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Best Safety Practices in Aluminium Industry

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Abstract- This project study will provide a comprehensive overview of the Best Safety Practices in Aluminium Industry at the end of the project. The study will enhance the Safety performance standards in the Aluminum Industry in order to achieve Zero Harm towards employees working in the industry & will ensure to minimize the accidents at site. Vedanta Limited (VL) has set up a 0.5 MTPA Aluminium Smelter-I, 1.25 MTPA Aluminium Smelter-II, 1215 MW Captive Power Plant & 2400 MW (4 x 600 MW) Thermal Power Plant at Jharsuguda, Odisha. Over past years, many Safety accidents have occurred at site due to various reason like Unsafe Act, Unsafe Conditions & Unsafe Behavior of employees during job at site. Our aim is to minimize the acccident by adopting Best Safety Standard Practices & inculcating those practices on our day to day activities. In conclusion, It was a wonderful & learning experience for me while working in this project. This project drives me a lot to go through the various phases of project development & gave the insights about the various best Safety practices adopted in Aluminium Industry. I have enjoyed a lot while tackling various challenges in the projects especially during the accident analysis part & all. This project will definitely give an insightful about the Safety Performance Standards & practices about Industries.

Index Terms- Safety Standards & Practices to Minimize Accidents.

I. INTRODUCTION

Vedanta Limited, a subsidiary of Vedanta Resources Limited, is one of the world's leading diversified natural resource companies with business operations in India, South Africa, Namibia, and Australia. Vedanta is a leading producer of Oil & Gas, Zinc, Lead, Silver, Copper, Iron Ore, Steel, Aluminium & Power.

Vedanta Limited (VL) has set up a 0.5 MTPA Aluminium Smelter-I, 1.25 MTPA Aluminium Smelter-II, 1215 MW Captive Power Plant & 2400 MW (4 x 600 MW) Thermal Power Plant at Jharsuguda, Odisha. The plant is situated at the Western end of Orissa on the state high way No. 10 and on the Howrah-Bombay main line of S.E.Railway and has direct train communication to the main metropolitan cities like Bombay, Calcutta, Delhi, and Madras. Air Services facilities are there from Jharsuguda as and when required by company. Detailed site lay out of the plant with hazardous area in colour and vicinity map indicating inhabitant area within 200 Meters radius

The purpose and scope of this project study is Identification of root cause for all Safety accidents happened over past years and Adopting best Safety performance standards & practices to improve the Safety culture & to minimize Safety accidents.

Main Process of Organization:
1. Smelting
2. Casting
3. Generation of Power

Products & By-Products:
1. Standard ingots
2. Billets
3. Wire rod
4. Power

Hazardous Substances Used:
1. Fuel Oil
2. Ammonia
3. Hydrochloric Acid
4. Sulphuric Acid
5. LPG

Types of credible Hazards due to hazardous substances handled

1. LPG – Leakage of LPG leading to Fire/Explosion
2. HFO- Pool fire in HFO/LDO Storage tanks
3. Ammonia- Leakage of Ammonia

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Identification Of Hazards:

In view of a few hazardous chemicals and operations at the Aluminium manufacturing facility of VEDANTA at Jharsuguda, a wide variety of incidents could be possible causing minor or major injury to plant personnel.

Major Safety Hazards at Plant:

- Hit by moving object/equipment
- Contact with electricity
- Entanglement with rotating parts/equipment
- Manual handling of Machinery parts & loads
- Fall from height
- Fall of objects
- Use of hand tools / pneumatic
- Splash of liquid/material
- Contact with hot materials
- Contact with hazardous chemicals
- Contact with hazardous waste
- Confined space
- Slip & trip
- Noise
- Vibration
- Pressure
- Radiation
- Electromagnetic field
- Heat / Cold
- Dusts
- Fumes
- Vapours
- Liquids
- Gases
- Ergonomics
- Psychological hazards

Past accidents:
Vedanta Aluminum Limited Jharsuguda, Odisha has started its operation in 2008. Many accidents have occurred in past. All Accidents have been investigated & analyzed. All Accidents are categorized under 4 Categories as per ICMM guidelines

a) FAI (First Aid Injury)
b) MTI (Medical Treatment Injury)
c) LTI(Lost Time Injury)
d) Fatal Injury

Cause wise analysis of Accidents over past 3 Years:
Vedanta follows below Safety Standard guidelines. Every accidents cause analyzed in line with Safety Standards violation if applicable for that event along with other parameters. Accordingly, corrective & preventive measure taken to prevent reoccurrence.

Safety Standards are:

1. Work at height
2. Electrical Safety
3. LOTOV
4. Vehicle & Driving Safety
5. Crane & Lifting Safety
6. Molten Material Safety
7. Machine Guarding Safety
8. Excavation Safety
9. Rail Safety

Main cause of the accidents are Based on the risk level determined, risk controls should be selected to reduce the risk level to an acceptable level. This can be done by reducing the Severity and/or Likelihood.
System root cause are identitfied into 4 buckets:

10. Man
11. Machine
12. Method
13. System

As indicated in the risk matrix, when the risk level is "High", effective and practicable risk controls must be implemented to bring down the High-Risk level to ALARP Level "As low as reasonably practicable". The table below shows the acceptability of risk and recommended actions for different risk levels, which can be used to guide the selection of risk controls.

We will employ qualified and competent electrical personnel as specified in general instruction. We will assess the size and location of the electrical loads and the manner in which they vary over time during the currency of the contract.

We will elaborate as to how the total supply is to be obtained / generated. The details of the source of electricity, earthing requirement, substation / panel boards, distribution system shall be prepared and necessary approval from Employer obtained before proceeding of the execution of the job. We will take consideration the requirements of the sub / petty contractors' electric power supply and arrive at the capacity of main source of power supply from diesel generators.

We will also submit electrical single line diagram, schematic diagram and the details of the equipment for all temporary electrical installation and these diagrams together with the temporary electrical equipment shall be submitted to the Employer's for necessary approval. No electrical equipment shall be put into use where its strength and capability may be exceeded in such a way as may give rise to danger.

Housekeeping is the act of keeping the working environment cleared of all unnecessary waste, thereby providing a first-line of defense against accidents and injuries. Contractor shall understand and accept that improper housekeeping is the primary hazard in any Aluminium Inductry Site and ensure that a high degree of housekeeping is always maintained. Indeed "Cleanliness is indeed next to Godliness.

Housekeeping is the responsibility of all site personnel and line management commitment shall be demonstrated by the continued efforts of supervising staff towards this activity.

All personals engaged for this job has to wear a Safety Helmet along with Chin Strap, as per the helmet color code.

Appropriate Hand Gloves will be used for Materials handling, Concreting, Welding, Grinding, Gas cutting, for Chemical Handling & Electrical work. Suitable goggles must be ensured for the personnel deployed for Welding (Face Shield), Grinding, Gas cutting, Concreting, Chipping, Operators, Painting etc. Work at site. The personnel engaged in the noise zone such as Power tool users, Vehicle and equipment Operators etc. will be equipped with suitable ear protection.

Suitable nose mask, face shield are to be used by the individuals to protect them from dust, fumes Mists or Vapors & poisonous and toxic gases. Appropriate body protection like Boiler Suit, Aprons must be used by the concern personnel at site. All personnel working over 1.8 meter height must have the Full body harness tied in his waist at the ground level. Further he will have to anchor the safety belt with a fixed structure before starting the work at height. Some special types of fall protection like Fall Arrest Devices and Spider harness for External painting also will be in used according to the nature & area of work. Safety nets closely installed under height works without any gap. Identify the constructs of a Journal – Essentially a journal consists of five major sections.

Welders shall wear helmets and goggles with suitable filter lenses. Whenever gas cutting or welding is to be done, the preservative coating over the parent materials should be removed for 100mm from the edge of the heat application.

No welding or Gas cutting should be done without proper ventilation over GI or any other preservative coated materials. A suitable fire extinguisher/water filled with bucket should be kept ready for immediate use at the places where welding is done.

The oxygen pressure for welding shall always be high enough to prevent acetylene flowing back in to the oxygen cylinder. Acetylene should not be used for welding at a pressure exceeding 1atm Guage. All the electrical cables should use industrial plug top/ sockets. Ensure Flash back arrester system/ NRV for Gas cutting at both sides. Ensure work permit system. Acetylene and oxygen cylinders needs to kept movable trolley, it should tie with wire rope/ chain.

Keep the working area neat and clean from hazardous/ flammable materials.
Unless adequate precautions are taken, no welding or cutting operations should be allowed near places where explosive or flammable that cannot be protected by other suitable means. When welding and cutting operations are being carried out in a confined space: Adequate ventilation, by means of exhaust fans or forced draught as the conditions require, should be constantly provided. Oxygen should not be used for the purpose.

The workers should take all necessary precautions to prevent unburned combustible gas or oxygen from escaping inside a tank or vessel. Necessary test like presence of Oxygen and any toxic gases present in

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confined space to be checked. When necessary to prevent danger, an attendant should watch the welder from outside. When welding in a confined space, the area of the work should be surrounded by materials which can absorb the radiation created by the electric arc. Gas cylinders should be inspected, stored, handled and transported as per prescribed norms. When in use, cylinders should be held in an upright position.

Welders should not tamper with or attempt to repair safety devices and valves on gas cylinders. Only the right pressure –reducing regulator should be used for the gas in the cylinder. Cylinder valves should be kept free from grease, oil, dust and dirt. Gas cylinder valve should be opened slowly to avoid sudden pressure applying at the valve; this may cause damage to the regulator valve. During fire operations the cylinders shall be kept at a distance of 20 ft from the operation spot. The maintenance schedule shall be maintained for, hoses and cutting torches, by a competent person.

Before starting excavation it is to be checked whether there are any underground utilities present like electrical power cable, water pipe line or any other service line in consultation with consultant or client.
Gumboots, Safety helmets and hand gloves should be provided to the workmen. Supply of any electrical dewatering pump to have routed through RCCB/earthing Ladder should be provided in each pit

No materials should be stacked at edge of the excavation pit. There should not be any vehicle movement close to the edge of the excavation.

Proper lighting is to provide for work at night. Excavated earth should be kept at least 1.5m away from excavation. There should not be any vehicle movement close to excavation

All steel scaffold must be satisfied the specified standards. These should be checked before erection of the same at site. During erection of the same the standard norms for scaffoldings are to be followed at site. Scaffold should not be tampered by any physical agents. These are to be maintained properly in regular intervals to ensure safety of the Personnel working over it & for its longer life. These are to be handled properly at site. Throwing them from height are to be restricted as there are chances of developing cracks& getting damage. Form work materials are to kept in a proper manner & away from the source of fire. The Shifting & placement of the same at site are to be carried out by the supervision of a Engineer / Supervisor so as to ensure the safe use of the same at site. Adequate supports for form work are to be given at site for their stability.

Site EHS Department will be authorized to certify the safe/unsafe condition of scaffolds prior to use. Upon inspection green/red tag will be installed to identify the condition of scaffold. Inspection tag will be signed by concerned Scaffolding person.

Scaffold should confirm IS: 2750-1964, IS: 4014 -1967, IS: 3696-1967 standards. Check instructions before use. Mobile access working towers may only be erected and dismantled by persons familiar with these instructions for erection use. Do not use any scaffold tower which is damaged, which has not been properly erected, which is not firm and stable and which has any missing or damaged parts. Do not erect a scaffold tower on unstable ground or objects such as loose bricks, boxes or blocks. Only a sound rigid footing must be used.

Only the authorized or trained person should erect the scaffold. Provide horizontal & vertical bracing supports to the scaffold. Use Tag system for scaffold. While erecting and dismantling wear proper PPE's and area should be barricaded. Safety harness should be anchor above the shoulder level. Ensure that the scaffold tower is always level and the adjustable legs are engaged. Check that you have taken all necessary precautions to prevent the tower being moved, or rolling away. Always apply all castor brakes or use base plates.

Ensure that all frames, braces and platforms are firmly in place and that all locking hooks are functioning correctly. Ensure that all frame locking clips are engaged. If any missing, replace them. Ensure that the scaffold tower is within the maximum platform height is stated and that the appropriate stabilizers are fitted. Outdoor scaffold towers should, wherever possible, be secured to a building or other structure. It is good practice to tie in all scaffold towers of any height, especially when they are left unattended, or in exposed or windy conditions.

A scaffold tower must not be used in winds stronger than 7.7 meters per second. Beaufort scale 4. Be cautious if erecting or using the tower in open places, such as hangers or unclad buildings. In such circumstances the wind forces can be increased, as a result of the funneling effect.

Do not erect or use a scaffold tower near un-insulated, live or energized electrical machinery or circuits, or near machinery in operation. If an overhead hazard exists, head protection should be worn.

Do not lean ladders against the tower, or climb the outside of the tower. Whatever your intended access system, it should only be used inside the tower. Never climb on horizontal or diagonal braces. Do not gain access or descend from the working platform other than by the intended access system. Do not work from ladders or stairways, they are a means of access only. Guardrails and toe boards must be fitted to the working platforms. Never jump on to or off platforms. DO not exceed the safe working load of the platform or structure by accumulating debris, material or tools on platforms as these can be a significant additional load.

If you must move a tower, remove all materials and personnel. When moving a scaffold tower, force must always be moved from the base. The tower should only be moved manually on firm, level ground which is free from obstacles. Normal walking speed should not be exceeded during relocation. The ground over which a tower is moved should be capable of supporting the weight of the structure.

Should you require additional platform height, add further frames. NEVER extend your adjustable legs to achieve extra height, these are for levelling only. NEVER use a ladder or other objects on the platform to achieve additional height.

It is not permissible to attach and use hoisting facilities on towers, unless specifically provided for by the manufacturer. It is not permissible to attach bridging sections between a scaffold tower and a building. Refer to the tower manufacturer.

Fire is the visible effect of the process of combustion – a special type of chemical reaction. It occurs between oxygen in the air and some sort of fuel. The products from the chemical reaction are completely different from the starting material.

The fuel must be heated to its ignition temperature for combustion to occur. The reaction will keep going as long as there is enough heat, fuel and oxygen. This is known as the fire triangle.

Class A - fires involving solid materials such as wood, paper or textiles.
Class B - fires involving flammable liquids such as petrol, diesel or oils.
Class C - fires involving gases.
Class D - fires involving metals.
Class K - fires involving cooking oils such as in deep-fat fryers.

We will develop a Work Permit system, which is a formal written system used to control certain types of work that are potentially hazardous. A work permit is a document, which specifies the work to be done and the precautions to be taken. Work Permits form an essential part of safe systems of work for many Aluminium Industry activities. They allow work to start only after safe procedures have been defined and they provide a clear record that all foreseeable hazards have been considered. Permits to Work are usually required in high-risk areas as identified by the Risk Assessments.

A permit is needed when Aluminium Industry work can only be carried out if normal safeguards are dropped or when new hazards are introduced by the work. Examples of high-risk activities. A Work Permit authorization form shall be completed with the maximum duration period not exceeding 12 hours Workmen & staffs are educated about the facilities available at site.

Any injury irrespective of the severity will be reported to the First Aid Centre. Proper First Aid shall be done with Trained First aid Asst. The condition shall be checked for a while and victim shall be shifted to hospital by Time Office if the injury is major and further treatment will be required. Reportable accidents are reported to from the time of the accident. (through Preliminary Accident report) First Aid injuries are analyzed and the analysis report is sent to Office once in a month. Injuries and Incidents are to be informed to the clients as per COC guidelines. Reports of all accidents (fatal / injury) and dangerous occurrences shall also be sent within 24 hours as per format provided in the Employer's Project SHE manual.

We shall take all necessary precautions to minimize fugitive dust emissions from operations involving excavation, grading and clearing of land and disposal of waste. He shall not allow emissions of fugitive dust from any transport, handling, Aluminium Industry or storage activity to remain visible in atmosphere beyond the property line of emission source for any prolonged period of time without notification to the Employer.

The Contractor shall use Aluminium Industry equipment designed and equipped to minimize or control air pollution. He shall maintain evidence of such design and equipment and make these available for inspection by Employer. In developing these remedial measures, the Contractor shall inspect and review all dust sources that may be contributing to air pollution. Remedial measures include use of additional / alternative equipment by the Contractor or maintenance / modification of existing equipment of the Contractor.

In the event that approved remedial measures are not being implemented and serious impacts persist, the Employer may direct the Contractor to suspend work until the measures are implemented, as required under the Contract.

Contractor's transport vehicles and other equipment shall conform to emission standards fixed by Statutory Agencies of Government of India or the State Government from time to time. The Contractor shall carry out periodical checks and undertake remedial measures including replacement, if required, so as to operate within permissible norms. Aluminium Industry activities that will generate dust impacts include excavation (including related activities), material handling and stockpiling, vehicular movement and wind erosion of unpaved work areas. The impact of fugitive dust on ambient air pollution depends on the quantity generated, as well as the drift potential of the dust particles injected into the atmosphere. Large dust particles will settle out near the source and smaller particles are likely to undergo dispersal over greater distance from the sources and impeded settling. SPM levels will be monitored to evaluate the dust impact during the Aluminium Industry phase of the Project.

The Contractor shall comply with the Indian Government legislation and other State regulations in existence in Delhi insofar as they relate to water pollution control and monitoring. A drainage system should be constructed at the commencement of the Works, to drain off all surface water from the work site into suitable drain outlet. The Contractor shall provide adequate precautions to ensure that no spoil or debris of any kind is pushed, washed, falls or deposited on land adjacent to the site perimeter including public roads or existing stream courses and drains within or adjacent to the site. In the event of any spoil or debris from Aluminium Industry works being deposited or any silt washed down to any area, then all such spoil, debris or material and silt shall be immediately removed and the affected land and areas restored to their natural state by the Contractor to the satisfaction of the Employer.

II. LITERATURE REVIEW

Safety management is a critical aspect of operation execution in Aluminium Industry, particularly in India, where the sector is plagued by high accident rates due to lax enforcement, inadequate training and poor safety culture. This literature review examines key aspects of Aluminium Industry safety management (CSM), focusing on risk assessment, safety compliance, behavioral safety and technological interventions.

Aluminium Industry is one of the most hazardous industries globally, with falls, electrocutions and equipment-related accidents being leading causes of fatalities (ILO, 2018). In India, the Building and Other Aluminium Industry Workers (BOCW) Act, 1996, mandates safety provisions, but implementation remains weak (Ministry of Labor, 2020).

Safety Management Systems (SMS) in Aluminium Industry- Safety Management Systems (SMS) involve structured policies, risk assessments, training and audits to minimize workplace hazards (Hinze, 2012). In India, firms following ISO 45001:2018 or OHSAS 18001 show 30% fewer accidents compared to non-certified firms (Gunduz & Laitinen, 2018).

Challenges in Indian Aluminium Industry Safety- Poor compliance with BOCW Act (Sawhney & Agrawal, 2017).

Migrant worker exploitation & lack of training (Kheni et al., 2010).

Weak enforcement of PPE usage (CIDC, 2019).

Key Components of Aluminium Industry Safety Management- Risk Assessment & Hazard Identification- Fuzzy AHP & Delphi methods are used to prioritize risks (Sawhney & Agrawal, 2017). Job Safety Analysis (JSA) helps in identifying site-specific hazards (Roughton & Crutchfield, 2013).

Safety Training & Behavioral Safety
Workers with formal safety training have 50% fewer accidents (Jitwasinkul & Hadikusumo, 2011).
Behavioral-based safety (BBS) programs improve compliance (Choudhry & Fang, 2008).

Technological Interventions
IoT & Wearable Sensors for real-time hazard detection (Tata Projects Case Study, 2021).
AI-based surveillance for PPE compliance monitoring (MoHUA, 2020).

Case Studies & Best Practices in Indian Firms
L&T Industry's "Zero Harm Policy" reduced accidents by 40% through strict PPE enforcement and digital checklists (CIDC, 2019).
Tata Projects' Chennai Metro used VR-based safety training, cutting incident rates by 25% (Patel, 2020).

Todd W. Loushin et.al (2005) described that a significant portion of Industry contract money was wasted due to insufficient planning and project mismanagement. They conducted interviews with management representatives to gain insight into their perception and use of safety and quality management in Construction Industry. From a safety standpoint, the sample admitted using similar performance measures. From a quality standpoint, the contractors relied on a variety of subjective or after-the-fact measures for quality. Worker attitude and lack of skilled workers were cited as major barriers to the improvement of quality and safety. They had concluded that the respondents did not see the potential benefits of integrating safety and quality management to reduce injuries while improving productivity.

Dayana.B.Costa et.al (2006): have discussed initiatives to develop performance measurement systems for benchmarking in four different countries the United Kingdom, Chile, the United States and Brazil. Their study pointed out some of the benefits, problems, limitations and opportunities for improvement of these initiatives. The lessons learned should be used for upgrading the existing initiatives and devising new ones. A joint effort involving several organizations is necessary for the successful design and implementation of benchmarking programs. Such an effort should not be limited to data collection but should also provide data analysis and training, as well as enable the exchange of best practices among the companies aiming to promote innovation. Moreover, these measures should be assessed and revised periodically, according to the needs of the companies involved. The commonalities among these initiatives indicate that they potentially could be used for International benchmarking.

Gregory Carter et.al (2006): presented an investigation indicating the current levels of hazard identification on three U.K. Industry projects. Their study reveal that a maximum of only 6.7% of the method statements analyzed on these projects managed to identify all of the hazards that should have been identified, based upon current knowledge. Maximum hazard identification levels were found to be 89.9% for an Industry project within the nuclear industry, 72.8% for a project within the railway industry and 66.5% for a project within both the railway and general Al Industry sector. Their results indicate that hazard identification levels are far from ideal. They had concluded with an information technology tool for Aluminium Industry safety management and, in particular, a module within total-safety designed to help Aluminium Industry personnel develop method statements with improved levels of hazard identification.

OsamaAbudayyeh et.al (2006): have carried out a study to determine the correlation between management commitment to safety and the frequency of Construction Industry-related injuries and illnesses. To achieve this purpose, a survey was developed and sent to a random sample of the top five hundred US Industry companies. Survey results point to a clear statistical correlation between management commitment on safety and injury and illness rates. The costs resulting from injuries and equipment damage, combined with the associated financial loss resulting from schedule disruptions, insurance hikes and workers compensation, impact the profitability of any Industry operation. They have concluded that these costs may be minimized or avoided through focused safety efforts on Industry job sites.

2.9 Xinyu Huang et.al (2006): described the owner's role in Industry safety. They were claiming that the recent improvements in Industry were due to the concerted efforts of owners, contractors, subcontractors and designers. While past safety studies have investigated the roles of contractors, subcontractors and designers, the owner's impact on Construction Industry safety has not been previously investigated. Data were obtained by conducting interviews on large Industry projects. The relationship between project safety performance and the owner's influence was examined, with particular focus on project characteristics, the selection of safe contractors, contractual safety requirements and the owner's participation in safety management during project execution. By identifying practices of owners associated with good project safety performances, the author has given guidance on how owners directly impact safety performance. Guidelines for safety management plans published by the workplace standards Tasmania deals with the importance of safety management plans in Aluminium Industry. It had clearly discussed the factors that have to be added in safety management plan. The factors include management commitment, policies, legal requirement, resources, training and competency, inspection and auditing etc.

III. PROBLEM IDENTIFICATION & OBJECTIVES

Problem Identification- Through site inspections and interactions with workers, engineers and safety officers, the following key problems were identified:

Non-Compliance with Personal Protective Equipment (PPE)-
Observation: Workers frequently neglected wearing helmets, safety harnesses, gloves and shoes.
Reason: Lack of strict enforcement, discomfort and poor awareness of risks.
Impact: Increased risk of head injuries, falls and hand related accidents.

Unsafe Scaffolding and Ladder Practices
Observation: Scaffolding was often improperly assembled and ladders were unstable or damaged.
Reason: Rushed work schedules, inadequate supervision and cost-cutting measures.
Impact: High risk of falls from heights, leading to severe injuries or fatalities.

Electrical and Fire Hazards
Observation: Exposed wiring, overloaded extension boards and insufficient fire extinguishers.
Reason: Poor electrical safety planning and lack of regular audits.
Impact: Potential electrocution, short circuits and fire outbreaks.

Poor Housekeeping and Slip/Trip Hazards
Observation: Cluttered workspaces, wet floors and uncovered trenches.
Reason: Lack of daily cleanup routines and poor material storage practices.
Impact: Increased slips, trips and falls, leading to minor and major injuries.

Lack of Proper Safety Training and Awareness
Observation: Workers, especially temporary workers, were unaware of safety protocols.
Reason: Inadequate induction programs and language barriers (migrant workers).

Impact: Higher likelihood of accidents due to unsafe work practices.

Inadequate Signage and Barricading
Observation: Missing warning signs near hazardous zones (excavation, heavy machinery).
Reason: Overlooking safety signage as a low-priority task.
Impact: Unauthorized entry into danger zones, leading to accidents.
Workforce and Subcontractor Challenges

Observation: High turnover of laborers and subcontractors bypassing safety norms.
Reason: Project deadlines prioritized over safety, lack of accountability.
Impact: Inconsistent safety compliance and difficulty in enforcing rules.

Objectives-
To determine broad parameters of EHS management at site.
Establish & define line of command for resolution of all hazard prevention issues. Define individual responsibilities, hazards, prevention & safety promotion responsibility at each level of the Aluminium Industry team. Identify highly hazardous operations within the scope of work & specially integrated preventive measures to mitigate the same.
To ensure compliance with relevant applicable legislation.
Continual EHS performance improvement by directing focus on the key areas for improvement in consistent manner. Achieve zero accident-free site.

IV. METHODOLOGY & DATA ANALYSIS

By referring to the accident records and other records related to working at height available in the organization.

By studying the procedure followed in analyzing the accident and investigation the accident / dangerous occurrences related to working at height.

By discussing with the line personnel, management personnel, supervisors and other workers in respect of the practices followed by them in working at height.

By referring to the standard practices of the organization by making literature survey on working at height system adopted by other organization.
By studying the case studies on working at height in the organization.

By discussing with the safety professionals in the plant to strengthen the safety system related to working at height in the organization.

To discussed with the safety committee members for assessing their involvement on safety activities and to suggest for the better participation to enhance the Health, safety and environment system in working at height in the organization.

By studying the safety promotional activities followed in the organization to suggest further for better Health, safety and environment for employees.

To highlight the top management, they needs to improve Health, safety and environment system in working at height and standards through graphical representation of safety performance.

Research Design-
The study adopted a case study approach focusing on a high-rise industrial Aluminium Industry site in Noida. The methodology combined qualitative observations and quantitative safety compliance measurements to evaluate the effectiveness of existing safety practices.

Duration of Study: 20 days continuous observation.
Participants: Site engineers, safety officers, subcontractors and 120 workers.
Tools Used: Safety audit checklists, PPE compliance sheets, hazard identification forms and interview questionnaires.

Data Collection Methods
Direct Observation- Daily walkthroughs of scaffolding, excavation zones, electrical wiring and fire safety equipment.

Recording unsafe acts and unsafe conditions.
Worker Interviews- Semi-structured interviews with 30 workers to understand awareness of safety protocols.

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Questions focused on PPE usage, emergency preparedness and hazard reporting.
Safety Documentation Review
Analysis of site-level safety committee minutes.
Review of accident/incident registers and training records.
Compliance Measurement
PPE compliance was measured by counting workers wearing helmets, harnesses, gloves and reflective jackets.
Emergency preparedness was assessed by checking availability of fire extinguishers, evacuation maps and first-aid kits.

Data Analysis Techniques-
Descriptive Statistics: Percentages and frequency distribution of PPE usage.
Comparative Analysis: Comparing safety compliance across different work zones (scaffolding, electrical, excavation).
Trend Analysis: Identifying recurring hazards and lapses over the 20-day period.

The analysis revealed that while awareness of safety protocols exists, implementation is inconsistent. PPE compliance is below acceptable standards, especially for harnesses at height. Electrical hazards and poor fire safety preparedness pose significant risks. Worker interviews highlighted lack of formal training and weak communication of emergency procedures

V. RESULTS & DISCUSSION

Recommendations
Based on the analysis of the collected data and observations made during the study, several recommendations have been proposed to improve health, safety and environmental (HSE) performance at the Aluminium Industry site. These recommendations aim to address the gaps identified during site observations and stakeholder interactions and to enhance overall safety culture and compliance at the workplace.

The methodology adopted for developing these recommendations included regular site walkthroughs conducted over a four-week period. During this period, interviews and informal discussions were carried out with site engineers, the safety officer, the project manager and Aluminium Industry workers to understand prevailing safety practices and challenges. In addition, photographic documentation of unsafe conditions was undertaken wherever permitted to support the observations and findings.

One of the primary recommendations is to improve the Personal Protective Equipment (PPE) policy at the site. High-quality PPE should be provided to all workers, including contract labor, to ensure adequate protection against occupational hazards. Adequate stock of PPE must be maintained for immediate replacement and regular PPE audits should be conducted to monitor usage and compliance.

Safety measures for work at height require significant strengthening. The use of standard and certified scaffolding materials should be strictly enforced across the site. Wearing safety harnesses must be made compulsory for all height-related activities and workers should receive proper training on safe working-at-height procedures to minimize the risk of falls and serious injuries.

Regular safety training is another essential requirement. Monthly toolbox talks should be organized focusing on specific hazards and site activities. Comprehensive safety induction programs must be conducted for all new workers before deployment. To effectively communicate safety instructions to illiterate or semi-literate workers, pictorial safety instructions should be prominently displayed and used during training sessions.
Electrical safety at the site needs immediate improvement. It is recommended that licensed electricians be engaged for all temporary and permanent electrical installations. All wiring should be properly insulated and waterproof junction boxes must be used to prevent electrical hazards. Furthermore, a lockout and tagout policy should be followed.

There are various causes of Accident

CAUSES	%	ACTION PLAN

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Vehicle & Driving	22%	Strengthening of Vehicle & Driving safety standard inline with corporate standards Defensive driving training & vehicle fitness test
Molten Material	15%	Review of Molten material incidents CAPA & horizontal deployment Molten material flash protection suit for all employees Consequence management against violation SOP/SMP review & training
Hit by Object	14%	Line of Fire training Pre Job Hazard Assessment training for PTW receivers
SOP Violation	8%	Periodic training of SOP/SMP Notice and consequence Management
Slip & Trip	7%	Housekeeping drive Analysis of repetitive cases of slip trip and their elimination
Crane & Lifting	5%	Training for Crane Operator & Rigger Healthiness of tools, tackles and cranes to be tested periodically Pre job checklist implemented of lifting tools and tackles

VI. CONCLUSION & FUTURE SCOPE

Analysis on Safety Improvements at Site
INJURY & HIPO – CAUSE WISE

Safety KPI's	FY 18	FY 19	FY 20
Near Miss Incidents	31530	25314	22692
LTI (Lost Time Injury)	6	7	4
MTI (Medical Treatment Injury)	14	9	14
LTIFR (Lost Time Injury Frequency Range)	0.22	0.23	0.13
HIPO (High Potential Incidents)	4	16	26
VSAP Score (Vedanta Sustainability Assurance Programme)	75	78	76
VSS (Vedanta Safety Standards) Score	57.6	71	64

Standardize the Safety Practices:

We have discussed many best Safety practices in top which are adopted in Aluminum Industry to reduce injury & accidents. So these Safety practices been standardized for development & implementation to optimize process repeatability, quality & Safety. All the Safety processes been defined with PDCA (Plan, Do, Check & Act) cycles.
There are many tools being used for driving as effective standardization implementation includes:

-An Internal Auditing Program
-A Lean Program
-Effective Communication

An Internal Auditing Program:

Preparing Audit checklist developed which addressing ISO 45001:2018 (OHSMS) Standards , HSE Policy, Safety Performance Standards , Management Standards, Technical Standards, Guidance Notes & other regulatory requirement etc. covering following elements:

- Training Compliance
- PPE's Compliance
- Maintenance of Lifting Tools & Tackles
- Machine Guarding
- Hazard Identification & Risk Assessment
- Housekeeping
- Emergency Preparedness
- Gas cylinder storage & handling
- HAZOP Study Compliance
- Forklift Operations
- SOP Compliance
- Behavior Safety of employees

A Lean Program:
A lean program is a tool for Standardization of process includes

- Standard work flow

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- Quality
- Kanban
- Equipment
- Supply chain
- Team work on Safety
- 5S (Housekeeping)

Similar to an internal audit programme, a checklist is prepared for effective implementation of a Lean program. Incorporating teamwork & 5S helped Organization on formulation of Safety Training program, incident investigation & contractor Safety management etc. Incorporating Safety into lean program elevates Safety Management into hands of plant leadership and not solely on the responsibility of Safety team.

Effective Communication:
It is an effective tool to standardize the Safety process & practices.

We have adopted many methods includes:-
- TBT (Tool Box Talk)
- Safety Committee Meetings
- Safety Campaigns Celebrations of National Safety week, Road Safety Week, National Fire Service Weeks
- Induction Training & Refresh Training Programmes
- Display of HSE Policy, SOP's, Do's & Don'ts signage's at Shop floor
- Safety & Health Management online portal & E-Library
- Safety newsletters
- Safety inspections & audits at workplace
- Worker participation & consultation

REFERENCES

[1] HSE Policy
[2] Vedanta Safety Manual.
[3] ICMM Manual (International Council on Mining & Metal).
[4] ISO 45001: 2018