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Study on High Voltage over Head Transmission Lines (HV OHTL) Construction Safety & Reducing Fall from Height Risk (A case study approach to HV OHTL Projects, United Arab Emirates)

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Abstract; With the increasing Urbanization, Industrialization, Power Inter connection of emirates within UAE, Proposed GCC Grid formation for the entire gulf and up gradation of living style in society, the demand for Electricity have increased manifold and the sector is growing steadily. As the transmission of Power by Over head transmission lines are cost effective and safe compared to underground power cabling, more OHTL projects are in progress in UAE in particular Abu Dhabi Western Region. The high risk working at height varies height 20 m to 70 m for different OHTL. As chances of high fatality rate is there in this kind of projects, a detailed study will support Zero Incidents target for the organization with good business prospects. In this study, the health and safety management system of High Voltage Over Head Transmission Line Projects in Abu Dhabi – United Arab Emirates (UAE) was reviewed. This report examines planned approaches to health and safety management in the workplace. It is the result of a 6 month study of onsite level health and safety management systems, as part of thesis for Master of Technology in Health, Safety & Environment Engineering (HSE). The need is highlighted by limited research on the efficacy of health and safety management systems. Based on the available records like occupational Health & Safety key performance Indicators (KPI's), Incident Investigation Reports, Customer satisfaction report, employee interaction and management review meeting minutes, the organization Occupational health and safety management system was evaluated. The working at height in Transmission line tower activity of the organization through step bolt access in the desert & dry mountains having high potential of risk and identified as one of the major physical hazards of the project .It is recommended that the usage of latest available fall arrestor & fall protection system by competent & experienced person and Mechanical methods with Mobile Elevated working platforms (MEWP) will reduce fall potentials of human being. A detailed action plan is proposed at the end this thesis to eliminate the possible hazards in the HV OHL construction projects and project risk level to minimum.
Keywords: HV OHTL, Power Transmission & Distribution, Personnel Protective Equipment, Fatal

I. INTRODUCTION

For the Continual support for booming UAE economy , the demand for Electricity have increased manifold and the sector is growing steadily. As the Power Transmission & Distribution by Over head transmission lines are ideal and relatively safe compared to underground power cabling, more OHTL projects are in progress in UAE in particular Abu Dhabi's Western Region. The high risk working at height varies height 20 m to 70 m for different OHTL. As chances of high fatality rate is there in this kind of projects, a detailed study will support Zero Incidents target for any organization with good business prospects.

II. METHODOLOGY

By studying the OHTL project manual and tower erection method statements
By reviewing technical literature in respect of the identified hazards.
By inspecting the project sites and measures incorporated therein.
By analyzing the past accident statistics in relation to causes and consequences.
By studying the safety organization and system of the project.

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III. RESULTS & DISCUSSION

Based on the below mentioned HSE statistics (Fig1 & Fig 2) for the last 10 years of OHTL projects in Abu Dhabi, it is understood that Fall from Height has the potential of higher fatal incidents. Substantial risk is involved while working at height for OHTL construction activities. So enough control measures shall be proposed to reduce the risk level to an accepted level in Height work activity.

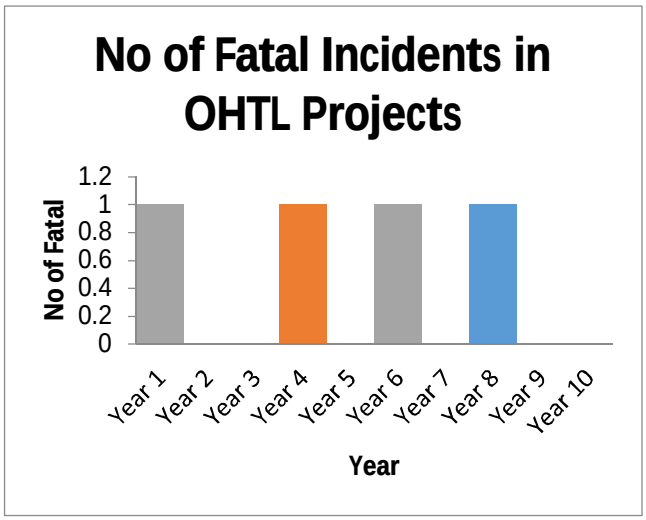

Fig 1

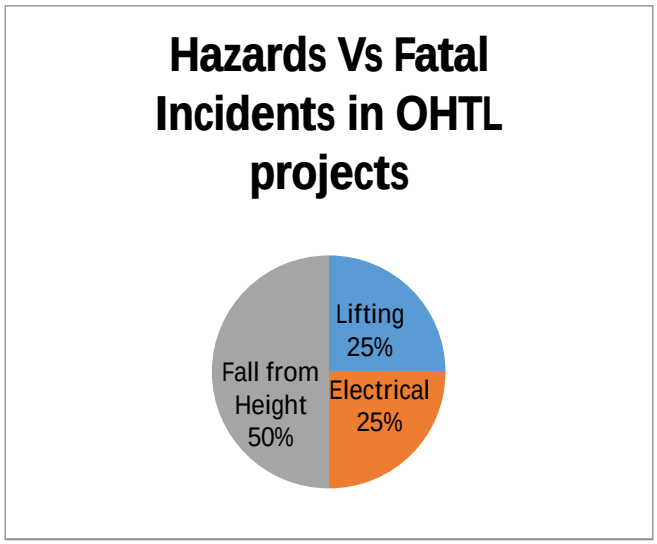

Fig 2

A. Hazard identification and Control Methods for Fall from Height Risk

Hazards/ Critical activity relevant to this OHTL projects are as follows

1) Mobilizing to Remote Location (Desert / Mountains)
2) Excavation /Pile Bore Hole
3) Tower Erection Work
4) Conductor Stringing
5) Tower Collapse – Design Failure
6) Tensioner work
7) Work on the conductor
8) Induction Current

9) Lifting Equipment & Tackles Failures
10) Energization Hazards

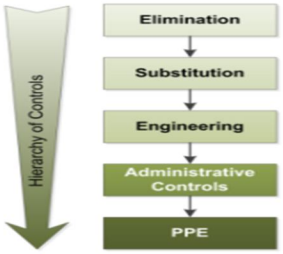

Fig 3

Contractor ensures that Safety risks are eliminated, reduced or mitigated to acceptable risks by considering the hierarchy of risk management: Refer to Figure. 3

B. Elimination

In OHTL work Fall from Height can be eliminated by means of fixing fall arrestor system both in vertical as well as Horizontal directions on the Lattice Tower itself. Risk may be 'eliminated' by redesigning a job sequence and removing a hazardous step. This may take place at design stage, for either permanent or temporary works.

Also Tower painting can be done at ground instead of at height. Also Medium height tower can be assembled at ground level and can be erected with the help of mobile crane Ref Fig 4

Fig 4

C. Substitution

Risk can be reduced through, for example, the 'substitution' of hazardous materials / substances for less hazardous materials / substances. This may take place at design stage for either permanent / temporary works.

Fig 5

D. Engineering

Engineering Controls' are an effective means of managing risk. Engineering controls use physical measures to separate workers from hazards. This may take place at design stage for either permanent / temporary works.

All the winch puller machine and tensioner machine shall be provided with limit switch and over load protection and shall be equipped with digital display to ensure the conductor Stringing is within the SWL of Tower & pull point pulleys

Fig 6

E. Administrative Controls

Administrative Controls' include the development of procedures, method statements, risk assessments etc. (Operational Controls). Administrative controls also include training. Administrative controls can be effective as workers become more aware of hazards and more competent in carrying out their duties in a safe manner. Administrative controls may also include work scheduling. For example, reducing shift times may reduce workers exposure to hazards.

Fig. 7

Fig. 8

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F. Training

It is one of the vital and important tools for the safety awareness within the Project and it really helps to reduce the accidents. There are of following types of training as:

1) Intensive Training- It is conducted for project employees as per the training calendar of the year.
2) Induction Training – It is conducted for the new Joiners and as and when required as refresher Training
3) Tool Box Talks –It is given on site based upon specifically project activity prior to starting the activity
4) Craft Training – Training for Selected employees for the specific activity. It will improve the Safety, Quality and progress of the work

Employees allocated for height shall be identified with different color uniform to confirm the competency. Height work permit system shall be followed without fail

G. PPE

PPE is the final element in the hierarchy of risk management. PPE should be used where no 'reasonably practicable' alternative is available. PPE will include general personal safety equipment and Respiratory Protective Equipment

Fig. 9

Fig. 10

H. Work at Height Permit System

Permit system shall be followed as part of Administrative control measures. Height work permit will be filled and signed by section/shift in charge taking all the measures as prescribed in the format of hot work permit. Then the permit will be signed by the section head/ departmental head, permit applicant and finally, after cross-checking the safety related aspects and the viability of the job, by the EHS manager.

Permit will be extended if job is continued beyond one shift. If job is also to be undertaken in silent hours then signatures of sectional head, authorized signatory and sectional head (HSE) are required for said extension.

No permit is valid until it bears the signature of all signatories concerned. All jobs related to height work permit will be carried out in general shift hours only. In case of extreme urgency the hot work permit can be extended for silent hours with the consent (signatures) of the authorized signatories.

The permittee shall surrender the permit after completion of the job or discontinuation of the job specifying the reasons by putting his signature and date.

I. Temperature and Heat Stress

Although human beings possess considerable ability to compensate for naturally occurring heat stress, many occupational environments and/or physical activities expose workers to heat loads which are so excessive as to threaten their health and productivity.

Interventions fall into five categories:

1) Maximizing heat tolerance among exposed individuals,
2) Assuring timely replacement of lost fluid and electrolytes,
3) Altering work practices to reduce exertion heat load,
4) Engineering control of climatic conditions, and
5) Use of protective clothing.

Factors outside the worksite, which may affect thermal tolerance, should not be ignored in the evaluation of the extent of exposure and developing preventive measures.

For example, the total burden to the body and the potential risk of heat disorders will be much higher if heat stress continues during off – duty hours through work at second jobs, strenuous leisure activities, or living in hot quarters.

In addition, the state of the body is linked to patterns of eating and drinking, which may also change with season or religious observances.

Worker in hot trades should be generally healthy and possess suitable physical attributes for the work to be done.

Obesity and cardiovascular disease are conditions that add to the risk, and individuals with a history of previous unexplained or repetitive heat illness characteristics beyond the control of individual, such as

Body size; gender; ethnicity and age;

And acquired characteristics, which are at least partly subject to control and include physical fitness, heat acclimatization,

Workers should be informed of the nature of heat stress and its negative effects as well as the protective measures provided in the workplace. They should be taught that heat tolerance depends to a large extent upon drinking enough water and eating a balanced diet.

In addition, workers should be taught the signs and symptoms of heat disorders, which include dizziness, faintness, breathlessness, palpitations and extreme thirst.

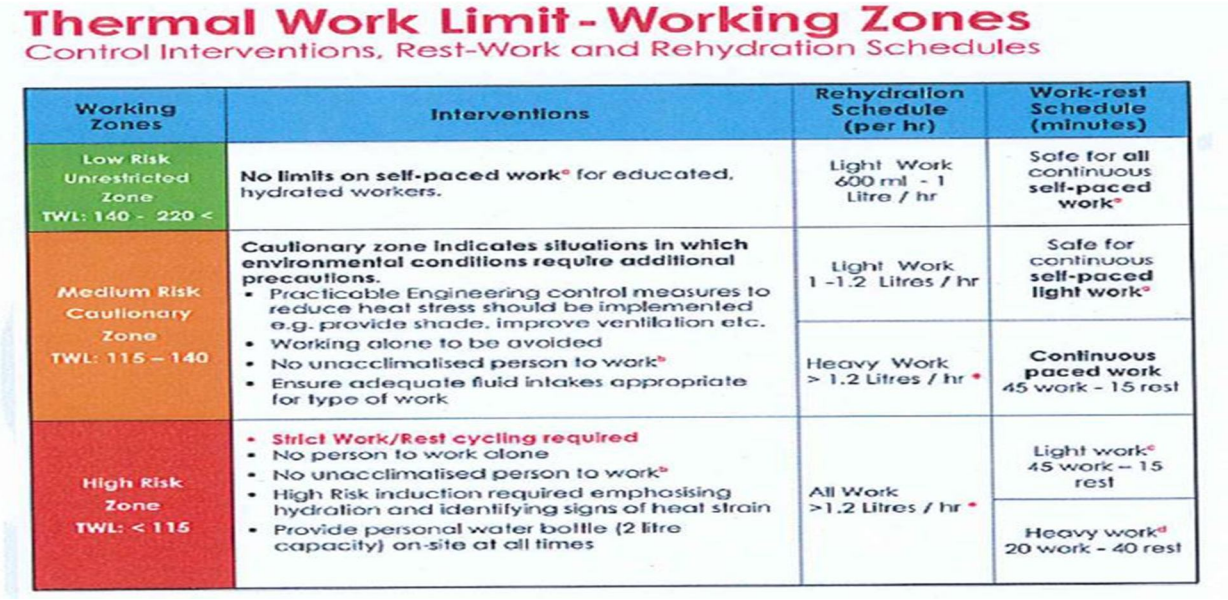
They should also learn the basics of first aid and where to call for help when they recognize these signs in themselves or others.

Occurrence of heat disorders in more than one person, or repeatedly in a single individual is often a warning of serious impending trouble and the need for immediate evaluation of the working environment and review of the adequacy of preventive measures.

Contractor will provide ready access to water or other appropriate drinks which encourage re-hydrationWorksite specific heat stress program shall be developed incorporating the following elements:

6) Acclimatization program for new employees, employees that have been on vacation, and employees that are moving from a worksite that has climate control to a worksite that has high temperatures with an allowance of 5-7 days for acclimatization before starting hard work in the hot environment.
7) Contractor shall ensure an effective heat stress program is conducted and implemented for this project where employees work in environments where high temperatures and humidity may pose a health risk.
8) Working area which is reasonably foreseeable to have, temperature at or above 35 degree Celsius at any time during a work shift, shall implement an effective heat stress program, unless they can document through risk assessment and Thermal Work Limit (TWL) that there is no risk to employees.
9) Process for assessing environmental conditions utilizing the Thermal Work Limit (TWL) to determining work / rest breaks and water consumption requirements for employees.
10) TWL shall be calculated by monitoring the following environmental monitoring and using HAAD website
11) Dry Bulb Temp (degC)
12) Wet Bulb temp (degC
13) Globe temp (degC
14) Wind Speed (m/sec

15) Training for employees and visitors will be done to inform the hazards of heat stress, signs and symptoms and steps to be taken to prevent heat stress
16) Appropriate amount of portable drinking water close to the worksite and appropriate electrolyte replacement drinks.



Thermal Work Limit - Working Zones

Control Interventions, Rest-Work and Rehydration Schedules

Working Zones	Interventions	Rehydration Schedule (per hr)	Work-rest Schedule (minutes)
Low Risk Unrestricted Zone TWL: 140 - 220 <	**No limits on self-paced work**[a] for educated, hydrated workers.	Light Work 600 ml - 1 Litre / hr	Safe for **all** continuous **self-paced work**[a]
Medium Risk Cautionary Zone TWL: 115 – 140	**Cautionary zone indicates situations in which environmental conditions require additional precautions.** • Practicable Engineering control measures to reduce heat stress should be implemented e.g. provide shade, improve ventilation etc. • Working alone to be avoided • No unacclimatised person to work[b] • Ensure adequate fluid intakes appropriate for type of work	Light Work 1 -1.2 Litres / hr	Safe for continuous **self-paced light work**[a]
		Heavy Work > 1.2 Litres / hr [c]	**Continuous paced work** 45 work - 15 rest
High Risk Zone TWL: < 115	• **Strict Work/Rest cycling required** • No person to work alone • No unacclimatised person to work[b] • High Risk induction required emphasising hydration and identifying signs of heat strain • Provide personal water bottle (2 litre capacity) on-site at all times	All Work >1.2 Litres / hr [c]	Light work[c] 45 work – 15 rest
			Heavy work[d] 20 work - 40 rest

Fig. 11

17) Training for employees and visitors will be done to inform the hazards of heat stress, signs and symptoms and steps to be taken to prevent heat stress.
18) Appropriate amount of portable drinking water close to the worksite and appropriate electrolyte replacement drinks.
19) Appropriate clothing and personal protective equipment with water bottles / water containers.
20) Designed shaded areas and cooling shelters for employees working outside during summer shall be done.
21) Process for scheduling physical activities in the summer months during the coolest part of the day to the extend reasonably practicable.
22) Pre-employment screening and medical clearance shall be done
23) Permit to work system shall be implemented where required.
24) Audit/ inspection shall be done and implementation the above program shall be monitored.
25) Safe, palatable water must be located within a few steps of each worker or brought to the worker every hour - more frequently under the most stressful conditions.
26) Clean drinking cups shall be provided, as it is nearly impossible to re - hydrate from a water fountain.

J. Safety Promotional Activities

To promote the safety, Project Management shall committed for the Continual Improvement in EHS management system. Various programs are conducted on the occasion of Safety Month, Safety day, world Environment day celebration. On such programs the following competitions shall organized as:

1) Safety slogans competition
2) Safety essay competition
3) Safety cartoons competition
4) Safety quiz competitions
5) Best Safety Conscious Employee Award
6) Safe Driver Award

All these are the best methods to promote the positive safety culture. The winners are given the awards for their encouragement & interest in safety.

IV. CONCLUSION & RECOMMENDATIONS

The analysis of health and safety statistics of the review period concluded that Fall from Height risk levels are reducing due to the implementation below recommendation and safety performance of the organization

A. Conclusion

This project work is not only to fulfill the requirement of the M.Tech -HSE conducted by University of Petroleum & Energy Studies, Dehradun but also an attempt to study the HV OHTL construction hazards and their controlling measures. It is hoped that this small work will be helpful in identifying the fall from height potentials & prevention methods and improve the safety performance of any HV OHTL projects

B. Recommendations

Based on the detailed study and project work the following recommendations are suggested for improving the HV OHTL projects safety performance

1) Screening of Workmen on Physical /mental aspects for OHTL Height work in desert conditions
2) Identifying the new workmen Job knowledge level by interviewing and providing onsite training through professional EHS training agencies including mockup
3) Identifying the height work manpower by different uniform and close monitored effective supervision
4) Implementing Various latest Fall protection and Fall Arrestor system and ensuring its effective usage
5) Ensuring 100 % Tie off policy of Double lanyard Full body harness with shock absorber
6) Effective communication and guidelines by using Megaphone / Short wave communication
7) Inter correspondence / communication between various work-centers and updating of latest developments in OHTL construction with EHS department playing the role of nodal agency preferably.
8) Language barrier between the contractor personnel and supervisor, as they belong to different places, may create a problem in communication in normal as well as in emergencies. Ensuring supervisor and worker are using common language for communication
9) Providing healthy and nutrient food
10) Prejob Health Fitness and On the job Occupational Health Surveillance on regular intervals

11) Emergency preparedness level of employees as well as contractor personnel requires to be raised through standby Emergency facilities and Trained Medical Practitioners
12) Corporate EHS Bulletin / EHS Bulletin covering the highlights / achievements / accidents / near miss / latest case studies / shortcomings etc. to be published with an attempt to provide / disseminate information available at the corporate level.
13) Promoting and awarding Positive Safety Culture in all level of the Organization
14) Provision of fines / punishments for breach of safety rules and regulations can be made in the project.

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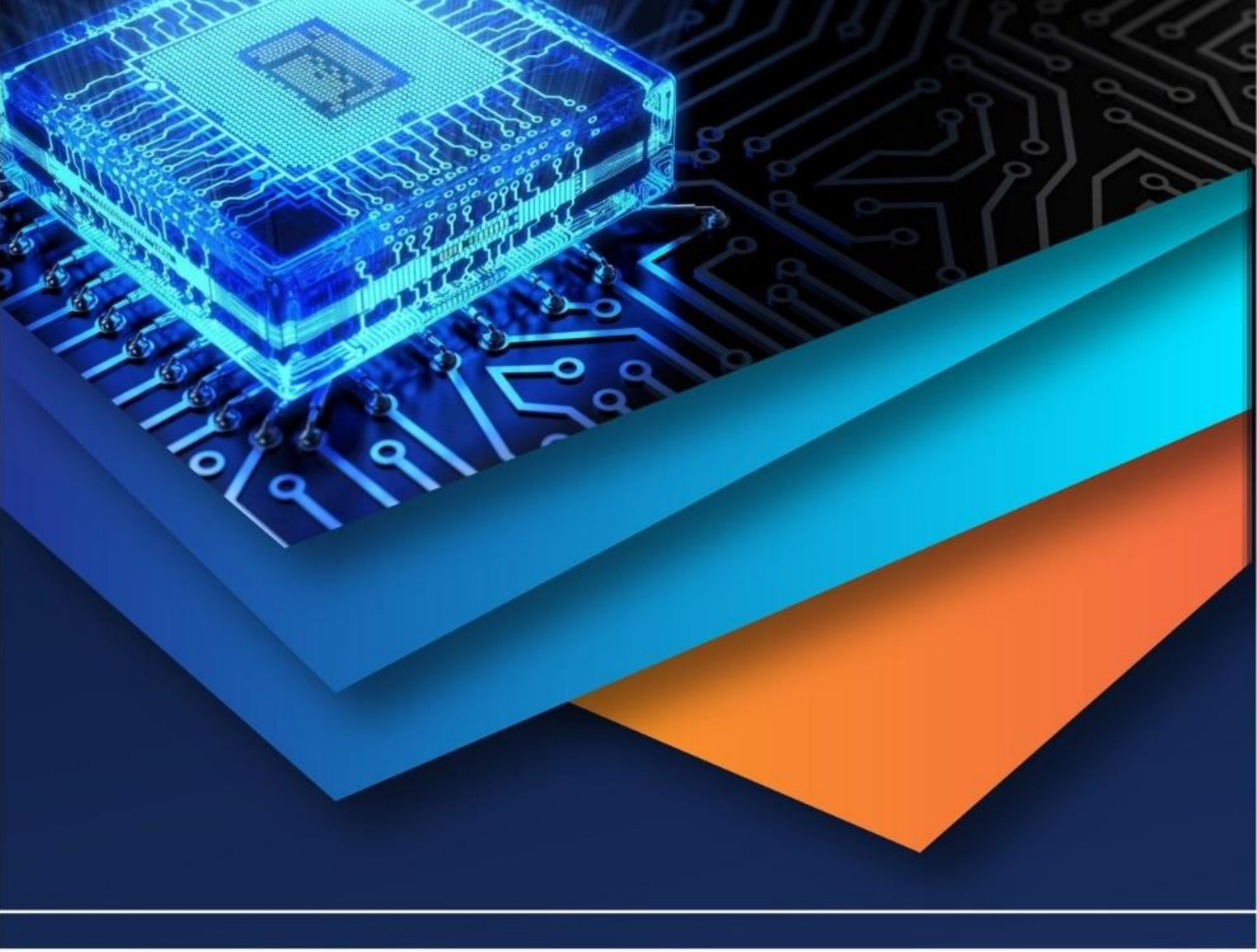

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