Supplemental Project Notice

ERGONOMICALLY ENHANCED TOOL FOR MANHOLE AND VAULT COVER REMOVAL: PHASE II

PROJECT HIGHLIGHTS

- Field-tested innovative tool design to manually move manhole and vault covers with less strain to the lower back
- May help reduce the incidence, severity, and cost of musculoskeletal injuries to utility workers
- Enhances safety in distribution operations through application of EPRI's ergonomics research expertise

Background, Objectives, and New Learnings

Electric and gas utilities with service areas in densely populated metropolitan areas have many of their distribution lines and infrastructure located underground. Access is obtained through manhole and vault covers, which are circular or rectangular plates on the street level. These plates can be opaque or have a mechanical grid for ventilation.

With large networks of underground infrastructure, utility workers must move covers to open and close manholes and vaults frequently during a shift. One utility has reported that the frequent daily movement of heavy covers has caused many physical injuries, or musculoskeletal disorders (MSDs), to their field workers. The magnitude of manual force and body posture are two key risk factors for MSD injuries.

To reduce the manual force required for cover removal, and awkward postures associated with this task, EPRI undertook a project focused on evaluating manhole cover removal processes and designing a battery assist tool that would reduce ergonomic risk associated with this activity. The tool incorporated a handle and hook configuration that is actuated by an electric motor assist. A battery powers the electric motor that results in the lifting and lowering of a manhole cover. This Phase I project culminated in a prototype tool that was shown to reduce forces to the lower back in field workers.

The objective of this Phase II of the research is to review and assess the prototype tool developed in Phase I for any changes and/or upgrades which will provide increased operability and risk reduction for manhole removal tasks. The project will include field tests and prototype iteration to deliver a manufacture-ready design of the final second-generation tool.

Benefits

Results from this project are expected to reduce the incidence, severity, and cost of MSDs to utility workers from manual movement of utility manhole and vault covers.

Such benefits could scale nationally and globally to the utility or other sectors with similar work requirements. This is particularly important going forward as utilities expand their underground infrastructure to support growing urban populations.

Project Approach and Summary

Manholes and vaults are accessed by workers removing circular or rectangular covers at street level. These covers are typically iron and heavy (up to 227 kg). Except on rare occasions, underground utility workers use manual tools to remove and replace covers. These tools are typically a hook and chain, a rigid bar with a handle (J-hook), or a lever (second-class lever). The objective of EPRI's Phase I project was to address the high risk of MSDs affecting utility workers with field tests of current work practices and design of a new cover removal tool ("Power Hook").

Biomechanical testing results of the Phase I tool revealed that the Power Hook reduced the peak lumbar torque by 7 to 56%, compressive forces by 6 to 30%, and shear forces by 9 to 49% at the L5-S1 level.

The EPRI team plans to conduct Phase II of this project, which will focus on making improvements to the tool developed in Phase I. This will include the following project tasks:

Task 1: Development and Fabrication of Phase II Power Hook Prototypes. Insights from Phase I, including ergonomic and usability feedback, will guide the design modifications for the Phase II version of the Power Hook. A fully functional prototype will be fabricated reflecting the updated design.

Task 2: Field Testing of Updated Prototype. A site visit will be conducted to test the Phase II prototype under real-world conditions. Field performance will be assessed and any changes or modifications that may be needed based on this testing will be identified. This task includes usability questionnaires and motion capture and biomechanical analysis

Task 3: Final Modifications Based on Field Test Results. Findings from Task 2, including user feedback and biomechanical data, will be used to guide the design of the final tool.

Task 4: Final Validation Testing at Multiple Sites. The final version of the Power Hook will be tested at two separate utility sites.

This phase will ensure broad usability and effectiveness across varied operational environments. As before, field testing will be documented using photographs and video.

Task 5: Documentation and Dissemination. A set of project deliverables (described below) will be produced.

Deliverables

This section lists the deliverables you may expect to get from this project. Be sure that you do NOT predict the outcome of the research. It is a required section:

- Comprehensive technical report detailing project methods, findings, and ergonomic impacts.
- CAD drawings and manufacturing blueprints for fabrication of the final tool.
- Fact Sheet on the final tool operation.
- Training presentation on the operation of the final tool.
- A peer-reviewed manuscript submitted to a scientific journal.

Price of Project

The price to participate in this project is $70K per participant. The cost can be distributed over three years. This project qualifies for the use of Self-Directed Funds (SDF).

Project Status and Schedule

This project is a two-year effort. EPRI anticipates a start date of November 15, 2025, with completion by November 15, 2027.

Who Should Join

Organizations with underground networks of electric and gas transmission and distribution.

Contact Information

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

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