Occupational Risks Associated with Solar Installations: A Review

Jesse C. Duroha[1], Jeffrey R. S. Brownson [2], and Gretchen A. Macht [1]

[1] Mechanical, Industrial & Systems Engineering, University of Rhode Island, Kingston, RI 02881 USA

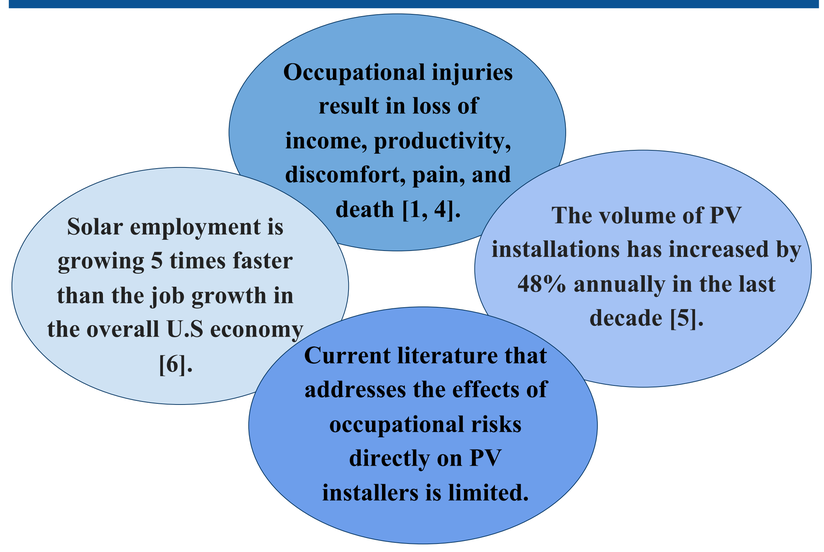
[2] Energy Engineering, Pennsylvania State University, University Park, PA 16802 USA

INTRODUCTION

There is a core need to review and assess the occupational risks associated with rooftop and ground-mount photovoltaic (PV) installations within the Engineering, Procurement and Construction (EPC) sector of the U.S. Solar industry. This poster presents the health and safety impact, and the means (Controls and Personal Protective Equipment [PPE]) to mitigate the effects of the following risks on PV Installers:

1. Falls from elevated working surfaces [1]
2. Musculoskeletal disorder (MSD) risks [2]
3. Electrical risks and hazards [1]
4. Heat stress [2, 3]

SIGNIFICANCE



1 Falls from Elevated Working Surfaces

75 % of fatal falls in construction involve ladders, roofs and scaffolding [7].

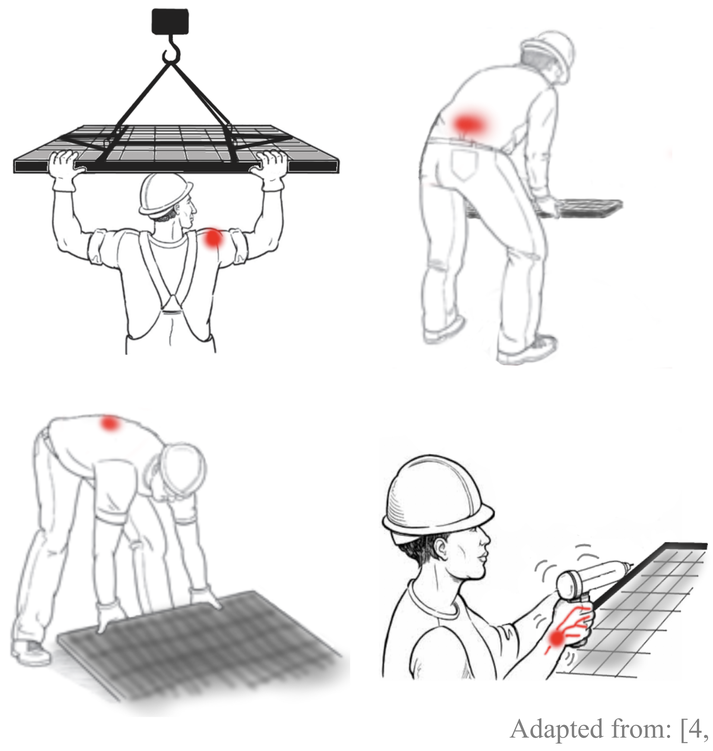
Adapted from: [7]

Controls and PPE

- ❑ Hazards identification training [1]
- ❑ Guardrails [8]
- ❑ Safety nets [8]
- ❑ Personal Fall Arrest System [8, 9]
- ❑ Prevention through Design [10, 11]

2 Musculoskeletal Disorder (MSD) Risks

Sprains, strains, soft tissue injuries and Hand Arm Vibration syndrome [4, 12, 13].



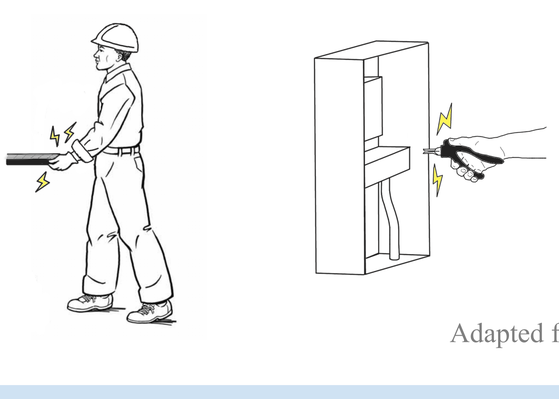
Adapted from: [4, 13]

Controls and PPE

- ❑ Site-specific lifting programs [14]
- ❑ Manual handling tools and equipment [4]
- ❑ Breaks and stretching sessions [15]
- ❑ Use reduced vibration tools [13]
- ❑ Anti-vibration gloves [13, 16]

3 Electrical Risks and Hazards

Exposure to shocks, burns and arc flash from electrical components and wiring [17].



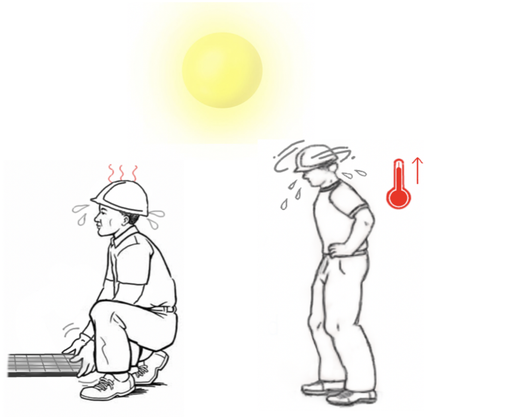
Adapted from: [13]

Controls and PPE

- ❑ Lockout/Tagout (LOTO) procedures [17, 18]
- ❑ Emergency response plan [18]
- ❑ Rubber insulating gloves and leather protectors [17]
- ❑ Fire-rated clothing [18]
- ❑ Arc flash protection [18]
- ❑ Protective eyewear [18]
- ❑ Safety footwear [18]

4 Heat Stress

Heat stress can result in heat related illnesses such as cramps, exhaustion, and strokes [19].



Adapted from: [13]

Controls and PPE

- ❑ Shade, rest stations, fluids [2, 20]
- ❑ Work-rest schedule based on wet bulb globe temperature [21, 22, 23]
- ❑ Monitor workers for symptoms [20]

CONCLUSION

This research can aid occupational safety and health professionals to develop safety protocols based on the hierarchy of controls (i.e., risk elimination, substitution, administrative and engineering controls, and PPE) that reduce occupational hazards, increase productivity on-site and provide an overall safe environment for PV installers.

ACKNOWLEDGMENTS

Emma McCool-Guglielmo

REFERENCES

[1] Solar Energy Industries Association. (2006) *Solar Construction Safety. https://www.coshnetwork.org/sites/default/files/OSEIA_Solar_Safety_12-06.pdf*

[2] Hanson, M., & Thatcher, A. (2020). Identifying Human Factors and Ergonomic Issues in Green Jobs: Facilitating Sustainable Green Jobs. In A. Thatcher, K. J. Zink & K. Fischer (Eds.), *Human Factors for Sustainability: Theoretical Perspectives and Global Applications* (pp. 171-192). CRC Press Taylor and Francis Group.

[3] *Solar Energy.* (n.d.). Occupational Safety and Health Administration. Retrieved June 2, 2020 from https://www.osha.gov/dep/greenjobs/solar.html

[4] NIOSH. (2013). Simple solutions for home building workers. https://www.cdc.gov/niosh/docs/2013-111/default.html

[5] Solar Energy Industries Association. (2020) *Solar Industry Research Data. https://www.seia.org/solar-industry-research-data*

[6] The Solar Foundation. (2020) *National Solar Jobs Census. https://www.thesolarfoundation.org/national/*

[7] Dong, X. S., Jackson, R., Varda, D., Betit, E., & Bunting, J. (2019). Trends of Fall Injuries and Prevention in the Construction Industry. *CPWR.*

[8] *Solar: Falls* (n.d.). Occupational Safety and Health Administration. Retrieved June 15, 2020 from https://www.osha.gov/dep/greenjobs/solar_falls.html

[9] Dong, X. S., Largay, J. A., Choi, S. D., Wang, X., Cain, C. T., & Romano, N. (2017). Fatal falls and PFAS use in the construction industry: Findings from the NIOSH FACE reports. *Accident Analysis & Prevention*, *102*, 136–143. https://doi.org/10.1016/j.aap.2017.02.028

[10] Rajendran, S., & Gambatese, J. (2013). Risk and Financial Impacts of Prevention through Design Solutions. *Practice Periodical on Structural Design and Construction*, *18*(1), 67–72. https://doi.org/10.1061/(asce)sc.1943-5576.0000129

[11] Dewlaney, K. S., & Hallowell, M. (2012). Prevention through design and construction safety management strategies for high performance sustainable building construction. *Construction Management and Economics*, *30*(2), 165–177. https://doi.org/10.1080/01446193.2011.654232

[12] Weir E., & Lander, L. (2005). Hand-arm vibration syndrome. *CMAJ. 172*(8), 1001–1002. doi: https://doi.org/10.1503/cmaj.045314

[13] Albers, J.T. & Estill, C.F. (2007). *Simple solutions: Ergonomics for construction workers* (NIOSH Publication No. 2007-122).

[14] Choi, D. S. (2008). Investigation of Ergonomic Issues in the Wisconsin Construction Industry. *Journal of SH&E Research.*

[15] Ludewig, P.M. & Borstad, J.D. (2003). Effects of a home exercise program on shoulder pain and functional status in construction workers. Occupational and Environmental Medicine, 60(11), 841-849.

[16] Choi, S. D., Yuan, L., & Borchardt, J. G. (2016). Musculoskeletal Disorders in Construction: Practical Solutions from the Literature. *American Society of Safety Engineers. Construction_Fatalities.pdf*

[17] White, J. R., & Mike Doherty (2017). Hazards in the Installation and Maintenance of Solar Panels. *IEEE.* 10.1109/ESW.2017.7914834

[18] Romich, E., & McGuire, K. (2015). On-Farm Solar Electric System Safety. https://ohioline.osu.edu/factsheet/CDFS-4105

[19] Center for Disease Control and Prevention (September 1, 2017). *Warning Signs and Symptoms of Heat-Related Illness.* https://www.cdc.gov/disasters/extremeheat/warning.html

[20] Department of Industrial Relations (2015, May 14) *Heat Illness Prevention Regulation Amendments.* https://www.dir.ca.gov/dosh/documents/Heat-Illness-Prevention-Regulation-Amendments.pdf

[21] Rowlinson, S., & Jia, Y. A. (2014). Application of the Predicted Heat Strain Model in Development of Localized, Threshold-based Heat Stress Management Guidelines for the Construction Industry. *The Annals of Occupational Hygiene*, *58*(3), 326–339. https://doi.org/10.1093/annhyg/met070

[22] Yi, W., & Chan, A. P. C. (2013). Optimizing work–rest schedule for construction rebar workers in hot and humid environment. *Building and Environment*, *61*, 104–113. https://doi.org/10.1016/j.buildenv.2012.12.01

[23] Acharya, P., Boggess, B., & Zhang, K. (2018). Assessing Heat Stress and Health among Construction Workers in a Changing Climate: A Review. *International Journal of Environmental Research and Public Health*, *15*(2), 247. https://doi.org/10.3390/ijerph15020247