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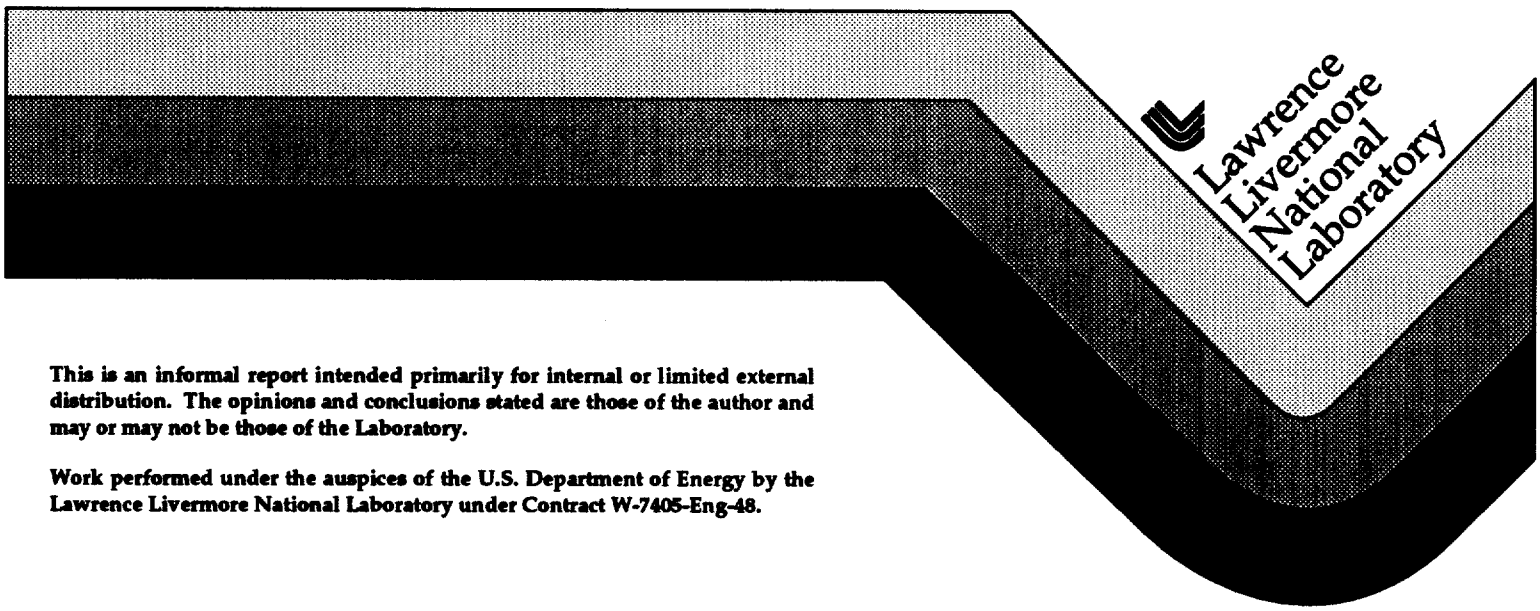
National Ignition Facility SubSystem Design Requirements Transportation & Handling SSDR 1.1.1.3.2

S. Yakuma
R. McNairy

July 10, 1996



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Subsystem Design Requirements
Transportation & Handling

SSDR 1.1.1.3.2

Original
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Approval Date: 7/24/96

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Paragraph	Title	Rev 0	Draft 0

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1.0 Scope

This Subsystem Design Requirement document is a development specification that establishes the performance, design, development, and test requirements for the Transportation & Material Handling Systems (WBS 1.1.1.3.2) of the NIF Laser System (WBS 1.3 and 1.4). The NIF is a multi-pass, 192-beam, high-power, neodymium-glass laser that meets requirements set forth in the NIF SDR 002 (Laser System).

2.0 Applicable Documents

This section lists NIF Project Documents, DOE and other government orders, codes, and standards, and national consensus standards which are applicable to the Transportation and Handling Subsystem. Applicable LLNL standards are also being considered contingent upon the decision of final site selection.

2.1 Applicable NIF Project Documents

Cleanliness Degradation Budgeting For The NIF Laser
TBD

2.1.2 Applicable NIF Drawings

The following NIF Project drawings apply as specified in sections 3.2 to 3.6. The specified revision applies.

TBD (Overall T & H transporters and canisters)
TBD (Facility footprint drawings)

2.1.3 Interface Control Documents

Interface requirements between WBS 1.1.1.3.2 and other subsystems are controlled through separate Interface Control Documents (ICDs).
ICD No. TBD

2.2 Applicable US Government Orders, Codes, and Standards

2.2.1 DOE Orders

(This section to be updated)

The following DOE orders are specifically referenced elsewhere in this document, and are applicable to the Transportation and Handling Subsystem.

∑ 5400.1 - General Environmental Protection Program
∑ 5700.6C - Quality Assurance
∑ 420.1 - Facility Safety
∑ 440.1 - Worker Protection Management for DOE Federal and Contractor Employees

The following DOE orders are generally applicable to NIF, as specified in the Functional Requirements and Primary Criteria, but they are not specifically referenced elsewhere in this document. These Orders are assumed to apply to the Transportation and Handling Subsystem until determined otherwise.

∑ 5480.1B - Environmental Protection, Safety, and Health Protection Program for DOE Operations
∑ 5480.9 - Construction Safety and Health Program
∑ 6430.1A - General Design Criteria
∑ 430.1 - Life Cycle Asset Management
∑ 440.1 - Worker Protection Management for DOE Federal and Contractor Employees
∑ P450.1 - Environment, Safety and Health Policy for the Department of Energy Complex
∑ 451.1 - National Environmental Policy Act Compliance Program
∑ 460.1 - Packaging and Transportation Safety

2.2.3 Other Government Regulations

(This section to be updated)

The following Government Regulations are specifically referenced elsewhere in this document, and are applicable to the Transportation and Handling Subsystem.

∑ 29 CFR 1910 - Occupational Safety and Health Act (OSHA) - Operation
∑ 40 CFR 260, 261, 262 - Hazardous Waste Management System
∑ 33 USC 1251 et seq. - Clean Water Act
∑ 42 USC 7401 - Clean Air Act
∑ 40 USC 6901-6992 - Resource Conservation and Recovery Act (RCRA)
∑ FED-STD-209E - Airborne Particulate Cleanliness Classes in Clean Rooms and Clean Zones
∑ MIL-STD-1246C - Product Cleanliness Levels And Contamination Control Program

The following Government Regulations are generally applicable to NIF, as specified in the Functional Requirements and Primary Criteria, but they are not specifically referenced elsewhere in this document. These regulations are assumed to apply to the Transportation and Handling Subsystem until determined otherwise.

∑ 10 CFR 835 - Occupational Radiation Protection (Non-ionizing)
∑ 10 CFR 20 - Standards for Protection Against Radiation (Non-ionizing)
∑ 42 USC 4321 et seq. - NEPA (National Environmental Policy Act)
∑ 15 USC 2601-2692 - Toxic Substance Control Act

2.3 Applicable National Consensus Codes and Standards

(This section to be updated)

The following National Consensus Codes and Standards are specifically referenced elsewhere in this document, and are applicable to the Transportation and Handling Subsystem.

Σ American National Standards Institute (ANSI):
  Σ ANSI Z136.1 -1993, Laser Safety

Σ DOE-STD-1020-94, Natural Phenomena Hazards Design and Evaluation Criteria for DOE Facilities.

The following National Consensus Codes and Standards are generally applicable to NIF, as specified in the Functional Requirements and Primary Criteria, but they are not specifically referenced elsewhere in this document. These regulations are assumed to apply to the Transportation and Handling Subsystem until determined otherwise. The order standards and codes listed as mandatory in DOE Orders are not referenced in this list.

Σ American National Standards Institute (ANSI)
  Σ ANSI MC96.1 - 1982, Temperature Measurement Thermocouples
  Σ ANSI C2 - 1993, National Electric Code
  Σ ANSI C84.1 - 1989, Electrical Power Systems and Equipment - Voltage Rating (60 Hz)

Σ American Society for Testing and Materials (ASTM)
  Σ ASTM A325 - 1994, Standard Specification for High Strength Bolts for Structural Steel Joints
  Σ ASTM A449 - 1993, Standard Specification for Quenched and Tempered Steel Bolts and Studs
  Σ ASTM A490 - 1993, Standard Specification for Heat-Treated Steel Structural Bolts, 150 ks Minimum Tensile Strength

Recommendations
Σ UCRL 53526 Rev 1 - Natural Phenomena Hazards Modeling Project for Department of Energy Sites (1985)
Σ UCRL 53582 Rev 1 - Natural Phenomena Hazards Modeling Project for Department of Energy Sites (1984)
Σ DOE-STD-1021-93, Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, & Components.

2.4 Applicable LLNL Standards

(This section to be updated)

Pending Final site selection, the following LLNL standards apply to the Transportation and Handling Subsystem, as specifically referenced in later sections.

LLNL M-012 Rev 7, Feb. 1993, "Design Safety Standards - Mechanical Engineering"

3.0 Requirements and Verification

3.1 Subsystem Definition

The Transport and Handling Subsystem provides the methodology and equipment necessary to transport, install, and remove the NIF optical assemblies between their installed positions and their defined maintenance and assembly facilities. The subsystem transfers the optical assemblies under the required environmental conditions. The serviced NIF optical assemblies are designated as Line Replaceable Units (LRUs).

3.1.0.1 LRU Description , WBS Number and Configuration

LRU	WBS# (1)	Qty Installed	CONFIG
Pre Amp Modules (PAMS)	1.3.1.2	192/?	UNIT
Blast shield	1.3.2.?	1824	COLUMN
Flashlamp cassette	1.3.2.1	1368	COLUMN
Amplifier FAU Slabs .	1.3.2.2	864	COLUMN
Pockels Cell	1.3.3.4	48	COLUMN
SFL1 Cavity Spatial Filter (CSF)	1.4.4.1	48	COLUMN
SFL2 CSF	1.4.4.1	48	COLUMN
Pinhole Assembly-CSF	1.4.4.1	24	BUNDLE
Turning mirrors, SW upfacing LM 4 &5	1.4.4.1	48	QUAD
Turning mirrors, SW dnfacing LM 4 &5	1.4.4.1	48	QUAD
Target Mirror LM 6 up&dn Face	1.4.4.1	12	QUAD
Target Mirror LM 7 up&dn Face	1.4.4.1	96	2X1
Target Mirror Upfacing LM 8	1.4.4.1	48	UNIT
Target Mirror Downfacing LM8	1.4.4.1	48	UNIT
LM1/Adaptive Optics	1.4.4.3	48	COLUMN
LM2	1.4.4.3	48	COLUMN
SFL3 Transport Spatial Filter(TSF)	1.4.4.3	48	COLUMN
SFL4 TSF	1.4.4.3	48	COLUMN
Pinhole Alignment Tower-TSF	1.4.4.3	24	BUNDLE
PL/LM3	1.4.4.3	144 ctr 96 end	COLUMN
Diagnostic Tower,1&3 omega, TSF	1.4.4.	24	BUNDLE
Input Sensor Package	1.7.2.2	192	UNIT
Output Sensor Package	1.7.2.2	96	2X1
Mid-chain Sensor Package	1.7.2.2	192	UNIT
Roving SY Mirror	1.7.2	2	UNIT
Roving SY Calorimeter	1.7.2	2	UNIT
FOA Assy	1.8.7	48	
FOA/int optic module		192	UNIT
FOA/ 3 omega Cal Spool		48	QUAD
FOA/Vac Iso Valve		48	QUAD
FOA/Debris Shield Box		48	QUAD
Vacuum window, upfacing-T	1.8.7	96	QUAD
Vacuum window, downfacing-TC	1.8.7	96	QUAD
Debris Shield	1.8.7.4	192	UNIT
3 omega Calorimeter	1.8.7.4	192/48?	TBD
Target Chamber Assemblies	1.8.X		TBD
LRU WBS# (1) Qty Installed	CONFIG		
First Wall	1.8.1.2	192?	
Target Positioning Systems	1.8.2	3	UNIT
Target Diagnostics (mechanical)	1.8.3.1 thru 9	6	UNIT
Longitudinal seal btw FAU encl	? ?		
Guillotines	1.3		none

3.1.1 SubSystem Description

The Transport and Handling Subsystem consists of several LRU Delivery Systems capable of transporting, manipulating, aligning, off loading, installing, and removing the NIF optical assemblies. The delivery systems are designed to maintain the optic assemblies' shock, vibration, cleanliness, and environment requirements during all phases of operations.

The Bottom Loading Delivery System and perhaps the Top Loading Delivery System provides lift, translation, docking, and alignment capability for the installation and removal of the optic assemblies in the Laser Bay. Both Systems employ canister and insertion subassemblies. The canisters are configured to dock/seal to the specified beam enclosures/structures to maintain cleanliness and environment requirements. The insertion subassemblies provide precision lift and translation to install and remove the optic assemblies.

The Side Loading Delivery System provides transportation, lift, and translation for the installation and removal of the selected optic assemblies in the Laser Bay. The enclosed optic assemblies have no environment (argon, nitrogen, etc.) requirements.

The Switchyard Delivery System provides transportation and lift of the optic assemblies to get them close to the insertion point. Once the assemblies are close, they are handed off to the insertion system

The Target Area Delivery System provides transport only, with the optic assemblies handed off for actual insertion and installation. The delivery system transports the enclosed optic assemblies to the appropriate floor level in the Target Area before being handed off.

All delivery systems use a common transporter design with the difference being in the physical size of the transporter footprint. The transporters are based on commercially available material handling technology modified to meet the unique needs of NIF. The transporters are self powered or towed.

3.1.2.1 SubSystem Functions

Transport and Handling LRU Delivery System Functions:

For Laser Bay Bottom Loading

1. Transport and install the 20 currently identified LRUs between the Optics Assembly Building (OAB) and the Laser Bays of the Laser Target Area Building (LTAB). The LRUs are bottom loaded by the Bottom Loading Delivery System for installation into the beamline. The same system is used to remove and transport the LRUs back for refurbishment.

2. Once the Bottom Loading Delivery System is at the proper location, the canister subassembly is lifted, aligned, docked, and sealed to the Beam Enclosure/Structure.

3. Once docked, the Bottom Loading Delivery System's insertion subassembly installs or removes the LRU.

For Laser Bay Top Loading

4. Transport and install the 4 currently identified LRUs between the OAB and the Laser Bays of LTAB. The LRUs are top loaded for installation into the beamline. The same system is used to remove and transport the LRUs back for refurbishment. The functions for this delivery system are similar to the bottom loading delivery system functions except that the LRUs are installed from the top.

For Laser Bay Side Loading

5. Transport and install the 4 currently identified LRUs between the OAB or other assembly facility and the Laser Bays of LTAB. The LRUs are side loaded for installation into the beamline. The same system is used to remove and transport the LRUs back for refurbishment.

For Switchyard Loading

6. Transport the 7 currently identified LRUs between the OAB and the Switchyards of LTAB. The LRUs are lifted close to the insertion site before being handed off to the insertion device for final installation. Also, after removal of the LRU from the beam enclosure, the same system is used to lift the LRU back down to the transporter. The LRU is then transported back to the OAB for refurbishment. In case of contamination, the affected LRUs are transported to the Decontamination Area. After the affected LRUs are declared "Decontaminated", they are transported to the OAB for refurbishment. The same type transporter is used to transport the LRU from the Decontamination Area in the basement of the Target Area back to the OAB for refurbishment.

For Target Area Loading

7. Transport the 17 currently identified LRUs between the OAB and the Target Area. The delivery system transports the LRUs to the appropriate level before being handed off for final installation. In case of contamination, the affected LRUs are transported to the Decontamination Area.

3.1.2.2 SubSystem Functions (Continued)

After the affected LRUs are declared "Decontaminated", they are transported to the OAB for refurbishment. The same type transporter is used to transport the LRU from the Decontamination Area in the basement of the Target Area back to the OAB for refurbishment.

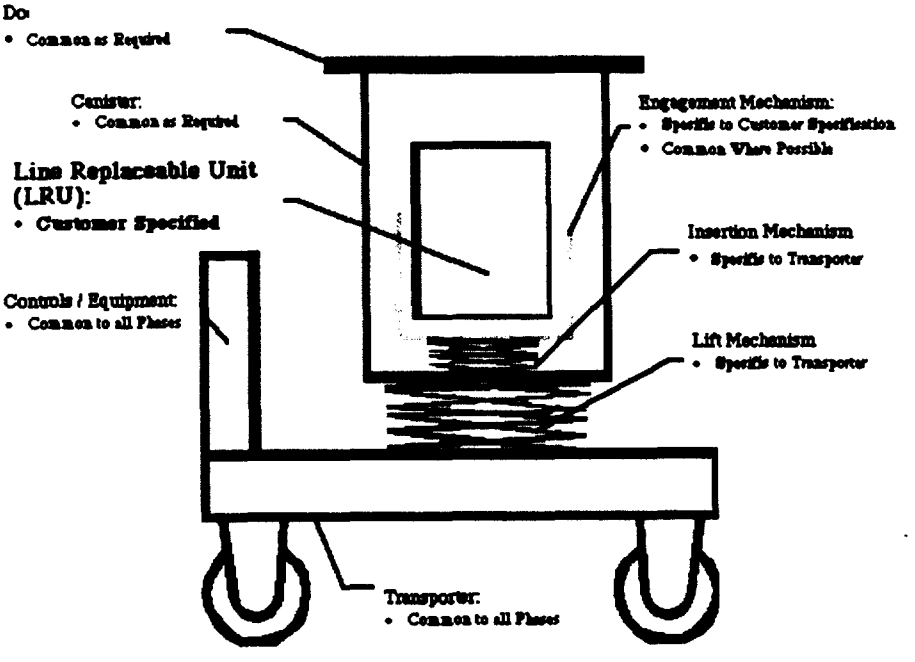
For All Areas Loading

8. During all phases of installation transporting and handling, each LRU is protected to meet the shock, vibration, cleanliness, and environment requirements.

3.1.3 System Diagrams

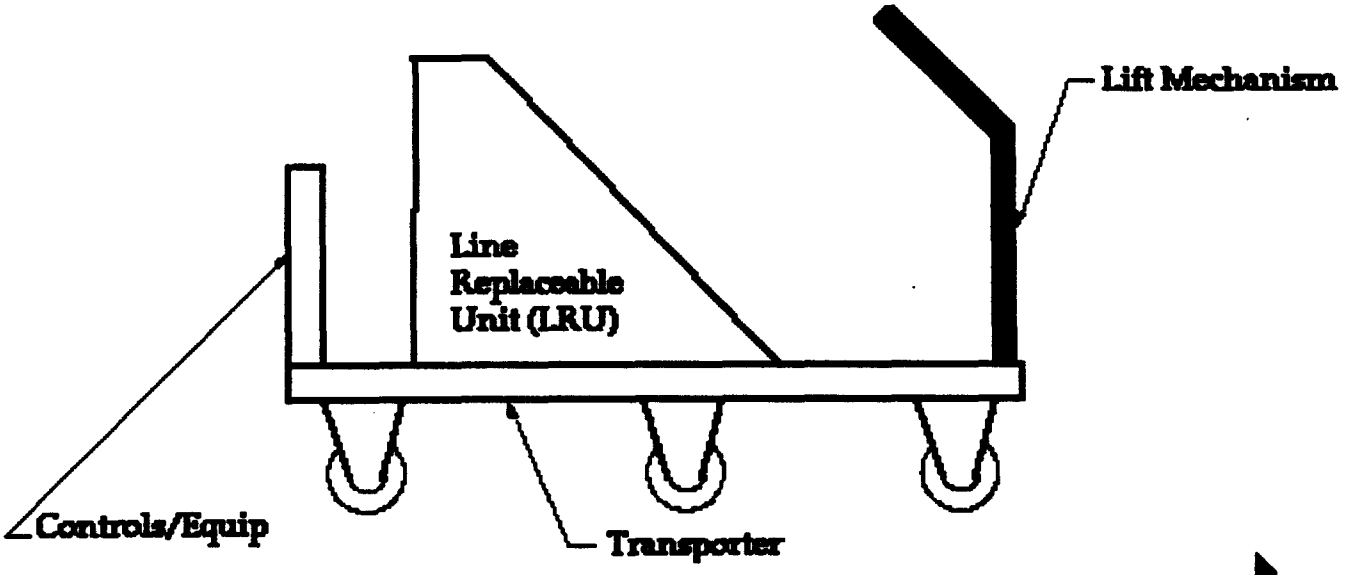
3.1.3.1 Bottom Loading Delivery System

BOTTOM LOADING DELIVERY SYSTEM



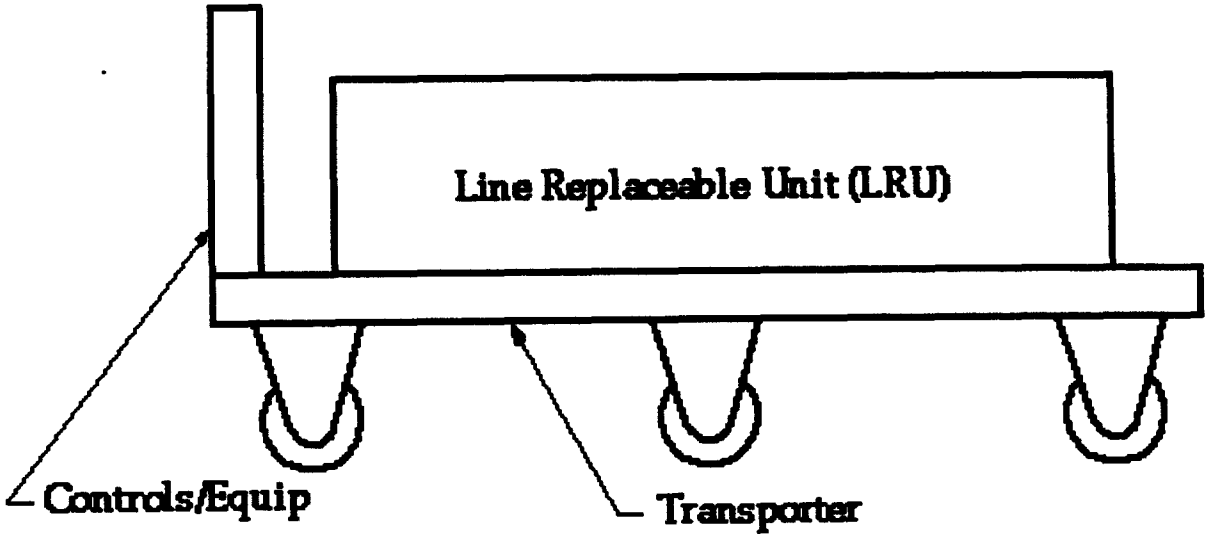
3.1.3.2 Switch Yard Delivery System

SWITCHYARD DELIVERY SYSTEM

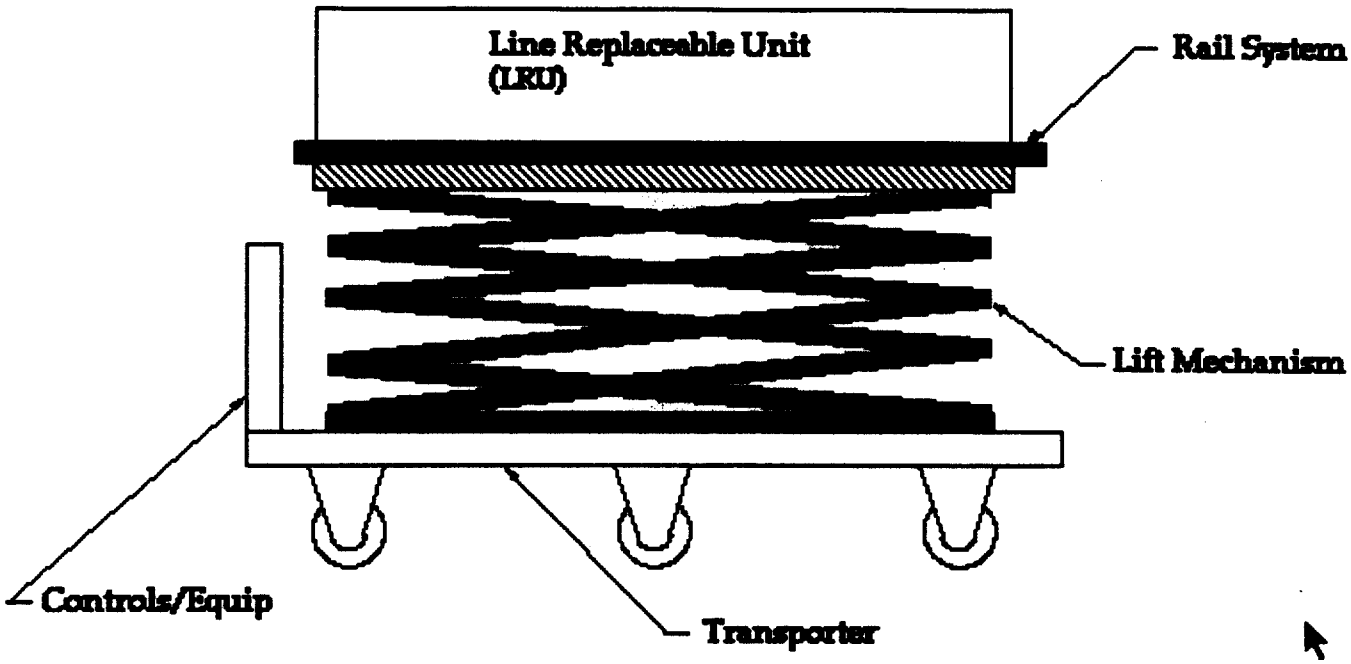


3.1.3.3 Target Area Delivery System

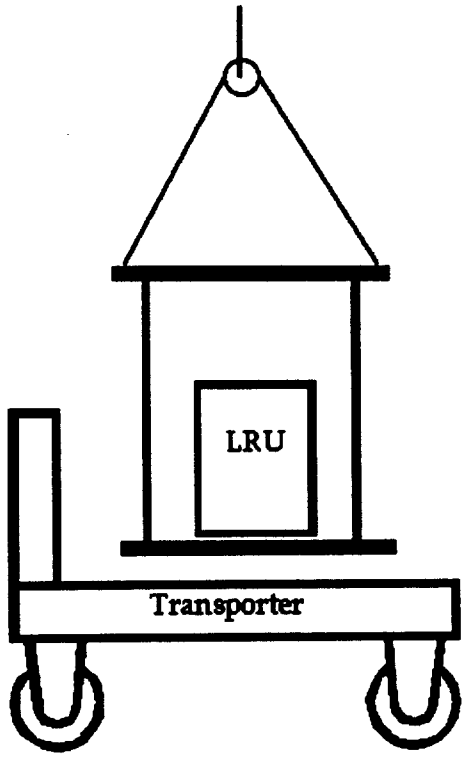
TARGET AREA DELIVERY SYSTEM



3.1.3.4 Side Loading Delivery System



3.1.3.5 Top Loading Delivery System



3.1.4.1 SubSystem Interfaces-1

The principal functional and physical interfaces for the Transport and Handling Subsystem are:

WBS 1.2.2.1 Laser Building
The Transport and Handling Subsystem travels throughout the Laser Building. The building should have sufficient clear corridor size to allow unconstrained transport of the largest LRU in a time that allows achievement of the required maintenance intervals.

The Transport and Handling Subsystem must not amplify vibrations to a point that will impact the performance of the optic assemblies. The Transport and Handling Subsystem must not affect local temperature and humidity excursions to a point that will affect the performance of the optic assemblies.

WBS 1.2.2.2 Target Building
The Transport and Handling Subsystem travels throughout the Target Area Building. The building should have sufficient clear corridor size to allow unconstrained transport of the largest LRU in a time that allows achievement of the required maintenance intervals.

The Transport and Handling Subsystem must not amplify vibrations to a point that will impact the performance of the optic assemblies. The Transport and Handling Subsystem must not affect local temperature and humidity excursions to a point that will affect the performance of the optic assemblies.

WBS 1.2.2.3 Optics Assembly Building
The Optics Assembly Building must be capable of maintaining, cleaning, configuring and loading the Transport and Handling Subsystem.

WBS 1.2.3 Support Facilities
During component inspection, acceptance testing, assembly, installation and maintenance, the Transport and Handling Subsystem will utilize support and storage facilities.

WBS 1.3.1 Optical Pulse Generation System
The Transport and Handling Subsystem transports and installs the identified LRUs in the Optical Pulse Generation System.

WBS 1.3.2 Amplifier System
The Transport and Handling Subsystem transports and installs the identified LRUs in the Amplifier System while maintaining cleanliness and environment requirements.

WBS 1.3.3 PEPC (Plasma Electrode Pockels Cell) System
The Transport and Handling Subsystem transports and installs the identified LRUs in the PEPC System while maintaining cleanliness and environment requirements.

3.1.4.2 SubSystem Interfaces-2

WBS 1.4.1 Spatial Filter Vessels/Enclosures
The Transport and Handling Subsystem transports and installs the identified LRUs in the Spatial Filter Vessels/Enclosures while maintaining cleanliness and environment requirements.

WBS 1.4.3 Support structures
The Transport and Handling Subsystem travels in the Laser Bay and Switchyard areas. The support structures access, catwalks, and mezzanines should have sufficient size and load capacity/stability to allow easy transport of the largest LRU in a time that allows achievement of the required maintenance intervals.

WBS 1.4.4.1 Switchyard Optical Mounts
The Transport and Handling Subsystem transports and lifts the identified LRUs in the Switchyard.

WBS 1.4.4.2 Periscope Optical Mounts
The Transport and Handling Subsystem transports and installs the identified Periscope LRUs using the LRU's optical mounts. For engagement to the requisite kinematic mounts, there should be adequate space between the LRU and the beam enclosure/structure to accommodate both the optical mounts and the insertion subsystem.

WBS 1.4.4.3 Spatial Filter Optical Mounts
The Transport and Handling Subsystem transports and installs the identified Spatial Filter LRUs using the LRU's optical mounts. For engagement to the requisite kinematic mounts, there should be adequate space between the LRU and the beam enclosure/structure to accommodate both the optical mounts and the insertion subsystem.

WBS 1.8.3 Target Diagnostics
The Transport and Handling Subsystem transports and installs the identified diagnostics LRUs.

WBS 1.8.4 Target Area Structures
The Transport and Handling Subsystem travels to the Target Area. The support structures access, catwalks, and platforms must have sufficient size and load capacity/stability to allow unconstrained transport of the largest LRU in a time that allows achievement of the required maintenance intervals.

WBS 1.8.5.8 Target Area/LRU Receiving, Storage, and Handling
The Transport and Handling Subsystem transports the identified Target Area LRUs from the Decontamination Area back to the OAB and from the OAB back to the Target Area.

WBS 1.8.7 Final Optics Assemblies
The Transport and Handling Subsystem transports the identified LRUs in the Final Optics System between the OAB and the Target Area while maintaining cleanliness and environment requirements.

3.1.5 Major Subsystems

The major components of the Transport and Handling Subsystem are:

- Transporter
- Canister
- Lifting Hardware
- Insertion Hardware
- Docking/sealing Hardware
- Engagement Hardware

3.2 System Characteristics and Verification

The requirements that the Transport and Handling Subsystem must meet are included in sections 3.2 through 3.6. The requirements defined by systems interfacing with the Transport and Handling subsystem are defined in ICDs with each of the elements listed.

The Transport and Handling Subsystem must conform to the Laser Bay General arrangement drawings. In turn, these drawings will show the location of the LRUs, and show sufficient space to transport, install and remove the LRUs.

3.2.1 Performance Characteristics

3.2.1.1 Cleanliness

During operation of the laser, the optical elements within the beam transport enclosures shall be maintained at a surface cleanliness level as defined by MIL-STD-1246C - Level 50. Permissible cleanliness degradation shall be budgeted across the assembly, measurement, transport, storage, installation and operation phases of laser construction. This budget is described in the document entitled, "Cleanliness Degradation Budgeting for the NIF Laser." The NVR (Non Volatile Residue) level for optical components shall conform to Level A/10 of MIL-STD-1246C or 1 mg m-2.

3.2.1.1.1 Cleanliness During Transport & Handling of Optics

The Transport and Handling Subsystem shall meet the required cleanliness budget allocation for the transport and insertion operations.

When transporting and handling optic assemblies, a cleanliness level of class 100 shall be maintained during all operation phases.

3.2.1.1.2 General Cleanliness

Wherever feasible, the Transport and Handling Subsystem to be deployed in the laser bays, switchyard, target bay, or other facilities shall be designed and constructed for class 100,000 use, and shall be compatible with cleaning by aqueous solutions. Subsystems to be used in areas of specified cleanliness less than 100,000 shall be designed to be compatible with the specified cleanliness levels.

3.2.1.2 Optics Environment

The Transport and Handling Subsystem shall maintain the optic assemblies' natural environment (Nitrogen, Argon, or Air) during all operation phases as defined in the ICDs.

3.2.1.3 Vibration Stability

TBD from specific ICDs

3.2.1.4 Shock

TBD from specific ICDs

3.2.1.5 Alignment

The Transport and Handling Subsystem shall meet alignment requirements (between the system and beamline LRU locations) as specified for a given LRU in the ICD document.

3.2.1.6 Installation of Optic Assemblies or LRUs

The Transport and Handling Subsystem shall meet motion requirements to insert and install the optic assemblies or LRUs.
"Y" Motion: TBD from specific ICDs
"Z" Motion: TBD from specific ICDs

3.2.2 Physical Characteristics

3.2.2.1 Delivery Systems Footprints

The Transport and Handling Subsystem footprint shall clear beamline and beamline support structures.

3.2.2.2 Delivery Systems Optic Assemblies' Weights

Weight Range:
Laser Bay Bottom Loading: TBD from specific ICDs
Laser Bay Top Loading: TBD from specific ICDs
Laser Bay Side Loading: TBD from specific ICDs
Switchyard Loading: TBD from specific ICDs
Target Area Loading: TBD from specific ICDs

3.2.2.3 Delivery Systems Optic Assemblies' Sizes

Dimension Size (H, W, D) Range:
Laser Bay Bottom Loading TBD from specific ICDs
Laser Bay Top Loading: TBD from specific ICDs
Laser Bay Side Loading: TBD from specific ICDs
Switchyard Loading: TBD from specific ICDs
Target Area Loading: TBD from specific ICDs

3.2.2.4 Delivery Systems Optic Assemblies' Center of Gravity Locations

TBD from specific ICDs

3.2.3 Reliability, Availability, Maintainability

3.2.3.1 Lifetime

The Transport and Handling Subsystem shall operate for 30 years.

3.2.3.2 Replaceability

The Transport and Handling Subsystem which cannot reasonably be designed for 30 year lifetime shall be designed to be replaced or repaired at reasonable cost in a timely manner consistent with the overall availability of the System.

3.2.3.3 Storage and Maintenance

All Transport and Handling Subsystem shall have designated storage and maintenance/repair facilities. They should be in close proximity to the OAB and LTAB to facilitate quick turnaround time and efficient repair/cleaning of the subsystems

3.2.3.4 Reliability

The Transport and Handling Subsystem which cannot reasonably be designed for 30 year lifetime shall be designed to be replaced or repaired at reasonable cost in a timely manner consistent with the overall availability of the System. The T & H equipment shall provide a backup means of movement, should the primary means fail. The backup system can rely on manual power or connection to an auxiliary power source.

3.2.4 Environmental

The site for NIF has not yet been selected. The present design is therefore non-site specific. For the purpose of Title I design, it shall be assumed that NIF will be constructed at a site with the general infrastructure as available at candidate sites. Specific environmental assumptions are listed in the following sections.

3.2.4.1 Ambient Temperature/Humidity

The Transport and Handling Subsystem within LTAB shall meet all requirements when operated at a temperature of 20 C ± 0.3 C, a relative humidity of 30% to 60%, and a pressure equal to ambient atmospheric pressure ±10 cm. water

3.2.4.2 Ambient Cleanliness

The Transport and Handling Subsystem shall meet all requirements when operated within LTAB. The ambient cleanliness levels in pertinent areas of the LTAB are as follows:

Area	Ambient Cleanliness Class
Laser Bay	100,000
Switchyard	100,000
Target Area	100,000

3.3 Design and Construction

The design and construction of the Transport and Handling Subsystem shall be consistent with applicable chapters of LLNL M-012 Rev 7, Feb. 1993, "Design Safety Standards - Mechanical Engineering".

3.3.1 Natural Hazards Classification

TBD

3.3.2 Safety

Unless otherwise specified herein, all elements of the T & H Subsystem shall meet the requirements of the LLNL Mechanical Engineering Design Safety Standards and Electrical Engineering Design Standards.

3.3.2.1 Life Safety

Life Safety shall comply with DOE Order 420.1, Facility Safety. Transport and Handling Subsystem shall not interfere with adequate means of egress, protection of vertical and horizontal openings, travel distances, capacities, and emergency lighting.

3.3.2.3 Occupational Safety

Industrial hygiene and occupational safety shall comply with 29 CFR 1910 and DOE Order 440.1, Worker Protection Management for DOE Federal and Contractor Employees.

Construction safety shall comply with the requirements of 29 CFR 1926, OSHA and DOE Order 440.1, Worker Protection Management for DOE Federal and Contractor Employees.

3.3.6 Human Factors

The Transport and Handling Subsystem shall be designed in an ergonomic fashion to ensure that human reliability during operation and maintenance is sustained at a level consistent with meeting overall availability and reliability objectives. Consistency in human interfaces should be maintained.

3.3.7 Interchangeability

The Transport and Handling Subsystem shall be designed to have Interchangeability of components preserved as much as practical. Equipment with the same function and physical characteristics shall be interchangeable.

3.3.8 Documentation and Records

The Transport and Handling Subsystem shall provide sufficient documentation to comply with the NIF Quality Assurance Plan, and DOE Order 5700.6C, Quality Assurance, Criterion-4 Documents and Records, which states: "Documents shall be prepared, reviewed, approved, issued, used and revised to proscribe processes, specify requirements of establish design. Records shall be specified, prepared, reviewed, approved, and maintained."
Examples of documents that should be controlled include drawings, data files, calculations, specifications, purchase orders, vendor supplied documents, procedures, work records, data sheets, and test records. Revisions should be reviewed by the organizations that originally prepared and approved the documents. Controlled documents should be distributed to those doing the work.

3.3.9 Design Processes

Design shall be carried out using sound engineering principles and appropriate standards. Design work including changes shall incorporate applicable requirements and design bases. Interfaces shall be identified and controlled. The adequacy of design products shall be verified of validated by qualified individuals other than those who did the work. Verification and Validation work shall be completed before approval and implementation of the design.

3.4 Logistics

The use of the Transport and Handling Subsystem shall be consistent with the NIF Activation and Operations Plan.

Meet requirement for operations:

Number of spares of T & H equipment: Sufficient number of spare T & H equipment shall be provided for initial installation and activation as well as for daily operations.

Replacement times allowed for transport and delivery: TBD

Other: TBD

3.4.1 Maintenance Equipment

As a part of the design, the Transport and Handling Subsystem shall provide all equipment required to inspect, service, and maintain all subsystems to meet the maintainability and availability requirements in section 3.2.3. Maintenance equipment shall include all handling fixtures, lifting equipment, cleaning equipment and other special tools not otherwise available within NIF, that are necessary to perform any planned or unplanned maintenance activity.

3.5 Other

3.6 Major Component Characteristics and Verification

4.0 QA Provisions

Quality Assurance for this subsystem will be determined by verification methods identified in §3, in combination with the identified Quality Level for individual components.

5.0 Notes

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