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Lawrence Livermore National Laboratory

CRADA NO. TC02408, Final Report, Thermonuclear Fusion Verification of Staged Z-Pinch Fusion on a 0.5 MA LTD Pulsed Power Generator

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Disclaimer

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Lawrence Livermore National Laboratory

COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENT (CRADA) FINAL REPORT

CRADA NO. TC02408 | THERMONUCLEAR FUSION VERIFICATION OF STAGED Z-PINCH FUSION ON A 0.5 MA LTD PULSED POWER GENERATOR

REPORT DATE: 05/05/2025

In accordance with requirements set forth in the terms of the CRADA, this document serves as the respective CRADA's Final Report, including a list of Subject Inventions. It is to be forwarded to the DOE Office of Scientific and Technical Information, as part of the commitment to the public to demonstrate results of federally funded research.

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This CRADA project was sponsored under the Department of Energy's Office of Science, Fusion Energy Sciences INFUSE Program.

Joint Work Statement Funding Table showing DOE funding commitment:

	Year 1		
Funding Type	Funds-in	*In-kind	Totals
MIFTI	$0	$49,344	$49,344
Dept. of Energy INFUSE Program	$185,000		$185,000
Totals	$234,344		$234,344
**Federal Administrative Charge (FAC)	$0		$0

Executive Summary of CRADA Work:

LLNL fielded neutron detectors at UCSD's CESZAR facility during the experimental campaigns investigating the staged Z-pinch concept. This concept uses high current to compress a cylindrical plasma composed a high atomic number gas, such as argon, surrounding fusion fuel. LLNL analyzed data from the diagnostics and improved the diagnostic setup specific to the experiment. This work helps to advance the mission creating a fusion energy source, which is a benefit to the economy and for energy security.

Summary of Research Results:

☐ This product contains Protected CRADA Information, which was produced on 05/05/2025 under CRADA No. TC02408 and is not to be further disclosed for a period of [up to and not to exceed] five (5) years from the date it was produced except as expressly provided for in the CRADA.

Technical Objectives:

Fielding of experimental diagnostics on the CESZAR device. LLNL will field neutron time-of-flight diagnostics and neutron activation detectors on the CESZAR device. The LLNL will help determine the best placement of these diagnostics to attain the highest quality data. The result will be high quality experimental data presented to the Participant.

LLNL and Participant will jointly analyze the data from experiments performed by the Participant on the CESZAR device. This will include the total neutron yields compared to relevant device parameters. It will also include analysis of the time-of-flight to better understand the energy and anisotropy of the neutrons from the device. The results will be presented to the Participant.

LLNL will improve the data analysis routine to include a more complete model of the neutron interaction. This model will be used to recreate the neutron time-of-flight diagnostics, by simulating neutrons from their birth at the detector to the eventual light output on the detectors. This will allow for a robust analysis of the uncertainty in the system and will potentially provide for concrete measurement of the neutron energies. The result from this task will be presented to the Participant, who will then evaluate and determine if any further experiments will be necessary.

Actual Accomplishments:

LLNL field neutron diagnostics on the CESZAR device taking high quality data. LLNL staff took three different trips and remotely supported experimental campaigns. Data was acquired, analyzed and a peer-reviewed publication was produced [Conti et al., J. Applied Physics 136, 095901 (2024)].

Subject Inventions:

No inventions were created.

Technology Transfer Activities:

No technology transfer was performed.