATION OF MARINE DIESEL ENGINES WHEN USING ENGINE OILS WITH DIFFERENT STRUCTURAL CHARACTERISTICS. Technology Audit and Production Reserves, 5(1), 22–32. https://doi.org/10.15587/2706-5448.2022.265868

Tarnapowicz, D., German-Galkin, S., Nerc, A., & Jaskiewicz, M. (2023). Improving the Energy Efficiency of a Ship's Power Plant by Using an Autonomous Hybrid System with a PMSG. Energies, 16(7). https://doi.org/10.3390/en16073158

Vrolijk, D. J. E. (2008). Challenges and solutions for marine engine oil technology. 14th Annual Fuels and Lubes Asia Conference. https://www.scopus.com/inward/record.uri?eid=2-s2.0-44649136780&partnerID=40&md5=25cc5d6e2b67d47ce4217163ca4dcc1a

Yang, H., & Sun, J. (2022). Development of Ship Fuel Supply Simulation Training System. Proceedings - 2022 7th International Conference on Automation, Control and Robotics Engineering, CACRE 2022, 281–287. https://doi.org/10.1109/CACRE54574.2022.9834207