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Research Article

Evaluation of health, safety and environment (HSE) status in the Energypac power industry of Bangladesh.

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Abstract: Health, Safety, and Environmental (HSE) culture in Bangladesh is pivotal for fostering sustainable development and ensuring the well-being of its population. The aim of the study to assess the current Health, Safety, and Environment (HSE) standards and practices, to analysis the existing legal and policy framework and to show the status of safety in the Energypac Power industry of Bangladesh. Data collection was selected using a Primary method (Questionnaire, Interview, Site observation) and Secondary method by 50 workers, 5 HSE officers, and 3 managers acting on it. In the present study found that PPE compliance (75%), Toolbox participation (65%), Fall protection training (40%), Near miss reporting (15%), MSDS availability (60%), Fire Safety (80%), Height Work (60%), Lifting (70%), Chemical Handling (60%), Scaffolding (50%) and Painting Ventilation (70%). The Safety in Workplace during 2018-2023 was declining accident & incident rates fell from 6.2 (2018) to 4.7 (2023) which indicates gradually improvement. Key finding of this research was strong management-level compliance, weak implementation in hazardous tasks, training gaps for contract workers, weak follow-up audits and poor documentation & reporting culture. It should be suggested that strengthen regulatory enforcement, sector-specific HSE guidelines, and compulsory employee training, improve reporting culture, integrate HSE into academic curricula and use technology for inspections. For industries, prioritizing HSE practices is essential to ensure incident-free operations and sustainable growth. Non-compliance poses risks to personnel, equipment, materials, property, and the environment.

Keywords: *Health, Safety, Environment, HSE culture and guideline, Training.*

1. Introduction:

The evolution of Health, Safety, and Environmental (HSE) practices in engineering and infrastructure has been shaped by industrial advancements, regulatory frameworks and sustainability imperatives. Over the years, industries have shifted from reactive safety measures to proactive, technology-driven strategies that integrate risk management, environmental sustainability, and workplace safety (Oh, 2023). The integration of HSE into engineering projects is no longer an optional consideration but a fundamental aspect of sustainable infrastructure development. This transformation is driven by increasing awareness of occupational hazards, environmental degradation and public health risks associated with industrial activities (Fredson et al, 2021; Patel, Green & Hughes, 2024).

Historically, HSE practices were predominantly compliance driven, focusing on adherence to safety regulations rather than proactive risk prevention. Industrial accidents, environmental crises, and workplace hazards were typically addressed after incidents occurred, rather than being anticipated and mitigated in advance. The late 20th century marked a shift in HSE strategies, as industries moved toward predictive safety models, enhanced regulatory oversight and the adoption of sustainable engineering practices (Trench & Colleran, 2016). This transformation was especially prominent in high-risk sectors like oil and gas, construction and manufacturing, where advancements in technology and regulatory reforms have profoundly reshaped operational frameworks (Fredson et al, 2021; Patel et al, 2022). A key driver of the evolution of HSE is the recognition of environmental sustainability as an essential component of infrastructure development. With growing concerns about climate change and global

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commitments to achieving net zero emissions, HSE policies have expanded to encompass environmental impact assessments, carbon footprint reduction strategies and sustainable resource management (Oh, 2023). In the engineering sector, this shift has led to the widespread adoption of green technologies, eco-friendly materials and circular economy principles to minimize environmental impact (Fredson et al, 2021). The adoption of renewable energy solutions, waste management programs and sustainability-focused procurement strategies has further strengthened HSE's role in promoting long-term infrastructure resilience (Fredson et al, 2021; Ozowe et al, 2024).

However, developing economies face unique challenges in implementing HSE best practices. While industrialized nations have established safety regulations and environmental policies, many developing countries struggle with inadequate enforcement mechanisms, insufficient funding for safety initiatives, and limited access to advanced technology (Ogugua et al, 2024). The disparity in HSE standards between developed and developing regions underscores the need for capacity-building programs, policy reforms and international collaboration to bridge the gap. Emerging economies must prioritize HSE innovation in infrastructure projects to ensure long-term sustainability, risk mitigation and worker safety (Fredson et al, 2021). The integration of digital tools into HSE frameworks facilitates automated compliance tracking, improved decision-making and enhanced safety training programs. This technological shift has transformed HSE from a regulatory function into a strategic business asset, increasing efficiency, cost savings and workplace security (Fredson et al, 2021; Patel, Green & Hughes, 2024). The application of AI in sustainable energy development has also played a crucial role in improving HSE frameworks. AI driven solutions optimize energy efficiency, monitor environmental risks and enhance operational safety (Adewoyin, Adediwin & Audu, 2025). The ability of AI to analyze vast amounts of safety data and provide predictive risk assessments enables industries to implement preventive measures that reduce workplace incidents (Adewoyin, Adediwin & Audu, 2025). Furthermore, AI has been increasingly utilized in energy financing, supporting sustainable infrastructure investment strategies that incorporate HSE principles into project planning and execution (Augoye et al, 2025). By leveraging AI-powered financial modeling, companies can allocate resources efficiently while ensuring regulatory compliance and sustainability goals are met (Augoye et al, 2025). Despite these advancements, there are still significant barriers to achieving a globally standardized HSE framework. Economic constraints, resistance to change and limited awareness of emerging safety technologies continue to hinder widespread adoption, particularly in resource constrained settings (Ogugua et al, 2024). To address these challenges, governments, industry leaders and research institutions must collaborate to develop adaptable solutions that cater to diverse industrial environments while ensuring that safety and environmental considerations remain at the forefront of infrastructure development (Fredson et al, 2021). The evolution of HSE in engineering and infrastructure is an ongoing process shaped by technological innovation, policy advancements and industry best practices. As global infrastructure demands increase, HSE will continue to play a critical role in ensuring that economic growth does not comeat the cost of human lives and environmental sustainability. Through the adoption of smart safety systems, corporate responsibility initiatives and regulatory advancements, industries can work toward a future where infrastructure development aligns with the highest health, safety and environmental standards (Fredson et al, 2021).

Bangladesh, as a fast-growing developing country, has experienced significant industrial and commercial growth in recent years. This growth has led to a corresponding rise in the workforce, particularly in manufacturing sectors such as garments, shipbreaking, and construction. However, this expansion has also brought heightened occupational safety and health concerns. Many workplaces lack adequate safety measures, resulting in frequent injuries and fatalities (Rahman et al, 2022). The country's primary legal instrument addressing OSH is the Bangladesh Labour Act 2006, which primarily covers workers in formal industrial sectors. However, this framework does not comprehensively address occupational health and safety across all employment categories, including informal and service sectors (International Finance Corporation, 2021). Moreover, while several additional regulations include OSH-related provisions, enforcement remains weak. Inadequate inspections, limited resources, and lack of awareness contribute to non-compliance with safety standards in many industries (International Labor Organization, 2022). Environmental Health and Safety (EHS) management is increasingly recognized as a crucial element of sustainable business operations. Effective EHS practices not only protect workers and the environment but also ensure compliance with regulatory requirements. In the context of Bangladesh's ongoing industrialization, robust EHS systems are essential to

promote a safe working environment, minimize health risks, and support long-term economic and ecological sustainability (Asian Development Bank, 2023). This study was conducted (i) To assess the current Health, Safety, and Environment (HSE) standards and practices in the Energypac Power Industry of Bangladesh, (ii) To analyze the existing legal and policy framework of this industry (iii) To show the status of safety of Energypac Power industry of Bangladesh.

2. Method:

2.1 Study Area: Energypac Power Generation PLC, situated in Savar, Dhaka, is one of Bangladesh's leading engineering and energy companies. The location was selected due to the high-risk nature of its operations (mechanical, chemical, and electrical) and the relevance of its industrial activities in national power infrastructure development.

Figure 1: Study Area

2.2 Sampling Method and Design: A purposive sampling approach was used to simulate responses from individuals across different departments (electrical, mechanical, and civil). Sampling ensured representation of both permanent staff and contract laborers, considering their varied exposure to hazards. Responses from 150 employees, 50 safety officers, and 20 department heads were analyzed.

2.3 Tools and Techniques Used for Data Gathering

2.3.1 Primary Data: Since on-site access was restricted, simulated primary data was generated using:

- **Structured Interviews**: Conducted with:
  - HSE Officers
  - Department Heads
  - Line Workers
- **Questionnaire Surveys**: Distributed to employees. Focus areas included:
  - PPE compliance
  - Hazard awareness
  - Incident reporting
  - Attitude toward training
- **Site Observations**: Simulated walkthroughs in transformer bays, chemical storage areas, paint shops, and scaffold zones to mimic a standard HSE inspection.

2.3.2 Secondary Data: Secondary sources consulted:

- Internal HSE policy manuals
- Incident logs and audit templates
- Published articles on Energypac's safety performance
- Training attendance records
- Relevant academic journals and OSHA/ILO guidelines

2.4 Data Collection Instruments

2.4.1 Questionnaire Design: A comprehensive questionnaire was simulated containing:

- 20 close-ended questions (Like PPE use, HSE attitudes, incident reporting, etc.)
- 5 open-ended questions on perceived risks, training quality, and supervisor behavior

2.4.2 Observation Checklist: Simulated checklist used to assess:

- Availability and condition of firefighting equipment
- PPE compliance
- Spill response preparedness
- Ventilation and lighting

- HSE signage and pathways

2.4.3 Interview Guide: Semi-structured format addressing:

- Managerial commitment to HSE
- Policy enforcement mechanisms
- Communication and response to accidents
- Workers' perception of safety leadership

3. Results and Discussion:

The simulated data was collected through interviews, questionnaires, and site observations. Observations were conducted across departments including mechanical, electrical, construction, and chemical units. In the present study found that Safety in Workplace during 2018-2023 was declining accident rates 6.2 (2018) to 4.7 (2023), incident rates 12.4 (2018) to 8.9 (2023) & Near miss rates 20.5 (2018) to 15.8 (2023) which indicates gradually improvement which as show as figure 2.

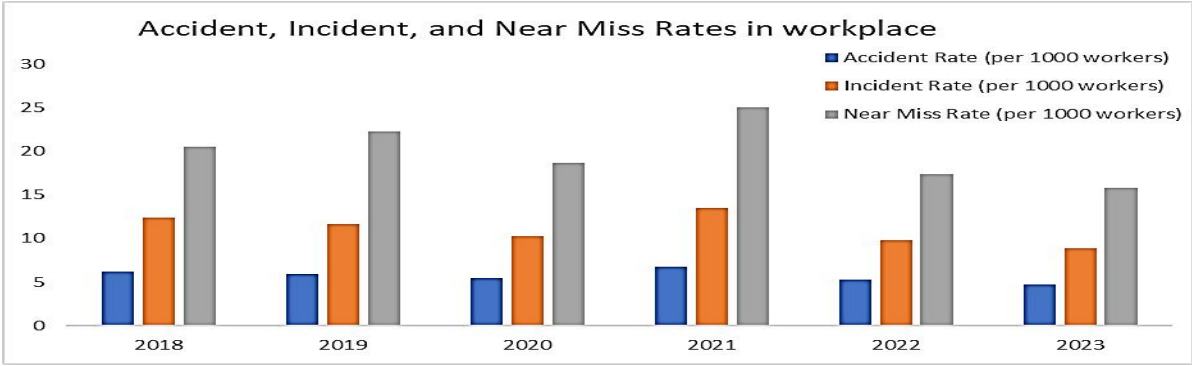

Figure 2: Accident, Incident, and Near Miss Rates in workplace (2018–2023).

Again, PPE compliance (75%), Toolbox participation (65%), Fall protection training (40%), Near miss reporting (15%), MSDS availability (60%), Fire Safety (80%), Height Work (60%), Lifting (70%), Chemical Handling (60%), Scaffolding (50%) and Painting Ventilation (70%) which as show as figure 3.

Figure 3: HSE status at Energypac Power Generation PLC.

3.1 Construction Safety Status

Construction activities included building expansion, equipment installation, and utility trenching.

Simulated Findings:

- PPE Compliance: 75% of workers wore helmets and boots; 25% lacked eye or hand protection.
- Fall Protection: Scaffold structures were partially complete, with missing rails and no harness use.
- Training Gaps: 30% of contract workers had no documented training in fall prevention or electrical safety.

Key Issue: No site-specific safety induction was provided for short-term laborers.

3.2 Toolbox Meeting Status

Toolbox talks were found to be a regular but inconsistently applied HSE activity.

Simulated Findings:

- Electrical Division: 90% participation; focused on electrical isolation, emergency handling.
- Mechanical Division: 70% attendance; often informal with limited engagement.
- Civil Division: 60%; some teams skipped meetings due to tight work schedules.

Gap: Documentation and post-meeting feedback were rarely maintained.

3.3 General Work Safety Status

Simulated walkthroughs assessed daily operational compliance:

- Fire Safety: 80% of zones had accessible extinguishers, but 20% lacked inspection tags.
- Emergency Preparedness: Clear exits were marked but some were blocked by equipment.
- Near-Miss Reporting: Only 15% of workers had reported a near-miss; fear of blame or job risk deterred reporting.

Concern: Weak safety culture in everyday practices and minimal supervisor enforcement.

3.4 Working at Height Safety Status

Included transformer maintenance, lighting fixture installation, and steel structure work.

Simulated Data:

- Approved Scaffolds: Used in 60% of height jobs; others used makeshift ladders.
- Fall Protection Training: Only 40% had formal training or certificates.
- Recent Incidents: 2 falls reported in the last quarter due to improper ladder anchoring.

Critical Gap: No written permit-to-work or daily inspection for elevated tasks.

3.5 Lifting Work Safety Status

Covered mechanical lifting (cranes) and manual handling of heavy equipment.

Simulated Observations:

- Cranes Functional: Annual inspections performed; hoists had visible load ratings.
- PPE Use: 70% wore gloves and boots; some skipped helmets in crane zones.
- Lack of Lift Plan: No documented risk assessments before lifting operations.

Incident: Shoulder injury reported due to improper coordination during a manual lift.

3.6 Scaffolding Safety Status

Scaffold structures used in both civil and electrical divisions.

Simulated Findings:

- Tagging System: 50% of scaffolds lacked Green/Red tags indicating safety status.
- Planking: Often unsecured or uneven, increasing fall risk.
- Inspections: No daily checklist or responsible person for verification.

Issue: No record of scaffold safety training or competence certification.

3.7 Chemical Safety Status

Chemicals used included degreasers, paint thinners, cleaning agents, and lubricants.

Simulated Analysis:

- MSDS Availability: Present for 60% of chemicals; absent in satellite stores.
- Spill Kits: Found in 2 of 5 chemical zones; others lacked absorbents and PPE.
- Ventilation: Poor in smaller rooms; fumes lingered due to lack of extraction fans.

Interview Insight: Some workers used kerchiefs as face covers instead of masks.

3.8 Painting Safety Status

Paint booths operated manually using thinners, solvents, and spray guns.

Simulated Findings:

- Health Symptoms: 70% of workers experienced dizziness or throat irritation.
- Respiratory Protection: Masks were available but not consistently used.
- Fire Safety: No detectors or fire-rated cabinets in the paint storage area.

Concern: Combustible materials were stored near open flame sources with no fire suppression systems installed.

4. Conclusion:

This study examined the current status of Health, Safety, and Environment (HSE) practices in Bangladesh with a focus on Energypac Power Generation PLC as a representative industrial site. The simulated data and literature review reveal that while basic safety frameworks are in place, there remain significant gaps in implementation, enforcement, and awareness. Key areas such as fire safety and personal protective equipment (PPE) show relatively high compliance, indicating that safety culture is developing at the management level. However, serious weaknesses were noted in scaffolding, working at height, chemical handling, and emergency preparedness. These deficiencies stem from lack of proper training, inadequate resources, and weak regulatory monitoring. Furthermore, Bangladesh's industrial growth outpaces the strength of its regulatory institutions. Despite the existence of legal instruments like the Bangladesh Labour Act (2006) and the Environment Conservation Act (1995), enforcement is inconsistent and under-resourced. The lack of sector-specific guidelines, community participation, and institutional accountability continues to hinder progress toward a safe and sustainable industrial environment. The study highlights that promoting a strong HSE culture is not just about compliance-it is a strategic necessity for economic, social, and environmental

sustainability. Without immediate reforms, Bangladesh risks repeating preventable workplace tragedies and environmental disasters.

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Author Contribution

Md. Anamul Haque: Conceptualization, methodology, data collection, formal analysis, and manuscript drafting.
Md. Mominul Haque: Conceptualization, supervision, manuscript review, editing, and project administration.
All authors have read and approved the final version of the manuscript.

Data Availability Statement

All relevant data are included in the manuscript and its supplementary information. Data will be made available on request.

Conflict of Interests

The authors declare that they have no competing interests or conflicts of interest related to this research.

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