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NIF Shot Operations Plan, February 2011

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National Ignition Facility

Shot Operations Plan



February 2011

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National Ignition Facility Shot Operations Plan

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1.0 INTRODUCTION

This document identifies the policies and general procedures necessary to perform and support routine shot operations in the NIF Facility. Shot Operations are defined as those activities directly related to or supporting the operation of the NIF Main Laser System, Precision Diagnostic System (PDS), Target Chamber (TC), and associated systems located on the NIF. Operations include delivery of low-power laser light through to the firing of the main laser amplifiers, operation of the beampath and associated utilities, target positioners and diagnostics, and the various computer control systems. Construction and maintenance activities are not covered here, except as they interface to ongoing operations. This document, in conjunction with the NIF Operations Management Plan¹ and NIF Maintenance Plan,² satisfies the requirements for a Conduct of Operations.

Duties, responsibilities, and reporting requirements of the various positions associated with shot operations are detailed herein. Guidelines for control room activities are also included.

General policies governing administrative and operational practices related to shot operations are included herein. This includes general responses for major facility off-normal conditions such as oxygen deficiency and crash button actuation. Operational Safety Procedures (OSPs) and operating procedures may include additional detailed steps, as required.

Processes for managing and using system operating procedures, OSPs, shot setup sheets, and shot checklists are contained herein. The detailed procedures should be used for the operation of the facility and equipment, where appropriate. If in doubt as to which documents apply, the approved detailed operational procedures supersede this document.

This document shall be revised before any the following events occur: the introduction of tritium into the facility, commencement of neutron-generating activities, or production of dispersed hazardous materials in the target chamber or classified operations.

1.1 Location

This document governs shot operations on the NIF, which includes the Laser and Target Area Building (LTAB, B581), Optics Assembly Building (OAB, B681) and associated utility pads and outbuildings (B582, B682, B683, and B684).

1.2 Terminology

Full System Shot—Shot sequence that involves firing any or all of the Main Laser Amplifier sections of a bundle with or without firing the multi-pass amplifier (MPA) rod amplifier. This may or may not involve propagation of high-energy laser light through the laser amplifier chain to either the Switchyard (SY) Roving Calorimeter, PDS or TC

Rod Shot—Shot sequences that involve firing any preamplifier module (PAM) MPA rod amplifier and not firing any Main Laser Amplifiers. This may or may not involve propagation of rod shot energy laser light through the laser amplifier chain to the SY Roving Calorimeter, PDS or TC.

PILC Shot—Pre-Ionization Lamp Checks (PILCs) test the flashlamps with a high voltage, low energy discharge

Shot Operations—Shot Operations start when the Shot Director (SD) or Lead Operator (LO) has started the Shot Cycle process.

Significant Programmatic Impact—The loss of a structure, system or component (SSC), which would preclude shots to Target Chamber Center (TCC) for more than 6 months.

2.0 ORGANIZATION AND ADMINISTRATION

2.1 Shot Operations Chain of Command

The operational organization used to conduct shot operations is shown in Figure 1. The individuals assigned to fill the various operational positions described may be assigned from several different organizations. When assigned to shot operations shifts, they report to the SD and LO for all operational activities.

Shot Operations formally begin with a pre-shift brief (Section 8.3.2) and subsequent initiation of the Shot Checklist.³ If a Work Control Officer (WCO) is stationed, they maintain overall responsibility for safety and work coordination in the facility outside of the shot cycle. When the Shot Cycle process is started, the primary focus in the facility is on the shot process. Other activities in the facility become secondary to the shot processes. On a case by case basis, operators may be assigned additional duties by their respective Subsystem Manager (SSM) (with approval from the Shot Operations Manager [SOM] or SD), provided these duties do not interfere with assigned shot operations tasks.

Training and Qualification of individuals to fill these shot operations roles are covered in Section 2.1. Personnel are assigned by their organization to this shot organization by shift (see Section 8.2). It is the responsibility of the supplying organization to provide alternate qualified personnel to fill these positions in the event of illness or other problem preventing the assigned individual from fulfilling the shift requirements. The SD and LO should be informed of the substitution as soon as possible.

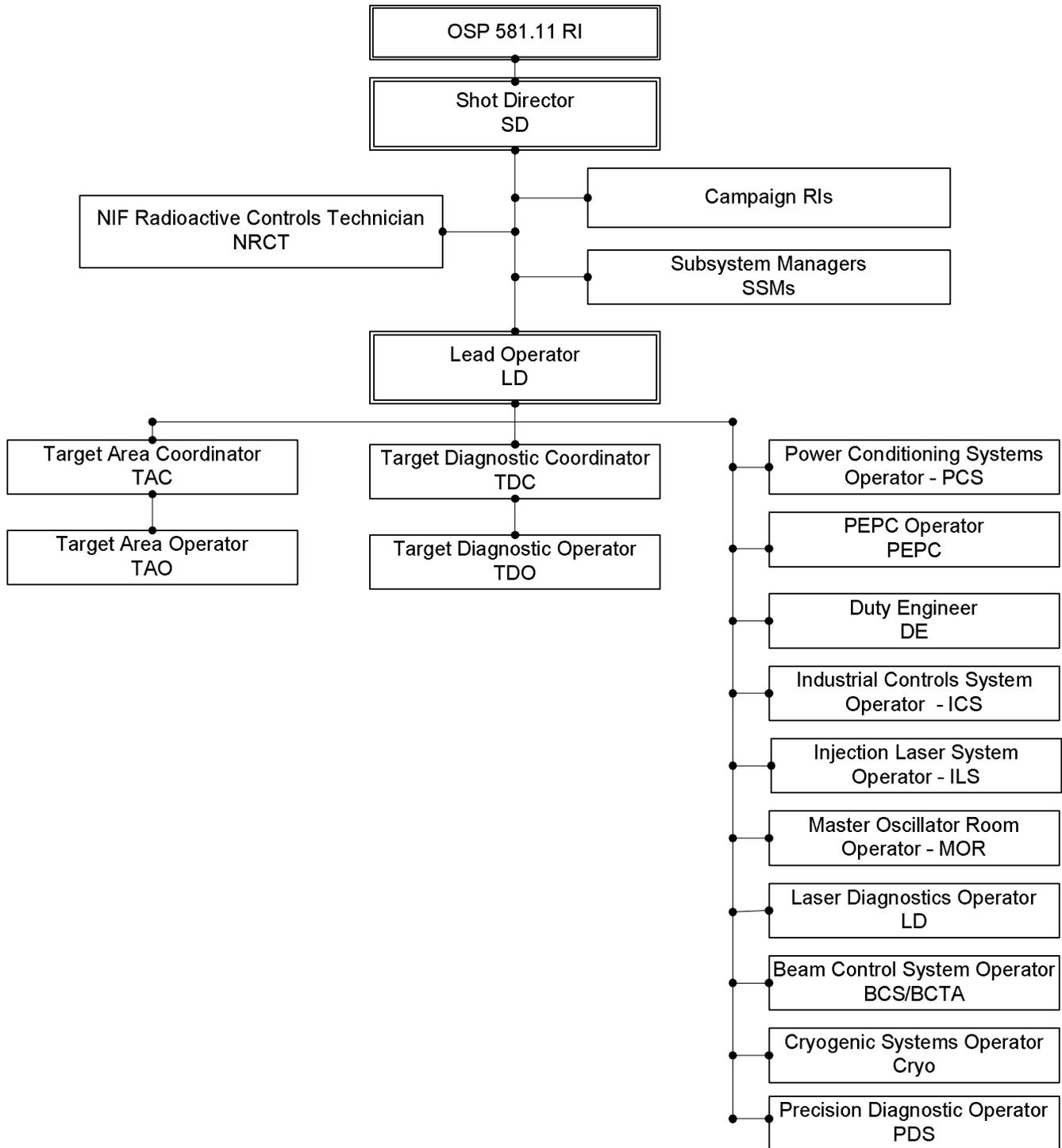


Figure 1. Shot Operations Organization

2.1 Shot Support, Personnel Qualifications and Required Training

All personnel must complete the initial subsystem qualification specified in Section **Error! Reference source not found.** Only those who have completed the requisite qualification and have maintained proficiency⁴ may support operations and be assigned on the

Shift Schedule. The Control Room Operations Manager (CROM) shall ensure that only qualified and proficient personnel operate the appropriate system. Lists of qualified operators and their proficiency status shall be maintained by the NIF Training Coordinator and reviewed by the CROM. The Lead Operator will verify that the shot operations personnel are qualified to perform their assigned roles on the shot operations team.

Minimum staffing requirements for laser propagation beyond the Master Oscillator Room (MOR) are specified in Table 1. These personnel are expected to be in the Control Room or Target Bay for shots unless otherwise specified. A list of applicable Qualification Cards is in **Appendix A**.

Table 1. Minimum Shot Operations Manning

Personnel	PCS HV Ops (no laser propagation)	Regen Laser Propagation beyond ISP	Rod Shot to ISP, FED, PABTS	Rod Shot to RMDE Cal	Main Laser to RMDE Cal	Rod Shot to PDS	Main Laser to PDS	Rod Shot to TCC	Main Laser to TCC
Shot Director	1			1 (Note 1)	1 (Note 4)	1 (Note 1)	1 (Note 4)	1 (Note 1)	1 (Note 4)
NIF Radiological Controls Technician									1 (Note 1,9)
Lead Operator	1 (Note 1)	1 (Note 1)	1	1	1	1	1	1	1
MOR Operator		1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)
Injection Laser System Operator		1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)	1	1
Power Conditioning System Operator	1				1		1		1
PEPC Operator				1 (Note 4)	1	1 (Note 4)	1	1 (Note 4)	1
Laser Diagnostics Operator				1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)
Beam Control System Operator		1		1	1	1	1	1	2 (Note 5)
Cryo Operator									1 (Note 7)
Duty Engineer	1 (Note 3)	1 (Note 3)	1	1	1	1	1	1	1
Industrial Controls System Operator	1 (Note 6)			1	2 (Note 5)	1	2 (Note 5)	1	2 (Note 5)
Precision Diagnostics System Operator						1	1		
Target Area Coordinator								1	1
Target Area Operator								1	2
Target Positioner Supervisor (TPS)								1 (Note 8)	1 (Note 8)
Target Diagnostics Coordinator									1 (Note 4)
Target Diagnostics Console Operator									1

Note 1: Personnel only required to be on site

Note 2: Not longer used .

Note 3: Personnel may be on call.

Note 4: These duties may be combined with another operator

Note 5: Second operator may be waived at SD discretion

Note 6: Only required when firing into flashlamps.

Note 7: Required for Cryo Target Operations

Note 8: Optional Position. Not req'd for Shot Operations

Note 9: NRCT required for TCC shots with tritium or Cat B yield shots. NRCT also to be assigned for any shift with planned radiological work

2.1.1 General requirements for all operators

- Maintain training currency with the Facility Safety Plan, NIF-5019665⁵ and OSP 581.11,⁶ follow all safety protocols and adhere to posted signs and barricades
- Prior to assuming responsibilities and duties for a control console (and with SD approval), operators will conduct a thorough turnover per Section 8.3
- Maintain logs for each subsystem (see Section 8.1)
- Participate in a Preshift Brief (Safe Plan of Action [SPA] Meeting). See section on Shift Turnover (Section 8.3).
- Operate only those consoles to which they are assigned for given shift. No operator shall operate another operator's console without the LO's permission.
- Follow procedures and checklists. Inform SD of necessary changes. Deviations from standard procedures shall be approved by the NIF Operations Manager (NOM) before being executed. No operations shall be conducted from memory.
- Promptly inform the LO/SD and respond to alarms or unplanned, out-of-specification parameters for equipment under their control
- In the event of an emergency, take the necessary immediate actions required to ensure personnel, equipment and environmental safety without obtaining prior approval, to the extent that their safety and the safety of others is not jeopardized. Supervisors shall be notified promptly after such actions have been taken
- Check in and check out with LO when arriving at or departing their workstation. All operators will wear radios and headsets during Shot Operations to maintain radio contact, unless otherwise authorized by the LO
- During shot operations, check in with the LO at the beginning of the shift and check out at the completion of the shift

2.1.2 The Shot Director (SD)

- Reports to the SOM
- Has completed the SD Qualification Card or equivalent
- Has responsibility for the safe, correct and efficient execution of authorized laser system shots and other coordinated activities. In this capacity, serves as the Work Permit Responsible Individual for shot operations
- Manages the activities of all personnel assigned to support shot operations, using the LO as described in his/her duties and responsibilities
- Provides the final authorization immediately prior to firing of a NIF Main Laser System Shot; therefore the SD shall prevent operation of the laser if they believe that it cannot be performed safely or properly
- Authorizes major changes to operational facility status as delegated by the NOM
- Executes the SD Shot Checklist
- Acts as the Work Control Officer when the WCO is not stationed
- Serves as the single point of contact for other groups interacting with the NIF facility during off-normal conditions occurring when the NOM is not present. This includes acting as the alternate Facility Point of Contact (FPOC) for purposes of interacting with emergency personnel until relieved of this duty by the FPOC or NOM

- Receives advice and recommendations on how to proceed with authorized shot campaigns from the Campaign Responsible Individual (RI) (or their stated representatives), but maintains authority over the shot and must comply with approved procedures for making significant changes to procedures, setups, and sequencing outside of their prerogative
- Authorizes the granting of Safety Interlock System (SIS) system permissive key turns and facility sweeps
- Ensures, in conjunction with the WCO, that the NOM or Shot Operations Manager (SOM) is notified per Section 6.0 of this procedure and that such notifications are documented in the OpsLog
- Ensures pre-shift briefs are conducted before commencing Shot Operations.
- Approves deviations from standard procedures as appropriate
- Approves operator relief during shift turnover.
- Shall inform the LO of their location if they will not be in the Control Room.
- Is responsible for interfacing with the Laser Performance Model software to assist in real time operational decisions:
 - Reviews rod shot data and compares it to predictions and makes a decision on whether or not to proceed to the system shot
 - Analyzes data to ensure system protection limits are not violated
- Conducts or participates in post-shot review according to Section 3.8 of this Plan

2.1.3 The Campaign Responsible Individual (Campaign RI):

- During shot operations, serves as staff advisor to the SD
- Prior to a shot, defines specific shot goals and completes shot setup
- During shot operations, provides advice and recommendations to the SD regarding the conduct of authorized shots within the campaign (as specified in the rules of engagement), including: shot sequencing, acceptability of diagnostics, concurrence to proceed in the case of minor off-normal parameters that can affect the experimental results, etc. The Campaign RI shall not direct specific actions to operators without the concurrence of the SD.
- Maintains check-in and check-out list for visiting experimentalists
- Ensures all assigned personnel attend pre-shift brief
- Conducts or participates in post-shot review of each shot in accordance with Section 3.8 of this Plan

2.1.4 NIF Radiological Control Technician (NRCT):

- As required to support shot operations, reports to the SD. NRCTs are NIF staff, matrixed from the Hazardous Controls Department.
- Has completed the NRCT qualification card and completes the steps in the Shot Checklist designated for the NRCT (for applicable shots)
- NRCTs perform radiological and Be support, including response to off-normal events
- Performs initial re-entry surveys to designated areas after high yield shots.
- Operates facility radiological monitoring systems

2.1.5 The Lead Operator (LO):

- Reports to the SD

- Has completed the LO Qualification Card or equivalent
- Efficiently coordinates the actions of the various operators assigned to the shot operations shift
- Runs the control system Shot Director software
- Serves as the Daily Work Team Leader for shot operations and coordinates the shift staffing with appropriate personnel
- Ensures most current revisions of all procedures and checklists are used for the shot
- Maintains accountability of shot operations staff (check-in and check-out)
- Informs the SD of their location if they will not be in the Control Room
- Controls radio communication nets to ensure reliable, efficient communications between shot operations personnel and that proper radio protocols are followed in accordance with Section 5.2
- Completes the steps in the latest version of the Shot Checklist designated for the LO and coordinates completion of the remainder of the checklist by the various operators
- Directs and supervises the completion of facility sweeps, integrity checks, and other safety-related tasks as specified in the Shot Safety Checklist
- Supervises control room activities and maintains decorum, and shall request non-shot personnel exit the control room if required to ensure safe and orderly operations

2.1.6 The Target Area Coordinator (TAC):

- Reports to the LO
- Has completed the TAC Qualification Card or equivalent
- Coordinates all shot-related activities in the Target Bay associated with positioners and control of Target Chamber Center
- Directs the activities of assigned Target Area Operators
- Completes the steps in the Shot Checklist designated for the TAC
- Coordinates diagnostics setup and configuration with Target Diagnostic Coordinator (TDC)
- Verifies target bay shot activities are carried out safely and efficiently, and in accordance with approved procedures and released Work Permits
- Ensures the proper target(s) are selected and loaded into the positioner and associated documentation is properly completed and routed per Target Management Procedure (NIF-5012336)⁷

2.1.7 Target Area Operator (TAO):

- Reports to the TAC
- Has completed the TAO Qualification Card or equivalent
- Operates assigned Target Area equipment per approved operating procedures, including but not limited to: Target Alignment Sensor Positioner (TASPOS), Target Positioners (TARPOS and CryoTARPOS), Target and Diagnostic Manipulator (DIM) positioners, the Chamber Interior Viewing System (CIVS), the Target Chamber Service System (TCSS), Chamber Center Reference System (CCRS), Opposed Port Alignment System (OPAS), Static X-ray Imager (SXI), Final Optics Damage Inspection (FODI) and Industrial Controls associated with operating each of these
- Completes the steps in the Shot Checklist designated for the TAO making preparations for and performing Target Chamber entries in support of shot operations

- Performs repairs of assigned equipment (if so authorized) to support shot operations
- Performs sweeps/unsweeps and beampath integrity checks for the target chamber and target bay as directed by the LO (through the TAC)

2.1.7.1 Target Chamber Positioner Supervisor (TPS)

- Reports administratively to the Target Area Commissioning, Operations and Maintenance Manager (TCOM); reports to the LO for TC coordination activities
- Has completed the TPS qual card
- Operates assigned Target Area equipment per approved operating procedures, including but not limited to: the TASPOS, TARPOS, CryoTARPOS, DIM positioners, CIVS, TCSS, CCRS, OPAS, SXI, FODI and the Industrial Controls associated with operating each of these

2.1.8 Target Diagnostics Coordinator (TDC)

- Reports to the LO
- Has completed the TDC Qualification Card or equivalent
- Coordinates setup and operation of diagnostics
- Directs the activities of assigned Target Diagnostics Console Operators and coordinates the activities of diagnostic equipment personnel
- Verifies Target Diagnostics are properly configured and prepared to support the shot
- Completes the steps in the Shot Checklist designated for the TDC
- Verifies diagnostic activities are carried out safely and efficiently, and in accordance with approved procedures and released Work Permits

2.1.9 Target Diagnostics Operator (TDO):

- Reports to the TDC
- Has completed the Qualification Cards for operation of assigned diagnostics or equivalent
- Operates assigned target diagnostic equipment per approved operating procedures
- Completes the steps in the Shot Checklist designated for the TDO
- May perform repairs of assigned equipment (if so authorized) to support shot operations in coordination with the TDC

2.1.10 Power Conditioning System Operator (PCS):

- Reports to the LO
- Has completed the PCS Qualification Card or equivalent
- Operates the Main Laser Power Conditioning Systems safely per approved procedures, including the Main Energy Storage Modules and associated main and PILC power supplies and diagnostics, and high voltage cabling.
- Completes the steps in the Shot Checklist designated for the PCS Operator
- Performs Lock-Out Tag-Out (LOTO) and safing of PCS systems as required to support Shot Operations (if qualified)
- Performs repairs of assigned equipment (if so authorized and qualified) to support shot operations
- Performs sweeps and un-sweeps of the capacitor bays as directed by the LO

2.1.11 Plasma Electrode Pockels Cell Operator (PEPC):

- Reports to the LO
- Has completed the PEPC Qualification Card or equivalent
- Operates the PEPC Systems safely per approved procedures, including the high voltage pulsers and associated equipment and diagnostics, PEPC LRU utilities and high voltage cabling.
- Completes the steps in the Shot Checklist designated for the PEPC Operator
- Performs Lock-Out Tag-Out (LOTO) and safing of PEPC LRUs as required to support shot operations, and performs connection/disconnection of LRUs associated with changeout of LRUs (if qualified)
- Performs repairs of assigned equipment (if so authorized) to support shot operations
- Performs sweeps and un-sweeps of the Laser Bays and Capacitor Bays as directed by the LO

2.1.12 Duty Engineer (DE):

- Reports to the LO
- Has completed the DE Qualification Card or equivalent
- Operates the Integrated Computer Control Systems (ICCS) and facility timing system safely, including associated Front End Processors, servers, controls hardware associated with ICCS controlled equipment, communications networks and associated diagnostics
- Responsible for performing startup/restart of the control system or portions thereof
- Ensures no changes are made to the software and database during shot operations without SD approval
- Completes the steps in the Shot Checklist designated for the Duty Engineer
- Performs repairs of assigned equipment (if so authorized) to support shot operations

2.1.13 Industrial Control Systems Operator (ICS):

- Reports to the LO
- Has completed the ICS Qualification Card or equivalent
- Operates the various process utility systems safely including:
Clean Dry Air (CDA), Compressed Air (CA), Humid Air(HA), Process Gas (PG), Liquid Nitrogen (LN) and Argon (ARG) Gas Systems and the Amplifier Cooling Systems Spatial Filter (SFV), PEPC (PEPCV), PDS (PDSV) and Target Area (TAVS) vacuum systems, Tempered Water (TWC), Low Conductivity (LCW) and Chilled Water (CHW), and Final Optics Assembly Cooling (FOAC) water systems and the amplifier portion of the Hot Water (HW) System
- Operates beampath equipment including Roving Mirror Diagnostic Enclosure (RMDE) Gate Valves, TTW Argon Barriers (TABs), LM-4/5 pneumatic seals, beampath covers and enclosures and actuators not operated by other groups
- Completes the steps in the Shot Checklist designated for the ICS Operator
- Monitors performance of major facility HVAC systems
- Performs walkthroughs of the mechanical equipment areas to monitor for abnormal conditions
- Performs repairs of assigned equipment (if so authorized) to support shot operations

- Performs sweeps and un-sweeps in the Laser Bays, Switchyards and RMDE as directed by the LO
- Monitors operation of the ICS server

2.1.14 Injection Laser Systems Operator (ILS):

- Reports to the LO
- Has completed the ILS Qualification Card or equivalent
- Operates of the Pre-Amplifier Module (PAM) regenerative, Multi-Pass Amplifiers (MPA) systems, and Pre-Amplifier Beam Transport Systems (PABTS) safely per approved procedures, including the high voltage PAM Power Conditioning Units (PCU) and associated equipment and diagnostics, and PAM/PABTS utilities
- Completes the steps in the Shot Checklist designated for the ILS Operator
- Performs Lock-Out Tag-Out (LOTO) of PAM PCUs or the Lower Injection Beam Block (LIBB) as required to support shot operations, and performs connection/disconnection of PAMs and PCUs associated with changeout of LRUs
- Performs repairs of assigned equipment (if so authorized) to support shot operations
- Performs sweeps and un-sweeps of the Laser Bays as directed by the LO

2.1.15 Laser Diagnostics Systems Operator (LD):

- Reports to the LO
- Has completed the LD Qualification Card or equivalent
- Operates the main laser, precision and drive diagnostics in the Laser Bay (LB), SY and Target Bay (TB)
- Completes the steps in the Shot Checklist designated for the LD Operator
- Performs repairs of assigned equipment (if so authorized) to support shot operations
- Performs sweeps and un-sweeps of the Laser Bays as directed by the LO

2.1.16 Beam Control Systems Operator (BCS):

- Reports to the LO
- Has completed the BCS Qualification Card or equivalent
- Operates the Wavefront Controls, Laser and Target Alignment, Large Optics Inspection System (LOIS), Side Inspection Damage Evaluation (SIDE), Target Chamber Vacuum Window Inspection, and FODI systems safely per approved procedures, coordinating with the TAC and TDC as appropriate
- Completes the steps in the Shot Checklist designated for the BCS Operator
- Performs repairs of assigned equipment (if so authorized) to support shot operations
- Performs sweeps and un-sweeps of the Laser Bays as directed by the LO

2.1.17 Master Oscillator Room Operator (MOR):

- Reports to the LO
- Has completed the MOR Operator Qualification Card or equivalent
- Operates the MOR systems safely including diagnostics and optical pulse generation and pulse shaping systems per approved procedures
- Conducts daily and pre-shot Failsafe System checks

- Completes the steps in the Shot Checklist designated for the MOR Operator
- Performs repairs of assigned equipment (if so authorized) to support shot operations

2.1.18 Precision Diagnostic System Operator (PDS):

- Reports to the LO
- Has completed the PDS Qualification Card or equivalent
- Completes the steps in the Shot Checklist designated for the PDS Operator
- Performs repairs of assigned equipment (if so authorized) to support shot operations
- Configures precision diagnostics to meet shot goals

2.1.19 Cryo system Operator

- Reports to the LO
- Has completed the Cryo System Operator Qualification Card or equivalent
- Completes the steps in the shot checklist designated for the Cryogenic System Operator (CSO)
- Operates CryoTARPOS target installation and gas fill systems, cryogenic systems and cryogenic layer x-ray characterization system
- Performs repairs of assigned equipment (if so authorized) to support shot operations

2.1.20 Sweeper

- When assigned in addition to other Control Room duties, reports to the LO
- Has completed the required training and qualification cards to perform the sweep procedures.
- Performs the pre-sweep, sweep, and beampath integrity checklists
- Reports ANY deviation or exception to the (pre) sweep or beampath integrity checklists to the LO

3.0 SAFETY PLANS AND OPERATIONS PRACTICES

3.1 Personnel Safety

All work in NIF shall be performed in accordance with the LLNL Environment, Safety, and Health (ES&H) Manual⁸ policy, NIF Facility Safety Plan,⁵ and the NIF Programs Safety Protocols and Requirements (NPSP&R)⁹ to perform work in a manner that protects the health and safety of employees and the public, preserves the quality of the environment, and prevents property damage.

Each worker is responsible for immediately stopping work if it is observed that an operation presents an imminent danger to health, safety, the environment or equipment. Further guidance and actions to restart work are contained in the NIF Operations Management Plan.¹

3.2 Off-Normal Events and Responses

For significant off-normal events such as fire, earthquake or shelter-in-place, follow the guidance in *NIF Emergency Preparedness and Response Plan*,¹⁰ *NIF Operations Management Plan* (NIF-5020544),¹ and *NIF Programs Directorate Notification Procedure (NIF-0072808)*.¹¹ For significant

off-normal occurrences involving personnel injury, damage to equipment, hazardous release or a near miss, NIF management should be notified as soon as possible after the situation has been stabilized.

3.2.1 Minor Alarms

The response to off-normal events not covered in the preceding section or to controls systems alarms (as differentiated from LLNL-wide announcements, or Fire/Evacuation Alarms) should follow the following general steps (some actions may be taken in parallel):

- Acknowledge and silence the alarm
- Verify the fault condition by reviewing other data or system parameters immediately available.
- Verify automatic response to the event by the appropriate control system (including equipment shutdown, startup or mode change as appropriate). Initiate any actions that should have been initiated by the appropriate software controls, but were not.
- Notify the SD and appropriate SSM and provide periodic updates.
- Contain the off-normal event and minimize its effects.
- Enter appropriate information into Operations Logs, Problem Logs and paper logs.
- Initiate Corrective Actions following the guidance in *NIF Project Site Work Permits (NIF-5018626)*.¹²

More detailed guidance for specific software systems is provided below.

3.2.2 SIS Alarms

The Safety Interlock System (SIS) Alarms Response Procedure (NIF-5015482)¹³ binder is maintained in the Control Room. This procedure details specific responses for SIS alarms, including fire, oxygen deficiency, radiological alarms, and recovery from Crash Button activation.

In the event of a SIS alarm, the Work Control Officer (WCO), SD or LO executes the SIS Alarms Response Procedure (NIF-5015482).¹³ In general, personnel shall take the actions necessary to ensure their own safety and then the safety of others, to the extent that they do not place themselves at risk. If knowledgeable and properly trained, they should then attempt to stop the source of further damage (water, smoke, fire, source of radiological contamination...) and minimize its spread. Subsequent repairs to affected systems will require a properly reviewed and released work permit.

3.2.3 ICCS Alerts

Each subsystem operator in the Control Room maintains an ICCS Alert Monitor open and active on their console during shot operations. These may be filtered to display only shot-related alerts for their subsystem.

Operators are expected to promptly respond to ICCS Alerts on their consoles or alarms affecting their equipment (per Section 2.1.1) and promptly notify the LO/SD of all alarms and any unusual alerts. In general, personnel should not accept locked-in alarms for long periods of time. Such alarms, that remain unresolved, tend to desensitize operators to their presence and urgency.

Prior to resetting alerts, operators should understand the cause of the alert and the needed response. Personnel shall inform the LO of any alarms that are not understood or cannot be cleared, and, as appropriate, take necessary actions to restore systems to normal operation.

3.2.4 Industrial Control System (ICS) Alarms

ICS Operators maintain an alarm window visible on the operating console at all times during shot operations and notify the SD/LO of alarms, which could affect laser system operation. ICS Operators shall follow the same guidance as for ICCS Alerts above.

3.3 Radiological / Hazardous Materials and Personnel Exposure Controls

OSP581.11⁶ has guidance for the use of Beryllium and sources of ionizing radiation in the NIF.

X-rays and neutrons (or protons) may be generated by shots to target chamber center. Controls for this hazard will be identified in the Facility Safety Plan, Radiation Protection Plan and specific Integrated Worksheet/Safety Plans (IWS/SPs). NIF Management has committed to maintaining individual worker doses and the collective worker dose below DOE legal limits and as low as reasonably achievable (ALARA). It is a fundamental worker responsibility to ensure that they maintain their radiological and Be exposures ALARA.

3.4 Safety Interlock System

The Safety Interlock System (SIS) is designed to control the operation of potentially hazardous processes and laser system equipment by granting or denying an independent permissive to selected equipment. The SIS does not directly control any equipment itself; the various control systems are used to operate the systems once permissives are issued by the SIS. Due to the inherent risk of not informing the appropriate personnel or taking the appropriate action associated with alarms from this system, these alarms should only be acknowledged or reset at the Control Room SIS Console under the direction of SD/LO.

The Safety Interlock System shall be fully operational to the maximum extent practicable, minimizing planned and unplanned down time. To ensure the reliability of this system, quarterly Facility Interlock Checks evaluate the functionality of the SIS system including facility announcements and alarms.

A locked box containing facility SIS Keys is maintained in the Control Room. This box contains SIS keys used to control SIS permissives and allow access to internal facility bays under Access Control System (ACS) controls by manually unlocking the associated doors. Access to this box is limited to only qualified SDs, LOs, WCOs and the NIF SIS Manager. The SIS permissives key shall only be used as authorized by the SD/LO (or the SIS Manager or their designee during testing). Administration of the key boxes should be maintained by the CROM as described in Section 3.6.8 of this procedure.

3.4.1 Guidelines for use of Facility Emergency Shutdown Buttons

Facility Emergency Shutdown (“crash”) buttons are located throughout the operational areas of the facility and the control room. The red “mushroom” type buttons are used when a rapid shutdown/prevention of operation of the following system(s) is required: the main laser Power Conditioning Systems (PCS); PAM Power Conditioning Units (PCUs); the Plasma Electrode Pockels Cells (PEPCs); Precision Diagnostic System (PDS) T08 Alignment Laser; alignment lasers in Velocity Interferometer System for Any Reflector (VISAR) and backscatter systems Laser Calibration (LCAL) diagnostics; the Argon Pad, and TB and PDS Edge lasers, the 4w Fiducial system laser and the CryoTARPOS X-ray sources. These buttons will also stop the motion of all Target Chamber positioners. In addition, the Emergency Shutdown buttons in the Control Room, Laser Bays, and

mechanical rooms shutdown the Main and Power Amplifier cooling fans. In general, anyone in the facility should actuate one of these buttons under any of the following conditions:

(1) When finding oneself inside of any swept area during shot operations. Indications that an area are swept include: sweep panels in the area indicate red, with text indicating “Extreme Hazard”; prior to issuing high-voltage permissives, public address announcements indicating that laser operations will begin within one minute in the area; and the klaxon begins sounding (sounds for 60 seconds prior to high voltage permissives being issued).

(2) When observing any imminent high voltage hazard or other condition that could cause injury to personnel or equipment damage. This could include arcing, smoke, personnel electrocution, laser exposure, major Argon leak, significant x-ray leakage, etc.

(3) During shot operations, to stop the shot to prevent equipment damage or shot failure. Prior to the last 60 seconds of the countdown, other methods (such as request to the LO to hold the countdown or signaling of a hold from the shot supervisor GUI) may be used if appropriate. During the final 60 seconds of the countdown, control room operators should employ the emergency shutdown button on their console if any concern arises; when in doubt, “fail safe” is the desired outcome during this period in the countdown.

After actuating any emergency shutdown button (including inadvertently), it is imperative that the control room be contacted with the location and reason for the actuation. Do not reset the button unless directed by control room personnel.

Yellow “Chamber Motion Stop” Buttons -similar in design to facility emergency shutdown buttons- are located in the control room and at positioner control consoles in the target area. These buttons only remove power from the motion controls for the target chamber positioners (e.g., TARPOS, CryoTARPOS, TASPOS, SXI, DIMs, FODI, etc...). Guidelines for use of these buttons are located in the Target Area Protocols section (Section 4.3).

3.4.2 Recovery from Emergency Shutdown

Actuation of the facility emergency shutdown (“crash”) buttons result in the following actions:

- Dropping of high-voltage permissives to the PCS bank modules, PAM PCUs and PEPC power supplies
- Shutdown of the Argon pad
- Amp Cooling Safe Shutdown (shutdown and isolation of fan units only; individual bundles should return to Pressure Control) NOTE: This applies only for buttons in the Control Room, Laser Bays, and mechanical rooms.
- Stopping of the Target Chamber positioners (removes power from motion control motors)

- Removal of permissives from auxiliary lasers (PDS Table 08, VISAR, 4w FIDU, LCAL, etc.)
- Removal of permissives from X-ray sources on CryoTARPOS

Detailed instructions for recovery from emergency shutdown button actuation are found in the SIS Alarm Response Procedure (NIF-5015482).¹³ Prior to restoring operations, the SD should ensure that the reason for the emergency shutdown actuation is understood and corrected (when applicable) to prevent reoccurrence. In addition, the SD should ensure that system conditions have stabilized adequately to support the intended operation.

If the emergency shutdown button was actuated by someone inside a swept area, shot operations shall not proceed until a review has been completed by the NOM and NIF Safety Officer. In this case, the NOM will specifically authorize restarting shot operations.

3.5 Accounting for Personnel

Normal Working Hours – The CROM maintains an Operations Shift and Vacation Schedule. The Schedule is posted in the Strategy Room and indicates the scheduled operating shift assigned to each individual. Personnel are to arrange Vacations, Travel, Jury Duty, etc. through the CROM and their normal supervisory chain of command. Any personnel changes to the shift schedule must be reviewed and approved by the CROM. (Changes to the Shift Plan [days or hours of scheduled shifts] must be approved by the NOM.)

Swing Shift and Owl Shift – In addition to the Shift and Vacation Schedule, the night LO coordinates personnel leaving the NIF operations areas (Laser Bays, Switchyards, Target Bay, Capacitor Bays, HVAC Machine Rooms, etc) at the end of the shot operations shifts. Operations personnel will coordinate with the LO that their work is complete and are clear of operational areas for the evening.

Absences- Operations personnel shall notify the CROM as soon as possible when it becomes known that they will be unable to support a scheduled operations shift. If unable to contact the CROM, personnel may leave a voice message on the Work Control Center non-emergency phone (4-4225). Work Control Officers will review messages and make the appropriate notifications.

3.6 Conduct of Pre-Sweeps/Sweeps/Un-sweeps

As governed by Laser Operations and Commissioning OSP 581.11,⁶ the pre-sweep and sweep processes are used in conjunction with the Safety Interlock System and Access Control System to ensure that personnel are clear of hazardous areas during the execution of laser shots, target experiments or other hazardous activities. In addition to the pre-sweep and sweep processes, additional controls are used to insure that personnel are clear of these areas including warning signs, and beacons, warning klaxons, and public address messages. Due to the potential lethal consequences of improperly executed sweep procedures, sweep procedures are designated as “continuous use” procedures.

The LO or SD directs the execution of the checklists. They are to determine which checklist is to be used for the specific upcoming activities based on the OSP and Shot Safety Checklist requirements. The sweep procedure to be used for some areas (e.g., TB and Sys) may change, or the required areas to be swept may change depending upon the expected neutron yield of the planned shots. This will be managed through the Shot Safety Checklist. The LO or SD will ensure that the qualified Sweeper has the proper checklist prior to their execution and issue keys in accordance with Section 3.6.8.

The Pre-Sweeps and Sweeps are an administrative process implemented through the use of checklists. Checklists shall be maintained and released in Enterprise Configuration Management System (ECMS), and used in the execution of the Sweep or Pre-Sweep. The checklists provide specific details of the Sweep or Pre-Sweep process for each area and each type of shot. Only qualified personnel are allowed to execute the checklists. The LO or SD are responsible to verify that the sweep teams are properly qualified to perform the task. The CROM will maintain a list of qualified sweepers via Livermore Training Records and Information Network (LTRAIN) and make the current list readily available to the SD and LO. The CROM maintains the pre-sweep and sweep checklists and insures that the most current copy is maintained in ECMS. Copies of the current version may be kept in the control room; if so, the LO shall verify the copy’s revision against the electronic file in ECMS. The LO or CROM will maintain a list of sweep and beam path integrity checklists with current released version verified daily when shots are scheduled. The CROM is responsible for clearing and disposing of the old procedures maintained in the procedure files located in the Control Room.

Upon completion, the checklists are to be returned to the LO. The LO reviews the checklist to verify they have been properly completed, dated and signed, that no exceptions or deviations have been identified, and that completed checklists are the current released version per ECMS. When a deviation has been identified by the sweep team, the LO shall halt shot operations and consult with the SD, SOM and/or NOM. Shot operations will not proceed until the deviation has been corrected or resolved. Deviations to sweeper routes due to construction equipment or temporary barriers may be evaluated and approved by the SD (by initialing the affected step(s) in the sweep checklist). Deviations to approved sweep checklists other than minor adjustments must be approved by the SOM or NOM. The LO will file the checklists with the other shot documentation for that day.

3.6.1 Pre-Sweep

Pre-sweeps are executed approximately 30 minutes prior to the final sweep process and shot. Prior to starting a pre-sweep, an announcement is made, using the public address system, to clear the area. The pre-sweep provides an opportunity for personnel to finish work in progress and clear the area prior to the final sweep and for operations personnel to address any equipment configuration issues prior to the final sweep process.

During the pre-sweep process, sweep team members do a preliminary search and inspection to clear the areas of any non-essential personnel. Personnel that require additional work time may remain in the area until the final sweep process. During the pre-sweep, as many personnel as possible are cleared from the area. This requires that elevated areas and platforms, accessible by ladders, also be verified clear of personnel. This process may include viewing the area with surveillance cameras, viewing the area from another location, such as an adjacent platform, or use of a mega-phone to clear personnel from the elevated areas. Areas that are determined to have a specific potential risk for injury during a system shot, such as the areas above the Main Amplifiers and Power Amplifiers due to high voltage hazard, shall be physically accessed and verified clear of personnel. The specific pre-sweep procedures for the type of shot to be conducted specify the detailed requirements.

Tamper seals may be used to indicate that an elevated area has been previously cleared and that it has not been accessed since that time. After an upper area has been cleared, the ladder access cover can be closed and locked and a tamper seal can be applied. Tamper seals may only be applied by qualified sweep personnel. The use and distribution of tamper seals is controlled by the LOs and SDs. The seals may be removed by anyone authorized to have access to the area.

3.6.2 Sweep

The Sweep process is the final check to ensure that personnel are clear of the area(s) affected prior to enabling Power Conditioning high voltage permissives in SIS, and conducting a laser shot. The sweep process requires a qualified operator to traverse a specific path, looking for personnel, and turning a key switch in the safety interlock panels located along the sweep route. As the operator progresses through the area, the safety interlock system monitors the key switch positions. When the process has been completed in the proper sequence within the designated time, and all affected areas and master permissive keys have been activated by the SD or LO, the SIS enables the interlock permissive for the affected area and the operators may proceed with high-voltage operations.

Personnel sweeping an area are to use mega-phones (or equivalent) during the sweep process, to assist in notifying personnel to clear the areas. The mega-phones are to be used continuously throughout the sweep process to insure the entire area is adequately covered.

ACS will be used by LO or SD to verify the absence of all personnel except the sweep team from operational areas where ACS is active. The LO or SD shall print the Operations report listing personnel that ACS indicates are still in the affected area. The LO/SD will take actions based on the personnel's area entry time as follows:

- (a) Entered within 4 hours of commencing sweep (or completing pre-sweep) LO or SD shall contact the person by radio, phone, pager or cell phone to ensure they are not present in the area. If contact is not made, the appropriate supervisor should be called to determine the individual's location. The SD may decide to proceed with shot operations if all attempts to reach the person or their supervisor failed and the sweep was completed successfully.
- (b) For all others, the LO/SD will provide the report to the NIF administration assistant the following day. The NIF administrative assistant will notify the employees and their immediate supervisors via email on the next working day.
- (c) The CROM will maintain notification records and the SOM or NOM will take additional actions to investigate repeat cases.

3.6.3 Short Sweep

A Short Sweep is a process that the SD and LO can use to maintain control of a previously swept area, while allowing a trained operator access to the area to complete a specific, short duration task. The SD or LO use the SIS system to re-configure the sweep path of a specific area, to a limited set of sweep stations. In coordination with the SD or LO, an area under access control can be “momentarily opened” to allow access of a trained operator. Immediately upon entry, the operator enables the first sweep station, thereby re-establishing perimeter control of the area. Permissives are not enabled until the final sweep station has been activated by the operator and he/she has left the area. The operator has a specific time (generally 5-10 minutes) to complete a specific task prior to activating the final sweep station and exiting the area. If the process is not completed during the specific time, the short sweep process will be broken, and a full sweep of the area will need to be performed.

3.6.4 Un-Sweeps

The Un-Sweep process is conducted upon the completion of shot activities or when directed by the SD. The LO or SD uses the SIS console to “Cancel Sweep” on selected areas that are no longer required for shot operations. After the area sweep has been canceled, a qualified sweeper goes through the area to unlock doors, unlock various ladders to allow access to elevated structures and remove signs as specified in the un-sweep procedure. Note that special procedures are required for initial re-entry into certain areas (as defined in the OSP) after certain categories of shots. These may include designated post-shot stay out times and radiation surveys upon re-entry. Upon completion of the un-sweep, the area is released for normal facility access.

3.6.5 Broken Sweeps

In the event that a Sweep is broken, the SIS annunciates an alarm in the Control Room and removes shot permissives, placing the laser system in a safe condition. The SD or LO shall use the SIS display, in conjunction with the SIS Alarm Response Procedure (NIF-5015482)¹³ to determine where the sweep was broken. After determining the cause for the broken sweep and taking necessary remedial actions, the affected area shall again be swept using a new checklist before laser operations may resume if any area access points were opened. If the offending person cannot be identified, obtain SOM approval before continuing shot activities requiring sweeps. Personnel who inadvertently break a sweep must immediately report to the control room to report the details of the event.

3.6.6 Development of Sweep Procedures

Sweep procedures are developed using a graded approach. The level of hazard in particular areas is one consideration in developing the detailed checklists. For example, different levels of checks may be employed for the Target Bay during yield shots (where potentially lethal radiation levels may exist), compared to the level of checks required at the floor level in the Laser Bay (where eye injury may be the main hazard). Such a graded approach may result in using different sweep techniques; for example, low hazard areas may be swept by video surveillance or locked accesses.

In general, sweeps in all areas are intended to locate any personnel in accessible areas that could be asleep or unconscious, or who could be working in a noisy environment or unable to hear announcements or klaxons, or those who might be incapacitated. Sweeps are not intended to locate personnel who are actively trying to avoid sweep teams, as the size and complexity of the facility make it impossible to counter such action. This is justifiable since such actions would be considered sabotage.

Changes to sweep procedures are reviewed by the SOM and SIS Manager (and SIS Change Control Board where required) and approved by the NOM. Approved versions of the checklists are maintained in ECMS and these are the only versions to be used unless otherwise approved by the NOM.

3.6.7 Training and Qualification of Sweepers

Sweep team personnel will be formally qualified to sweep each area per the associated qualification card. Records of qualification will be maintained in LTRAIN.

Sweeper trainees must be trained in the importance of compliance with the sweep checklist and the need to clarify with the LO/SD any questions or any observed abnormal conditions prior to completing the sweep. Changes to sweep procedures may be communicated to qualified sweepers via Required Reading or partial requalification/walkthroughs as specified by the SOM based on the complexity of the change.

3.6.8 Sweep Key Control

Sweep Keys are used in conjunction with the sweep procedures. The Sweep Keys are kept in the Control Room key box. Access to the key box is described in the NIF Operations Management Plan.¹ During the process of configuring the facility for shot operations, the SD or LO determines which areas need to be swept. Once the areas have been identified, they retrieve the required keys from the key box and assign them to qualified individuals performing the sweep. Once the sweeps are complete, the keys are returned to the Control Room key box.

3.6.9 Beampath Integrity Checks

Beampath Integrity Checklists are used to verify the proper configuration of the laser beampath and beampath enclosure integrity and to ensure personnel safety, prior to firing a rod shot with personnel present in the laser operations areas. They are used to verify that the preamplifier support structure (PASS)/Warzone area, main laser beampath, RMDE, PDS, final optics, and target chamber are properly configured to ensure personnel and equipment safety prior to firing a laser shot. The process involves inspecting specific areas of the beampath to ensure that the laser beam is properly enclosed and personnel have no potential of laser exposure. Additionally, some items on the checklists are used to ensure proper system configuration to minimize potential equipment damage.

The beampath integrity checks are an administrative process implemented through the use of checklists. Checklists are developed and maintained by the SOM, and used in the execution of the beampath integrity checks. The details of the process are to be specified in the checklist developed for each area. Only ECMS released checklists shall be used. Only qualified personnel are allowed to execute the checklists.

The CROM maintains the beampath integrity checklists and ensures that only the most current version is located in the Control Room.

3.7 Machine Safety

3.7.1 Rules of Engagement

The Rules of Engagement represent collective additional guidance to Operations personnel for the operation of systems or equipment to preclude significant equipment damage. This may allow a graded approach to the safe operation of equipment outside of ideal parameters. These rules are reviewed by the Rules of Engagement / Machine Safety (REMS) Working Group (or other appropriate group) and approved by the Operations Manager. Many of these rules are incorporated into the automatic checks performed by LPOM and displayed for the SD's review.

These guidelines are organized into green/yellow/red zones. For green operations, personnel are allowed to operate the equipment under normal procedures and controls. Yellow operations may proceed when, in the judgment of the SD, such operation is warranted and safe for the specific situation. Red operations are not authorized without first consulting the NOM.

For laser system operations, these guidelines are contained in Rules of Engagement for Main Laser Operations, NIF-5022606.¹⁵

3.7.2 Target Chamber Positioner Movements

To prevent collision of and damage to target positioners, the positioner movement rules of Section 4.3 should be followed unless specifically allowed otherwise in a procedure approved by the TCOM and concurred by the SOM.

As new devices are added to Target Chamber, it is expected that the list of allowed activities will change. Evaluation by Target Bay Change Control Board (CCB5) expert group will determine which activities are on the list and provide definition of these activities. A given activity may be restricted to be well outside the 500-mm radius, for example a handoff point 1 meter from TCC.

3.7.3 Issuing Permissives

3.7.3.1 *Non-Integrated Shots*

The LO or SD will maintain control of the keys used for providing facility permissives required for laser shots. These keys are kept in the NIF Control Room Master Shot Key box. During the process of non-integrated rod shots or PCS test shots, a selection of keys will be used (depending on the shot requirements) to provide the necessary permissives to the facility. Using the PAM Manual Permissives Checklist, NIF-5015558,¹⁶ for non-integrated rod shots, or the LB1/2 Shot Safety Checklist, NIF-5012321,¹⁷ for PCS test shots, the LO will retrieve the required keys from the Master Shot Key box and insert and turn the keys at the NIF Master Shot Enable panel in the Control Room at the SIS console. Once the shot is complete, using the PAM Manual Permissives Checklist, NIF-5015558,¹⁶ for non-integrated rod shots, or the LB1/2 Shot Safety Checklist, NIF-5012321,¹⁷ for PCS test shots, the LO will remove the keys from the NIF Master Shot Enable panel and return them to the Master Shot Key box in the Control Room.

3.7.3.2 *Integrated Shot Mode*

The LO or SD will maintain control of the keys used for providing facility permissives required for integrated laser shots. These keys are kept in the NIF Control Room Master Shot Key box. During the process of laser shots, a selection of keys will be used (depending on the experiment requirements) to provide the necessary permissives to the facility for laser shots. Using the Shot Checklist³ and the LB 1/2 Shot Safety Checklist, NIF-5012321,¹⁷ the LO will retrieve the required keys from the Master Shot Key box and insert and turn the keys at the NIF Master Shot Enable panel in the Control Room at the SIS console. Once the shot is complete, the LO will remove the keys from the NIF Master Shot Enable panel and return them to the Master Shot Key box in the Control Room.

3.7.3.3 *Other Device Permissives*

NIF-5029707²⁶ (LCAL and VISAR) and NIF-50303085²⁷ (CryoTARPOS x-ray characterization sources) contain checklists for issuing permissives required to operate these devices.

3.8 Shot Support Systems

3.8.1 In addition to the foundation Integrated Computer Control System (ICCS) there are numerous business systems that are critical to preparations for and conduct of shot operations. A list of systems that must be functioning and available to support shot operations is provided in Appendix F, "NIF Business Services Required for Shot Operations". Any plans to take these critical business tools out of service during shot operations preparations or during a shot must be reviewed and approved by the SOM or designated representative prior to starting work. If any of these systems are not available or in reduced status, NOM approval should be obtained before proceeding with operations that would be negatively impacted.

3.9 Shot Planning, Approval and Execution Process

Shot campaign planning and approval is addressed in the NIF Operations Management Plan.¹ The SD will sign the hard copy of the approved shot setup sheet and have it duplicated for use in the shot cycle. Once the automated shot preparations checklist has been fully tested and integrated into shot operations and planned, the SD coordinating shots for the upcoming shift will be the final signature in LoCos, signifying approval of the shot setup. The SD will also process a Work Permit specifying the shots to be conducted and any other required scope. The NOM approves the Work Permit for shots and will only approve the permit when the WAP is approved and system status supports the shot. Approved shots will be executed in accordance with the Shot Checklist.³ The shot checklists for operators generally include the following steps:

1. On the day of the planned Shot, the duty SD will perform a final review of the setup, ensuring it is consistent with facility conditions and verify that it is in the Laser Performance Operations Model (LPOM) list of "Ready" experiments, indicating the completion of proper processing of the setup through LPOM. The SD shall also verify facility readiness by reviewing Location Component and State (LoCoS) Restrictions, Seating Charts, Problem Logs and Category A/B Work Permits for the laser beamlines to be used. The Access Control System electronic log shall be reviewed to check for personnel occupancy in the facility prior to performing a full system shot. The LO or SD should review the Interlock Bypass Log prior to shot operations to ensure that bypasses have been cleared, and those remaining in place are consistent with planned operations.

2. When the shot is executed, the SD shall annotate any required redlines on his copy of the Shot Setup Sheet (which becomes the master). The SD ensures that any required redlines are annotated on the copies of the setup sheets used by the affected subsystem operator(s). The SD annotates the NIF Shot Number for the executed shot on the master setup and forwards it to the Shot Operations Administrator for filing. Completed Master Setups will be retained as specified in the NIF Operations Management Plan.¹

3. After the shot, a review of the shot data will be conducted to ensure that there is no indication that it is not safe to proceed with the next shot on that bundle(s) from an equipment safety perspective. Minimum quorum for this review (of other than commissioning/calibration shots) is a SD, a Beamline Integrated Performance (BLIP) Representative and the Campaign RI. The review leader, normally the Campaign RI or representative, will formally communicate this review to the SD and the SOM, indicating that it is acceptable to proceed to the next shot, and include any recommendations for

changes. Deviations from this minimum quorum or other requirements may be approved by the NOM, based on the nature of the shots.

4.0 OPERATIONAL CONTROL AREA ACTIVITIES

4.1 Control Room Protocol

All laser and process utility operations are normally controlled from the Control Room (room 1017) and the Master Oscillator Room (room 1019) in the central core area of Building 581. Other (localized) control of subsystems outside the control room may be authorized by exception (for example, positioner operations may be conducted from the control console located in the TB Level 2).

4.1.1 Routine Control Room and MOR Access and Occupancy

The WCO, CROM and LO have the responsibility and authority to insure that only authorized personnel have access to the Control Room during Non-Shot Operations.

- Only personnel that have been trained on Control Room Protocol and have been granted ACS access by the CROM will be allowed unescorted access to the Control Room (TESA access for MOR). All other personnel are considered visitors under this protocol. TESA access will be maintained for limited group of personnel in case of ACS access problems.
- Visiting experimenters shall be required to read and sign the additional restrictions as outlined in **Appendix B** in order to have access to the Control Room to monitor/observe shot activities. The CROM shall retain this form for the duration of the visit.
- Access will be restricted to those personnel conducting official business who have a need to be in the Control Room or MOR and will be limited as necessary by the LO/SD/WCO.
- Incidental use of consoles by any personnel other than the assigned operator for test or maintenance (e.g., database maintenance or ICCS regression testing) purposes requires prior approval from the LO or SD. This also applies to the use of consoles by operators other than their designated workstations.

4.1.2 Visitor Control and Tours

- Visitors will not be allowed in the Control Room unless approved by the NOM, SOM, CROM, SD or LO and shall be limited to the area designated by them
- Visitors are required to comply with the Control Room Protocol as described in this document and directed by the NOM, SOM, CROM, SD or LO
- Visitors shall be under the escort of a person qualified and authorized to have Control Room access
- Visitors will not be allowed to operate any systems under any circumstances
- Tours are not allowed in the Control Room unless authorization has been obtained in advance from the NOM. Tours are allowed to view Control Room operations from the hallway viewing windows.

4.1.3 Personnel Activities

- Potentially distracting activities (e.g., radio listening, game playing, non-job-related literature reading) are prohibited
- Non-job related discussions shall be minimized to avoid disturbance of shift activities

- Personal phone calls are generally not permitted except in an emergency
- The noise level shall be kept to a minimum
- Accessing Internet sites for other than job-related business or training is not allowed
- Personnel shall not “prop” their feet on the consoles and recline in their chairs
- Personnel are not permitted to sit on the console tables
- All operators have the responsibility and authority to notify the SD or LO of any activities that distract them from or interfere with their operational duties
- No food is allowed in the MOR, Control and Computer Rooms at any time
- Drinks, in closed containers, are permitted. Personnel shall remove or discard containers when they leave the area
- Impromptu meetings or gatherings may take place in the Control Room during Non-Shot Operations on a non-interfering basis as determined by the SD or LO

4.1.4 Housekeeping

- Console desk areas should be kept clean at all times and only shot-related materials should be used (checklist, shot set-up sheet...)
- Post-it type notes, etc. will generally not be placed on the face of the consoles
- Personnel should remove papers, notes, etc. at the end of their shift
- Personnel are responsible for removing the material they generate, or bring into the area
- Items left after a shift will be removed by the NOM, SOM, CROM, SD or LO and discarded at their discretion
- Notebooks and reference material should be kept in the file cabinets and bookcases provided
- No documents should be left where they can be read from the viewing windows
- Items such as hardhats, binders, etc. shall not be placed on top of the consoles at any time
- Operators should pick-up any printed materials from the Control Room printers as soon as available. Left over print outs will be removed at the end of the shift.

4.1.5 Equipment and Hardware – Setups and Modifications

Figure 2 shows the typical Control Room layout. No equipment modifications are permitted in the control and computer rooms without a released work permit. During non-shot operations, the large projection screens may display any information necessary to support the operations being conducted at the time. When specific operations do not require the projection system, it may be configured to provide general system overviews in support of facility tours.

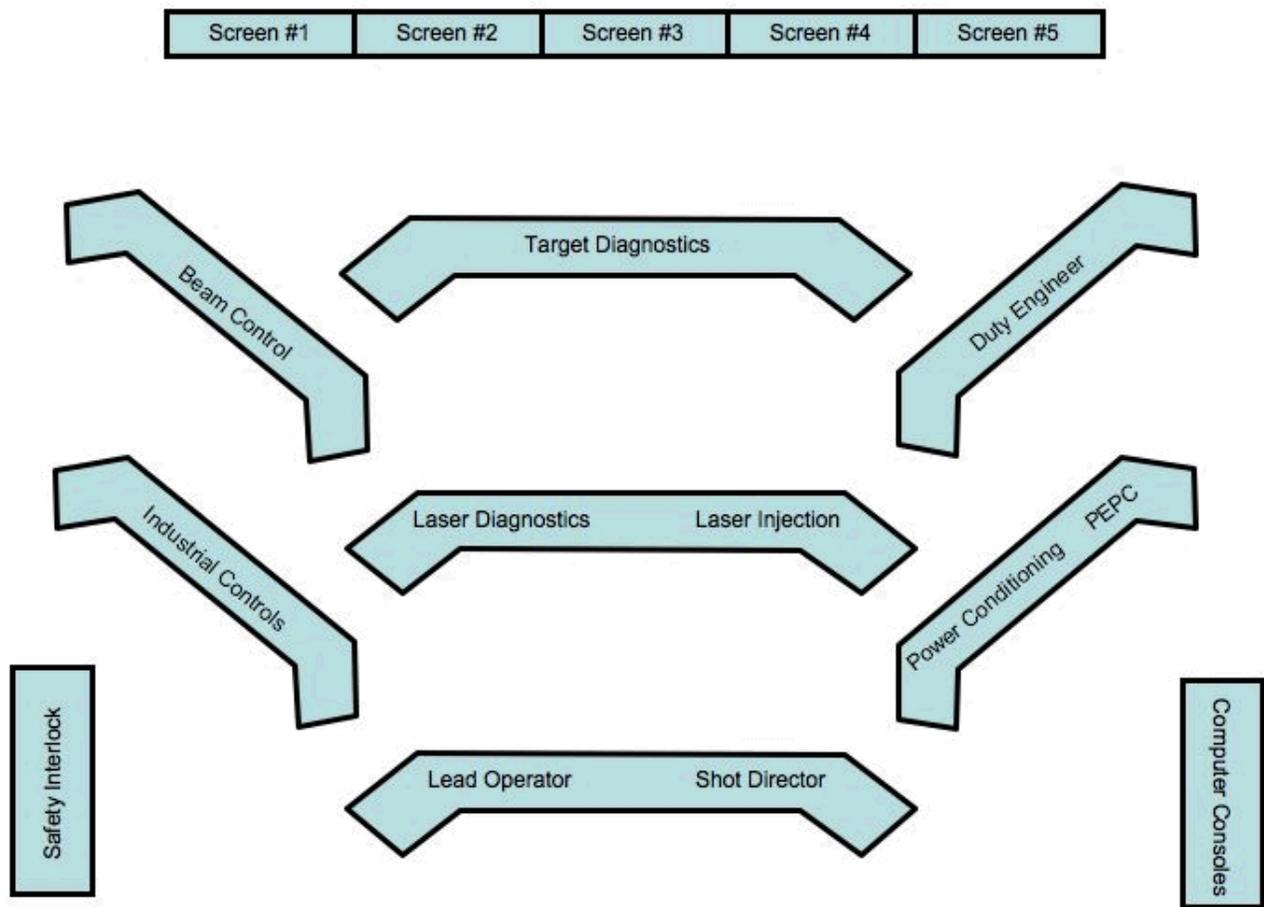


Figure 2. Typical Control Room Layout.

4.1.5.1 Use of the Integrated Computer Control System (ICCS)

All console operators are required to complete the Control System Operator Qualification Card (NIF-5009911)¹⁸ prior to use of the ICCS. This qualification covers such topics as shot holds/aborts/crash button activation, shot countdown, use of Target Motion Stop Button and various alarm panels. Upon completion of this qualification card, and approval by the CROM, operators may be given Group Account Access to the ICCS, See **Appendix C**. Operations personnel should lock their workstations when they leave the workstation unattended.

For operation of any ICS console, operators are required to complete ICS operator familiarization training NP-0012. This training familiarizes operators with symbols and control methods, and with alarms.

Designated laptop computers or other mobile computers used outside the control room for localized control operations are configured to operate on the NIF control network at designated network outlets. These computers are used for installation, commissioning, and maintenance activities that are approved through work control processes, and are not used for shot operations. Use of these computers is limited to properly trained personnel, and administrative privileges are limited to NIF Information Technology (IT) personnel, unless specific needs are identified and exceptions granted. Computers that

have not been configured by NIF IT personnel are not able to communicate to other computer systems on the control network.

4.2 Shot Operations Protocol

In addition to the regular protocols prescribed in this document, the higher complexity and risk associated with Shot Operations demands a higher level of formality.

Each operator is responsible for immediately stopping work if he/she judges that any operation presents an imminent or substantial danger to health, safety, the environment or equipment. At any time when immediate danger to health, safety, environment or equipment exists, the operator shall press the nearest emergency stop button. These buttons are located throughout the facility and on each operator console. During a shot sequence this is the quickest way to remove an immediate danger to personnel or equipment. During the actual shot cycle, operators can issue a hold or abort through the shot control software up to 60 seconds prior to shot time (i.e., T-60) to stop the shot process for issues that are not an immediate concern. Issues may include hardware or software not responding as required, or a subsystem needing a delay before continuing the shot process. After T-60, operators should utilize the emergency stop button to remove permissives to hazardous equipment. NOTE: Between the start of the critical region and T-60, the shot cycle cannot be held. Any attempt to hold the shot cycle will result in ICCS aborting the shot and returning to the Ready state.

All Subsystem Operators (SSOs) should review the shot goals prior to the start of every shot. It is the responsibility of every operator to request clarification or explanation for any issue that is not clear or raises questions. The SSOs also have the responsibility to warn the LO or SD if they are aware of any issue with the system that could prevent the shot being successful or create unsafe conditions.

4.2.1 Personnel Activities for Shot Operations

The SD and LO shall maintain a professional atmosphere in the Control Room in a manner commensurate with a safe and efficient shot operation. No impromptu meetings or gatherings may take place in the Control Room during shot operations unless approved by the SD

Operators need approval from the SD or LO to leave the Control Room during shot operations. All operators must be present at their consoles from the start of Countdown state until the completion of the Post Shot Countdown state. All operators shall check out with the SD or LO at the end of the Shot Operations shift.

Operators shall not activate subsystem GUIs other than their own and the bundle(s) they are operating per the Shot Setup Sheet during shot operations, unless authorized by the SD/LO.

The Target Area Coordinator (TAC) reports to the LO and will keep LO/SD apprised of target area shot operations activities. The TAC will notify the LO or SD when they will be out of the 581/681 complex when shot operations are in progress.

4.2.2 Equipment and Hardware for Shot Operations

No network, database or computer system modifications are allowed during shot operations unless authorized by the SD. Any ICCS diagnostic activity during shot operations must be reviewed and approved by the SD prior to implementation.

The SD/LO may dim Control Room lights to provide focus during shot operations.

No personnel other than LO or SD should modify the configuration of the SIS console screens.

During shot operations, the screens in the front of the room will normally display the following information (viewing from left to right):

Screen 1: Sweep Status, Utility Status

Screen 2: SD discretion

Screen 3: SD-Main Shot Status (during shot cycle operations)

Screen 4: SD discretion

Screen 5: SD discretion

Operators are expected, at a minimum, to have their appropriate Shot Supervisor GUI displayed during the shot.

4.2.3 Shot Operations Control Room Access and Occupancy

During shot operations, a higher level of access control shall be in effect. Only authorized personnel will have access to the Control Room unless approved by the SD or LO in accordance with Appendix B. The SD and LO have the responsibility and authority to clear the Control Room of nonessential personnel. No personnel, other than operators, should be allowed in the computer room during shot operations (unless approved by the SD or LO).

Subsystem Managers (SSMs) for critical subsystems may be allowed in the Control Room during a shot with the approval of the SD or LO. Assigned console operators, the LO and SD have the ultimate responsibility for the operation of the system and will follow the established checklists and procedures. SSM shall address their concerns with any part or all of the operation with the SD and LO.

The Control Room entrances will be posted with signs indicating that shot operations are in progress, and Control Room access is closed to non-operations personnel.

Additional operators may be allowed in the Control Room, during shot operations, for the purpose of training or commissioning operations, with the approval of the SD or LO. Support personnel (e.g., ICCS) may be required in the Control Room to support shot operations, with approval of the SD or LO. Other support personnel may be required to be on-call to respond as needs arise.

Under no circumstances should personnel other than the LO, SD or SSO operate their consoles. The DE should not operate any consoles except for their station unless authorized by the LO or SD. The only exception to this policy is during specific ICCS testing. ICCS personnel may perform specific test activities using production hardware, when properly approved.

4.3 Target Area Protocols

Operation of target area equipment requires the coordination of several groups. The Target Area Coordinator (TAC) works with the Target Diagnostic Coordinator (TDC) and the LO to prepare the target area systems to support shot activities. Set-up and configuration of target diagnostic devices, in the target bay and the target diagnostic mezzanines, is specified by the shot set-up and executed by the TDC and the TAC. During set-up and shot operations access to the diagnostic mezzanines is limited to target diagnostic operators working to establish the authorized shot configuration. The SD must authorize any other access to the diagnostic mezzanines during set-up and shot operations.

Set-up and configuration of the positioners and insertable diagnostics is also specified by the shot set-up sheet and is executed by the LO and the TAC. Access to the 17'6" level of the Target Bay is restricted to target area operators working to establish the authorized shot configuration. In addition, the

areas immediately adjacent to the Target Positioners (TARPOS and CryoTARPOS) and the Target Alignment Sensor Positioner (TASPOS) are barricaded during movement of the applicable positioner and remain barricaded for the duration of the shot cycle after shot configuration has been established.

A TAC must be assigned to manage all positioner operations inside the Target Chamber. In general, TAOs perform TARPOS, CryoTARPOS and TASPOS movements between the fully retracted position (inside the positioner vessel) and pre-defined “hand-off” positions. Movements of TASPOS, CryoTARPOS and TARPOS between the “hand-off” position and target chamber center are normally performed by BCS from the control room. Movements of DIM-based devices and SXIs are normally performed by TAOs. Positioner and DIM movements may require a second operator to monitor the movements by use of the Chamber Interior Viewing System (CIVS) for collision avoidance as described in subsequent sections.

4.3.1 Authorized Operator Cards and Target Chamber Device Control

A number of target bay devices, operated through ICCS can be controlled from both the target bay and the control room. During shot operations, some of these devices are controlled from each location at different points in the shot sequence. To ensure the positive control of these devices and systems, a system of Authorized Operator Cards (AOCs) has been instituted for the following devices:

- Target Positioners: TARPOS and Cryo TARPOS
- (Target) Alignment Sensor Positioner (TASPOS)
- Diagnostic Instrument Manipulators (DIM) @ 90-78, 90-315, and 0-0 ports
- Final Optics Damage Inspection DIM (FODI DIM)
- Upper and Lower Static X-ray Imagers (SXI)

These devices also have unique ‘run inhibit’ keys attached to the AOCs. These run inhibit keys are used in conjunction with local interlock boxes installed on each device. These boxes have “run” and “inhibit” positions. When a key is inserted and turned to the “run” position, power is available to the motors on that device and movement is possible. When a key is inserted and turned to the “inhibit” position, power is removed from the device motors and no movement is possible. Keys are not captured in either position and should remain attached to the AOC at all times.

AOCs and keys are stored in the Control Room and must be checked out through the LO or SD. When checking out an AOC/key, the operator makes an entry into the control room key logbook maintained at the LO console. When work is complete, the operator returns the AOC and key to the Control Room and makes an entry in the logbook documenting the return.

Control of the AOCs and inhibit keys is managed differently depending on whether they are used in shot operations or non-shot operations:

Shot Operations

AOCs and inhibit keys for the systems used during shot operations should normally be in the possession of the Target Area Coordinator (TAC). The TAC, with authorization from and in coordination with the LO, will direct the operation of the devices during the shot cycle. All device operations must strictly adhere to the shot checklist. No one should operate a controlled device without the approval and direction of the LO or TAC. AOCs and keys not used during shot operations should remain under the control of the LO. During the shot cycle, control of positioners will transfer between the TAC and LO according to established checklists.

Non-shot Operations

In non-shot operations, AOCs and control keys should be controlled and issued by the LO or SD; qualified TAOs/TACs should contact the LO or SD to check out the AOC and control key for a device to be operated. Operators must be in possession of the appropriate AOC and control key to operate any of the devices listed above. The person checking out the AOC and control key may not authorize others to operate devices, except for coordinated activities with the Control Room operators. Instead, the AOC and key must be returned to – and checked in with- the LO, then checked out to another individual if transfer of custody is required. Outside of the shot cycle, control of positioners will be determined by the TAC and LO.

4.3.2 General Movement Rules for Target Chamber Devices and use of Chamber Interior Viewing System

In general, movement of devices inside the target chamber requires authorization from a SD/LO, TPS or TAC and a released work permit. In addition, the operator must be in possession of the appropriate AOC and control key as described in the previous section.

Normal positioner operations shall be conducted using the TAP (Target Area Positoner) high level GUIs. Use of these tools, provide the required software limits to support safe routine operations.

Use of lower level maintenance panel GUIs do not provide these additional controls. Use of maintenance panels is only authorized for conduct of approved test procedures, or as approved by the TAC/TPS and the Positioner Sub-System Manager to support specific maintenance activities. During shot operations, the SD and TAC may authorize their use for specific tasks after consultation with appropriate personnel.

When the Target Chamber Service system (TCSS) is inserted into the Target Chamber, all positioners must normally be fully retracted. Exceptions to this may be only made using a procedure approved by the Target Area Commissioning, Operations and Maintenance (TCOM) manager. Generally the TCSS will be positioned first and locked in place, and then the required positioner will be moved to the required location

Chamber Interior Viewing System

The NIF target chamber has a number of devices that can extend into the chamber, resulting in the possibility of collision. In order to prevent such collisions from occurring, a Chamber Interior Viewing System (CIVS) is installed. It consists of surveillance cameras and associated light emitting diode (LED) ring light sources mounted on ports around the target chamber. Cameras are remotely controlled through ICCS. Monitors and computers are co-located with the Chamber Motion Stop button in several locations. There are three locations on the chamber with two cameras, each that have preset or fixed views of target chamber center. These fixed views are used to support all positioner movements; they are used by the operators to direct movements and by the associated CIVS operators to monitor the moves. The fixed views to be used are defined in the ICCS database and are displayed automatically on the TAP GUI based upon the specific controls used.

For other operations, the CIVS operator can select any “flexible view” camera and control the camera’s pan, tilt, and zoom functions at any time. The software will allow several camera views to be displayed on a monitor at the same time.

Use of Chamber Motion Stop Button

When more than a single positioner is inside the target chamber, a minimum of two qualified operators is required. One operator will use ICCS to control the device being moved (normally a TAO

or BCS operator) while a second operator uses the CIVS to monitor the movement. The CIVS operator must be stationed within reach of one of the Chamber Motion Stop Buttons. If a collision appears imminent or any unexpected movement occurs, the CIVS operator will use a Chamber Motion Stop button to de-energize all the devices that can extend into the chamber. In those cases in which only a single device is to be moved within the target chamber, and all others have been retracted, the TAC/TPS may perform both the operator and CIVS functions described above. This process removes electrical power to all the motor control chasses associated with devices capable of movement inside the target chamber, thereby stopping all movement.

Note that this stop button is distinct from the Facility Emergency Shutdown buttons mounted on the facility walls that shutdown facility operations including high voltage and laser operations. The Chamber Motion Stop button de-energizes only target chamber device motors. Actuation of any of these shutdowns will result in a "TC Motion Stop Button" alarm on the SIS annunciator panel in the control room.

In addition, each device has an individual emergency stop button mounted near its motors that de-energize only that device. It should be noted that these buttons do not de-energize devices installed in a DIM. They shut down the power to the DIM motor controllers only, power to the diagnostic remains in the last position. These emergency stop buttons are to be used by local operators who detect abnormal/unsafe operation of that specific positioner.

Recovery from Chamber Motion Stop Button actuation

Recovery from use of the stop button, or the locally mounted stop button, requires a number of steps. Refer to the SIS Alarm Response Procedure (NIF-5015482)¹³ for instructions for evaluating the reason for use of the stop button and recovery. When those actions are complete, all ICCS errors for the specific device that were produced by the emergency stop must then be cleared.

4.3.3 Operating Multiple Positioners in the Target Chamber Concurrently

Normally, only one device at a time is allowed to be in motion inside the Target Chamber. However, multiple devices may be operated under certain conditions. For device movement purposes, the target chamber is nominally divided into three zones: the first being within 500 mm of Target Chamber Center (TCC), the second beyond 500 mm from TCC up to the predefined "Safe Handoff" point (currently defined as 1.4 m from TCC for most positioners), and the third from the safe handoff point to fully retracted out of the chamber. The safe handoff radius corresponds to the swept volume possible when the FODI DIM is at TCC. The 500-mm zone represents the potential collision area for all other positioners.

Two target positioners may be involved in a single shot. To prevent the possibility of inadvertent shroud interactions or laser damage, both target positioner shrouds must either be open at shot time, or the respective positioner gate valve must be closed. Only one shroud system may be active during countdown, and the T-1 safety system will ensure that the active shroud opens by the appropriate time in the countdown, or it will prevent main laser operation.

The shot checklist generally sequences all positioner activities both inside and outside the safe handoff zone as serial activities, however, parallel execution of some of those activities is allowed within the following general guidelines:

Prior to simultaneous movements, coordination shall occur between LO and TAC.

Rules for outside of the safe handoff point (typically 1.4 m from TCC):

- a) **Multiple positioners** may be moved simultaneously up to the safe handoff point at the discretion of the TAC/LO; the TAC shall ensure that these positioners are unlocked only to the safe handoff point using the TAP GUI.
- b) **A single CIVS operator**, monitoring the chamber wide view CIVS, may supervise multiple moves at the discretion of the TAC (and LO during shot operations). This operator may have no other function while positioners are in operation. This operator is **in addition to** any CIVS operator stationed to monitor individual positioner moves as described below.
- c) The CIVS operator shall verify the path is clear prior to movements and shall ensure the movements proceed generally as intended.
- d) Positioner moves may be made using established setpoints using “go to” commands.

Rules for the zone between the safe handoff point and 500 mm from TCC:

- a) Only **a single positioner** of any type **may be moved within this zone at any one time**; all other positioners within the zone must be locked out by the TAC using the TAP GUI or by LO reservations on the status verifier.
- b) **A dedicated CIVS operator** must be stationed to monitor this positioner using the appropriate CIVS views as defined on the TAP GUI; this operator may serve no other function when the positioner in this zone is unlocked and free to move. Note that this operator is in addition to any CIVS operator stationed to monitor moves outside of this zone as described in 2 b).
- c) The **positioner operator will communicate with the CIVS operator** prior to initiating moves (or a series of moves) to ensure that the CIVS operator is engaged and to ensure the intended path is clear.
- d) When **FODI** is inside this zone, **no other positioner** may be present in this zone or within 500 mm of TCC.
- e) Moves within this zone are normally conducted with the TAP GUI joysticks or “drag moves”; setpoint moves may be conducted if part of an approved procedure or shot checklist (for example, initial insertion of the TAS to TCC during a shot cycle with no other positioners inserted may be conducted using a “Go To TCC” move).

Additional Rules for the zone inside 500 mm of TCC:

- a) **All moves within this zone must be approved by a second operator**, normally the dedicated CIVS operator. This will be accomplished using the “propose move”/”accept move” protocol built into the TAP GUIs. The second person verifies that the proposed move is safe from a collision perspective prior to allowing the move to be executed. The CIVS operator must be informed prior to initiating each move or sequence of moves within a small volume

At any point during the shot sequence the TAC or the LO can propose the performance of one or more parallel activities. SD must authorize all parallel activities.

4.3.4 Adding Diagnostics to the Target Chamber

Before adding devices to the Target Chamber, the device RI must follow the process in NIF Project Procedure 5.19, Work Authorization Review.²⁰ For Target Diagnostics, a specific Target Diagnostic Work Authorization Point checklist contained in the procedure identifies specific expert groups and SSMs who must review and concur on each installation.

5.0 COMMUNICATIONS

The effective and safe operation of NIF requires that operations related communications be concise, precise, and formal. This applies to all face-to-face, headset, or public address communications. To ensure effective communications, the following standardized procedures apply to all NIF operations. The SD and LO are responsible for maintaining the formality of all communications in the Control Room.

5.1 General

Informal or personal communications will not be transmitted on headsets or the public address system.

To ensure all personnel are aware of shot progress, shot-related communications applicable to all operators will be conducted on radios. The NIF Operations Management Plan¹ contains radio circuit assignments.

To avoid confusion, first names are not to be used in formal communications; operating station titles should be used or, if not assigned to a console, either the last or full name will be used.

All approved equipment/station designations and acronyms are listed in **Appendix D**. These designations should be followed at all times to ensure clarity of the information intended to be conveyed.

Directive communications (not informational in nature) will be repeated back to the person giving the direction to ensure the directions are clearly understood, when required for clarity. An acknowledgement will be performed before the directed action is taken. Upon completion of the directed action, the person performing the action will inform the person directing the action that it is complete (or not), and will include any unusual events. Refer to **Appendix D**.

All communications should be conducted in the quietest manner possible to maintain the general noise level in the Control Room as low as possible.

5.2 Radio Circuit Protocol

Radio circuit protocols are managed by the SOM.

Anyone needing to use the radio circuit for emergency communications shall take control of the circuit by saying "Break, Break" then passing the emergency information. Upon hearing "Break, Break" all other operators shall cease all communications until the emergency information has been passed.

Radio communications must be concise, precise, and formal and idle chatter should not occur. Do not interrupt communications in progress, unless you have an urgent communication affecting operations or safety.

To minimize circuit noise, close your microphone when not in use.

Station Identifiers will be used on the radio circuits to gain the attention of the station being called and minimize repeated information or requests. The station being called will be spoken first, then the station calling, then the clear and concise message may be transmitted .

Informational communications between two people should be positively acknowledged by using an appropriate term, such as “copy,” “affirmative” or “roger.”

6.0 NOTIFICATIONS

The SOM or NOM shall be notified as soon as practicable when:

- Unusual, abnormal or unexplained system performance
- Repetitive problems occur
- Process parameters are out of specification or indicate unexplained trends
- Scheduled shots cannot be executed

The SOM will also ensure appropriate COMs (and the NOM when appropriate) are notified of these problems.

7.0 SOFTWARE UPGRADES AND HARDWARE RETESTS

7.1 ICCS Software Upgrades

After the on-line testing WAP has been approved, ICCS software deployment and manual non-shot-cycle regression testing can proceed in NIF. The procedure for installation and rollback of ICCS software releases is described in document NIF-5014353.²¹ Testing is coordinated in the control room by a SD and/or LO. The testing is performed by subsystem operators, following approved regression test procedures, with ICCS Test Team personnel observing and recording any issues for follow-on troubleshooting and creation of SCRs.

After completion of manual regression testing and approval by the Campaign AI, shot cycle tests can proceed. This phase involves execution of approved experimental shots to test the operation of the shot automation software.

ICCS database changes and minor field software changes that are needed prior to the next software release, can be applied after documenting the requested change and getting necessary approvals using the B581 Production Software Environment Change Request form, NIF-5016317.²² Many database changes are required during commissioning, as they define the specific operational parameters of ICCS-controlled devices. Field software changes are less frequent and are used to apply and test urgent fixes that have limited scope. All proposed changes must be approved by the SSM. A SD must approve changes that affect operation of a commissioned bundle. Changes are verified by a subsystem operator or SSM before closing out the change request.

7.2 Laser Hardware Retests

NIF Work Permits (NIF Procedure 5.8)¹² describes how retests should be documented as part of the work process. These retests are proposed and reviewed by the Laser COM. For CIs and SPIs, a formal retest is required, usually specified in the maintenance or work procedure.

8.0 RECORD KEEPING

8.1 Logs

Logs are the record of events in the facility and provide a history of facility operations and will be maintained by all key personnel. Due to the highly automated nature of the facility, most logs are recorded electronically and very few paper logs are maintained. Operators enter comments about equipment or evolutions in the Operations Logs in LoCoS, where the entry is tied to a specific system or component. Equipment problems are entered into the Problem Log module of LoCoS, and further addressed through SMaRT Work Orders and equipment histories (for CF/BUS equipment) and LoCoS Work Permits (for all equipment). Most equipment parameters are monitored and controlled electronically, with automated archiving of system operating parameters and alarms. All electronic logs and archives are readily available to operators at the appropriate work stations. Log entries should be made in a timely manner and be easily understood.

The SD/LO or WCO in charge of the facility is responsible for ensuring that certain important events, as listed in Table 3 below, are logged into the Shot Operations LoCoS Log file.

Table 3. Important Event Logging Instructions

Category	Event/Action	Logged By/Log	Amplifying information
Personnel Safety Related	Personnel Injury	SD/LO or WCO in charge	Name of person injured, how injury occurred, medical treatment provided, immediate disposition, and notifications per NIF Notification Procedure.
	Off Normal Events (Section 3.2)	SD/LO or WCO in charge	Description of event including cause and extent of damage, immediate disposition, and notifications per NIF Notification Procedure.
	O2 deficiency alarms	SD/LO or WCO in charge	Detector(s) alarming, minimum readings, false/actual alarm. Evacuations implemented. Time access restored. Resolution
	Fire/Smoke alarm/Sprinkler actuation	SD/LO or WCO in charge	Location, cause, action taken. Any damage. See SIS alarm response procedure and Section 3.4
	Broken Sweep or SIS failure	SD/LO	Location of breach/failure. Cause/person responsible.

Category	Event/Action	Logged By/Log	Amplifying information
			Actions taken prior to resuming operations. (See Section 3.4.2 for required actions)
	Failed PILC	SD/LO	Reason PILC not completed. Bundle and Slab location(s).
	Failed Optics Inspection on fracture critical vacuum-loaded optics	SD/LO or WCO in charge	Specific location of failed optic (LRU, beamline, etc.) Action taken.
	Near miss when injury or major equipment damage narrowly averted	SD/LO or WCO in charge	Nature of incident, location, individuals involved. Actions taken and notifications per NIF Notification Procedure.
	SIS Interlocks bypassed/restored	SIS Manager or SD/LO	Device bypassed/ restored, reason for bypass. Approved by. Follow SIS Interlock Bypass Procedure
Environmental incident	Hazardous Material spill	SD/LO or WCO in charge	Nature of incident, location, individuals involved. Actions taken and notifications per NIF Notification Procedure
Major Changes to Facility Conditions	Argon Fill/Vent of major portions of system	SD/LO or WCO in charge	Reason for vent. Affected volume. Time of fill/vent start and completion.
	Opening Target Chamber for Entry/Securing Access	TAC or SD/LO	Reason for access. Port(s) removed.
	Major planned or unplanned facility power outage/interruption	SD/LO or WCO in charge	Reason/cause. Areas affected. Time of outage and restoration of power.
	Opening of Target Bay Shield Doors for access after a yield shot.	SD/LO or RSO	Yield of shot. Time since shot. Approved by. Door opened.
Radiological Events	Planned Special Exposures	RSO or SD/LO	Person(s) affected. Access area. Reason for entry. Approved by.
	Overexposure of an individual (>legal limit)	RSO or SD/LO	Person(s) affected. Location. Nature of event.
	High airborne tritium reading or major tritium release from facility resulting in an alarm	RSO or SD/LO/WCO in charge	Alarming sensor(s). Magnitude of alarm. Area(s) evacuated. Actions taken. Time access restored (if applicable). Follow SIS alarm response procedure.
	Radiological spill or	RSO or SD/LO/WCO in	Person(s) affected. Location.

Category	Event/Action	Logged By/Log	Amplifying information
	personnel contamination	charge	Nature of event. Contamination levels. Actions taken.
Major Equipment Damage	Major Equipment Damage resulting in taking down a quad of beams or more, or estimated damage >\$10K	SD/LO or WCO in charge	Person(s) involved. Location. Nature of event. Actions taken.
Machine Safety	Daily MOR checks, operation of Failsafe System	MOR Operator	Failsafe disabled and re-enabled per MOR Daily Startup Checklist

Personnel shall use the LoCoS Operations Log utility for Shot Operations related entries. Log entries in LoCoS should be made under the applicable subsystem category. Errors in electronic logs shall only be corrected by the person making the entry, or with their concurrence. The correct information should be entered, including a note about what was changed with the name of the person making the change and the date the change was made. Equipment failures or issues that require follow up or maintenance should also be logged as LoCoS Problem Logs referenced to the particular LRU, component or part number as applicable.

System operators are responsible to log (in the LOCOS subsystem Ops Log) important system activities, events, and equipment and system status throughout their shift. They should make special effort to log all pertinent information needing to be passed on to subsequent shifts. Events to be logged include: Completed test procedures (such as IQs/OQs), problems encountered (reference Problem Log for equipment deficiencies), unusual system behavior and methods successfully employed to work through them. The LO should maintain a log of major shift events including shots completed, significant delays or problems encountered, etc. in the LoCoS Ops Log.

Unanticipated out-of-specification parameters should be logged with information about why the parameter was “out of spec,” who was informed, and what action taken has been taken to return the parameter to within specification.

Periodic reviews of all logs should be conducted by supervisors or appropriate SSMs as deemed necessary.

8.1.1 Shot Operations Shift Summary

The SD is responsible for writing a shift Shot Operations Summary describing what events/issues took place during the shift. The SD will also list any safety issues, important problem reports (by number), and status of facility at end of shift. This summary is emailed to selected individuals at the end of the shift. The Shot Operations Summary will be posted on LoCoS automatically, and periodically verified by the NIF Shot Operations Administrative Assistant.

8.2 Shift Schedules

The CROM maintains a Shift and Vacation Schedule. The schedule covers NIF Operations personnel staffing the Shot Operations and Non-Shot Operations shifts. The schedule is generally prepared two months in advance and will be posted in the Strategy Room. Any changes to the schedule

are coordinated through and approved by the SOM, CROM or SD. Personnel that cannot make a scheduled shift shall call the CROM and let them know when they will be absent and when they expect to be able to return to work. The CROM, or designated alternate, will make appropriate adjustments to the schedule.

8.3 Shift Turnover

Shift Turnover for shot operations staff is conducted by the oncoming SD using NIF Operations Procedure, NIF Shot Operations Shift Turnover Process, NIF-5018061.²³ This brief includes at a minimum: SPA, facility status, utilities status, alignment status, shift shot plan, diagnostics requirements and problems experienced during the previous shift. This brief is an appropriate place to review compliance with the Required Reading program (Section 9.0) and qualification proficiencies. This turnover meeting is used to ensure all personnel (including visiting experimenters) are briefed before performing their duties.

As most NIF equipment status/data is available electronically through the control systems or administrative web applications (such as LoCoS), limited use is made of paper logs and status boards. Therefore, the individual operator turnover sheets do not contain detailed equipment status; these sheets focus more on activity status and off-normal condition turnover. Turnover checklists are to be used whenever a transfer of operations responsibility from one complete shift of operators is planned, or (at the discretion of the SD/LO) when the relief of a subset of operators is to be conducted. Formal turnover is required whenever shot operations are in progress. For facility activities not including shot operations, the SD/LO may employ a graded approach to turnover.

The off-going shift prepares the status information for review by the on-coming shift. The on-coming shift then reviews the information, resolves any questions, and participates in the briefing of the planned activities for their shift. Relief of operators is authorized and coordinated through the on-coming and off-going SDs/LOs. Reliefs will not normally be authorized during any Countdown or Pre-Countdown shot state.

When two consecutive shifts will not be able to conduct a direct turnover (i.e., over holidays or weekends) the off-going shift completes the turnover checklists and leaves them readily available for the next shift. The Shot Operations Summary email is also used to provide additional information to the next shift. The Shot Schedule tool is used to provide direction for planned shot activities.

8.3.1 Off-Going Shift Responsibilities

Subsystem Operators shall:

- Obtain a copy of the Shift Turnover Checklist for their operating station at the start of the shift.
- Fill out the header information (names, shift date/time, etc.).
- Transfer any applicable items noted on the turnover from the previous shift in the appropriate section of the checklist.
- Complete any required LOCOS logs (Problem Reports, Ops Logs, etc.) throughout the shift; note items of particular interest to on-coming shifts on the appropriate section of the turnover checklist. In particular, note any safety items or abnormal operating procedures.
- Near the end of the shift, update the turnover checklist with any status changes.

- Ensure documents for operations in progress (Shot Checklist, Commissioning Procedures, etc.) are complete through the current step and provide them to the on-coming operator as part of the relief process. Specifically review the status of procedures in progress, including the next required steps and ensure the on-coming operator is aware of the system status.

For operating stations that have manual equipment logs (“Round” sheets), the off-going operator (normally) completes a set of log readings and makes them available for the on-coming shift to review.

8.3.2 On-Coming Shift Responsibilities

Prior to relieving the shift, the on-coming operator should review pertinent logged information (Ops Log, Problem Reports, Hot Sheets, SIS Bypass, ICCS Changes, etc) as specified in the Turnover Checklists.

When appropriate and facility conditions permit, conduct a physical walk-down of the operating equipment, noting conditions. This is usually required when the operator manually operates equipment in the field (as opposed to operating equipment from the control room only).

When authorized to relieve the on-coming shift, the on-coming operator proceeds to the operating console and reviews the checklist prepared by the off-going operator, and discusses any points of interest. If not already done, review the electronics logs for a period of at least 24 hours (or until last on shift, whichever is shorter).

Review all applicable operating documents (including shot checklists, Shot Setup Sheets, Commissioning Procedures, etc.), and make particular note of what steps are complete, in progress or not started. Obtain clarification from the off-going operator where required.

Review the status of the system GUIs and the Shot Supervisor and Alert GUIs and be certain that all indications are understood.

Finally, the off-going operator should provide a turnover of any other operational items not covered elsewhere.

8.3.3 Relief Process

The on-coming SD/LO will review the shift status with the off-going SD/LO and review shift plans prepared by the SOM. They will determine the plan for the shift and identify an appropriate time for operator turnovers to commence. Turnovers may be authorized for the entire set of shift operators, or specific individuals (depending upon conditions)

Prior to shift turnover, the on-coming shift may be authorized to conduct non-shot commissioning activities (on a not-to-interfere basis) using secondary consoles. Similarly, if appropriate, shift turnover may occur early in the overlap period, and the off-going operators may switch to non-shot activities.

Once conditions are stable and the SDs and LOs agree it is appropriate, operators will be directed to start turnover of individual operating stations.

The SD/LO turnover normally occurs after the other stations, when the new operators have settled in.

If a turnover occurs between a final rod shot and a system shot, the on-coming SD must review the Rod Shot and other necessary data, and concur that it acceptable to proceed with the system shot. Responsibility for shot safety rests with the SD conducting the shot.

Submit completed turnover checklists to the Shot Operations Administrative Assistant. Turnover checklists need be retained for only 1 week.

9.0 REQUIRED READING

A Required Reading binder shall be maintained by the Shot Operations Manager in the Control Room for review by Shot Operations personnel. This binder should be organized into sections for all-hands and each subsystem operator. Each section or document should have a review list attached for personnel to indicate reviews, as appropriate. As an example, current minutes from the weekly safety meetings, recent lessons learned and change synopsis for site-wide documentation (i.e., OSP 581.11,⁶ NIF Docs, various procedures,) will be placed in the all-hands section. Material may be removed after all specified personnel have completed their review or when the material is no longer applicable.

This binder should be reviewed periodically as part of the shift turnover process (Section 8.3) and as determined by the CROM to ensure personnel are staying current with changes to the facility and operations.

10.0 INSTRUCTIONS TO WORKERS AND USE OF PROCEDURES

For normal operations, operators should follow written procedures and/or checklists. Each operator shall use Shot Operations and system operation checklists when approved for use. The format for operations and maintenance procedures is detailed in the NIF Management Procedure 11.1, Index and Writer's Guide (NIF-0114548).²⁴

Before any procedure is performed the first time, the safety section must be reviewed in the field by the entire work team. The RI or designee must lead the review, and additional safety considerations must be written on the procedure at that time and the procedure subsequently updated and revised as necessary.

10.1 Use of the Shot Checklist

Shot Operations Checklists are used during all shot cycle operations. This complete checklist shall contain manual, automated and commissioning-specific steps for all subsystems controlled from the Control Room or Target area during a shot cycle. The checklist will be formatted for the specific shot type being conducted, based on beam fate and activity (i.e. commissioning, software regression testing, automated shots...). The checklist contains steps necessary to complete the shot cycle and ensure that relevant data is collected and archived.

The Shot Operations Checklist shall include the necessary references to the Shot Safety Checklist. The Shot Safety Checklist outlines the necessary beampath integrity checks and sweeps and other activities necessary to ensure personnel safety during laser operations. The LO appends the Shot Safety Checklist to the Shot Checklist, and performs the two checklists in parallel during the shot cycle.

10.2 Management of the Shot Checklist

Shot Operations Checklists (and redlines) are managed by the Shot Checklist Manager using a Checklist Approval Form. The Shot Checklist Manager should post the latest approved version of the shot checklist on the NIF Control Room server and submit the update to ECMS. The approved shot checklists will then be available for use in shot operations.

Certain steps in the shot checklist (identified with an asterisk * adjacent to the step number) have been identified as being critical to safe operation of the laser. These steps are designated as quality level 2 (RQ-2) and may not be deleted or substantively changed without approval of the Rules of Engagement/Machine Safety (REMS) expert group.

Changes to the Shot Safety Checklist must be approved by the NOM. This checklist is managed the same as the Shot Checklists, with the exception that only ECMS released versions are authorized for use for shot operations. The LO retrieves the most current version from ECMS prior to use.

The LO is responsible for ensuring that the most recent, approved version of the shot checklist and Shot Safety Checklist is being used. Unless explicitly approved by the NOM, only checklists released as described above shall be used. The SD may authorize paper redlines only to correct clearly administrative errors or necessary workarounds for one-time problems. It is the responsibility of the SD to obtain concurrence from the responsible SSM or SOM and approval from the NOM when appropriate.

All Operators are required to use the most current, approved checklists during Shot Operations. Operating from memory is not permitted. Unless otherwise directed by the SD, a new checklist will be used for each new shot setup.

10.3 Temporary Standing Orders

The NOM or SOM may issue temporary directions to their staff through the use of Temporary Standing Orders (TSO). These orders may establish new policies or clarify existing policies, but shall not be used to negate policies or procedures issued by higher authority. Where the change in policy is intended to be permanent, the appropriate process owner will be notified and an ECR created, as appropriate. The TSOs shall be distributed to all affected personnel via email and maintained in the Control Room Required Reading Binder.

11.0 OPERATOR AID POSTINGS

The use of Posted Operator Aides such as equipment setpoints, diagrams and procedures, where such posting are the actual guidance for operating the system, should in general be discouraged. When these types of postings are necessary, they shall be approved by the SOM. They shall not conflict with other official guidance or procedures, shall be updated annually or upon changes to the system that affects the posted operator aid, and shall not obscure or interfere with proper operation of instruments, equipment or controls.

Operator aids in the form of signs should be legible and posted unambiguously, so it is clear and obvious what they refer to. These postings should be made of metal or laminated as appropriate for their location. Signs that are illegible or confusing should be removed.

The list of approved Posted Operator Aids is maintained in **Appendix E**.

12.0 REFERENCES

1. NIF Operations Management Plan, NIF-5020544
2. NIF Maintenance Plan, NIF-5018526
3. Shot Checklist, NIF-5016158
4. NIF Training Plan, NIF-5018705
5. Facility Safety Plan for Buildings 581, 582, 682, 683, and 684, NIF-5019665
6. Operational Safety Procedure 581.11, NIF Laser System Installation, Commissioning, and Operation
7. Target Management Procedure, NIF-5012336
8. LLNL Environment, Safety and Health (ES&H) Manual, UCRL-AM-133867
9. NIF Program Safety Protocols and Requirements, https://nif-int.llnl.gov/procedures_docs_forms/procedures.php
10. NIF Emergency Preparedness and Response Plan, NIF-5017354
11. NIF Procedure 5.21, NIF Programs Off-Normal Event Initial Response and Notification Procedure, NIF-0072808
12. NIF Procedure 5.8, NIF Project Site Work Permits, NIF-5018626
13. NIF Safety Interlock System Alarm Response Procedure, NIF-5015482
14. No longer used
15. Shot Operations Rules of Engagement, for NIF Main Laser Operations, NIF-5022606
16. Preamplifier Module (PAM) Manual Permissives Checklist, NIF-5015558
17. Laser Bay 1-2 Shot Safety Checklist, NIF-5015558
18. Control System Operator Qualification Card, NIF-5009911
19. NIF Procedure 5.26, Deployment in NIF of Hardware Used at Other Facilities, NIF-5018882
20. NIF Procedure 5.19, Work Authorization Review, NIF-5018658
21. Building 581 Production Release Installation Procedure, NIF-5014353
22. Building 581 Production Software Environment Change Request, NIF-5016317
23. NIF Shot Operations Shift Turnover Process, NIF-5018061
24. NIF Management Procedure 11.1, Index and Writer's Guide, NIF-5020542
25. Conduct of Operations Applicability Matrix for the NIF, NIF-0113665
26. VISAR/LCAL Manual Permissives Checklist , NIF-5029707
27. Cryogenic Target Positioner CryoTARPOS Operating Procedure, NIF-5030385

13.0 REVISION LOG

Revisions to this procedure must be evaluated with respect to the *Conduct of Operations Applicability Matrix* (NIF-0113665)²⁵

Rev. No.	Effective Date	ECR No.	Pages Affected	Brief Description of Revision
AG	Feb 2011	TBD	Various	Added NIF Business System requirements for Shot Operations and Shot Ops Preparations. Corrected typos in paragraph numbering
AF	April 2010	0022130	Various	Updated for radiological operations and cryogenic target positioner operations. Updated organization charts.
AE	Jan. 2010	0020312	Various	Modified role of Hazards Control Technician to include Radiological Controls Tech activities. Added role Target Chamber Positioner Supervisor (TPS). Added references to operations that generate Neutrons (or Protons). Modified rules of engagement for case with only one device in the TC
AD	Sept. 2008	0016925	Various	Minor administrative updates to align with current practices, added a section on Temporary Standing Orders, updated training requirements, removed references to TALIS and the Shot Checklist CCB5, and updated roles and responsibilities to the new org chart.
AC	July 2008	0015835	Various	Incorporates items identified through the MSA process.
AB	February 2008	0015579	All	Updated to reflect management changes and other minor edits. Many sections were moved to the NIF Management Plan in their entirety.
AA	June 2007	N/A	All	Initial release

1.0 APPENDICES

APPENDIX A — Qualification Cards for Shot Operations Personnel

APPENDIX B — Protocol for Visiting Experimenters during NIF Shot Operations

APPENDIX C — ICCS Control Network Group Account Responsibilities

APPENDIX D — Communications

APPENDIX E — Approved Posted Operator Aids

APPENDIX F --- NIF Business Services Required for Shot Operations

Appendix A: Qualification Cards for Shot Operations Personnel

Personnel	Training Required (Course or Qualification Card Number and Title)
All Control Room Operators	NP0080, NIF Operations Shot Director NP0454-OJT, NIF Shot Director Target Shot Supplement Qual Card
Shot Director	NP0080, NIF Operations Shot Director
NIF Radiological Controls Technician	NP-0506-OJT NIF Radiological Controls Technician
Lead Operator	NP0079, NIF Operations Lead Operator
MOR Operator	NP0064-A, Master Oscillator Room (MOR) Subsystem Console Operation NP0064-B, Master Oscillator Room (MOR) Shot Cycle Qualification
Injection Laser System Operator	NP0035-A, ILS Operator/PAM Operator NP0328, Lower Injection Beam Block Installer Qual Card
Power Conditioning System Operator	NP0074, PCS Console Operator Qual Card NP0304, Power Conditioning System Shot Cycle Qual Card
PEPC Operator	NP0399-A, PEPC Subsystem Basic Operator
Laser Diagnostics Operator	NP0044-B, Generic Streak Camera Platform (GSCP) Operator Qualification Card NP0415, Laser Diagnostics System Console Operator NP0408, PDS Subsystem Console Operator
Beam Control System Operator	NP0048-B, Control Room - Collision Avoidance/CIVS Operator Qual Card NP0052, SIDE Operator NP0053, Basic Laser Alignment NP0068, LOIS Operator Qual Card NP0069, Alignment Sensor and Target Positioner Operation for BCS NP0308, BCS Shot Cycle Qualification NP0335, PFODI Operations with Edge Illumination NP0394, PFODI Operation with 1 Omega Illumination NP0457-OJT, Final Optics Damage Inspection (FODI) Instrument Operator Qual Card
Duty Engineer	NP0078, ICCS Duty Engineer NP0303, ICCS Shot Cycle Qualification

Industrial Controls System Operator	NP0012, Industrial Controls RSView GUI Fundamentals and Usage NP0041, Target Area Vacuum System Operator NP0054, FOA Vacuum System Operator Qualification Card NP0055, FOA Vacuum Control Room Operator Qualification Card NP0057, Spatial Filter Vacuum System Operator NP0058, Argon System Operator NP0067, Basic Utility Systems Operator NP0087, Advanced Utility Systems Operator Qual Card
Target Area Coordinator	NP0088, NIF Target Area Coordinator Qualified Target Area Operator and associated TAO qualifications
Target Area Operator	NP0090, Diagnostic Instrument Manipulator Operator NP0085, Target and Alignment sensor Position Operation NP0041, Target Area Vacuum System Operator NP0317, OPAS Basic Operator NP0326, Diagnostic Mechanical Utility Operator NP0048, Target Area & Control Room Collision Avoidance/CIVS Operator NP0092, Streaked X-ray Detector-Backup (SXD-B) Operator NP0093-A, Static X-ray Imager (SXI) Operations-Mechanical NP0455, Target Area Operator (TAO) Qual Card
Target Diagnostics Console Operator	NP0082, DIM Utilities Control NP0044, Generic Streak Camera Platform Operator NP0093, SXI Technician – Mechanical and Control System NP0309, Target Diagnostic Shot Cycle Qualification NP0066, Dante Operator NP0367, Filter Fluorescer Experiment (FFLEX) Basic Operator NP0044, Generic Streak Camera Platform (GSCP) Operator NP0070-A, VISAR Control Room Operations NP0086-B, Full Aperture Backscatter Station (FABS) Operator NP0092, Streaked X-ray Detector-Backup (SXD-B) Operator NP0093-B, Static X-ray Imager (SXI) Operations-Control Systems NP0301, Flexible X-ray Imager (FXI) Operator NP0309, Target Diagnostics Shot Cycle NP0318, Near Backscatter Imager (NBI) NP0337, Target Diagnostic Status (TDS) and Control Supervisor NP0450, Target Diagnostic Operator (TDO) Qual Card
Target Chamber Positioner Supervisor	NP0034 Control System Operator Qual Card NP0447 Target Chamber Positioner Supervisor Qual Card
Cryogenic Technician System Operator	NP1102-OJT Cryogenic Technician System Operator Qual Card

Appendix B: Protocol for Visiting Experimenters during NIF Shot Operations

The purpose of this procedure is to define the responsibilities of visitors within the NIF facility during shot operations. To insure personnel and equipment safety, it is imperative that the system operators are not disturbed or distracted during shot operations. This procedure applies to all visitors working in the Control Room, Laser Bays, Target Area and associated support areas during shot operations.

- During shot operations, the SD and LO have the authority to clear any area of the facility of nonessential personnel. Nonessential personnel are those personnel that the SD/LO determine that are not required in the immediate area during shot operations.
- During the shot cycle, from the beginning of the Implement Plan state to the End Shot state, only shot operations staff are allowed in the Control Room unless approved by the SD/LO.
- Visitors may reside in the strategy room or other nearby locations until completion of the shot cycle.
- The SD/LO may allow the Lead Experimenter(s) (LE) or designee(s) (at most 1 or 2 personnel) in the Control Room under the following conditions:
 - The LE shall be identified during pre-shot SPA and any LE personnel changes shall be approved by the SD/LO.
 - The LE may inspect target alignment, beam positioning or diagnostic set-up at appropriate operator stations during the shot cycle with SD/LO approval. However, the LE shall not modify procedures or instruct operators to move or modify devices, without prior SD/LO approval.
 - Upon completion of set-up the LE shall vacate the Control Room unless prior arrangements have been made with the SD. During the remainder of the shot cycle the LE shall obtain SD/LO approval before entering the Control Room or before modifying procedures or system devices.
 - With SD approval the LE may be stationed in rear of the Control Room to witness a system shot. During the shot cycle the LE may only communicate directly with the SD. During countdown the LE should refrain from any communication unless personnel or equipment safety is at stake.
- The experimental and diagnostic support staff may monitor radio communications during the shot cycle. Visitors shall not transmit on the shot operations channel unless directly to the SD/LO regarding time urgent information. Loan radios are available from the LO. For general questions or discussions with the SD/LO use the phone and call 3-7009 (the SD console).

I have read and understand the Protocol for Visiting Experimenters:

Name (print)

Name (signature)

Date

Appendix D: Communications

All communications that are either directive in nature or allow action to be initiated should consist of a to/from address, message, and acknowledgement as follows:

To Address The operator to which the message is intended, e.g., “Beam control, Mechanical Room, Shot Director,” etc.

From Address The operator that originates the message. (Note: The From Address is not used for public address system). Both the voice and the authority to issue a directive must be clear (i.e., while a specific individual has authority when actually assigned as operator, that person does not have authority to issue a directive that changes system status when he/she is not the designated operator).

Message The order or informational item to be communicated.

Acknowledgement The affirmation that a message is received and understood.

If the message is a directive that requires action and includes letters, numbers, or movement direction—the message should be acknowledged by repeating back the message followed by stating your station title and “copy, acknowledge, understood, roger,” or another clear affirmative word indicating understanding. If the repeat back is in error, the originator will state “wrong,” and will repeat the entire message.

If the message is either informational or doesn’t include letters, numbers, or direction or movement—the message need not be repeated back and may be acknowledged by simply stating your station title and “copy, understood, acknowledge, roger,” or other clear affirmative word indicating understanding.

Terminology for operating stations and locations.

Written	Abbreviated	Spoken
Shot Director	SD	Shot Director
(the number) 0,1,2,3,4,5,6,7,8,9		Zero, One, Two, Three, Four, Five, Six, Seven, Eight, Nine
Alphabet A–Z		Alpha, Bravo, Charlie, Delta, Echo, Foxtrot, Golf, Hotel, India, Juliet, Kilo, Lima, Mike, November, Oscar, Papa, Quebec, Romeo, Sierra, Tango, Uniform, Victor, Whiskey, X-ray, Yankee, Zulu (this phonetic alphabet need only be used when necessary to avoid confusion)
Beamline Bundle XX, number Y	B317 (example)	Beam Three-One-Seven (not “three seventeen”)
Lead Operator	LO	Lead Operator
Power Conditioning Operator	PCS	Power Conditioning
Plasma Electrode Pockels Cell Operator	PEPC	Pepsi
Beam Control Operator	BCS	Beam Control
Laser Diagnostics Operator	LD	Laser Diagnostics
Injection Laser System Operator	ILS	I. L. S.
Laser Performance Optical Model Operator	LPOM	L-Pom
Industrial Controls System Operator (or Utility System Operator)	ICS	Industrial Controls

Written	Abbreviated	Spoken
T-1 Control System Operator	T-1	Tee minus one
Integrated Computer Control System Engineer	DE	Duty Engineer
Large Optics Inspection System Operator	LOIS	Lois
Target Area Operator	TAO	Target Area Operator
Target Diagnostics Operator	TDO	Target Diagnostics
Target Diagnostics Coordinator	TDC	Target Diagnostics Coordinator
Target Area Coordinator	TAC	Target Area Coordinator or TAC
Master Oscillator Room Operator	MOR	M .O. R.
NIF Location Component and State Tracking System	LoCoS	Locos
Chamber Interior Viewing Systems Operator	CIVS	Sieves Operator

Nomenclature for equipment.

Equipment Nomenclature	Title or Accepted Acronyms
Plasma Electrode Pockels Cell	PEPC
Input Sensor Package	ISP
Output Sensor Package	OSP
Pre-amplifier System	PAM
Pre-Amplifier Beam Transport System	PABTS
Capacitor Bay 1-4	Cap Bay 1, 2, 3, 4
Cavity Spatial Filter	CSF
Transport Spatial Filter	TSF
Laser Mirror Number 1 to n	LM1...n
Diagnostic Mezzanine	DM
Safety Interlock System	SIS
Target Bay	TB
Switchyard 1 & 2	SY1, 2
Laser Bay 1 & 2	LB1, 2
Optics Assembly Building	OAB
Optics Assembly Building Corridor	OAB Corridor
Master Oscillator Room	MOR
Mechanical Room 3 rd Floor	MR3
Mechanical Room 5 th Floor	MR5
NIF Entrance Lobby	NEL
Roving Mirror Diagnostics Enclosure	RMDE

Equipment Nomenclature	Title or Accepted Acronyms
Diagnostic Beam Splitter	DBS
Laser and Target Area Building	LTAB
Target Alignment Sensor	TAS
Target Positioner	TARPOS
Chamber Center Reference System	CCRS
Chamber Interior Viewing System	CIVS
Diagnostic Manipulator	DIM
Target Chamber Service System	TCSS
Clean Dry Air System	CDA
TSF Alignment Tower	TSF-A
TSF Diagnostic Tower	TSF-D
Pre-Amplifier Module Power Conditioning Unit	PAM PCU
Main Energy Storage Module	MESM
Capacitor Bank Module	BM
Front End Processor	FEP
Programmable Logic Controller	PLC
Final Optics Assembly	FOA
Integrated Optics Module	IOM
Precision Diagnostics System	PDS
Diagnostic Mezzanine	DM 1, 2 Upper or Lower

Appendix E: Approved Posted Operator Aids

Argon Pad valve schematic

Additional posted procedures in Health Physics lab and HMMA

Appendix F: NIF Business Services Required for Shot Operations

Table contains list of NIF business application and platforms required to conduct shot operations. Services may be required for shot preparations (prior to loading the shot), shot operations (once shot is loaded) or both.

<u>Service Name</u> <u>(Production Environment)</u>	<u>Acronym</u>	<u>Required for</u> <u>shot</u> <u>preparations/pri</u> <u>or to loading</u> <u>shot</u>	<u>Required to</u> <u>perform shot.</u>
Control Systems	ICCS Prod	Y	Y
NIF-IT Security Web Service	SEC-WS	Y	Y
Target Diagnostics Instrument Based Controller Boot services	IBC Boot Svc	Y	Y
Shot Setup	CMT	Y	N
Shot Readiness - Config Checker	Config	Y	N
Shot Analysis Data Visualization	SADV	Y	Y
Shot Analysis, Visualization and Infrastructure	SAVI	Y	Y
Optics Requirements Verification Package	RVP	Y	N
Quicklooks	QL	Y	Y
Optics Inspection Analysis	OIA	Y	Y
Optics Inspection Data Visualization	OIDV	Y	Y
Connection Broker	CB	Y	Y
Beamline Status Seating Chart	Beamline	Y	N
Optics Inspection Compute cluster	OI Cluster	Y	Y
Recycle Now Interactive	RNI	Y	N
NIF Loop Viewer	NLV	Y	N
Location Component State	LoCoS	Y	Y
Laser Performance Operations Model (LPOM) Shot Setup and Compute Cluster	LPOM/LPO M Cluster	Y	Y
B581 Control Room equipment & Support	Infrastructu	Y	Y
Industrial Control System	ICS	Y	Y
Safety Interlock System	SIS	Y	Y
Access Control System	ACS	Y	Y
Glovia	Glovia	Y	Y
Decision Support - Shot Setup	MSSAR /	Y	Y
Automated Alignment Data Visualization	AADV	N	Y
Auto Alignment compute cluster	AA Cluster	Y	Y
Enterprise Change Management System	ECMS	Y	N
NIF IT Web Page	NIFIT	Y	Y
Requirements Management Systems	RMS	Y (1)	N
<p>Notes (1) For Neutron yield shots.</p>			

National Ignition Facility Shot Operations Plan

Action	Name	Title
Prepared by	Bob Burr	Deputy Shot Operations Manager
Concurred by	Tom Kohut	Shot Operations Manager
Approved by	Bruno Van Wonterghem	Operations Manager

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1.0 INTRODUCTION

This document identifies the policies and general procedures necessary to perform and support routine shot operations in the NIF Facility. Shot Operations are defined as those activities directly related to or supporting the operation of the NIF Main Laser System, Precision Diagnostic System (PDS), Target Chamber (TC), and associated systems located on the NIF. Operations include delivery of low-power laser light through to the firing of the main laser amplifiers, operation of the beampath and associated utilities, target positioners and diagnostics, and the various computer control systems. Construction and maintenance activities are not covered here, except as they interface to ongoing operations. This document, in conjunction with the NIF Operations Management Plan¹ and NIF Maintenance Plan,² satisfies the requirements for a Conduct of Operations.

Duties, responsibilities, and reporting requirements of the various positions associated with shot operations are detailed herein. Guidelines for control room activities are also included.

General policies governing administrative and operational practices related to shot operations are included herein. This includes general responses for major facility off-normal conditions such as oxygen deficiency and crash button actuation. Operational Safety Procedures (OSPs) and operating procedures may include additional detailed steps, as required.

Processes for managing and using system operating procedures, OSPs, shot setup sheets, and shot checklists are contained herein. The detailed procedures should be used for the operation of the facility and equipment, where appropriate. If in doubt as to which documents apply, the approved detailed operational procedures supersede this document.

This document shall be revised before any the following events occur: the introduction of tritium into the facility, commencement of neutron-generating activities, or production of dispersed hazardous materials in the target chamber or classified operations.

1.1 Location

This document governs shot operations on the NIF, which includes the Laser and Target Area Building (LTAB, B581), Optics Assembly Building (OAB, B681) and associated utility pads and outbuildings (B582, B682, B683, and B684).

1.2 Terminology

Full System Shot—Shot sequence that involves firing any or all of the Main Laser Amplifier sections of a bundle with or without firing the multi-pass amplifier (MPA) rod amplifier. This may or may not involve propagation of high-energy laser light through the laser amplifier chain to either the Switchyard (SY) Roving Calorimeter, PDS or TC

Rod Shot—Shot sequences that involve firing any preamplifier module (PAM) MPA rod amplifier and not firing any Main Laser Amplifiers. This may or may not involve propagation of rod shot energy laser light through the laser amplifier chain to the SY Roving Calorimeter, PDS or TC.

PILC Shot—Pre-Ionization Lamp Checks (PILCs) test the flashlamps with a high voltage, low energy discharge

Shot Operations—Shot Operations start when the Shot Director (SD) or Lead Operator (LO) has started the Shot Cycle process.

Significant Programmatic Impact—The loss of a structure, system or component (SSC), which would preclude shots to Target Chamber Center (TCC) for more than 6 months.

2.0 ORGANIZATION AND ADMINISTRATION

2.1 Shot Operations Chain of Command

The operational organization used to conduct shot operations is shown in Figure 1. The individuals assigned to fill the various operational positions described may be assigned from several different organizations. When assigned to shot operations shifts, they report to the SD and LO for all operational activities.

Shot Operations formally begin with a pre-shift brief (Section 8.3.2) and subsequent initiation of the Shot Checklist.³ If a Work Control Officer (WCO) is stationed, they maintain overall responsibility for safety and work coordination in the facility outside of the shot cycle. When the Shot Cycle process is started, the primary focus in the facility is on the shot process. Other activities in the facility become secondary to the shot processes. On a case by case basis, operators may be assigned additional duties by their respective Subsystem Manager (SSM) (with approval from the Shot Operations Manager [SOM] or SD), provided these duties do not interfere with assigned shot operations tasks.

Training and Qualification of individuals to fill these shot operations roles are covered in Section 2.1. Personnel are assigned by their organization to this shot organization by shift (see Section 8.2). It is the responsibility of the supplying organization to provide alternate qualified personnel to fill these positions in the event of illness or other problem preventing the assigned individual from fulfilling the shift requirements. The SD and LO should be informed of the substitution as soon as possible.

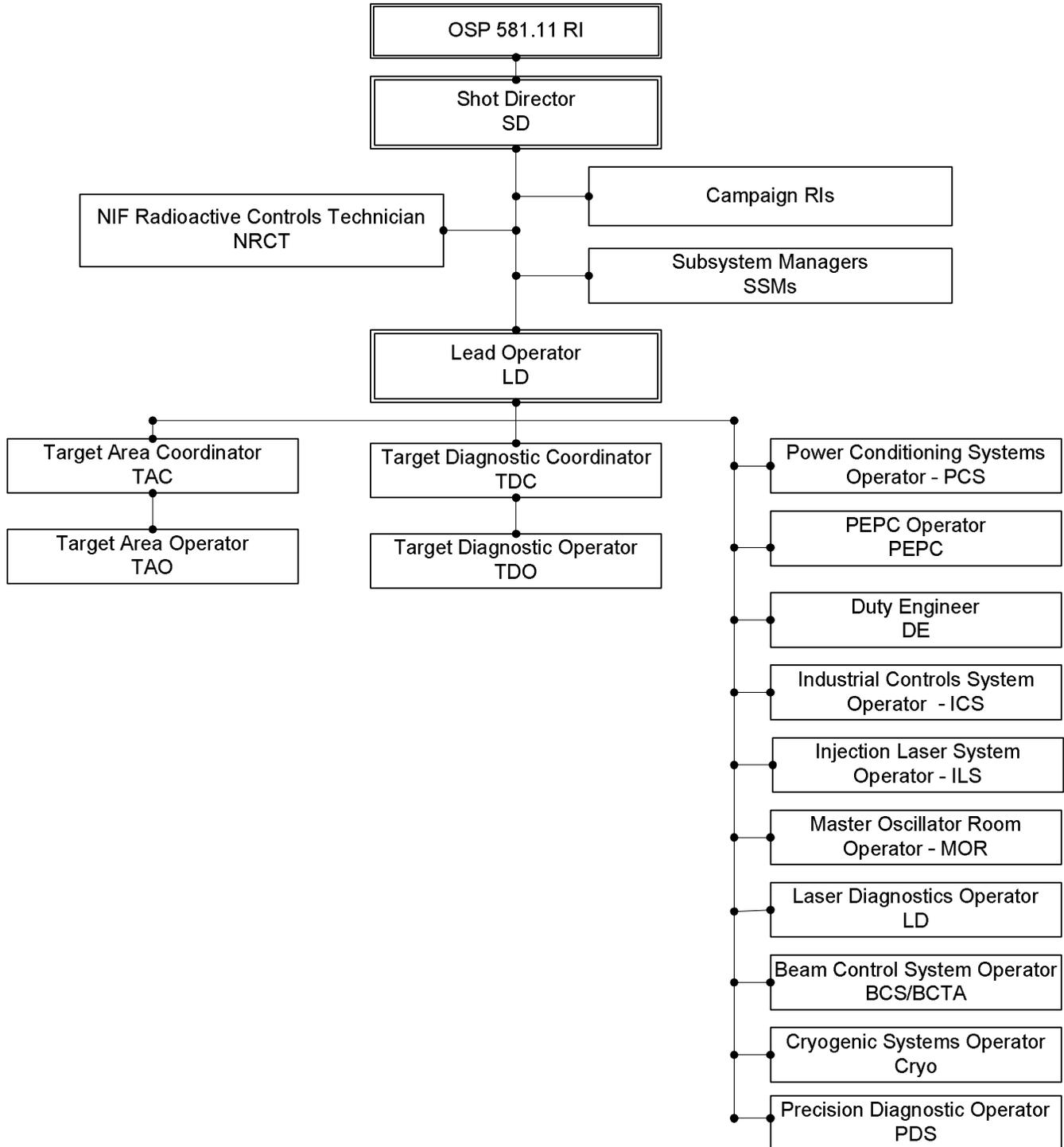


Figure 1. Shot Operations Organization

2.1 Shot Support, Personnel Qualifications and Required Training

All personnel must complete the initial subsystem qualification specified in Section **Error!** **Reference source not found.** Only those who have completed the requisite qualification and have maintained proficiency⁴ may support operations and be assigned on the Shift Schedule. The Control Room Operations Manager (CROM) shall ensure that only qualified and

proficient personnel operate the appropriate system. Lists of qualified operators and their proficiency status shall be maintained by the NIF Training Coordinator and reviewed by the CROM. The Lead Operator will verify that the shot operations personnel are qualified to perform their assigned roles on the shot operations team.

Minimum staffing requirements for laser propagation beyond the Master Oscillator Room (MOR) are specified in Table 1. These personnel are expected to be in the Control Room or Target Bay for shots unless otherwise specified. A list of applicable Qualification Cards is in **Appendix A**.

Table 1. Minimum Shot Operations Manning

Personnel	PCS HV Ops (no laser propagation)	Regen Laser Propagation beyond ISP	Rod Shot to ISP, FED, PABTS	Rod Shot to RMDE Cal	Main Laser to RMDE Cal	Rod Shot to PDS	Main Laser to PDS	Rod Shot to TCC	Main Laser to TCC
Shot Director	1			1 (Note 1)	1 (Note 4)	1 (Note 1)	1 (Note 4)	1 (Note 1)	1 (Note 4)
NIF Radiological Controls Technician									1 (Note 1,9)
Lead Operator	1 (Note 1)	1 (Note 1)	1	1	1	1	1	1	1
MOR Operator		1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)
Injection Laser System Operator		1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)	1	1
Power Conditioning System Operator	1				1		1		1
PEPC Operator				1 (Note 4)	1	1 (Note 4)	1	1 (Note 4)	1
Laser Diagnostics Operator				1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)	1 (Note 4)
Beam Control System Operator		1		1	1	1	1	1	2 (Note 5)
Cryo Operator									1 (Note 7)
Duty Engineer	1 (Note 3)	1 (Note 3)	1	1	1	1	1	1	1
Industrial Controls System Operator	1 (Note 6)			1	2 (Note 5)	1	2 (Note 5)	1	2 (Note 5)
Precision Diagnostics System Operator						1	1		
Target Area Coordinator								1	1
Target Area Operator								1	2
Target Positioner Supervisor (TPS)								1 (Note 8)	1 (Note 8)
Target Diagnostics Coordinator									1 (Note 4)
Target Diagnostics Console Operator									1

Note 1: Personnel only required to be on site

Note 2: Not longer used .

Note 3: Personnel may be on call.

Note 4: These duties may be combined with another operator

Note 5: Second operator may be waived at SD discretion

Note 6: Only required when firing into flashlamps.

Note 7: Required for Cryo Target Operations

Note 8: Optional Position. Not req'd for Shot Operations

Note 9: NRCT required for TCC shots with tritium or Cat B yield shots. NRCT also to be assigned for any shift with planned radiological work

2.1.1 General requirements for all operators

- Maintain training currency with the Facility Safety Plan, NIF-5019665⁵ and OSP 581.11,⁶ follow all safety protocols and adhere to posted signs and barricades
- Prior to assuming responsibilities and duties for a control console (and with SD approval), operators will conduct a thorough turnover per Section 8.3
- Maintain logs for each subsystem (see Section 8.1)
- Participate in a Preshift Brief (Safe Plan of Action [SPA] Meeting). See section on Shift Turnover (Section 8.3).
- Operate only those consoles to which they are assigned for given shift. No operator shall operate another operator's console without the LO's permission.
- Follow procedures and checklists. Inform SD of necessary changes. Deviations from standard procedures shall be approved by the NIF Operations Manager (NOM) before being executed. No operations shall be conducted from memory.
- Promptly inform the LO/SD and respond to alarms or unplanned, out-of-specification parameters for equipment under their control
- In the event of an emergency, take the necessary immediate actions required to ensure personnel, equipment and environmental safety without obtaining prior approval, to the extent that their safety and the safety of others is not jeopardized. Supervisors shall be notified promptly after such actions have been taken
- Check in and check out with LO when arriving at or departing their workstation. All operators will wear radios and headsets during Shot Operations to maintain radio contact, unless otherwise authorized by the LO
- During shot operations, check in with the LO at the beginning of the shift and check out at the completion of the shift

2.1.2 The Shot Director (SD)

- Reports to the SOM
- Has completed the SD Qualification Card or equivalent
- Has responsibility for the safe, correct and efficient execution of authorized laser system shots and other coordinated activities. In this capacity, serves as the Work Permit Responsible Individual for shot operations
- Manages the activities of all personnel assigned to support shot operations, using the LO as described in his/her duties and responsibilities
- Provides the final authorization immediately prior to firing of a NIF Main Laser System Shot; therefore the SD shall prevent operation of the laser if they believe that it cannot be performed safely or properly
- Authorizes major changes to operational facility status as delegated by the NOM
- Executes the SD Shot Checklist
- Acts as the Work Control Officer when the WCO is not stationed
- Serves as the single point of contact for other groups interacting with the NIF facility during off-normal conditions occurring when the NOM is not present. This includes acting as the alternate Facility Point of Contact (FPOC) for purposes of interacting with emergency personnel until relieved of this duty by the FPOC or NOM

- Receives advice and recommendations on how to proceed with authorized shot campaigns from the Campaign Responsible Individual (RI) (or their stated representatives), but maintains authority over the shot and must comply with approved procedures for making significant changes to procedures, setups, and sequencing outside of their prerogative
- Authorizes the granting of Safety Interlock System (SIS) system permissive key turns and facility sweeps
- Ensures, in conjunction with the WCO, that the NOM or Shot Operations Manager (SOM) is notified per Section 6.0 of this procedure and that such notifications are documented in the OpsLog
- Ensures pre-shift briefs are conducted before commencing Shot Operations.
- Approves deviations from standard procedures as appropriate
- Approves operator relief during shift turnover.
- Shall inform the LO of their location if they will not be in the Control Room.
- Is responsible for interfacing with the Laser Performance Model software to assist in real time operational decisions:

Reviews rod shot data and compares it to predictions and makes a decision on whether or not to proceed to the system shot

Analyzes data to ensure system protection limits are not violated

- Conducts or participates in post-shot review according to Section 3.8 of this Plan

2.1.3 The Campaign Responsible Individual (Campaign RI):

- During shot operations, serves as staff advisor to the SD
- Prior to a shot, defines specific shot goals and completes shot setup
- During shot operations, provides advice and recommendations to the SD regarding the conduct of authorized shots within the campaign (as specified in the rules of engagement), including: shot sequencing, acceptability of diagnostics, concurrence to proceed in the case of minor off-normal parameters that can affect the experimental results, etc. The Campaign RI shall not direct specific actions to operators without the concurrence of the SD.
- Maintains check-in and check-out list for visiting experimentalists
- Ensures all assigned personnel attend pre-shift brief
- Conducts or participates in post-shot review of each shot in accordance with Section 3.8 of this Plan

2.1.4 NIF Radiological Control Technician (NRCT):

- As required to support shot operations, reports to the SD. NRCTs are NIF staff, matrixed from the Hazardous Controls Department.
- Has completed the NRCT qualification card and completes the steps in the Shot Checklist designated for the NRCT (for applicable shots)
- NRCTs perform radiological and Be support, including response to off-normal events
- Performs initial re-entry surveys to designated areas after high yield shots.
- Operates facility radiological monitoring systems

2.1.5 The Lead Operator (LO):

- Reports to the SD
- Has completed the LO Qualification Card or equivalent

- Efficiently coordinates the actions of the various operators assigned to the shot operations shift
- Runs the control system Shot Director software
- Serves as the Daily Work Team Leader for shot operations and coordinates the shift staffing with appropriate personnel
- Ensures most current revisions of all procedures and checklists are used for the shot
- Maintains accountability of shot operations staff (check-in and check-out)
- Informs the SD of their location if they will not be in the Control Room
- Controls radio communication nets to ensure reliable, efficient communications between shot operations personnel and that proper radio protocols are followed in accordance with Section 5.2
- Completes the steps in the latest version of the Shot Checklist designated for the LO and coordinates completion of the remainder of the checklist by the various operators
- Directs and supervises the completion of facility sweeps, integrity checks, and other safety-related tasks as specified in the Shot Safety Checklist
- Supervises control room activities and maintains decorum, and shall request non-shot personnel exit the control room if required to ensure safe and orderly operations

2.1.6 The Target Area Coordinator (TAC):

- Reports to the LO
- Has completed the TAC Qualification Card or equivalent
- Coordinates all shot-related activities in the Target Bay associated with positioners and control of Target Chamber Center
- Directs the activities of assigned Target Area Operators
- Completes the steps in the Shot Checklist designated for the TAC
- Coordinates diagnostics setup and configuration with Target Diagnostic Coordinator (TDC)
- Verifies target bay shot activities are carried out safely and efficiently, and in accordance with approved procedures and released Work Permits
- Ensures the proper target(s) are selected and loaded into the positioner and associated documentation is properly completed and routed per Target Management Procedure (NIF-5012336)⁷

2.1.7 Target Area Operator (TAO):

- Reports to the TAC
- Has completed the TAO Qualification Card or equivalent
- Operates assigned Target Area equipment per approved operating procedures, including but not limited to: Target Alignment Sensor Positioner (TASPOS), Target Positioners (TARPOS and CryoTARPOS), Target and Diagnostic Manipulator (DIM) positioners, the Chamber Interior Viewing System (CIVS), the Target Chamber Service System (TCSS), Chamber Center Reference System (CCRS), Opposed Port Alignment System (OPAS), Static X-ray Imager (SXI), Final Optics Damage Inspection (FODI) and Industrial Controls associated with operating each of these
- Completes the steps in the Shot Checklist designated for the TAO making preparations for and performing Target Chamber entries in support of shot operations
- Performs repairs of assigned equipment (if so authorized) to support shot operations

- Performs sweeps/unsweeps and beampath integrity checks for the target chamber and target bay as directed by the LO (through the TAC)

2.1.7.1 Target Chamber Positioner Supervisor (TPS)

- Reports administratively to the Target Area Commissioning, Operations and Maintenance Manager (TCOM); reports to the LO for TC coordination activities
- Has completed the TPS qual card
- Operates assigned Target Area equipment per approved operating procedures, including but not limited to: the TASPOS, TARPOS, CryoTARPOS, DIM positioners, CIVS, TCSS, CCRS, OPAS, SXI, FODI and the Industrial Controls associated with operating each of these

2.1.8 Target Diagnostics Coordinator (TDC)

- Reports to the LO
- Has completed the TDC Qualification Card or equivalent
- Coordinates setup and operation of diagnostics
- Directs the activities of assigned Target Diagnostics Console Operators and coordinates the activities of diagnostic equipment personnel
- Verifies Target Diagnostics are properly configured and prepared to support the shot
- Completes the steps in the Shot Checklist designated for the TDC
- Verifies diagnostic activities are carried out safely and efficiently, and in accordance with approved procedures and released Work Permits

2.1.9 Target Diagnostics Operator (TDO):

- Reports to the TDC
- Has completed the Qualification Cards for operation of assigned diagnostics or equivalent
- Operates assigned target diagnostic equipment per approved operating procedures
- Completes the steps in the Shot Checklist designated for the TDO
- May perform repairs of assigned equipment (if so authorized) to support shot operations in coordination with the TDC

2.1.10 Power Conditioning System Operator (PCS):

- Reports to the LO
- Has completed the PCS Qualification Card or equivalent
- Operates the Main Laser Power Conditioning Systems safely per approved procedures, including the Main Energy Storage Modules and associated main and PILC power supplies and diagnostics, and high voltage cabling.
- Completes the steps in the Shot Checklist designated for the PCS Operator
- Performs Lock-Out Tag-Out (LOTO) and safing of PCS systems as required to support Shot Operations (if qualified)
- Performs repairs of assigned equipment (if so authorized and qualified) to support shot operations
- Performs sweeps and un-sweeps of the capacitor bays as directed by the LO

2.1.11 Plasma Electrode Pockels Cell Operator (PEPC):

- Reports to the LO

- Has completed the PEPC Qualification Card or equivalent
- Operates the PEPC Systems safely per approved procedures, including the high voltage pulsers and associated equipment and diagnostics, PEPC LRU utilities and high voltage cabling.
- Completes the steps in the Shot Checklist designated for the PEPC Operator
- Performs Lock-Out Tag-Out (LOTO) and safing of PEPC LRUs as required to support shot operations, and performs connection/disconnection of LRUs associated with changeout of LRUs (if qualified)
- Performs repairs of assigned equipment (if so authorized) to support shot operations
- Performs sweeps and un-sweeps of the Laser Bays and Capacitor Bays as directed by the LO

2.1.12 Duty Engineer (DE):

- Reports to the LO
- Has completed the DE Qualification Card or equivalent
- Operates the Integrated Computer Control Systems (ICCS) and facility timing system safely, including associated Front End Processors, servers, controls hardware associated with ICCS controlled equipment, communications networks and associated diagnostics
- Responsible for performing startup/restart of the control system or portions thereof
- Ensures no changes are made to the software and database during shot operations without SD approval
- Completes the steps in the Shot Checklist designated for the Duty Engineer
- Performs repairs of assigned equipment (if so authorized) to support shot operations

2.1.13 Industrial Control Systems Operator (ICS):

- Reports to the LO
- Has completed the ICS Qualification Card or equivalent
- Operates the various process utility systems safely including:
Clean Dry Air (CDA), Compressed Air (CA), Humid Air(HA), Process Gas (PG), Liquid Nitrogen (LN) and Argon (ARG) Gas Systems and the Amplifier Cooling Systems Spatial Filter (SFV), PEPC (PEPCV), PDS (PDSV) and Target Area (TAVS) vacuum systems, Tempered Water (TWC), Low Conductivity (LCW) and Chilled Water (CHW), and Final Optics Assembly Cooling (FOAC) water systems and the amplifier portion of the Hot Water (HW) System
- Operates beampath equipment including Roving Mirror Diagnostic Enclosure (RMDE) Gate Valves, TTW Argon Barriers (TABs), LM-4/5 pneumatic seals, beampath covers and enclosures and actuators not operated by other groups
- Completes the steps in the Shot Checklist designated for the ICS Operator
- Monitors performance of major facility HVAC systems
- Performs walkthroughs of the mechanical equipment areas to monitor for abnormal conditions
- Performs repairs of assigned equipment (if so authorized) to support shot operations
- Performs sweeps and un-sweeps in the Laser Bays, Switchyards and RMDE as directed by the LO
- Monitors operation of the ICS server

2.1.14 Injection Laser Systems Operator (ILS):

- Reports to the LO
- Has completed the ILS Qualification Card or equivalent
- Operates of the Pre-Amplifier Module (PAM) regenerative, Multi-Pass Amplifiers (MPA) systems, and Pre-Amplifier Beam Transport Systems (PABTS) safely per approved procedures, including the high voltage PAM Power Conditioning Units (PCU) and associated equipment and diagnostics, and PAM/PABTS utilities
- Completes the steps in the Shot Checklist designated for the ILS Operator
- Performs Lock-Out Tag-Out (LOTO) of PAM PCUs or the Lower Injection Beam Block (LIBB) as required to support shot operations, and performs connection/disconnection of PAMs and PCUs associated with changeout of LRUs
- Performs repairs of assigned equipment (if so authorized) to support shot operations
- Performs sweeps and un-sweeps of the Laser Bays as directed by the LO

2.1.15 Laser Diagnostics Systems Operator (LD):

- Reports to the LO
- Has completed the LD Qualification Card or equivalent
- Operates the main laser, precision and drive diagnostics in the Laser Bay (LB), SY and Target Bay (TB)
- Completes the steps in the Shot Checklist designated for the LD Operator
- Performs repairs of assigned equipment (if so authorized) to support shot operations
- Performs sweeps and un-sweeps of the Laser Bays as directed by the LO

2.1.16 Beam Control Systems Operator (BCS):

- Reports to the LO
- Has completed the BCS Qualification Card or equivalent
- Operates the Wavefront Controls, Laser and Target Alignment, Large Optics Inspection System (LOIS), Side Inspection Damage Evaluation (SIDE), Target Chamber Vacuum Window Inspection, and FODI systems safely per approved procedures, coordinating with the TAC and TDC as appropriate
- Completes the steps in the Shot Checklist designated for the BCS Operator
- Performs repairs of assigned equipment (if so authorized) to support shot operations
- Performs sweeps and un-sweeps of the Laser Bays as directed by the LO

2.1.17 Master Oscillator Room Operator (MOR):

- Reports to the LO
- Has completed the MOR Operator Qualification Card or equivalent
- Operates the MOR systems safely including diagnostics and optical pulse generation and pulse shaping systems per approved procedures
- Conducts daily and pre-shot Failsafe System checks
- Completes the steps in the Shot Checklist designated for the MOR Operator
- Performs repairs of assigned equipment (if so authorized) to support shot operations

2.1.18 Precision Diagnostic System Operator (PDS):

- Reports to the LO

- Has completed the PDS Qualification Card or equivalent
- Completes the steps in the Shot Checklist designated for the PDS Operator
- Performs repairs of assigned equipment (if so authorized) to support shot operations
- Configures precision diagnostics to meet shot goals

2.1.19 Cryo system Operator

- Reports to the LO
- Has completed the Cryo System Operator Qualification Card or equivalent
- Completes the steps in the shot checklist designated for the Cryogenic System Operator (CSO)
- Operates CryoTARPOS target installation and gas fill systems, cryogenic systems and cryogenic layer x-ray characterization system
- Performs repairs of assigned equipment (if so authorized) to support shot operations

2.1.20 Sweeper

- When assigned in addition to other Control Room duties, reports to the LO
- Has completed the required training and qualification cards to perform the sweep procedures.
- Performs the pre-sweep, sweep, and beampath integrity checklists
- Reports ANY deviation or exception to the (pre) sweep or beampath integrity checklists to the LO

3.0 SAFETY PLANS AND OPERATIONS PRACTICES

3.1 Personnel Safety

All work in NIF shall be performed in accordance with the LLNL Environment, Safety, and Health (ES&H) Manual⁸ policy, NIF Facility Safety Plan,⁵ and the NIF Programs Safety Protocols and Requirements (NPSP&R)⁹ to perform work in a manner that protects the health and safety of employees and the public, preserves the quality of the environment, and prevents property damage.

Each worker is responsible for immediately stopping work if it is observed that an operation presents an imminent danger to health, safety, the environment or equipment. Further guidance and actions to restart work are contained in the NIF Operations Management Plan.¹

3.2 Off-Normal Events and Responses

For significant off-normal events such as fire, earthquake or shelter-in-place, follow the guidance in *NIF Emergency Preparedness and Response Plan*,¹⁰ *NIF Operations Management Plan* (NIF-5020544),¹ and *NIF Programs Directorate Notification Procedure (NIF-0072808)*.¹¹ For significant off-normal occurrences involving personnel injury, damage to equipment, hazardous release or a near miss, NIF management should be notified as soon as possible after the situation has been stabilized.

3.2.1 Minor Alarms

The response to off-normal events not covered in the preceding section or to controls systems alarms (as differentiated from LLNL-wide announcements, or Fire/Evacuation Alarms) should follow the following general steps (some actions may be taken in parallel):

- Acknowledge and silence the alarm

- Verify the fault condition by reviewing other data or system parameters immediately available.
- Verify automatic response to the event by the appropriate control system (including equipment shutdown, startup or mode change as appropriate). Initiate any actions that should have been initiated by the appropriate software controls, but were not.
- Notify the SD and appropriate SSM and provide periodic updates.
- Contain the off-normal event and minimize its effects.
- Enter appropriate information into Operations Logs, Problem Logs and paper logs.
- Initiate Corrective Actions following the guidance in *NIF Project Site Work Permits (NIF-5018626)*.¹²

More detailed guidance for specific software systems is provided below.

3.2.2 SIS Alarms

The Safety Interlock System (SIS) Alarms Response Procedure (NIF-5015482)¹³ binder is maintained in the Control Room. This procedure details specific responses for SIS alarms, including fire, oxygen deficiency, radiological alarms, and recovery from Crash Button activation.

In the event of a SIS alarm, the Work Control Officer (WCO), SD or LO executes the SIS Alarms Response Procedure (NIF-5015482).¹³ In general, personnel shall take the actions necessary to ensure their own safety and then the safety of others, to the extent that they do not place themselves at risk. If knowledgeable and properly trained, they should then attempt to stop the source of further damage (water, smoke, fire, source of radiological contamination...) and minimize its spread. Subsequent repairs to affected systems will require a properly reviewed and released work permit.

3.2.3 ICCS Alerts

Each subsystem operator in the Control Room maintains an ICCS Alert Monitor open and active on their console during shot operations. These may be filtered to display only shot-related alerts for their subsystem.

Operators are expected to promptly respond to ICCS Alerts on their consoles or alarms affecting their equipment (per Section 2.1.1) and promptly notify the LO/SD of all alarms and any unusual alerts. In general, personnel should not accept locked-in alarms for long periods of time. Such alarms, that remain unresolved, tend to desensitize operators to their presence and urgency.

Prior to resetting alerts, operators should understand the cause of the alert and the needed response. Personnel shall inform the LO of any alarms that are not understood or cannot be cleared, and, as appropriate, take necessary actions to restore systems to normal operation.

3.2.4 Industrial Control System (ICS) Alarms

ICS Operators maintain an alarm window visible on the operating console at all times during shot operations and notify the SD/LO of alarms, which could affect laser system operation. ICS Operators shall follow the same guidance as for ICCS Alerts above.

3.3 Radiological / Hazardous Materials and Personnel Exposure Controls

OSP581.11⁶ has guidance for the use of Beryllium and sources of ionizing radiation in the NIF.

X-rays and neutrons (or protons) may be generated by shots to target chamber center. Controls for this hazard will be identified in the Facility Safety Plan, Radiation Protection Plan and specific Integrated Worksheet/Safety Plans (IWS/SPs). NIF Management has committed to maintaining individual worker doses and the collective worker dose below DOE legal limits and as low as reasonably achievable (ALARA). It is a fundamental worker responsibility to ensure that they maintain their radiological and Be exposures ALARA.

3.4 Safety Interlock System

The Safety Interlock System (SIS) is designed to control the operation of potentially hazardous processes and laser system equipment by granting or denying an independent permissive to selected equipment. The SIS does not directly control any equipment itself; the various control systems are used to operate the systems once permissives are issued by the SIS. Due to the inherent risk of not informing the appropriate personnel or taking the appropriate action associated with alarms from this system, these alarms should only be acknowledged or reset at the Control Room SIS Console under the direction of SD/LO.

The Safety Interlock System shall be fully operational to the maximum extent practicable, minimizing planned and unplanned down time. To ensure the reliability of this system, quarterly Facility Interlock Checks evaluate the functionality of the SIS system including facility announcements and alarms.

A locked box containing facility SIS Keys is maintained in the Control Room. This box contains SIS keys used to control SIS permissives and allow access to internal facility bays under Access Control System (ACS) controls by manually unlocking the associated doors. Access to this box is limited to only qualified SDs, LOs, WCOs and the NIF SIS Manager. The SIS permissives key shall only be used as authorized by the SD/LO (or the SIS Manager or their designee during testing). Administration of the key boxes should be maintained by the CROM as described in Section 3.6.8 of this procedure.

3.4.1 Guidelines for use of Facility Emergency Shutdown Buttons

Facility Emergency Shutdown (“crash”) buttons are located throughout the operational areas of the facility and the control room. The red “mushroom” type buttons are used when a rapid shutdown/prevention of operation of the following system(s) is required: the main laser Power Conditioning Systems (PCS); PAM Power Conditioning Units (PCUs); the Plasma Electrode Pockels Cells (PEPCs); Precision Diagnostic System (PDS) T08 Alignment Laser; alignment lasers in Velocity Interferometer System for Any Reflector (VISAR) and backscatter systems Laser Calibration (LCAL) diagnostics; the Argon Pad, and TB and PDS Edge lasers, the 4w Fiducial system laser and the CryoTARPOS X-ray sources. These buttons will also stop the motion of all Target Chamber positioners. In addition, the Emergency Shutdown buttons in the Control Room, Laser Bays, and mechanical rooms shutdown the Main and Power Amplifier cooling fans. In general, anyone in the facility should actuate one of these buttons under any of the following conditions:

(1) When finding oneself inside of any swept area during shot operations. Indications that an area are swept include: sweep panels in the area indicate red, with text indicating “Extreme Hazard”; prior to issuing high-voltage permissives, public address announcements indicating that laser operations will begin within one minute in the area; and the klaxon begins sounding (sounds for 60 seconds prior to high voltage permissives being issued).

(2) When observing any imminent high voltage hazard or other condition that could cause injury to personnel or equipment damage. This could include arcing, smoke, personnel electrocution, laser exposure, major Argon leak, significant x-ray leakage, etc.

(3) During shot operations, to stop the shot to prevent equipment damage or shot failure.

Prior to the last 60 seconds of the countdown, other methods (such as request to the LO to hold the countdown or signaling of a hold from the shot supervisor GUI) may be used if appropriate. During the final 60 seconds of the countdown, control room operators should employ the emergency shutdown button on their console if any concern arises; when in doubt, “fail safe” is the desired outcome during this period in the countdown.

After actuating any emergency shutdown button (including inadvertently), it is imperative that the control room be contacted with the location and reason for the actuation. Do not reset the button unless directed by control room personnel.

Yellow “Chamber Motion Stop” Buttons -similar in design to facility emergency shutdown buttons- are located in the control room and at positioner control consoles in the target area. These buttons only remove power from the motion controls for the target chamber positioners (e.g., TARPOS, CryoTARPOS, TASPOS, SXI, DIMs, FODI, etc...). Guidelines for use of these buttons are located in the Target Area Protocols section (Section 4.3).

3.4.2 Recovery from Emergency Shutdown

Actuation of the facility emergency shutdown (“crash”) buttons result in the following actions:

- Dropping of high-voltage permissives to the PCS bank modules, PAM PCUs and PEPC power supplies
- Shutdown of the Argon pad
- Amp Cooling Safe Shutdown (shutdown and isolation of fan units only; individual bundles should return to Pressure Control) NOTE: This applies only for buttons in the Control Room, Laser Bays, and mechanical rooms.
- Stopping of the Target Chamber positioners (removes power from motion control motors)
- Removal of permissives from auxiliary lasers (PDS Table 08, VISAR, 4w FIDU, LCAL, etc.)
- Removal of permissives from X-ray sources on CryoTARPOS

Detailed instructions for recovery from emergency shutdown button actuation are found in the SIS Alarm Response Procedure (NIF-5015482).¹³ Prior to restoring operations, the SD should ensure that the reason for the emergency shutdown actuation is understood and corrected (when applicable) to prevent reoccurrence. In addition, the SD should ensure that system conditions have stabilized adequately to support the intended operation.

If the emergency shutdown button was actuated by someone inside a swept area, shot operations shall not proceed until a review has been completed by the NOM and NIF Safety Officer. In this case, the NOM will specifically authorize restarting shot operations.

3.5 Accounting for Personnel

Normal Working Hours – The CROM maintains an Operations Shift and Vacation Schedule. The Schedule is posted in the Strategy Room and indicates the scheduled operating shift assigned to each individual. Personnel are to arrange Vacations, Travel, Jury Duty, etc. through the CROM and their normal supervisory chain of command. Any personnel changes to the shift schedule must be reviewed and approved by the CROM. (Changes to the Shift Plan [days or hours of scheduled shifts] must be approved by the NOM.)

Swing Shift and Owl Shift – In addition to the Shift and Vacation Schedule, the night LO coordinates personnel leaving the NIF operations areas (Laser Bays, Switchyards, Target Bay, Capacitor Bays, HVAC Machine Rooms, etc) at the end of the shot operations shifts. Operations personnel will coordinate with the LO that their work is complete and are clear of operational areas for the evening.

Absences- Operations personnel shall notify the CROM as soon as possible when it becomes known that they will be unable to support a scheduled operations shift. If unable to contact the CROM, personnel may leave a voice message on the Work Control Center non-emergency phone (4-4225). Work Control Officers will review messages and make the appropriate notifications.

3.6 Conduct of Pre-Sweeps/Sweeps/Un-sweeps

As governed by Laser Operations and Commissioning OSP 581.11,⁶ the pre-sweep and sweep processes are used in conjunction with the Safety Interlock System and Access Control System to ensure that personnel are clear of hazardous areas during the execution of laser shots, target experiments or other hazardous activities. In addition to the pre-sweep and sweep processes, additional controls are used to insure that personnel are clear of these areas including warning signs, and beacons, warning klaxons, and public address messages. Due to the potential lethal consequences of improperly executed sweep procedures, sweep procedures are designated as “continuous use” procedures.

The LO or SD directs the execution of the checklists. They are to determine which checklist is to be used for the specific upcoming activities based on the OSP and Shot Safety Checklist requirements. The sweep procedure to be used for some areas (e.g., TB and Sys) may change, or the required areas to be swept may change depending upon the expected neutron yield of the planned shots. This will be managed through the Shot Safety Checklist. The LO or SD will ensure that the qualified Sweeper has the proper checklist prior to their execution and issue keys in accordance with Section 3.6.8.

The Pre-Sweeps and Sweeps are an administrative process implemented through the use of checklists. Checklists shall be maintained and released in Enterprise Configuration Management System (ECMS), and used in the execution of the Sweep or Pre-Sweep. The checklists provide specific details of the Sweep or Pre-Sweep process for each area and each type of shot. Only qualified personnel are allowed to execute the checklists. The LO or SD are responsible to verify that the sweep teams are properly qualified to perform the task. The CROM will maintain a list of qualified sweepers via Livermore Training Records and Information Network (LTRAIN) and make the current list readily available to the SD and LO. The CROM maintains the pre-sweep and sweep checklists and insures that the most current copy is maintained in ECMS. Copies of the current version may be kept in the control room; if so, the LO shall verify the copy’s revision against the electronic file in ECMS. The LO or CROM will maintain a list of sweep and beam path integrity checklists with current released version verified daily when shots are scheduled. The CROM is responsible for clearing and disposing of the old procedures maintained in the procedure files located in the Control Room.

Upon completion, the checklists are to be returned to the LO. The LO reviews the checklist to verify they have been properly completed, dated and signed, that no exceptions or deviations have been identified, and that completed checklists are the current released version per ECMS. When a deviation has been identified by the sweep team, the LO shall halt shot operations and consult with the SD, SOM and/or NOM. Shot operations will not proceed until the deviation has been corrected or resolved. Deviations to sweeper routes due to construction equipment or temporary barriers may be evaluated and approved by the SD (by initialing the affected step(s) in the sweep checklist). Deviations to approved sweep checklists other than minor adjustments must be approved by the SOM or NOM. The LO will file the checklists with the other shot documentation for that day.

3.6.1 Pre-Sweep

Pre-sweeps are executed approximately 30 minutes prior to the final sweep process and shot. Prior to starting a pre-sweep, an announcement is made, using the public address system, to clear the area. The pre-sweep provides an opportunity for personnel to finish work in progress and clear the area prior to the final sweep and for operations personnel to address any equipment configuration issues prior to the final sweep process.

During the pre-sweep process, sweep team members do a preliminary search and inspection to clear the areas of any non-essential personnel. Personnel that require additional work time may remain in the area until the final sweep process. During the pre-sweep, as many personnel as possible are cleared from the area. This requires that elevated areas and platforms, accessible by ladders, also be verified clear of personnel. This process may include viewing the area with surveillance cameras, viewing the area from another location, such as an adjacent platform, or use of a mega-phone to clear personnel from the elevated areas. Areas that are determined to have a specific potential risk for injury during a system shot, such as the areas above the Main Amplifiers and Power Amplifiers due to high voltage hazard, shall be physically accessed and verified clear of personnel. The specific pre-sweep procedures for the type of shot to be conducted specify the detailed requirements.

Tamper seals may be used to indicate that an elevated area has been previously cleared and that it has not been accessed since that time. After an upper area has been cleared, the ladder access cover can be closed and locked and a tamper seal can be applied. Tamper seals may only be applied by qualified sweep personnel. The use and distribution of tamper seals is controlled by the LOs and SDs. The seals may be removed by anyone authorized to have access to the area.

3.6.2 Sweep

The Sweep process is the final check to ensure that personnel are clear of the area(s) affected prior to enabling Power Conditioning high voltage permissives in SIS, and conducting a laser shot. The sweep process requires a qualified operator to traverse a specific path, looking for personnel, and turning a key switch in the safety interlock panels located along the sweep route. As the operator progresses through the area, the safety interlock system monitors the key switch positions. When the process has been completed in the proper sequence within the designated time, and all affected areas and master permissive keys have been activated by the SD or LO, the SIS enables the interlock permissive for the affected area and the operators may proceed with high-voltage operations.

Personnel sweeping an area are to use mega-phones (or equivalent) during the sweep process, to assist in notifying personnel to clear the areas. The mega-phones are to be used continuously throughout the sweep process to insure the entire area is adequately covered.

ACS will be used by LO or SD to verify the absence of all personnel except the sweep team from operational areas where ACS is active. The LO or SD shall print the Operations report listing personnel that ACS indicates are still in the affected area. The LO/SD will take actions based on the personnel's area entry time as follows:

- (a) Entered within 4 hours of commencing sweep (or completing pre-sweep) LO or SD shall contact the person by radio, phone, pager or cell phone to ensure they are not present in the area. If contact is not made, the appropriate supervisor should be called to determine the individual's location. The SD may decide to proceed with shot operations if all attempts to reach the person or their supervisor failed and the sweep was completed successfully.

- (b) For all others, the LO/SD will provide the report to the NIF administration assistant the following day. The NIF administrative assistant will notify the employees and their immediate supervisors via email on the next working day.
- (c) The CROM will maintain notification records and the SOM or NOM will take additional actions to investigate repeat cases.

3.6.3 Short Sweep

A Short Sweep is a process that the SD and LO can use to maintain control of a previously swept area, while allowing a trained operator access to the area to complete a specific, short duration task. The SD or LO use the SIS system to re-configure the sweep path of a specific area, to a limited set of sweep stations. In coordination with the SD or LO, an area under access control can be “momentarily opened” to allow access of a trained operator. Immediately upon entry, the operator enables the first sweep station, thereby re-establishing perimeter control of the area. Permissives are not enabled until the final sweep station has been activated by the operator and he/she has left the area. The operator has a specific time (generally 5-10 minutes) to complete a specific task prior to activating the final sweep station and exiting the area. If the process is not completed during the specific time, the short sweep process will be broken, and a full sweep of the area will need to be performed.

3.6.4 Un-Sweeps

The Un-Sweep process is conducted upon the completion of shot activities or when directed by the SD. The LO or SD uses the SIS console to “Cancel Sweep” on selected areas that are no longer required for shot operations. After the area sweep has been canceled, a qualified sweeper goes through the area to unlock doors, unlock various ladders to allow access to elevated structures and remove signs as specified in the un-sweep procedure. Note that special procedures are required for initial re-entry into certain areas (as defined in the OSP) after certain categories of shots. These may include designated post-shot stay out times and radiation surveys upon re-entry. Upon completion of the un-sweep, the area is released for normal facility access.

3.6.5 Broken Sweeps

In the event that a Sweep is broken, the SIS annunciates an alarm in the Control Room and removes shot permissives, placing the laser system in a safe condition. The SD or LO shall use the SIS display, in conjunction with the SIS Alarm Response Procedure (NIF-5015482)¹³ to determine where the sweep was broken. After determining the cause for the broken sweep and taking necessary remedial actions, the affected area shall again be swept using a new checklist before laser operations may resume if any area access points were opened. If the offending person cannot be identified, obtain SOM approval before continuing shot activities requiring sweeps. Personnel who inadvertently break a sweep must immediately report to the control room to report the details of the event.

3.6.6 Development of Sweep Procedures

Sweep procedures are developed using a graded approach. The level of hazard in particular areas is one consideration in developing the detailed checklists. For example, different levels of checks may be employed for the Target Bay during yield shots (where potentially lethal radiation levels may exist), compared to the level of checks required at the floor level in the Laser Bay (where eye injury may be the main hazard). Such a graded approach may result in using different sweep techniques; for example, low hazard areas may be swept by video surveillance or locked accesses.

In general, sweeps in all areas are intended to locate any personnel in accessible areas that could be asleep or unconscious, or who could be working in a noisy environment or unable to hear announcements or klaxons, or those who might be incapacitated. Sweeps are not intended to locate personnel who are actively trying to avoid sweep teams, as the size and complexity of the facility make it impossible to counter such action. This is justifiable since such actions would be considered sabotage.

Changes to sweep procedures are reviewed by the SOM and SIS Manager (and SIS Change Control Board where required) and approved by the NOM. Approved versions of the checklists are maintained in ECMS and these are the only versions to be used unless otherwise approved by the NOM.

3.6.7 Training and Qualification of Sweepers

Sweep team personnel will be formally qualified to sweep each area per the associated qualification card. Records of qualification will be maintained in LTRAIN.

Sweeper trainees must be trained in the importance of compliance with the sweep checklist and the need to clarify with the LO/SD any questions or any observed abnormal conditions prior to completing the sweep. Changes to sweep procedures may be communicated to qualified sweepers via Required Reading or partial requalification/walkthroughs as specified by the SOM based on the complexity of the change.

3.6.8 Sweep Key Control

Sweep Keys are used in conjunction with the sweep procedures. The Sweep Keys are kept in the Control Room key box. Access to the key box is described in the NIF Operations Management Plan.¹ During the process of configuring the facility for shot operations, the SD or LO determines which areas need to be swept. Once the areas have been identified, they retrieve the required keys from the key box and assign them to qualified individuals performing the sweep. Once the sweeps are complete, the keys are returned to the Control Room key box.

3.6.9 Beampath Integrity Checks

Beampath Integrity Checklists are used to verify the proper configuration of the laser beampath and beampath enclosure integrity and to ensure personnel safety, prior to firing a rod shot with personnel present in the laser operations areas. They are used to verify that the preamplifier support structure (PASS)/Warzone area, main laser beampath, RMDE, PDS, final optics, and target chamber are properly configured to ensure personnel and equipment safety prior to firing a laser shot. The process involves inspecting specific areas of the beampath to ensure that the laser beam is properly enclosed and personnel have no potential of laser exposure. Additionally, some items on the checklists are used to ensure proper system configuration to minimize potential equipment damage.

The beampath integrity checks are an administrative process implemented through the use of checklists. Checklists are developed and maintained by the SOM, and used in the execution of the beampath integrity checks. The details of the process are to be specified in the checklist developed for each area. Only ECMS released checklists shall be used. Only qualified personnel are allowed to execute the checklists.

The CROM maintains the beampath integrity checklists and ensures that only the most current version is located in the Control Room.

3.7 Machine Safety

3.7.1 Rules of Engagement

The Rules of Engagement represent collective additional guidance to Operations personnel for the operation of systems or equipment to preclude significant equipment damage. This may allow a graded approach to the safe operation of equipment outside of ideal parameters. These rules are reviewed by the Rules of Engagement / Machine Safety (REMS) Working Group (or other appropriate group) and approved by the Operations Manager. Many of these rules are incorporated into the automatic checks performed by LPOM and displayed for the SD's review.

These guidelines are organized into green/yellow/red zones. For green operations, personnel are allowed to operate the equipment under normal procedures and controls. Yellow operations may proceed when, in the judgment of the SD, such operation is warranted and safe for the specific situation. Red operations are not authorized without first consulting the NOM.

For laser system operations, these guidelines are contained in Rules of Engagement for Main Laser Operations, NIF-5022606.¹⁵

3.7.2 Target Chamber Positioner Movements

To prevent collision of and damage to target positioners, the positioner movement rules of Section 4.3 should be followed unless specifically allowed otherwise in a procedure approved by the TCOM and concurred by the SOM.

As new devices are added to Target Chamber, it is expected that the list of allowed activities will change. Evaluation by Target Bay Change Control Board (CCB5) expert group will determine which activities are on the list and provide definition of these activities. A given activity may be restricted to be well outside the 500-mm radius, for example a handoff point 1 meter from TCC.

3.7.3 Issuing Permissives

3.7.3.1 *Non-Integrated Shots*

The LO or SD will maintain control of the keys used for providing facility permissives required for laser shots. These keys are kept in the NIF Control Room Master Shot Key box. During the process of non-integrated rod shots or PCS test shots, a selection of keys will be used (depending on the shot requirements) to provide the necessary permissives to the facility. Using the PAM Manual Permissives Checklist, NIF-5015558,¹⁶ for non-integrated rod shots, or the LB1/2 Shot Safety Checklist, NIF-5012321,¹⁷ for PCS test shots, the LO will retrieve the required keys from the Master Shot Key box and insert and turn the keys at the NIF Master Shot Enable panel in the Control Room at the SIS console. Once the shot is complete, using the PAM Manual Permissives Checklist, NIF-5015558,¹⁶ for non-integrated rod shots, or the LB1/2 Shot Safety Checklist, NIF-5012321,¹⁷ for PCS test shots, the LO will remove the keys from the NIF Master Shot Enable panel and return them to the Master Shot Key box in the Control Room.

3.7.3.2 *Integrated Shot Mode*

The LO or SD will maintain control of the keys used for providing facility permissives required for integrated laser shots. These keys are kept in the NIF Control Room Master Shot Key box. During the process of laser shots, a selection of keys will be used (depending on the experiment requirements) to provide the necessary permissives to the facility for laser shots. Using the Shot Checklist³ and the LB 1/2 Shot Safety Checklist, NIF-5012321,¹⁷ the LO will retrieve the required keys from the Master Shot Key box and insert and turn the keys at the NIF Master Shot Enable panel in the Control Room at the

SIS console. Once the shot is complete, the LO will remove the keys from the NIF Master Shot Enable panel and return them to the Master Shot Key box in the Control Room.

3.7.3.3 *Other Device Permissives*

NIF-5029707²⁶ (LCAL and VISAR) and NIF-50303085²⁷ (CryoTARPOS x-ray characterization sources) contain checklists for issuing permissives required to operate these devices.

3.8 Shot Support Systems

3.8.1 In addition to the foundation Integrated Computer Control System (ICCS) there are numerous business systems that are critical to preparations for and conduct of shot operations. A list of systems that must be functioning and available to support shot operations is provided in Appendix F, "NIF Business Services Required for Shot Operations". Any plans to take these critical business tools out of service during shot operations preparations or during a shot must be reviewed and approved by the SOM or designated representative prior to starting work. If any of these systems are not available or in reduced status, NOM approval should be obtained before proceeding with operations that would be negatively impacted.

3.9 Shot Planning, Approval and Execution Process

Shot campaign planning and approval is addressed in the NIF Operations Management Plan.¹ The SD will sign the hard copy of the approved shot setup sheet and have it duplicated for use in the shot cycle. Once the automated shot preparations checklist has been fully tested and integrated into shot operations and planned, the SD coordinating shots for the upcoming shift will be the final signature in LoCos, signifying approval of the shot setup. The SD will also process a Work Permit specifying the shots to be conducted and any other required scope. The NOM approves the Work Permit for shots and will only approve the permit when the WAP is approved and system status supports the shot. Approved shots will be executed in accordance with the Shot Checklist.³ The shot checklists for operators generally include the following steps:

1. On the day of the planned Shot, the duty SD will perform a final review of the setup, ensuring it is consistent with facility conditions and verify that it is in the Laser Performance Operations Model (LPOM) list of "Ready" experiments, indicating the completion of proper processing of the setup through LPOM. The SD shall also verify facility readiness by reviewing Location Component and State (LoCoS) Restrictions, Seating Charts, Problem Logs and Category A/B Work Permits for the laser beamlines to be used. The Access Control System electronic log shall be reviewed to check for personnel occupancy in the facility prior to performing a full system shot. The LO or SD should review the Interlock Bypass Log prior to shot operations to ensure that bypasses have been cleared, and those remaining in place are consistent with planned operations.

2. When the shot is executed, the SD shall annotate any required redlines on his copy of the Shot Setup Sheet (which becomes the master). The SD ensures that any required redlines are annotated on the copies of the setup sheets used by the affected subsystem operator(s). The SD annotates the NIF Shot Number for the executed shot on the master setup and forwards it to the Shot Operations Administrator for filing. Completed Master Setups will be retained as specified in the NIF Operations Management Plan.¹

3. After the shot, a review of the shot data will be conducted to ensure that there is no indication that it is not safe to proceed with the next shot on that bundle(s) from an equipment safety perspective.

Minimum quorum for this review (of other than commissioning/calibration shots) is a SD, a Beamline Integrated Performance (BLIP) Representative and the Campaign RI. The review leader, normally the Campaign RI or representative, will formally communicate this review to the SD and the SOM, indicating that it is acceptable to proceed to the next shot, and include any recommendations for changes. Deviations from this minimum quorum or other requirements may be approved by the NOM, based on the nature of the shots.

4.0 OPERATIONAL CONTROL AREA ACTIVITIES

4.1 Control Room Protocol

All laser and process utility operations are normally controlled from the Control Room (room 1017) and the Master Oscillator Room (room 1019) in the central core area of Building 581. Other (localized) control of subsystems outside the control room may be authorized by exception (for example, positioner operations may be conducted from the control console located in the TB Level 2).

4.1.1 Routine Control Room and MOR Access and Occupancy

The WCO, CROM and LO have the responsibility and authority to insure that only authorized personnel have access to the Control Room during Non-Shot Operations.

- Only personnel that have been trained on Control Room Protocol and have been granted ACS access by the CROM will be allowed unescorted access to the Control Room (TESA access for MOR). All other personnel are considered visitors under this protocol. TESA access will be maintained for limited group of personnel in case of ACS access problems.
- Visiting experimenters shall be required to read and sign the additional restrictions as outlined in **Appendix B** in order to have access to the Control Room to monitor/observe shot activities. The CROM shall retain this form for the duration of the visit.
- Access will be restricted to those personnel conducting official business who have a need to be in the Control Room or MOR and will be limited as necessary by the LO/SD/WCO.
- Incidental use of consoles by any personnel other than the assigned operator for test or maintenance (e.g., database maintenance or ICCS regression testing) purposes requires prior approval from the LO or SD. This also applies to the use of consoles by operators other than their designated workstations.

4.1.2 Visitor Control and Tours

- Visitors will not be allowed in the Control Room unless approved by the NOM, SOM, CROM, SD or LO and shall be limited to the area designated by them
- Visitors are required to comply with the Control Room Protocol as described in this document and directed by the NOM, SOM, CROM, SD or LO
- Visitors shall be under the escort of a person qualified and authorized to have Control Room access
- Visitors will not be allowed to operate any systems under any circumstances
- Tours are not allowed in the Control Room unless authorization has been obtained in advance from the NOM. Tours are allowed to view Control Room operations from the hallway viewing windows.

4.1.3 Personnel Activities

- Potentially distracting activities (e.g., radio listening, game playing, non-job-related literature reading) are prohibited
- Non-job related discussions shall be minimized to avoid disturbance of shift activities
- Personal phone calls are generally not permitted except in an emergency
- The noise level shall be kept to a minimum
- Accessing Internet sites for other than job-related business or training is not allowed
- Personnel shall not “prop” their feet on the consoles and recline in their chairs
- Personnel are not permitted to sit on the console tables
- All operators have the responsibility and authority to notify the SD or LO of any activities that distract them from or interfere with their operational duties
- No food is allowed in the MOR, Control and Computer Rooms at any time
- Drinks, in closed containers, are permitted. Personnel shall remove or discard containers when they leave the area
- Impromptu meetings or gatherings may take place in the Control Room during Non-Shot Operations on a non-interfering basis as determined by the SD or LO

4.1.4 Housekeeping

- Console desk areas should be kept clean at all times and only shot-related materials should be used (checklist, shot set-up sheet...)
- Post-it type notes, etc. will generally not be placed on the face of the consoles
- Personnel should remove papers, notes, etc. at the end of their shift
- Personnel are responsible for removing the material they generate, or bring into the area
- Items left after a shift will be removed by the NOM, SOM, CROM, SD or LO and discarded at their discretion
- Notebooks and reference material should be kept in the file cabinets and bookcases provided
- No documents should be left where they can be read from the viewing windows
- Items such as hardhats, binders, etc. shall not be placed on top of the consoles at any time
- Operators should pick-up any printed materials from the Control Room printers as soon as available. Left over print outs will be removed at the end of the shift.

4.1.5 Equipment and Hardware – Setups and Modifications

Figure 2 shows the typical Control Room layout. No equipment modifications are permitted in the control and computer rooms without a released work permit. During non-shot operations, the large projection screens may display any information necessary to support the operations being conducted at the time. When specific operations do not require the projection system, it may be configured to provide general system overviews in support of facility tours.

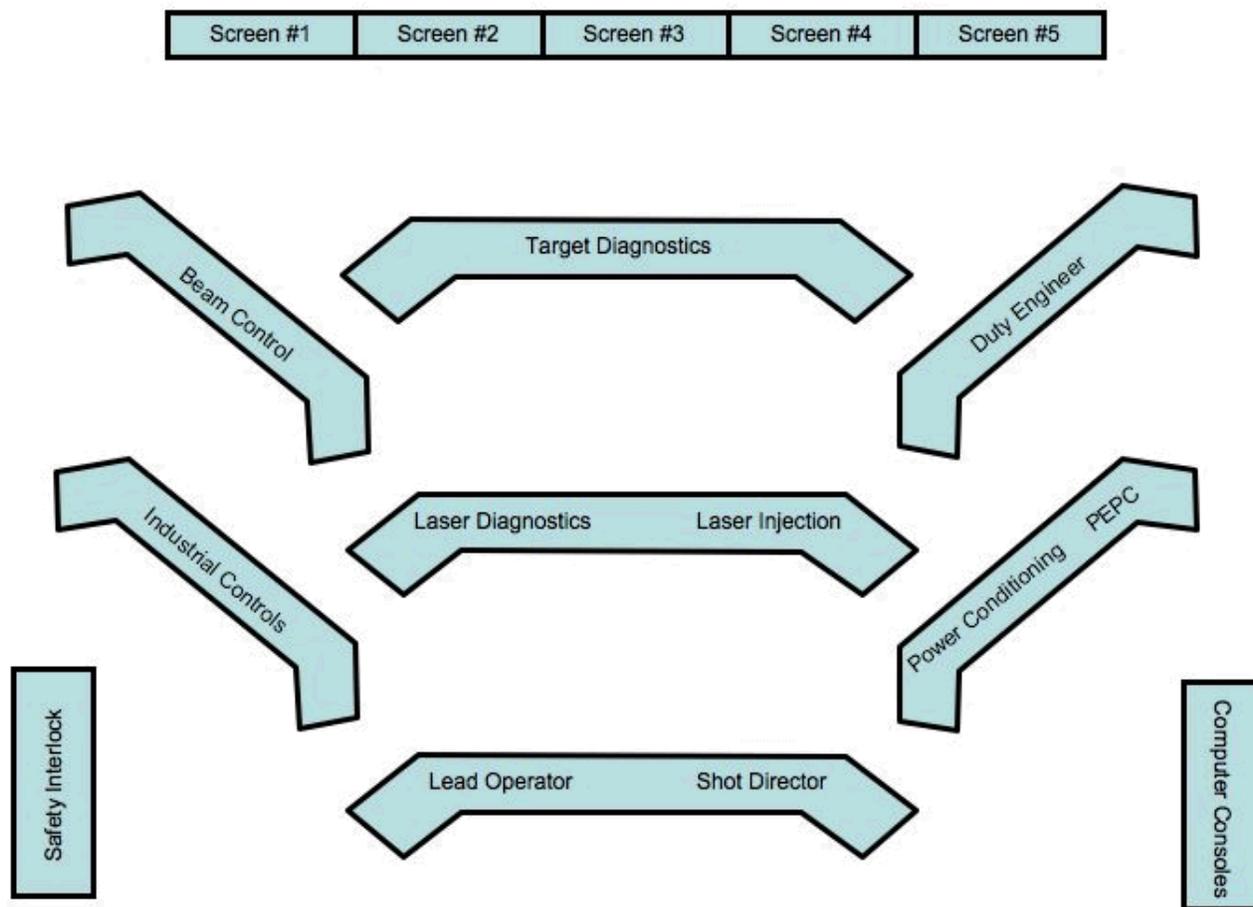


Figure 2. Typical Control Room Layout.

4.1.5.1 *Use of the Integrated Computer Control System (ICCS)*

All console operators are required to complete the Control System Operator Qualification Card (NIF-5009911)¹⁸ prior to use of the ICCS. This qualification covers such topics as shot holds/aborts/crash button activation, shot countdown, use of Target Motion Stop Button and various alarm panels. Upon completion of this qualification card, and approval by the CROM, operators may be given Group Account Access to the ICCS, See **Appendix C**. Operations personnel should lock their workstations when they leave the workstation unattended.

For operation of any ICS console, operators are required to complete ICS operator familiarization training NP-0012. This training familiarizes operators with symbols and control methods, and with alarms.

Designated laptop computers or other mobile computers used outside the control room for localized control operations are configured to operate on the NIF control network at designated network outlets. These computers are used for installation, commissioning, and maintenance activities that are approved through work control processes, and are not used for shot operations. Use of these computers is limited to properly trained personnel, and administrative privileges are limited to NIF Information Technology (IT) personnel, unless specific needs are identified and exceptions granted. Computers that

have not been configured by NIF IT personnel are not able to communicate to other computer systems on the control network.

4.2 Shot Operations Protocol

In addition to the regular protocols prescribed in this document, the higher complexity and risk associated with Shot Operations demands a higher level of formality.

Each operator is responsible for immediately stopping work if he/she judges that any operation presents an imminent or substantial danger to health, safety, the environment or equipment. At any time when immediate danger to health, safety, environment or equipment exists, the operator shall press the nearest emergency stop button. These buttons are located throughout the facility and on each operator console. During a shot sequence this is the quickest way to remove an immediate danger to personnel or equipment. During the actual shot cycle, operators can issue a hold or abort through the shot control software up to 60 seconds prior to shot time (i.e., T-60) to stop the shot process for issues that are not an immediate concern. Issues may include hardware or software not responding as required, or a subsystem needing a delay before continuing the shot process. After T-60, operators should utilize the emergency stop button to remove permissives to hazardous equipment. NOTE: Between the start of the critical region and T-60, the shot cycle cannot be held. Any attempt to hold the shot cycle will result in ICCS aborting the shot and returning to the Ready state.

All Subsystem Operators (SSOs) should review the shot goals prior to the start of every shot. It is the responsibility of every operator to request clarification or explanation for any issue that is not clear or raises questions. The SSOs also have the responsibility to warn the LO or SD if they are aware of any issue with the system that could prevent the shot being successful or create unsafe conditions.

4.2.1 Personnel Activities for Shot Operations

The SD and LO shall maintain a professional atmosphere in the Control Room in a manner commensurate with a safe and efficient shot operation. No impromptu meetings or gatherings may take place in the Control Room during shot operations unless approved by the SD

Operators need approval from the SD or LO to leave the Control Room during shot operations. All operators must be present at their consoles from the start of Countdown state until the completion of the Post Shot Countdown state. All operators shall check out with the SD or LO at the end of the Shot Operations shift.

Operators shall not activate subsystem GUIs other than their own and the bundle(s) they are operating per the Shot Setup Sheet during shot operations, unless authorized by the SD/LO.

The Target Area Coordinator (TAC) reports to the LO and will keep LO/SD apprised of target area shot operations activities. The TAC will notify the LO or SD when they will be out of the 581/681 complex when shot operations are in progress.

4.2.2 Equipment and Hardware for Shot Operations

No network, database or computer system modifications are allowed during shot operations unless authorized by the SD. Any ICCS diagnostic activity during shot operations must be reviewed and approved by the SD prior to implementation.

The SD/LO may dim Control Room lights to provide focus during shot operations.

No personnel other than LO or SD should modify the configuration of the SIS console screens.

During shot operations, the screens in the front of the room will normally display the following information (viewing from left to right):

Screen 1: Sweep Status, Utility Status

Screen 2: SD discretion

Screen 3: SD-Main Shot Status (during shot cycle operations)

Screen 4: SD discretion

Screen 5: SD discretion

Operators are expected, at a minimum, to have their appropriate Shot Supervisor GUI displayed during the shot.

4.2.3 Shot Operations Control Room Access and Occupancy

During shot operations, a higher level of access control shall be in effect. Only authorized personnel will have access to the Control Room unless approved by the SD or LO in accordance with Appendix B. The SD and LO have the responsibility and authority to clear the Control Room of nonessential personnel. No personnel, other than operators, should be allowed in the computer room during shot operations (unless approved by the SD or LO).

Subsystem Managers (SSMs) for critical subsystems may be allowed in the Control Room during a shot with the approval of the SD or LO. Assigned console operators, the LO and SD have the ultimate responsibility for the operation of the system and will follow the established checklists and procedures. SSM shall address their concerns with any part or all of the operation with the SD and LO.

The Control Room entrances will be posted with signs indicating that shot operations are in progress, and Control Room access is closed to non-operations personnel.

Additional operators may be allowed in the Control Room, during shot operations, for the purpose of training or commissioning operations, with the approval of the SD or LO. Support personnel (e.g., ICCS) may be required in the Control Room to support shot operations, with approval of the SD or LO. Other support personnel may be required to be on-call to respond as needs arise.

Under no circumstances should personnel other than the LO, SD or SSO operate their consoles. The DE should not operate any consoles except for their station unless authorized by the LO or SD. The only exception to this policy is during specific ICCS testing. ICCS personnel may perform specific test activities using production hardware, when properly approved.

4.3 Target Area Protocols

Operation of target area equipment requires the coordination of several groups. The Target Area Coordinator (TAC) works with the Target Diagnostic Coordinator (TDC) and the LO to prepare the target area systems to support shot activities. Set-up and configuration of target diagnostic devices, in the target bay and the target diagnostic mezzanines, is specified by the shot set-up and executed by the TDC and the TAC. During set-up and shot operations access to the diagnostic mezzanines is limited to target diagnostic operators working to establish the authorized shot configuration. The SD must authorize any other access to the diagnostic mezzanines during set-up and shot operations.

Set-up and configuration of the positioners and insertable diagnostics is also specified by the shot set-up sheet and is executed by the LO and the TAC. Access to the 17'6" level of the Target Bay is restricted to target area operators working to establish the authorized shot configuration. In addition, the areas immediately adjacent to the Target Positioners (TARPOS and CryoTARPOS) and the Target

Alignment Sensor Positioner (TASPOS) are barricaded during movement of the applicable positioner and remain barricaded for the duration of the shot cycle after shot configuration has been established.

A TAC must be assigned to manage all positioner operations inside the Target Chamber. In general, TAOs perform TARPOS, CryoTARPOS and TASPOS movements between the fully retracted position (inside the positioner vessel) and pre-defined “hand-off” positions. Movements of TASPOS, CryoTARPOS and TARPOS between the “hand-off” position and target chamber center are normally performed by BCS from the control room. Movements of DIM-based devices and SXIs are normally performed by TAOs. Positioner and DIM movements may require a second operator to monitor the movements by use of the Chamber Interior Viewing System (CIVS) for collision avoidance as described in subsequent sections.

4.3.1 Authorized Operator Cards and Target Chamber Device Control

A number of target bay devices, operated through ICCS can be controlled from both the target bay and the control room. During shot operations, some of these devices are controlled from each location at different points in the shot sequence. To ensure the positive control of these devices and systems, a system of Authorized Operator Cards (AOCs) has been instituted for the following devices:

- Target Positioners: TARPOS and Cryo TARPOS
- (Target) Alignment Sensor Positioner (TASPOS)
- Diagnostic Instrument Manipulators (DIM) @ 90-78, 90-315, and 0-0 ports
- Final Optics Damage Inspection DIM (FODI DIM)
- Upper and Lower Static X-ray Imagers (SXI)

These devices also have unique ‘run inhibit’ keys attached to the AOCs. These run inhibit keys are used in conjunction with local interlock boxes installed on each device. These boxes have “run” and “inhibit” positions. When a key is inserted and turned to the “run” position, power is available to the motors on that device and movement is possible. When a key is inserted and turned to the “inhibit” position, power is removed from the device motors and no movement is possible. Keys are not captured in either position and should remain attached to the AOC at all times.

AOCs and keys are stored in the Control Room and must be checked out through the LO or SD. When checking out an AOC/key, the operator makes an entry into the control room key logbook maintained at the LO console. When work is complete, the operator returns the AOC and key to the Control Room and makes an entry in the logbook documenting the return.

Control of the AOCs and inhibit keys is managed differently depending on whether they are used in shot operations or non-shot operations:

Shot Operations

AOCs and inhibit keys for the systems used during shot operations should normally be in the possession of the Target Area Coordinator (TAC). The TAC, with authorization from and in coordination with the LO, will direct the operation of the devices during the shot cycle. All device operations must strictly adhere to the shot checklist. No one should operate a controlled device without the approval and direction of the LO or TAC. AOCs and keys not used during shot operations should remain under the control of the LO. During the shot cycle, control of positioners will transfer between the TAC and LO according to established checklists.

Non-shot Operations

In non-shot operations, AOCs and control keys should be controlled and issued by the LO or SD; qualified TAOs/TACs should contact the LO or SD to check out the AOC and control key for a device

to be operated. Operators must be in possession of the appropriate AOC and control key to operate any of the devices listed above. The person checking out the AOC and control key may not authorize others to operate devices, except for coordinated activities with the Control Room operators. Instead, the AOC and key must be returned to – and checked in with- the LO, then checked out to another individual if transfer of custody is required. Outside of the shot cycle, control of positioners will be determined by the TAC and LO.

4.3.2 General Movement Rules for Target Chamber Devices and use of Chamber Interior Viewing System

In general, movement of devices inside the target chamber requires authorization from a SD/LO, TPS or TAC and a released work permit. In addition, the operator must be in possession of the appropriate AOC and control key as described in the previous section.

Normal positioner operations shall be conducted using the TAP (Target Area Positoner) high level GUIs. Use of these tools, provide the required software limits to support safe routine operations.

Use of lower level maintenance panel GUIs do not provide these additional controls. Use of maintenance panels is only authorized for conduct of approved test procedures, or as approved by the TAC/TPS and the Positioner Sub-System Manager to support specific maintenance activities. During shot operations, the SD and TAC may authorize their use for specific tasks after consultation with appropriate personnel.

When the Target Chamber Service system (TCSS) is inserted into the Target Chamber, all positioners must normally be fully retracted. Exceptions to this may be only made using a procedure approved by the Target Area Commissioning, Operations and Maintenance (TCOM) manager. Generally the TCSS will be positioned first and locked in place, and then the required positioner will be moved to the required location

Chamber Interior Viewing System

The NIF target chamber has a number of devices that can extend into the chamber, resulting in the possibility of collision. In order to prevent such collisions from occurring, a Chamber Interior Viewing System (CIVS) is installed. It consists of surveillance cameras and associated light emitting diode (LED) ring light sources mounted on ports around the target chamber. Cameras are remotely controlled through ICCS. Monitors and computers are co-located with the Chamber Motion Stop button in several locations. There are three locations on the chamber with two cameras, each that have preset or fixed views of target chamber center. These fixed views are used to support all positioner movements; they are used by the operators to direct movements and by the associated CIVS operators to monitor the moves. The fixed views to be used are defined in the ICCS database and are displayed automatically on the TAP GUI based upon the specific controls used.

For other operations, the CIVS operator can select any “flexible view” camera and control the camera’s pan, tilt, and zoom functions at any time. The software will allow several camera views to be displayed on a monitor at the same time.

Use of Chamber Motion Stop Button

When more than a single positioner is inside the target chamber, a minimum of two qualified operators is required. One operator will use ICCS to control the device being moved (normally a TAO or BCS operator) while a second operator uses the CIVS to monitor the movement. The CIVS operator must be stationed within reach of one of the Chamber Motion Stop Buttons. If a collision appears imminent or any unexpected movement occurs, the CIVS operator will use a Chamber Motion Stop

button to de-energize all the devices that can extend into the chamber. In those cases in which only a single device is to be moved within the target chamber, and all others have been retracted, the TAC/TPS may perform both the operator and CIVS functions described above. This process removes electrical power to all the motor control chasses associated with devices capable of movement inside the target chamber, thereby stopping all movement.

Note that this stop button is distinct from the Facility Emergency Shutdown buttons mounted on the facility walls that shutdown facility operations including high voltage and laser operations. The Chamber Motion Stop button de-energizes only target chamber device motors. Actuation of any of these shutdowns will result in a “TC Motion Stop Button” alarm on the SIS annunciator panel in the control room.

In addition, each device has an individual emergency stop button mounted near its motors that de-energize only that device. It should be noted that these buttons do not de-energize devices installed in a DIM. They shut down the power to the DIM motor controllers only, power to the diagnostic remains in the last position. These emergency stop buttons are to be used by local operators who detect abnormal/unsafe operation of that specific positioner.

Recovery from Chamber Motion Stop Button actuation

Recovery from use of the stop button, or the locally mounted stop button, requires a number of steps. Refer to the SIS Alarm Response Procedure (NIF-5015482)¹³ for instructions for evaluating the reason for use of the stop button and recovery. When those actions are complete, all ICCS errors for the specific device that were produced by the emergency stop must then be cleared.

4.3.3 Operating Multiple Positioners in the Target Chamber Concurrently

Normally, only one device at a time is allowed to be in motion inside the Target Chamber. However, multiple devices may be operated under certain conditions. For device movement purposes, the target chamber is nominally divided into three zones: the first being within 500 mm of Target Chamber Center (TCC), the second beyond 500 mm from TCC up to the predefined “Safe Handoff” point (currently defined as 1.4 m from TCC for most positioners), and the third from the safe handoff point to fully retracted out of the chamber. The safe handoff radius corresponds to the swept volume possible when the FODI DIM is at TCC. The 500-mm zone represents the potential collision area for all other positioners.

Two target positioners may be involved in a single shot. To prevent the possibility of inadvertent shroud interactions or laser damage, both target positioner shrouds must either be open at shot time, or the respective positioner gate valve must be closed. Only one shroud system may be active during countdown, and the T-1 safety system will ensure that the active shroud opens by the appropriate time in the countdown, or it will prevent main laser operation.

The shot checklist generally sequences all positioner activities both inside and outside the safe handoff zone as serial activities, however, parallel execution of some of those activities is allowed within the following general guidelines:

Prior to simultaneous movements, coordination shall occur between LO and TAC.

Rules for outside of the safe handoff point (typically 1.4 m from TCC):

- a) **Multiple positioners** may be moved simultaneously up to the safe handoff point at the discretion of the TAC/LO; the TAC shall ensure that these positioners are unlocked only to the safe handoff point using the TAP GUI.

- b) **A single CIVS operator**, monitoring the chamber wide view CIVS, may supervise multiple moves at the discretion of the TAC (and LO during shot operations). This operator may have no other function while positioners are in operation. This operator is **in addition to** any CIVS operator stationed to monitor individual positioner moves as described below.
- c) The CIVS operator shall verify the path is clear prior to movements and shall ensure the movements proceed generally as intended.
- d) Positioner moves may be made using established setpoints using “go to” commands.

Rules for the zone between the safe handoff point and 500 mm from TCC:

- a) Only a **single positioner** of any type **may be moved within this zone at any one time**; all other positioners within the zone must be locked out by the TAC using the TAP GUI or by LO reservations on the status verifier.
- b) A **dedicated CIVS operator** must be stationed to monitor this positioner using the appropriate CIVS views as defined on the TAP GUI; this operator may serve no other function when the positioner in this zone is unlocked and free to move. Note that this operator is in addition to any CIVS operator stationed to monitor moves outside of this zone as described in 2 b).
- c) The **positioner operator will communicate with the CIVS operator** prior to initiating moves (or a series of moves) to ensure that the CIVS operator is engaged and to ensure the intended path is clear.
- d) When **FODI** is inside this zone, **no other positioner** may be present in this zone or within 500 mm of TCC.
- e) Moves within this zone are normally conducted with the TAP GUI joysticks or “drag moves”; setpoint moves may be conducted if part of an approved procedure or shot checklist (for example, initial insertion of the TAS to TCC during a shot cycle with no other positioners inserted may be conducted using a “Go To TCC” move).

Additional Rules for the zone inside 500 mm of TCC:

- a) **All moves within this zone must be approved by a second operator**, normally the dedicated CIVS operator. This will be accomplished using the “propose move”/ “accept move” protocol built into the TAP GUIs. The second person verifies that the proposed move is safe from a collision perspective prior to allowing the move to be executed. The CIVS operator must be informed prior to initiating each move or sequence of moves within a small volume

At any point during the shot sequence the TAC or the LO can propose the performance of one or more parallel activities. SD must authorize all parallel activities.

4.3.4 Adding Diagnostics to the Target Chamber

Before adding devices to the Target Chamber, the device RI must follow the process in NIF Project Procedure 5.19, Work Authorization Review.²⁰ For Target Diagnostics, a specific Target Diagnostic Work Authorization Point checklist contained in the procedure identifies specific expert groups and SSMs who must review and concur on each installation.

5.0 COMMUNICATIONS

The effective and safe operation of NIF requires that operations related communications be concise, precise, and formal. This applies to all face-to-face, headset, or public address communications. To ensure effective communications, the following standardized procedures apply to all NIF operations. The SD and LO are responsible for maintaining the formality of all communications in the Control Room.

5.1 General

Informal or personal communications will not be transmitted on headsets or the public address system.

To ensure all personnel are aware of shot progress, shot-related communications applicable to all operators will be conducted on radios. The NIF Operations Management Plan¹ contains radio circuit assignments.

To avoid confusion, first names are not to be used in formal communications; operating station titles should be used or, if not assigned to a console, either the last or full name will be used.

All approved equipment/station designations and acronyms are listed in **Appendix D**. These designations should be followed at all times to ensure clarity of the information intended to be conveyed.

Directive communications (not informational in nature) will be repeated back to the person giving the direction to ensure the directions are clearly understood, when required for clarity. An acknowledgement will be performed before the directed action is taken. Upon completion of the directed action, the person performing the action will inform the person directing the action that it is complete (or not), and will include any unusual events. Refer to **Appendix D**.

All communications should be conducted in the quietest manner possible to maintain the general noise level in the Control Room as low as possible.

5.2 Radio Circuit Protocol

Radio circuit protocols are managed by the SOM.

Anyone needing to use the radio circuit for emergency communications shall take control of the circuit by saying "Break, Break" then passing the emergency information. Upon hearing "Break, Break" all other operators shall cease all communications until the emergency information has been passed.

Radio communications must be concise, precise, and formal and idle chatter should not occur. Do not interrupt communications in progress, unless you have an urgent communication affecting operations or safety.

To minimize circuit noise, close your microphone when not in use.

Station Identifiers will be used on the radio circuits to gain the attention of the station being called and minimize repeated information or requests. The station being called will be spoken first, then the station calling, then the clear and concise message may be transmitted .

Informational communications between two people should be positively acknowledged by using an appropriate term, such as “copy,” “affirmative” or “roger.”

6.0 NOTIFICATIONS

The SOM or NOM shall be notified as soon as practicable when:

- Unusual, abnormal or unexplained system performance
- Repetitive problems occur
- Process parameters are out of specification or indicate unexplained trends
- Scheduled shots cannot be executed

The SOM will also ensure appropriate COMs (and the NOM when appropriate) are notified of these problems.

7.0 SOFTWARE UPGRADES AND HARDWARE RETESTS

7.1 ICCS Software Upgrades

After the on-line testing WAP has been approved, ICCS software deployment and manual non-shot-cycle regression testing can proceed in NIF. The procedure for installation and rollback of ICCS software releases is described in document NIF-5014353.²¹ Testing is coordinated in the control room by a SD and/or LO. The testing is performed by subsystem operators, following approved regression test procedures, with ICCS Test Team personnel observing and recording any issues for follow-on troubleshooting and creation of SCRs.

After completion of manual regression testing and approval by the Campaign AI, shot cycle tests can proceed. This phase involves execution of approved experimental shots to test the operation of the shot automation software.

ICCS database changes and minor field software changes that are needed prior to the next software release, can be applied after documenting the requested change and getting necessary approvals using the B581 Production Software Environment Change Request form, NIF-5016317.²² Many database changes are required during commissioning, as they define the specific operational parameters of ICCS-controlled devices. Field software changes are less frequent and are used to apply and test urgent fixes that have limited scope. All proposed changes must be approved by the SSM. A SD must approve changes that affect operation of a commissioned bundle. Changes are verified by a subsystem operator or SSM before closing out the change request.

7.2 Laser Hardware Retests

NIF Work Permits (NIF Procedure 5.8)¹² describes how retests should be documented as part of the work process. These retests are proposed and reviewed by the Laser COM. For CIs and SPIs, a formal retest is required, usually specified in the maintenance or work procedure.

8.0 RECORD KEEPING

8.1 Logs

Logs are the record of events in the facility and provide a history of facility operations and will be maintained by all key personnel. Due to the highly automated nature of the facility, most logs are recorded electronically and very few paper logs are maintained. Operators enter comments about equipment or evolutions in the Operations Logs in LoCoS, where the entry is tied to a specific system or component. Equipment problems are entered into the Problem Log module of LoCoS, and further addressed through SMaRT Work Orders and equipment histories (for CF/BUS equipment) and LoCoS Work Permits (for all equipment). Most equipment parameters are monitored and controlled electronically, with automated archiving of system operating parameters and alarms. All electronic logs and archives are readily available to operators at the appropriate work stations. Log entries should be made in a timely manner and be easily understood.

The SD/LO or WCO in charge of the facility is responsible for ensuring that certain important events, as listed in Table 3 below, are logged into the Shot Operations LoCoS Log file.

Table 3. Important Event Logging Instructions

Category	Event/Action	Logged By/Log	Amplifying information
Personnel Safety Related	Personnel Injury	SD/LO or WCO in charge	Name of person injured, how injury occurred, medical treatment provided, immediate disposition, and notifications per NIF Notification Procedure.
	Off Normal Events (Section 3.2)	SD/LO or WCO in charge	Description of event including cause and extent of damage, immediate disposition, and notifications per NIF Notification Procedure.
	O2 deficiency alarms	SD/LO or WCO in charge	Detector(s) alarming, minimum readings, false/actual alarm. Evacuations implemented. Time access restored. Resolution
	Fire/Smoke alarm/Sprinkler actuation	SD/LO or WCO in charge	Location, cause, action taken. Any damage. See SIS alarm response procedure and Section 3.4
	Broken Sweep or SIS failure	SD/LO	Location of breach/failure. Cause/person responsible. Actions taken prior to resuming operations. (See Section 3.4.2 for required actions)
	Failed PILC	SD/LO	Reason PILC not completed. Bundle and Slab location(s).
	Failed Optics Inspection on	SD/LO or WCO in charge	Specific location of failed

Category	Event/Action	Logged By/Log	Amplifying information
	fracture critical vacuum-loaded optics		optic (LRU, beamline, etc.) Action taken.
	Near miss when injury or major equipment damage narrowly averted	SD/LO or WCO in charge	Nature of incident, location, individuals involved. Actions taken and notifications per NIF Notification Procedure.
	SIS Interlocks bypassed/restored	SIS Manager or SD/LO	Device bypassed/ restored, reason for bypass. Approved by. Follow SIS Interlock Bypass Procedure
Environmental incident	Hazardous Material spill	SD/LO or WCO in charge	Nature of incident, location, individuals involved. Actions taken and notifications per NIF Notification Procedure
Major Changes to Facility Conditions	Argon Fill/Vent of major portions of system	SD/LO or WCO in charge	Reason for vent. Affected volume. Time of fill/vent start and completion.
	Opening Target Chamber for Entry/Securing Access	TAC or SD/LO	Reason for access. Port(s) removed.
	Major planned or unplanned facility power outage/interruption	SD/LO or WCO in charge	Reason/cause. Areas affected. Time of outage and restoration of power.
	Opening of Target Bay Shield Doors for access after a yield shot.	SD/LO or RSO	Yield of shot. Time since shot. Approved by. Door opened.
Radiological Events	Planned Special Exposures	RSO or SD/LO	Person(s) affected. Access area. Reason for entry. Approved by.
	Overexposure of an individual (>legal limit)	RSO or SD/LO	Person(s) affected. Location. Nature of event.
	High airborne tritium reading or major tritium release from facility resulting in an alarm	RSO or SD/LO/WCO in charge	Alarming sensor(s). Magnitude of alarm. Area(s) evacuated. Actions taken. Time access restored (if applicable). Follow SIS alarm response procedure.
	Radiological spill or personnel contamination	RSO or SD/LO/WCO in charge	Person(s) affected. Location. Nature of event. Contamination levels. Actions taken.
Major Equipment Damage	Major Equipment Damage resulting in taking down a quad of beams or more, or	SD/LO or WCO in charge	Person(s) involved. Location. Nature of event. Actions taken.

Category	Event/Action	Logged By/Log	Amplifying information
	estimated damage >\$10K		
Machine Safety	Daily MOR checks, operation of Failsafe System	MOR Operator	Failsafe disabled and re-enabled per MOR Daily Startup Checklist

Personnel shall use the LoCoS Operations Log utility for Shot Operations related entries. Log entries in LoCoS should be made under the applicable subsystem category. Errors in electronic logs shall only be corrected by the person making the entry, or with their concurrence. The correct information should be entered, including a note about what was changed with the name of the person making the change and the date the change was made. Equipment failures or issues that require follow up or maintenance should also be logged as LoCoS Problem Logs referenced to the particular LRU, component or part number as applicable.

System operators are responsible to log (in the LOCOS subsystem Ops Log) important system activities, events, and equipment and system status throughout their shift. They should make special effort to log all pertinent information needing to be passed on to subsequent shifts. Events to be logged include: Completed test procedures (such as IQs/OQs), problems encountered (reference Problem Log for equipment deficiencies), unusual system behavior and methods successfully employed to work through them. The LO should maintain a log of major shift events including shots completed, significant delays or problems encountered, etc. in the LoCoS Ops Log.

Unanticipated out-of-specification parameters should be logged with information about why the parameter was “out of spec,” who was informed, and what action taken has been taken to return the parameter to within specification.

Periodic reviews of all logs should be conducted by supervisors or appropriate SSMs as deemed necessary.

8.1.1 Shot Operations Shift Summary

The SD is responsible for writing a shift Shot Operations Summary describing what events/issues took place during the shift. The SD will also list any safety issues, important problem reports (by number), and status of facility at end of shift. This summary is emailed to selected individuals at the end of the shift. The Shot Operations Summary will be posted on LoCoS automatically, and periodically verified by the NIF Shot Operations Administrative Assistant.

8.2 Shift Schedules

The CROM maintains a Shift and Vacation Schedule. The schedule covers NIF Operations personnel staffing the Shot Operations and Non-Shot Operations shifts. The schedule is generally prepared two months in advance and will be posted in the Strategy Room. Any changes to the schedule are coordinated through and approved by the SOM, CROM or SD. Personnel that cannot make a scheduled shift shall call the CROM and let them know when they will be absent and when they expect to be able to return to work. The CROM, or designated alternate, will make appropriate adjustments to the schedule.

8.3 Shift Turnover

Shift Turnover for shot operations staff is conducted by the oncoming SD using NIF Operations Procedure, NIF Shot Operations Shift Turnover Process, NIF-5018061.²³ This brief includes at a

minimum: SPA, facility status, utilities status, alignment status, shift shot plan, diagnostics requirements and problems experienced during the previous shift . This brief is an appropriate place to review compliance with the Required Reading program (Section 9.0) and qualification proficiencies. This turnover meeting is used to ensure all personnel (including visiting experimenters) are briefed before performing their duties.

As most NIF equipment status/data is available electronically through the control systems or administrative web applications (such as LoCoS), limited use is made of paper logs and status boards. Therefore, the individual operator turnover sheets do not contain detailed equipment status; these sheets focus more on activity status and off-normal condition turnover. Turnover checklists are to be used whenever a transfer of operations responsibility from one complete shift of operators is planned, or (at the discretion of the SD/LO) when the relief of a subset of operators is to be conducted. Formal turnover is required whenever shot operations are in progress. For facility activities not including shot operations, the SD/LO may employ a graded approach to turnover.

The off-going shift prepares the status information for review by the on-coming shift. The on-coming shift then reviews the information, resolves any questions, and participates in the briefing of the planned activities for their shift. Relief of operators is authorized and coordinated through the on-coming and off-going SDs/LOs. Reliefs will not normally be authorized during any Countdown or Pre-Countdown shot state.

When two consecutive shifts will not be able to conduct a direct turnover (i.e., over holidays or weekends) the off-going shift completes the turnover checklists and leaves them readily available for the next shift. The Shot Operations Summary email is also used to provide additional information to the next shift. The Shot Schedule tool is used to provide direction for planned shot activities.

8.3.1 Off-Going Shift Responsibilities

Subsystem Operators shall:

- Obtain a copy of the Shift Turnover Checklist for their operating station at the start of the shift.
- Fill out the header information (names, shift date/time, etc.).
- Transfer any applicable items noted on the turnover from the previous shift in the appropriate section of the checklist.
- Complete any required LOCOS logs (Problem Reports, Ops Logs, etc.) throughout the shift; note items of particular interest to on-coming shifts on the appropriate section of the turnover checklist. In particular, note any safety items or abnormal operating procedures.
- Near the end of the shift, update the turnover checklist with any status changes.
- Ensure documents for operations in progress (Shot Checklist, Commissioning Procedures, etc.) are complete through the current step and provide them to the on-coming operator as part of the relief process. Specifically review the status of procedures in progress, including the next required steps and ensure the on-coming operator is aware of the system status.

For operating stations that have manual equipment logs (“Round” sheets), the off-going operator (normally) completes a set of log readings and makes them available for the on-coming shift to review.

8.3.2 On-Coming Shift Responsibilities

Prior to relieving the shift, the on-coming operator should review pertinent logged information (Ops Log, Problem Reports, Hot Sheets, SIS Bypass, ICCS Changes, etc) as specified in the Turnover Checklists.

When appropriate and facility conditions permit, conduct a physical walk-down of the operating equipment, noting conditions. This is usually required when the operator manually operates equipment in the field (as opposed to operating equipment from the control room only).

When authorized to relieve the on-coming shift, the on-coming operator proceeds to the operating console and reviews the checklist prepared by the off-going operator, and discusses any points of interest. If not already done, review the electronics logs for a period of at least 24 hours (or until last on shift, whichever is shorter).

Review all applicable operating documents (including shot checklists, Shot Setup Sheets, Commissioning Procedures, etc.), and make particular note of what steps are complete, in progress or not started. Obtain clarification from the off-going operator where required.

Review the status of the system GUIs and the Shot Supervisor and Alert GUIs and be certain that all indications are understood.

Finally, the off-going operator should provide a turnover of any other operational items not covered elsewhere.

8.3.3 Relief Process

The on-coming SD/LO will review the shift status with the off-going SD/LO and review shift plans prepared by the SOM. They will determine the plan for the shift and identify an appropriate time for operator turnovers to commence. Turnovers may be authorized for the entire set of shift operators, or specific individuals (depending upon conditions)

Prior to shift turnover, the on-coming shift may be authorized to conduct non-shot commissioning activities (on a not-to-interfere basis) using secondary consoles. Similarly, if appropriate, shift turnover may occur early in the overlap period, and the off-going operators may switch to non-shot activities.

Once conditions are stable and the SDs and LOs agree it is appropriate, operators will be directed to start turnover of individual operating stations.

The SD/LO turnover normally occurs after the other stations, when the new operators have settled in.

If a turnover occurs between a final rod shot and a system shot, the on-coming SD must review the Rod Shot and other necessary data, and concur that it acceptable to proceed with the system shot. Responsibility for shot safety rests with the SD conducting the shot.

Submit completed turnover checklists to the Shot Operations Administrative Assistant. Turnover checklists need be retained for only 1 week.

9.0 REQUIRED READING

A Required Reading binder shall be maintained by the Shot Operations Manager in the Control Room for review by Shot Operations personnel. This binder should be organized into sections for all-hands and each subsystem operator. Each section or document should have a review list attached for personnel to indicate reviews, as appropriate. As an example, current minutes from the weekly safety meetings, recent lessons learned and change synopsis for site-wide documentation (i.e., OSP 581.11,⁶

NIF Docs, various procedures,) will be placed in the all-hands section. Material may be removed after all specified personnel have completed their review or when the material is no longer applicable.

This binder should be reviewed periodically as part of the shift turnover process (Section 8.3) and as determined by the CROM to ensure personnel are staying current with changes to the facility and operations.

10.0 INSTRUCTIONS TO WORKERS AND USE OF PROCEDURES

For normal operations, operators should follow written procedures and/or checklists. Each operator shall use Shot Operations and system operation checklists when approved for use. The format for operations and maintenance procedures is detailed in the NIF Management Procedure 11.1, Index and Writer's Guide (NIF-0114548).²⁴

Before any procedure is performed the first time, the safety section must be reviewed in the field by the entire work team. The RI or designee must lead the review, and additional safety considerations must be written on the procedure at that time and the procedure subsequently updated and revised as necessary.

10.1 Use of the Shot Checklist

Shot Operations Checklists are used during all shot cycle operations. This complete checklist shall contain manual, automated and commissioning-specific steps for all subsystems controlled from the Control Room or Target area during a shot cycle. The checklist will be formatted for the specific shot type being conducted, based on beam fate and activity (i.e. commissioning, software regression testing, automated shots...). The checklist contains steps necessary to complete the shot cycle and ensure that relevant data is collected and archived.

The Shot Operations Checklist shall include the necessary references to the Shot Safety Checklist. The Shot Safety Checklist outlines the necessary beampath integrity checks and sweeps and other activities necessary to ensure personnel safety during laser operations. The LO appends the Shot Safety Checklist to the Shot Checklist, and performs the two checklists in parallel during the shot cycle.

10.2 Management of the Shot Checklist

Shot Operations Checklists (and redlines) are managed by the Shot Checklist Manager using a Checklist Approval Form. The Shot Checklist Manager should post the latest approved version of the shot checklist on the NIF Control Room server and submit the update to ECMS. The approved shot checklists will then be available for use in shot operations.

Certain steps in the shot checklist (identified with an asterisk * adjacent to the step number) have been identified as being critical to safe operation of the laser. These steps are designated as quality level 2 (RQ-2) and may not be deleted or substantively changed without approval of the Rules of Engagement/Machine Safety (REMS) expert group.

Changes to the Shot Safety Checklist must be approved by the NOM. This checklist is managed the same as the Shot Checklists, with the exception that only ECMS released versions are authorized for use for shot operations. The LO retrieves the most current version from ECMS prior to use.

The LO is responsible for ensuring that the most recent, approved version of the shot checklist and Shot Safety Checklist is being used. Unless explicitly approved by the NOM, only checklists released as described above shall be used. The SD may authorize paper redlines only to correct clearly administrative errors or necessary workarounds for one-time problems. It is the responsibility of the SD

to obtain concurrence from the responsible SSM or SOM and approval from the NOM when appropriate.

All Operators are required to use the most current, approved checklists during Shot Operations. Operating from memory is not permitted. Unless otherwise directed by the SD, a new checklist will be used for each new shot setup.

10.3 Temporary Standing Orders

The NOM or SOM may issue temporary directions to their staff through the use of Temporary Standing Orders (TSO). These orders may establish new policies or clarify existing policies, but shall not be used to negate policies or procedures issued by higher authority. Where the change in policy is intended to be permanent, the appropriate process owner will be notified and an ECR created, as appropriate. The TSOs shall be distributed to all affected personnel via email and maintained in the Control Room Required Reading Binder.

11.0 OPERATOR AID POSTINGS

The use of Posted Operator Aides such as equipment setpoints, diagrams and procedures, where such posting are the actual guidance for operating the system, should in general be discouraged. When these types of postings are necessary, they shall be approved by the SOM. They shall not conflict with other official guidance or procedures, shall be updated annually or upon changes to the system that affects the posted operator aid, and shall not obscure or interfere with proper operation of instruments, equipment or controls.

Operator aids in the form of signs should be legible and posted unambiguously, so it is clear and obvious what they refer to. These postings should be made of metal or laminated as appropriate for their location. Signs that are illegible or confusing should be removed.

The list of approved Posted Operator Aids is maintained in **Appendix E**.

12.0 REFERENCES

1. NIF Operations Management Plan, NIF-5020544
2. NIF Maintenance Plan, NIF-5018526
3. Shot Checklist, NIF-5016158
4. NIF Training Plan, NIF-5018705
5. Facility Safety Plan for Buildings 581, 582, 682, 683, and 684, NIF-5019665
6. Operational Safety Procedure 581.11, NIF Laser System Installation, Commissioning, and Operation
7. Target Management Procedure, NIF-5012336
8. LLNL Environment, Safety and Health (ES&H) Manual, UCRL-AM-133867
9. NIF Program Safety Protocols and Requirements, https://nif-int.llnl.gov/procedures_docs_forms/procedures.php
10. NIF Emergency Preparedness and Response Plan, NIF-5017354
11. NIF Procedure 5.21, NIF Programs Off-Normal Event Initial Response and Notification Procedure, NIF-0072808

12. NIF Procedure 5.8, NIF Project Site Work Permits, NIF-5018626
13. NIF Safety Interlock System Alarm Response Procedure, NIF-5015482
14. No longer used
15. Shot Operations Rules of Engagement, for NIF Main Laser Operations, NIF-5022606
16. Preamplifier Module (PAM) Manual Permissives Checklist, NIF-5015558
17. Laser Bay 1-2 Shot Safety Checklist, NIF-5015558
18. Control System Operator Qualification Card, NIF-5009911
19. NIF Procedure 5.26, Deployment in NIF of Hardware Used at Other Facilities, NIF-5018882
20. NIF Procedure 5.19, Work Authorization Review, NIF-5018658
21. Building 581 Production Release Installation Procedure, NIF-5014353
22. Building 581 Production Software Environment Change Request, NIF-5016317
23. NIF Shot Operations Shift Turnover Process, NIF-5018061
24. NIF Management Procedure 11.1, Index and Writer's Guide, NIF-5020542
25. Conduct of Operations Applicability Matrix for the NIF, NIF-0113665
26. VISAR/LCAL Manual Permissives Checklist , NIF-5029707
27. Cryogenic Target Positioner CryoTARPOS Operating Procedure, NIF-5030385

13.0 REVISION LOG

Revisions to this procedure must be evaluated with respect to the *Conduct of Operations Applicability Matrix* (NIF-0113665)²⁵

Rev. No.	Effective Date	ECR No.	Pages Affected	Brief Description of Revision
AH	Mar 2014	0033261	Various	Editorial changes, removed Terry Land as approver
AG	Feb 2011	0023956	Various	Added NIF Business System requirements for Shot Operations and Shot Ops Preparations. Corrected typos in paragraph numbering
AF	April 2010	0022130	Various	Updated for radiological operations and cryogenic target positioner operations. Updated organization charts.
AE	Jan. 2010	0020312	Various	Modified role of Hazards Control Technician to include Radiological Controls Tech activities. Added role Target Chamber Positioner Supervisor (TPS). Added references to operations that generate Neutrons (or Protons). Modified rules of engagement for case with only one device in the TC
AD	Sept. 2008	0016925	Various	Minor administrative updates to align with current practices, added a section on Temporary Standing Orders, updated training requirements, removed references to TALIS and the Shot Checklist CCB5, and updated roles and responsibilities to the new org chart.
AC	July 2008	0015835	Various	Incorporates items identified through the MSA process.
AB	February 2008	0015579	All	Updated to reflect management changes and other minor edits. Many sections were moved to the NIF Management Plan in their entirety.
AA	June 2007	N/A	All	Initial release

1.0 APPENDICES

APPENDIX A — Qualification Cards for Shot Operations Personnel

APPENDIX B — Protocol for Visiting Experimenters during NIF Shot Operations

APPENDIX C — ICCS Control Network Group Account Responsibilities

APPENDIX D — Communications

APPENDIX E — Approved Posted Operator Aids

APPENDIX F --- NIF Business Services Required for Shot Operations

Appendix A: Qualification Cards for Shot Operations Personnel

Personnel	Training Required (Course or Qualification Card Number and Title)
All Control Room Operators	NP0080, NIF Operations Shot Director NP0454-OJT, NIF Shot Director Target Shot Supplement Qual Card
Shot Director	NP0080, NIF Operations Shot Director
NIF Radiological Controls Technician	NP-0506-OJT NIF Radiological Controls Technician
Lead Operator	NP0079, NIF Operations Lead Operator
MOR Operator	NP0064-A, Master Oscillator Room (MOR) Subsystem Console Operation NP0064-B, Master Oscillator Room (MOR) Shot Cycle Qualification
Injection Laser System Operator	NP0035-A, ILS Operator/PAM Operator NP0328, Lower Injection Beam Block Installer Qual Card
Power Conditioning System Operator	NP0074, PCS Console Operator Qual Card NP0304, Power Conditioning System Shot Cycle Qual Card
PEPC Operator	NP0399-A, PEPC Subsystem Basic Operator
Laser Diagnostics Operator	NP0044-B, Generic Streak Camera Platform (GSCP) Operator Qualification Card NP0415, Laser Diagnostics System Console Operator NP0408, PDS Subsystem Console Operator
Beam Control System Operator	NP0048-B, Control Room - Collision Avoidance/CIVS Operator Qual Card NP0052, SIDE Operator NP0053, Basic Laser Alignment NP0068, LOIS Operator Qual Card NP0069, Alignment Sensor and Target Positioner Operation for BCS NP0308, BCS Shot Cycle Qualification NP0335, PFODI Operations with Edge Illumination NP0394, PFODI Operation with 1 Omega Illumination NP0457-OJT, Final Optics Damage Inspection (FODI) Instrument Operator Qual Card
Duty Engineer	NP0078, ICCS Duty Engineer NP0303, ICCS Shot Cycle Qualification

Industrial Controls System Operator	NP0012, Industrial Controls RSView GUI Fundamentals and Usage NP0041, Target Area Vacuum System Operator NP0054, FOA Vacuum System Operator Qualification Card NP0055, FOA Vacuum Control Room Operator Qualification Card NP0057, Spatial Filter Vacuum System Operator NP0058, Argon System Operator NP0067, Basic Utility Systems Operator NP0087, Advanced Utility Systems Operator Qual Card
Target Area Coordinator	NP0088, NIF Target Area Coordinator Qualified Target Area Operator and associated TAO qualifications
Target Area Operator	NP0090, Diagnostic Instrument Manipulator Operator NP0085, Target and Alignment sensor Position Operation NP0041, Target Area Vacuum System Operator NP0317, OPAS Basic Operator NP0326, Diagnostic Mechanical Utility Operator NP0048, Target Area & Control Room Collision Avoidance/CIVS Operator NP0092, Streaked X-ray Detector-Backup (SXD-B) Operator NP0093-A, Static X-ray Imager (SXI) Operations-Mechanical NP0455, Target Area Operator (TAO) Qual Card
Target Diagnostics Console Operator	NP0082, DIM Utilities Control NP0044, Generic Streak Camera Platform Operator NP0093, SXI Technician – Mechanical and Control System NP0309, Target Diagnostic Shot Cycle Qualification NP0066, Dante Operator NP0367, Filter Fluorescer Experiment (FFLEX) Basic Operator NP0044, Generic Streak Camera Platform (GSCP) Operator NP0070-A, VISAR Control Room Operations NP0086-B, Full Aperture Backscatter Station (FABS) Operator NP0092, Streaked X-ray Detector-Backup (SXD-B) Operator NP0093-B, Static X-ray Imager (SXI) Operations-Control Systems NP0301, Flexible X-ray Imager (FXI) Operator NP0309, Target Diagnostics Shot Cycle NP0318, Near Backscatter Imager (NBI) NP0337, Target Diagnostic Status (TDS) and Control Supervisor NP0450, Target Diagnostic Operator (TDO) Qual Card
Target Chamber Positioner Supervisor	NP0034 Control System Operator Qual Card NP0447 Target Chamber Positioner Supervisor Qual Card
Cryogenic Technician System Operator	NP1102-OJT Cryogenic Technician System Operator Qual Card

Appendix B: Protocol for Visiting Experimenters during NIF Shot Operations

The purpose of this procedure is to define the responsibilities of visitors within the NIF facility during shot operations. To insure personnel and equipment safety, it is imperative that the system operators are not disturbed or distracted during shot operations. This procedure applies to all visitors working in the Control Room, Laser Bays, Target Area and associated support areas during shot operations.

- During shot operations, the SD and LO have the authority to clear any area of the facility of nonessential personnel. Nonessential personnel are those personnel that the SD/LO determine that are not required in the immediate area during shot operations.
- During the shot cycle, from the beginning of the Implement Plan state to the End Shot state, only shot operations staff are allowed in the Control Room unless approved by the SD/LO.
- Visitors may reside in the strategy room or other nearby locations until completion of the shot cycle.
- The SD/LO may allow the Lead Experimenter(s) (LE) or designee(s) (at most 1 or 2 personnel) in the Control Room under the following conditions:
 - The LE shall be identified during pre-shot SPA and any LE personnel changes shall be approved by the SD/LO.
 - The LE may inspect target alignment, beam positioning or diagnostic set-up at appropriate operator stations during the shot cycle with SD/LO approval. However, the LE shall not modify procedures or instruct operators to move or modify devices, without prior SD/LO approval.
 - Upon completion of set-up the LE shall vacate the Control Room unless prior arrangements have been made with the SD. During the remainder of the shot cycle the LE shall obtain SD/LO approval before entering the Control Room or before modifying procedures or system devices.
 - With SD approval the LE may be stationed in rear of the Control Room to witness a system shot. During the shot cycle the LE may only communicate directly with the SD. During countdown the LE should refrain from any communication unless personnel or equipment safety is at stake.
- The experimental and diagnostic support staff may monitor radio communications during the shot cycle. Visitors shall not transmit on the shot operations channel unless directly to the SD/LO regarding time urgent information. Loan radios are available from the LO. For general questions or discussions with the SD/LO use the phone and call 3-7009 (the SD console).

I have read and understand the Protocol for Visiting Experimenters:

Name (print)	Name (signature)	Date
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Appendix C: ICCS Control Network Group Account Responsibilities

Background

The LLNL computer security standards require that each person have a unique login on a computer and that passwords are never shared. NIF shot-time operations require multiple operators per workstation and multiple shifts in a single workday. This requirement is difficult to meet if each operator must have a unique login. The NIF Control System has an approved exception to the computer security standard to establish and maintain multiple group user accounts on the ICCS Controls Network. The exception was approved because the Controls Network is effectively isolated from Open LabNet, physical access to the NIF in general is limited, and access to the Control Room, MOR, Laser Bays, Switch Yards, and Target Bay in particular is further controlled. A group account exists for each ICCS control subsystem and for the SD, LO, and Duty Engineer.

The exception requires that a list of all operators authorized to use group accounts be maintained, that operators are informed of their responsibilities with respect to use of group accounts, that passwords change periodically, and that a NIF ISSO periodically review security logs.

The following requirements define responsibilities for users of the group accounts to mitigate unauthorized use of the NIF Control System.

Group Account Use Responsibilities

1. Authorization to use a group account must be requested from the Integrated Controls COM or CROM. Once authorized, the password to a group account will be given to the operator and the operator will be added to the authorized user list.
2. Operators will use only those group accounts they have specifically been authorized to use.
3. An operator will not divulge the password for a group account.
4. The person who initially logs in to a workstation with a group account is aware that other people coming in behind him or her will use that account.
5. When an operator leaves a workstation unattended, the workstation session shall be locked.
6. At the end of control system operations for the day (for the day, not for the shift), the last operator will logout of the group account or lock the screen.

I understand my group account use responsibilities and agree to abide by them:

Name (Print)

Signature

Date

Appendix D: Communications

All communications that are either directive in nature or allow action to be initiated should consist of a to/from address, message, and acknowledgement as follows:

To Address The operator to which the message is intended, e.g., “Beam control, Mechanical Room, Shot Director,” etc.

From Address The operator that originates the message. (Note: The From Address is not used for public address system). Both the voice and the authority to issue a directive must be clear (i.e., while a specific individual has authority when actually assigned as operator, that person does not have authority to issue a directive that changes system status when he/she is not the designated operator).

Message The order or informational item to be communicated.

Acknowledgement The affirmation that a message is received and understood.

If the message is a directive that requires action and includes letters, numbers, or movement direction—the message should be acknowledged by repeating back the message followed by stating your station title and “copy, acknowledge, understood, roger,” or another clear affirmative word indicating understanding. If the repeat back is in error, the originator will state “wrong,” and will repeat the entire message.

If the message is either informational or doesn’t include letters, numbers, or direction or movement—the message need not be repeated back and may be acknowledged by simply stating your station title and “copy, understood, acknowledge, roger,” or other clear affirmative word indicating understanding.

Terminology for operating stations and locations.

Written	Abbreviated	Spoken
Shot Director	SD	Shot Director
(the number) 0,1,2,3,4,5,6,7,8,9		Zero, One, Two, Three, Four, Five, Six, Seven, Eight, Nine
Alphabet A–Z		Alpha, Bravo, Charlie, Delta, Echo, Foxtrot, Golf, Hotel, India, Juliet, Kilo, Lima, Mike, November, Oscar, Papa, Quebec, Romeo, Sierra, Tango, Uniform, Victor, Whiskey, X-ray, Yankee, Zulu (this phonetic alphabet need only be used when necessary to avoid confusion)
Beamline Bundle XX, number Y	B317 (example)	Beam Three-One-Seven (not “three seventeen”)
Lead Operator	LO	Lead Operator
Power Conditioning Operator	PCS	Power Conditioning
Plasma Electrode Pockels Cell Operator	PEPC	Pepsi
Beam Control Operator	BCS	Beam Control
Laser Diagnostics Operator	LD	Laser Diagnostics
Injection Laser System Operator	ILS	I. L. S.
Laser Performance Optical Model Operator	LPOM	L-Pom
Industrial Controls System Operator (or Utility System Operator)	ICS	Industrial Controls

Written	Abbreviated	Spoken
T-1 Control System Operator	T-1	Tee minus one
Integrated Computer Control System Engineer	DE	Duty Engineer
Large Optics Inspection System Operator	LOIS	Lois
Target Area Operator	TAO	Target Area Operator
Target Diagnostics Operator	TDO	Target Diagnostics
Target Diagnostics Coordinator	TDC	Target Diagnostics Coordinator
Target Area Coordinator	TAC	Target Area Coordinator or TAC
Master Oscillator Room Operator	MOR	M .O. R.
NIF Location Component and State Tracking System	LoCoS	Locos
Chamber Interior Viewing Systems Operator	CIVS	Sieves Operator

Nomenclature for equipment.

Equipment Nomenclature	Title or Accepted Acronyms
Plasma Electrode Pockels Cell	PEPC
Input Sensor Package	ISP
Output Sensor Package	OSP
Pre-amplifier System	PAM
Pre-Amplifier Beam Transport System	PABTS
Capacitor Bay 1-4	Cap Bay 1, 2, 3, 4
Cavity Spatial Filter	CSF
Transport Spatial Filter	TSF
Laser Mirror Number 1 to n	LM1...n
Diagnostic Mezzanine	DM
Safety Interlock System	SIS
Target Bay	TB
Switchyard 1 & 2	SY1, 2
Laser Bay 1 & 2	LB1, 2
Optics Assembly Building	OAB
Optics Assembly Building Corridor	OAB Corridor
Master Oscillator Room	MOR
Mechanical Room 3 rd Floor	MR3
Mechanical Room 5 th Floor	MR5
NIF Entrance Lobby	NEL
Roving Mirror Diagnostics Enclosure	RMDE

Equipment Nomenclature	Title or Accepted Acronyms
Diagnostic Beam Splitter	DBS
Laser and Target Area Building	LTAB
Target Alignment Sensor	TAS
Target Positioner	TARPOS
Chamber Center Reference System	CCRS
Chamber Interior Viewing System	CIVS
Diagnostic Manipulator	DIM
Target Chamber Service System	TCSS
Clean Dry Air System	CDA
TSF Alignment Tower	TSF-A
TSF Diagnostic Tower	TSF-D
Pre-Amplifier Module Power Conditioning Unit	PAM PCU
Main Energy Storage Module	MESM
Capacitor Bank Module	BM
Front End Processor	FEP
Programmable Logic Controller	PLC
Final Optics Assembly	FOA
Integrated Optics Module	IOM
Precision Diagnostics System	PDS
Diagnostic Mezzanine	DM 1, 2 Upper or Lower

Appendix E: Approved Posted Operator Aids

Argon Pad valve schematic

Additional posted procedures in Health Physics lab and HMMA

Appendix F: NIF Business Services Required for Shot Operations

Table contains list of NIF business application and platforms required to conduct shot operations. Services may be required for shot preparations (prior to loading the shot), shot operations (once shot is loaded) or both.

<u>Service Name</u> <u>(Production Environment)</u>	<u>Acronym</u>	<u>Required for</u> <u>shot</u> <u>preparations/pri</u> <u>or to loading</u> <u>shot</u>	<u>Required to</u> <u>perform shot.</u>
Control Systems	ICCS Prod	Y	Y
NIF-IT Security Web Service	SEC-WS	Y	Y
Target Diagnostics Instrument Based Controller Boot services	IBC Boot Svcs	Y	Y
Shot Setup	CMT	Y	N
Shot Readiness - Config Checker	Config	Y	N
Shot Analysis Data Visualization	SADV	Y	Y
Shot Analysis, Visualization and Infrastructure	SAVI	Y	Y
Optics Requirements Verification Package	RVP	Y	N
Quicklooks	QL	Y	Y
Optics Inspection Analysis	OIA	Y	Y
Optics Inspection Data Visualization	OIDV	Y	Y
Connection Broker	CB	Y	Y
Beamline Status Seating Chart	Beamline	Y	N
Optics Inspection Compute cluster	OI Cluster	Y	Y
Recycle Now Interactive	RNI	Y	N
NIF Loop Viewer	NLV	Y	N
Location Component State	LoCoS	Y	Y
Laser Performance Operations Model (LPOM) Shot Setup and Compute Cluster	LPOM/LPO M Cluster	Y	Y
B581 Control Room equipment & Support	Infrastructu	Y	Y
Industrial Control System	ICS	Y	Y
Safety Interlock System	SIS	Y	Y
Access Control System	ACS	Y	Y
Glovia	Glovia	Y	Y
Decision Support - Shot Setup	MSSAR /	Y	Y
Automated Alignment Data Visualization	AADV	N	Y
Auto Alignment compute cluster	AA Cluster	Y	Y
Enterprise Change Management System	ECMS	Y	N
NIF IT Web Page	NIFIT	Y	Y
Requirements Management Systems	RMS	Y (1)	N
Notes (1) For Neutron yield shots.			