

# Hazard Identification, Risk Assessment And Risk Control In a 250 MW Solar Power Plant Project: A Case Study

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**Abstract** - Renewable power plants are booming these days. Constructions of renewable power plants pose serious risks to workers safety and health. To ensure its success we need to make sure that it remains safe, reliable and sustainable throughout its construction and operation phase. This can be achieved by effectively evaluating a power plant's health and safety, associated hazards and risks and implementing necessary control measures. In this study, we have used a HIRARC (Hazard Identification, Risk assessment & Risk control) model to identify all the hazards and associated risk to the worker's safety and health on a 250MW Solar Power plant. Hazard identification is carried out by critically analysing existing risk assessments, interviewing personnel and conducting walkthroughs. Risk assessment is carried out using qualitative analysis of hazard's likelihood and its consequence severity. Quantitative analysis is used to divide the risk in high, medium and low categories using simple 5X5 risk matrix. The findings were then used to identify and recommend necessary control measures to deal with high risk activities and bring down its risk level to an acceptable range. The aim of this study is to make solar power projects much safer and accident free by identifying significant hazards, evaluating the associated risks and determining the necessary control measures based on the basic risk control hierarchy. These measures will help in making solar power projects a safer project sites, reducing accident rates at site, reducing staff turnover rates, improving safety culture and increasing worker's satisfaction in terms of safety.

**Key Words:** Solar Power Plants, HIRARC, Risk Assessment, Hazard Identification.

## 1. INTRODUCTION

Renewable energy has started playing an increasingly important role for augmentation of grid power, providing energy access, reducing consumption of fossil fuels and helping India pursue its low carbon development path. Ahead of COP 21, India submitted its Intended Nationally Determined Contribution (INDC) to the United Nations Framework Conventions on Climate Change (UNFCCC), outlining the country's post-2020 climate actions. India's INDC builds on its goal of installing 175 gigawatts (GW) of renewable power capacity by 2022. India has set a target to increase the country's share of non-fossil-based installed

electric capacity to 40 percent by 2030. The INDC also commits to reduce India's GHG emissions intensity per unit GDP by 33 to 35 percent below 2005 levels by 2030, and to create an additional carbon sink of 2.5 to 3 billion tonnes of carbon dioxide through additional tree cover.

In this paper, the hazard identification, risk assessment and risk control techniques are discussed in a 250 MW solar power plant project, the various sub Divisions are being taken into consideration and found many hazards in all Departments which should be considered deeply for the reduction of the risks by implementing various Risk Assessment Techniques such as HIRA, Risk Matrix, Hierarchy of Control etc.

The general conference of the International Labour Organization has been convened at Geneva by the governing body of the International Labour Office on its 90th session on 3<sup>rd</sup> June 2002 (R 194, List of occupational Diseases Recommendation). In this conference it has been discussed about to strengthen recording, identification and notification procedures for occupational diseases and accidents with the aim of establishing the preventive measures, identifying the root causes for any accident/incident. They have also discussed about several occupational diseases caused by exposure to agents arising from work activities. They have discussed about diseases caused by chemical agents, physical agents, biological agents. They have also discussed about infectious and parasitic diseases, Respiratory diseases, Skin diseases, Musculoskeletal disorders, Mental & behavioural disorders etc. [1]

Paul Solvic[2] Studied about risk perception to examine the judgements of people when they are asked to evaluate hazardous activities. Through this research risk analysis and policy-making on the basis of understanding and people responses to hazards and by improving the communication of risk information technical experts, people and decision makers.

Mary Douglas and Aaron Wildavsky[3]studied about the cultural theory of risk. They have characterized the risk and culture mentioning that, when anyone is taking the risk, the cultural role is ignored and the second prominent theory which is related to social psychology.

Lingard.H and Rawlinson, [5] studied about “Occupational Health and Safety in project management”. They have studied about various risk management methodologies and risk communication. They have mentioned a step by step procedure for health & safety risk assessment, control & communication.

Phil Hughes, Ed Ferrett[6] studied and mentioned the risk matrix technique with colour code to know the level of the risk. The risk has been categorized in to minimal, low, medium, high. They have also explained the process of finding the root cause of an accident/incident through effective investigation process. They have also explained about health and safety training, manual handling needs, access/egress, machine guarding and explained about process of hazard identification.

### 1.1 Problem Identification

By going through literature and site visit a preliminary problem identification can be drawn with three objective which will be the basic aim of this paper to be fulfilled. As 250 MW solar power plant project is quite big it has major operational challenges during entire project implementation phase. The three objectives which are framed are as follows:

1. To identify major activities under a solar power plant project.
2. To analyze and assess risk and its control for each activity.
3. To give control measure for each activity individually.

## 2. METHOODOLGY

This procedure is established, documented, implemented and maintained to help an organization for ongoing identification of OH and S hazards, assessment of risk and determination of necessary controls. This shall focus its resources on those areas that is most important to achievement of its goals.

An effective OH&S Management System begins with identification of hazards in the process & understanding how an organization can control the hazards by assessing risks involved. The source, situation, or act with a potential for harm in terms of human ill health or injury or both can be a hazard.

Identification process shall take into consideration as follows:-

- Routine and non-routine activities,
- Activities of all personnel having access to the work place (including subcontractors and visitors),
- Infrastructure, equipment and materials at the work place, whether provided by the organization or others,

- Human behavior capabilities and other human factors,
- Identified hazards originating outside the workplace capable of adversely affecting the health and safety of persons under the control of organization within the workplace,
- Hazards created in the vicinity of the work place by work related activities under the control of organization,
- Changes or proposed changes in the organization both plants, its activities or material,
- Modification to the EOHS Management System including temporary changes, and there impacts on operations, processes and activities,
- Any applicable legal obligations relating to risk assessment and implementation of necessary controls,
- The design of work areas, processes, installations, machinery/equipment operating procedures and work organization, including their adoption to human capabilities.

Methodology for hazard identification and risk assessment is:-

- a) Defined with respect to its scope, nature and timings to ensure that it is proactive rather than reactive.
- b) Provide for the identification, prioritization and documentation of risks and application of control as appropriate.

Classify the work activities as per following guidelines:-

- Tasks being carried out, their duration and frequency,
- Location where the work is carried out,
- Who normally/occasionally carries out the tasks? Who else may be effected by the work (for example visitors, subcontractors, public etc.),
- Training that personnel have received about the tasks,
- Written systems of work and/or permit-to-work procedures prepared for the tasks,
- Plant and machinery, Powered Hand Tools that may be used. Manufacturers and Suppliers instructions for operation and maintenance are referred,
- Size, shape, surface character and weight of materials that might be handled,

- Distance and heights of the place where materials have to be moved by Hand Services used (for example compressed air),
- Substances used or encountered during the work. Physical form of substances used or encountered (fume, gas, vapors, liquid, dust/powder, solid etc.),
- Content and recommendations of safety data sheets relating to substances used or encountered,
- Relevant acts, regulations and standards relating to the work being done, the plant and machinery used, and the materials used or encountered,
  - Available monitoring data gained as a result of information from within and outside the organization, incident, accident and ill-health experience associated with the work being done, equipment and substances used and
  - Finding of any existing assessments relating to the work activity Control measures believed to be in place.

Falling into the bore holes	Conceivable	3
DTH Vehicle	Remote	2
Drill bits of DTH	Conceivable	3
Cement mixers	Conceivable	3
Shifting column post	Possible	4
Handling of cement bags	Most likely	5
Handling of templates	Conceivable	3
Handling bolts, other tools	Conceivable	3
Dehydration	Possible	4

Table 2 Severity of identified hazards

HAZARD	SEVERITY	LEVEL
Extreme temperature	Minor	2
Dust	Minor	2
Mental stress	Negligible	1
Vibration	Negligible	1
Ergonomics	Negligible	1
Falling into the bore holes	Minor	2
DTH Vehicle	Fatal	4
Drill bits of DTH	Serious	3
Cement mixers	Fatal	4
Shifting column post	Negligible	1
Handling of cement bags	Serious	3
Handling of templates	Minor	2
Handling bolts, other tools	Negligible	1
Dehydration	Serious	3

### 3 RESULT & DISCUSSION

During the inspection of the Solar power plant, several hazards were found on the site, and the details of the hazards has been kept in the records and will be informed to the plant EOHS Department.

The hazards identification and risk assessment and its control are carried out for all hazards in the concerned division and will be reported to the company and also recommendations will be given to the company for elimination of the hazards and reduction of the risk.

During the site visit & site inspection, many hazards found on the site which may harm and may cause any incident/accident in coming future are mentioned below in their respective head along with control measure:

Table 1 Likelihood of identified hazards

HAZARD	LIKELIHOOD	LEVEL
Extreme temperature	Most likely	5
Dust	Possible	4
Mental stress	Remote	2
Vibration	Remote	2
Ergonomics	Conceivable	3

**Table 5.3 Risk level as per Risk Matrix of the identified hazards**

HAZARD	RISK (S*L)	RISK LEVEL
Extreme temperature	10	Medium
Dust	8	Medium
Mental stress	2	Low
Vibration	2	Low
Ergonomics	3	Low
Falling into the bore holes	6	Medium
DTH Vehicle	8	Medium
Drill bits of DTH	9	Medium
Cement mixers	12	Medium
Shifting column post	4	Low
Handling of cement bags	15	HIGH
Handling of templates	6	Medium
Handling bolts, other tools	3	Low
Dehydration	12	Medium

**Risk Control, elimination and reduction:**

1. Extreme temperature: Risk can be controlled by providing training to the workers on how to be protected from heat strokes, providing glucose water, Suggesting increase water consumption by the body, wear light color clothes.
2. Dust: Risk can be controlled by sprinkling water and by using respirator masks.
3. Mental Stress: suggesting work in shifts or take rest while lunch in resting shelters.
4. Vibration: Risk is tolerable.
5. Ergonomics: Risk is tolerable and could carry out work in shifts.
6. Falling into bore holes: Risk can be controlled by Barricading the area and assigning work permit.

7. DTH vehicle: Risk can be control by ensuring that the vehicle has competent driver and having back horn all lights and signals are working appropriately or by using red flag when in operation and by providing vehicle permit.
8. Drill bits of DTH: Risk could be control by not allowing any other work by providing work permit and by providing specific training.
9. Cement mixers: Risk can be control by ensuring that the vehicle has competent driver and having back horn all lights and signals are working appropriately or by using red flag when in operation and by providing vehicle permit and could use sirens also while mobile.
10. Shifting column post: Risk can be controlled by providing training to the workers for safe material handling and using proper PPE's.
11. Handling cement bags: Risk severity is very high and only solution is to train the workers for safe handling of cement and using proper PPE's specially Masks.
12. Handling of templates: Risk can be controlled by providing training to the workers for safe material handling and using proper PPE's.
13. Handling of bolts, tools: Risk can be reduced by providing training to the workers for safe material handling and using proper PPE's.
14. Dehydration: Risk can be reduced by training the workers for consuming more and more water, taking rest in shelters when the temperature is more than 42 degree.

**4. CONCLUSIONS**

Now a days solar power will play a crucial role in nation building and therefore it becomes very necessary to complete each and every project of solar power quite efficiently and safely. Hazards in Solar power plant project can be eliminated if we follow proper techniques to identify the hazards and also the risk of accident/incident can be reduced. Hazards are the agents which are having the potential to cause harm those who are exposed to it. There were so many activities found during project phase of solar power plant during the site inspection. The hazards found on the site has been recorded and informed to the company. Due to the activity which are coming under risk (person/property/business) has been reported to the company and risk matrix and hierarchy of control

techniques are being studied to eliminate the hazard and control the risks associated with the hazards.

Some main points of conclusions are summarized as follows:

- Maximum employees are young which indicate that physical manpower of the industry is very strong resulting more productivity.
- Maximum employees are under matrix.
- Maximum workers are skilled. So quality of the work will be good.
- Maximum employees are getting lesser emoluments. So the cost of the manpower will be less.
- Maximum employees are married .So psychologically they stable which is good for the factory.
- Management is more aware with hazards, which indicate the concern of the management for safety of its employees.
- Maximum hazards are identified by the management which saves the time of employees.
- Management is more safety conscious. So provides the safety of the appliances.
- Maximum employees require light fitting clothing for working due to temperature.
- A major concern during the project is handling of cement bags since due to dry air the particulate can spread very rapidly.
- Mobile crane, concrete mixtures and many more heavy construction vehicles are operating at project site for which proper movement path should be identified.
- For providing electrical supply from the solar power plant heavy cables will be installed which comes wrapped in heavy drums, during shifting of these drums a major concern is required.

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