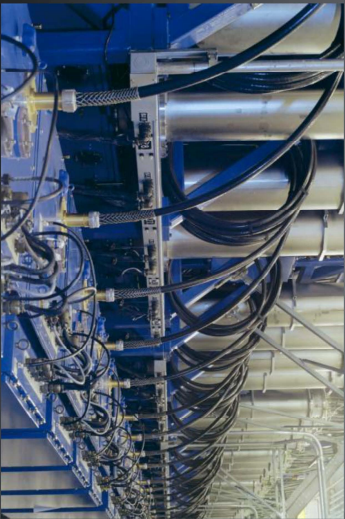


DARHT Accelerator Operations Under the Department of Energy (DOE) Conduct of Operations Order 422.1

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The mission of the Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility is to experiment on dynamic events of extremely dense materials. These experiments are conducted using two linear induction accelerators oriented at right angles to one another. The objective of DOE Order 422.1 is to support mission success by reducing the likelihood of human fallibility, technical failures or organizational system failures with the implementation of structured operations.



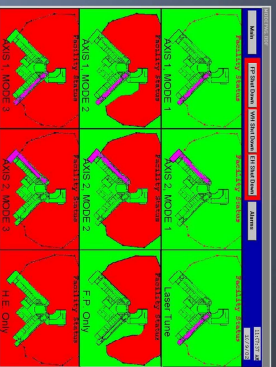
Basic Operational Overview

The DARHT facility is designed to produce high-resolution flash radiographs of hydrodynamic and other explosive experiments. The deformation of the test object is imaged using short, intense pulses of x-rays produced by the electrons from the DARHT accelerators. Each electron beam is accelerated to a nominal energy of 20 MeV using linear induction accelerators (LIAs) to produce the short-x-ray pulses. The x-rays create, along two orthogonal axes, images of parts of an experimental assembly when these parts are being accelerated and deformed by high-explosive charges. Each x-ray image is detected with a digital Gamma-Ray Camera System and/or radiographic film.

Modes of Operation

Each accelerator (Axis 1 or Axis 2) may be operated in one of four modes, each defined in terms of a pair of numbers. Sixteen combinations of modes are possible for both axes. The first number corresponds to the status of the Axis 1 accelerator, and the second number corresponds to the status of the Axis 2 accelerator. The numbers 0-3 indicate the status of the current activity of the accelerator. The mode of operation defines the requirements for personnel exclusion in an area and therefore procedural sweep patterns. Personnel Software System (PSS) controls are programmed to allow certain modes for each axis depending on the mode of the other axis. The modes of operation are shown below:

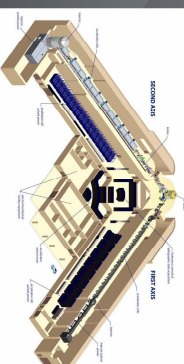
Mode	Activities
0	Beam Off
1	Beam in the Accelerator
2	Beam in the Hall and on the Firing Point
3	Beam in the Hall on the Firing Point in Combination with Explosive Operations on the Firing Point



Operation Organization and Administration

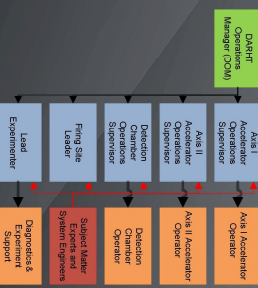
Operational organization and administration is defined in the DARHT Operations Standard. The DARHT Operations Standard was developed to implement the requirements of Los Alamos National Laboratory (LANL) Institutional Policy P310: Formality of Operations. P310 ensures compliance with the Department of Energy (DOE) Order 422.1.

Operations at DARHT face the unique challenge of coordinating simultaneous activities between two unique accelerators and a High Explosive (HE) firing system. The DARHT Detection Chamber (DDC) houses the Master Control Console (MCC) for interface to setup, fire and acquire data from an experiment at the DARHT facility.



The Accelerator operators team is responsible for acquiring and analyzing accelerator data, producing the accelerator ready interlocks, and releasing control to the MCC for executing the experiment.

- The **DOM** is responsible for the overall safety and safe operation of DARHT activities. All personnel at DARHT are accountable to this position for the performance of their respective organizations.
- The **Accelerator Operations Supervisor** is responsible for the safe and effective operation of the accelerator.
- The **Accelerator Operator** is responsible for the status, repair and the reporting of abnormal conditions of the accelerator and support equipment. This information is relayed to the Operations Supervisor.
- The **DDC Operations Supervisor** is responsible for the safe and efficient operation of the DDC.

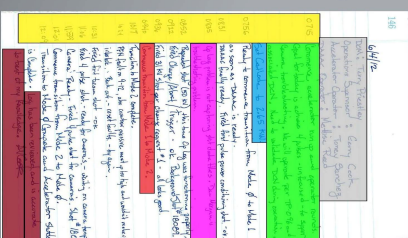


- The **DDC Operator** is responsible for the status, operation and maintenance of the DDC and support equipment and reports abnormal conditions to the DDC Operations Supervisor.
- The **Firing Site Leader** is responsible for the safety and security of all HE operations at DARHT, and reports abnormal conditions to the DOM.
- The **Laser Experimentor** is responsible for ensuring that the design and execution of experiments at DARHT return high quality data meeting design release requirements. This includes the preparation and fielding of all diagnostics and the coordination of supporting activities (e.g. gas transfer).
- The **DARHT Operations Subject Matter Experts** (SMEs) (e.g. Physics, Pulsed Power, Injector, Mechanical, PSS, controls, firing systems, shot setup) are responsible for developing safe and efficient operating parameters for their systems.

Narrative Log

The Operations Supervisor for each accelerator maintains a narrative log which provides an overview of operations for the day and consists of the following information. (An example is provided in figure 4):

- The responsibilities of DOM, Operations Supervisor and Operators of the accelerator and Data Acquisition, Analysis, Archive, and Control (DAAAC).
- Entries are made beginning with a time in the **24 hour format** and are then followed by a description of the condition.
- Entries are made in chronological order with no lines left blank.
- If a late entry is made, the entry shall begin with the actual time of entry, followed by "Late Entry" (e.g., 1532 (Late Entry) – At 1448 entered Mode 2 Operations).
- Changing conditions which include, but are not limited to:
 - Commencement of operations with a goal for the day, adjustment set points, which are verified by operators, problems that may occur along with troubleshooting and corrective actions, and mode transitions.
- A **final entry** which should include a positive verification of the completeness and accuracy of the log (e.g., "The log has been reviewed and has been verified to be complete and accurate to the best of my knowledge"), followed by the signature of the Operations Supervisor.
- The Operations Supervisor is to ensure that all entries are promptly entered in indelible ink in a manner such that they can be easily read and understood.
- Corrections to a log entry are made, a single line will be drawn through the incorrect entry, followed by the initials of the person making the correction.



Future Plans for Narrative Log Keeping

Presently, DARHT utilizes a handbound narrative log. Our current goal in the next year will be to transition to an automated log using the control system to provide the majority of the input. With a narrative log, scientists, operations team, and managers would be able to review the same data remotely. This process will reduce the risk of communication and transcribing errors resulting in an increase to the overall efficiency of accelerator operations.

In summary, the objective of DOE Order 422.1 is to support mission success by reducing the likelihood of human fallibility, technical failures or organizational system failures with the implementation of organizational structured operations. The DARHT facility's approach to operational organization, administrative and narrative log keeping in compliance with DOE Order 422.1 has proven to be an integral part of DARHT's success. Future plans to further automate machine parameters into the automated log will increase the efficiency, accuracy, and availability to daily operations.

