Conference Paper

Determination of Occupational Health and Safety Risks in Solar Energy

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Abstract.

Solar energy systems (photovoltaics, solar thermal, solar power) provide significant environmental benefits in comparison to the conventional energy sources, thus contributing to the sustainable development of human activities. However, sometimes, the wide scale deployment faces potential negative health and safety implications. To cope with these problems this paper presents an overview of an occupational health assessment of solar energy. The analysis provides the potential burdens to the workers' health and safety working in solar energy, which includes hazard identification like toxic materials, general job site safety risks and other less focused risks in solar energy such as psychosocial hazards.

Keywords: solar energy, occupational safety, health

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Published 7 December 2023

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the ICESG Conference Committee.

1. Introduction

One of the cleanest ways to produce electricity is through solar energy. However, solar energy also has significant drawbacks in comparison to other energy sources. Benefits of solar energy include reduced carbon emissions, less dependence on fossil fuels, long-term solar resources, quick payback, and others. However, it has been observed that every type of energy producing source emits carbon at some point (Bakhiyi et al., 2014). The usage of some extremely toxic materials, such as cadmium, lead, arsenic, nickel, and others, which have been limited by international ecological safety rules, is employed in the production of PV solar cells. The mass use of such materials has a very negative impact on the environment occupational, safety & health point of view. Solar plants also need careful handling in the recycling process. And other factors like workload and uncertain working times should also be considered while assessing hazards present in solar energy industry (Sen & Karmakar, 2021).

The aim of this study is to review and highlight the risks which may or may not have been identified before, specifically in solar energy.

2. Impacts of Solar Energy on OSH

Solar power is regarded as a ”Green Source” of energy. Before solar technology is widely used, there are some Safety, Health, and Environmental challenges that need to be resolved. Nanotechnology, which is regarded as a ”clean tech” technology, provides the foundation of solar panels (Nasrollahzadeh et al., 2019). Three stages of a solar panel’s life—manufacturing, operation (generating), and decommissioning—can be used to analyze its effects. When it is true that solar panels do not pollute the air while producing electricity, the manufacturing process for them uses numerous toxic elements, which is extremely dangerous from an OSH standpoint. After the panel’s anticipated lifespan has passed and throughout the recycling process, there are certain worries. The following issues will be covered in this section.Presence of Toxic Materials

Different chemicals are utilized in the production of solar panels, especially when the solar cell is extracted. For instance, cadmium (Cd), a highly hazardous element, is used in cadmium telluride-based thin film solar cells as a semiconductor material to convert solar energy into electrical energy. Dust and vapor from cadmium are classified as carcinogens by the National Institute of Occupational Safety and Health (NIOSH) (causing cancer). Similar to this, a variety of dangerous chemicals are employed as solvents to remove dirt and dust from solar panels. According to the Restriction of Hazardous Substances Directive (RoHS) laws, the European Union first forbade the use of harmful substances such as Cd, Pb, Hg, and others (Alharbi et al., 2011; Tripathi et al., 2020). However, the decision by the European Union had a significant impact on the manufacturing of solar panels using cadmium telluride (CdTe). In order to support the solar manufacturing sector and help the EU reach its renewable energy generation targets, EU law exempted solar panels from the ban in November 2010. Particular issues with these harmful elements exist, especially for nearby environments. In recent years, mishaps caused by the release of dangerous chemicals into the water system in September 2011 sparked local unrest and ultimately led to the company’s closure (Tripathi et al., 2020). In some central tower systems that use molten salts or liquid sodium as a heat-transfer medium, the risk could be significant. Under normal operating circumstances, this shouldn’t endanger the operators, but if the tracking systems malfunction, stray beams may be a risk to workplace safety at site. (Aman et al., 2015)

3. General Job Site Safety Risks

Installing solar panels and systems can be risky. Workers in the solar industry face various risks, like:

1. Falls from high rooftops.
2. Electrocution or other electric hazards.
3. Repetitive stress injuries.
4. Cuts or sprains.

Lifting and Handling Solar Panels

Solar panels are heavy and awkward to lift and carry. Loading and unloading panels from trucks and onto roofs can cause:

1. Strains
2. Sprain
3. Muscle pull
4. Back injuries

Solar panels also heat up quickly when exposed to sunlight. So, if PPE is not worn or panels aren't handled correctly, they can cause burns.

Trips and Falls

Trips and falls are the second most common nonfatal injury in the construction industry. In fact, there were over 25,000 nonfatal slips, trips and fall injuries in 2019. Rooftop solar installations can pose a higher fall risk because there's less workspace as more panels get installed.

Workers in the solar energy industry are potentially exposed to a variety of serious hazards, such as arc flashes (which include arc flash burn and blast hazards), electric shock, falls, and thermal burn hazards that can cause injury and death. Solar energy employers (connecting to grid) are covered by the Electric power generation, transmission, and distribution standards and therefore may be required to implement the safe work practices and worker training requirements of OSHA's Electric Power Generation, Transmission and Distribution Standard, 29 CFR 1910.269. While solar energy is a growing industry, the hazards are not unique, and OSHA has many standards that cover them. Some hazards that workers in the solar industry may face.

1. Falls
2. Lockout/Tagout
3. Crane and Hoist Safety
4. Electrical
5. Heat/Cold Stress
6. Personal Protective Equipment

During all the stages of solar job site safety, unique work situations appearing during placement, plumbing, electrical connections, final testing, regular maintenance, and operations of the unit/ installation, several common conditions and quite a few unique situations appear. Work in charge and Safety professionals need to develop safe work practices to tide over the job- hazards, train the working team for following the requisite safety measures, strictly supervise to follow the safe practices during work execution to finally accomplish the Job task with total Safety.

4. Other Hazards (Psychosocial Hazards)

There are risks other than chemical and physical hazards, which need a close consideration by researchers as there are few to none studies when it comes to assess hazards related with worker's psychosocial health or work organization. Experts believe the new form of work in renewable energy or working in solar energy for instance, include precarious work, unstable employment, underemployment, workers may face skill obsolescence, psychosocial stress, and increased workload. Also, the increased incorporation of technology Considering the possibility of increasing the complexity of production systems across industries, which could lead to an increase in workload, stress, and a decline in employee motivation(Johansson et al., 2017; Latos et al., 2018).Additionally, factors like disconnection; dislocation; displacement; financial strain; polarization, restricted migration; skills gaps; unemployment will have adverse OHS effects (Ghislieri et al., 2018).

There is substantial evidence linking occupational psychosocial hazards to several negative outcomes. Unfortunately, there has been little attention to psychosocial hazards in the renewable workforce despite the rapid emergence of this new sector and the importance of these factors in maintaining optimal health.

5. Method

A pronged approach was used to conduct comprehensive search from literature describing health hazards associated with solar energy.

6. Searching for occupational health hazards in solar energy in the peer-reviewed literature

The authors looked for peer-reviewed literature with future-of-work scenarios using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Moher et al., 2009) as a guide. The databases Public Health Database, PubMed, PsychINFO, SCOPUS, Social Sciences Database, and Sociological Abstracts were searched between July and September 2022. A reference had to have been published in English between 2010 and 2022 and at least one term from the authors' lists had to be present in either the title or abstract. For screening, the search produced 1202 records. The most important screening criteria included making sure an article met the operational definition of work scenario used in the current study, which is a product (i.e., piece of writing) that "describes some conceivable future condition or tells the story of how such a condition could manifest" (Bishop et al., 2007, p. 8). As part of the screening process, key terms were also automatically searched for, abstracts were manually read for mention of at least one future-of-work scenario, the inclusion of publishing years (2010 to the present) was adjusted, and the level of work description was evaluated (job or task).

An overview of the selection procedure, which led to the retention of seventeen peer-reviewed publications, is shown in Figure 1.

7. Results

This review identified seventeen peer-reviewed papers describing occupational health hazards, summarized in for the purposes of review, OSH challenges present in solar energy.

The current review summarizes three major hazard categories based on scenarios found in peer- reviewed sources. The most common scenarios involved the exacerbation of toxic material's hazards, followed by general job site safety risks and few other hazards (psychosocial).

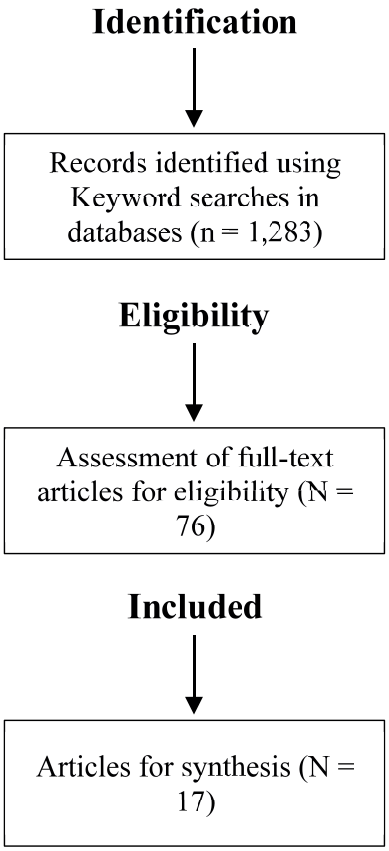

Figure 1: Review article selection process.

TABLE 1: Potential occupational safety & health hazards in solar energy.

Potential hazard	Study/Reference
Toxic chemicals	Hauke et al. (2018), Iavicoli et al. (2018), Tripathi (2020), Aman et al. (2015), Nasrollahzadeh et al. (2019), Alharbi el al. (2012), Izam et al. (2022).
General job site safety risks	Sen et al. (2021a), Bakhiyi et al. (2014), Sen et al (2021b), Islam et al. (2015), Peckham et al. (2017)
Others (Psychosocial)	World Economic Forum (2018a), Fernandez et al. (2017), Aman et al. (2015), Cartwright et al. (2018), Ellwood et al (2012), Mulloy et al. (2013),

8. Conclusion

According to the findings in this review, there is a subsequent evidence of occupational hazards presence within solar energy industry. Still seems to be contradiction in studies in relate to strong findings other than chemical hazards. It is necessary to be aware that, researchers, have not, used the both the work/nonwork characteristics which may lead towards the biased end results. Moreover, conceptual, and operational variables were not collectively measured/ investigated. Based on literature findings, it is observed that

future research which more towards the analysis of symptoms development and prevalence and factors like psychological hazards at work should be considered. Continuous surveillance of occupational hazards as mentioned in this article including psychosocial hazards, is recommended in this rapidly emerging workforce. However, such studies may provide a better insight to the stakeholders in identifying the severity of the occupational hazards and to formulate the new and more effective policies towards better health of workforce in the new era of energy.

Acknowledgment

The authors acknowledge that current research is funded by the project entitled *Development of Integrated IoT Application Framework in Safety and Health Management for Sarawak Energy Sector.*

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