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Conceptual Design of an Electron Accelerator for Bio-Solid Waste Treatment

Cooperative Research and Development Agreement Final Report

CRADA Number: FRA-2016-0034

Fermilab Technical Contact: Charlie Cooper

Summary Report
24 September 2019

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NOTICE

In accordance with Requirements set forth in Article X.A(2) of the CRADA document, this document is the final CRADA report, including a list of Subject Inventions, to be forwarded to the Office of Science and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

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CRADA Title: Conceptual Design of an Electron Accelerator for Bio-Solid Waste Treatment

Parties to the Agreement: Metropolitan Water Reclamation District of Greater Chicago and Fermi Research Alliance, LLC

Abstract of CRADA work:

Several studies have identified electron beam (EB) irradiation of municipal wastewater and bio-solids as an effective and promising approach to the environmental remediation of the enormous quantities of human waste created by a growing world-wide population and increased urbanization. However, despite the technical success of experimental and pilot programs over the last several decades, the technique is still not in commercial use anywhere in the world. In addition, the report also identifies the need for "Financial and infrastructure participation from a utility for demonstration project" and "Education and awareness of safety of utilizing electron beam technology" as two additional roadblocks preventing technology adoption of EB treatment for bio-solids. In this concept design, we begin to address these barriers by working with Metropolitan Water Reclamation District of Greater Chicago (MWRD) and by the applying the latest accelerator technologies developed at Fermilab and within the DOE Office of Science laboratory complex.

Summary of Research Results:

Completed the conceptual design of a 1 MW accelerator system that meets all FOA LAB 16-1438 requirements for a Type 3 accelerator and that we believe is fully viable for commercial irradiation of municipal bio-solids. Computer simulation indicates the beam physics works. Our simulation efforts have yielded no show-stoppers. We also believe we have developed a viable conceptual design for the accelerator that is ready to move to subsystem tests; a full engineering design; and construction of a first article 250 kW test accelerator. If such an accelerator were built, it would represent the first of a new class of cost effective, simple, SRF-based industrial accelerators that can enable many new accelerator applications. We have outlined key R&D areas that require immediate funding support. We have also designed a beam delivery and shielding system that is viable for treating bio-solids from a large municipal waste water treatment facility such as the Stickney plant operated by MWRD.

Beyond the proposed R&D, the next logical step is a full engineering design leading to the construction of the proposed test accelerator.

Related Reports, Publications, and Presentations:

Cooper, Charles. *Final Report: Conceptual Design of an Electron Accelerator for Bio-Solid Waste Treatment*. United States: N. p., 2017. Web. doi:10.2172/1431331.

Subject Inventions listing:

NONE

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