Target LRU Assembly and Test Stand

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Introduction/Project Overview

At the heart of Lawrence Livermore National Laboratory's (LLNL) National Ignition Facility (NIF) lies the Target Line Replaceable Unit (LRU), which holds the laser's target in place. Formerly, the design of the LRU was constrained by the need to assemble the component inside the NIF. In our project, we create an assembly and test stand allowing the new LRU to be built and evaluated externally before installation in the NIF. Our stand will enable a new LRU design as well as eliminate the waiting time associated with assembling the LRU internally.

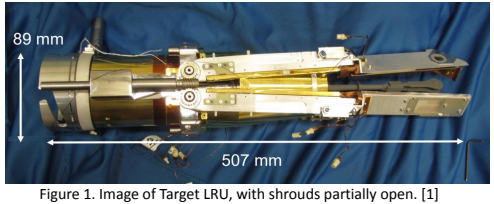

Figure 1. Image of Target LRU, with shrouds partially open. [1]

Design Requirements

- The ability to safely rotate the target LRU 135°clockwise and raise it 20° relative to the optic table for stripline curing
- A repeatability factor of ±50 microns at the tip of the target LRU
- Protect the stripline, a ~1-meter-long s-shaped cable, during assembly
- Interface with an existing Photographic Quality Assurance System (Photo QA)

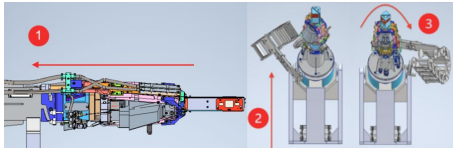

Figure 2. Target Installation Procedure

How It Works

1. Target LRU connects to assembly stand via LRU Target Inserter Cryostat (LTIC) interface
2. Labjack beneath assembly stand body raises Target LRU 20°
3. Spring-loaded latch pin is released and operator rotates LTIC interface 135° until latch pin re-inserts itself
4. Stripline loaded into stripline protection subassembly while the stripline leads cure underneath the blast shield for 24 hrs
5. Photo QA stand brought forward for validation assembly after Target LRU is returned to nominal position to verify proper target installation.
6. Transportation stand is brought forward to load assembled Target LRU and stripline protection subassembly off assembly stand to be transported to Target Chamber.

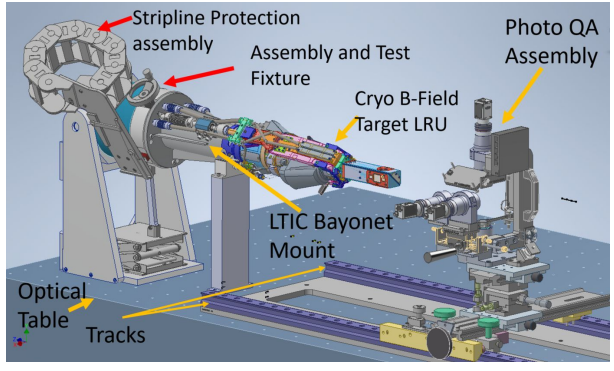

Figure 3. Target LRU Assembly and Test Stand with Photo QA System

Design Overview

The assembly stand uses tapered roller bearings to allow rotation of the Target LRU. Shown in Figure 4, the rotor is aligned in the midsection by a screw pulling the rotor inwards onto a small chamfer. A spring-loaded latch pin prevents rotation of the LTIC interface while the Target LRU is in the nominal or potting position. A labjack connected to a lift bar alters the pitch of the LRU. Underneath the LTIC interface is a hardstop that supports the assembly stand at its center of gravity. A locking linear bearing connected to the stripline transportation subassembly allows easy integration between the transportation fixture and the assembly stand. The assembly stand's location on the optic table allows for the Photo QA device to be brought forward for assembly validation. In the rotor face lies a small gearbox that allows the operator to open the shrouds with a handwheel.

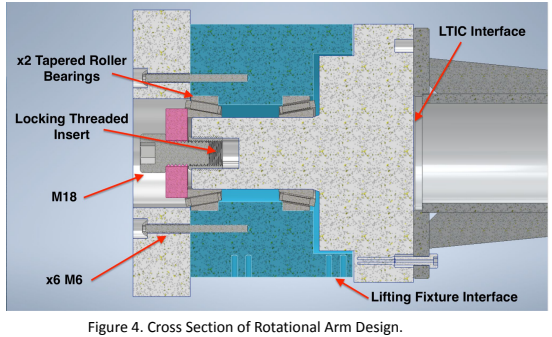

Figure 4. Cross Section of Rotational Arm Design.

Analysis

- FEA was conducted on the lift bar and bracket to ensure that they will withstand a 66 kg weight from the Target LRU and rotational arm assembly. Failure would result in damage to LRU by hitting hardstop.
- The bracket experiences load at vertical and 20° from vertical whereas the bar experiences axial force when the lift table is raised. Both components are made from 6061 Aluminum and were examined with these parameters.
- The results indicated a maximum stress of 18.55 MPa on the lift bar and 13.99 MPa for the bracket. Because the maximum stresses are smaller than yield strength of 260 MPa, they have high safety factors, being 19.19 for the bracket and 14.01 for the bar. These critical components will behave optimally.

Testing

- Evaluate stripline rigidity by repetitive bending at specified points
- Ensure design is compliant with repeatability requirements by using Photo QA stand to establish a dataset for analysis

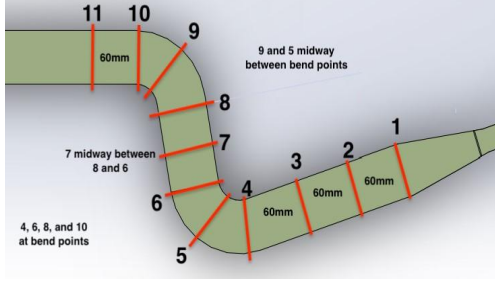

Figure 5. Stripline Bending Test Locations

Future Areas of Improvement

If given more time, our team would like to analyze the integration of the assembly and testing fixture with the transportation stand used to move the Target LRU to the NIF target chamber

Acknowledgements

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[1] K. Boehm and J. Fry, "Target Line Replaceable Unit (LRU) for the use on TARPOS" [*PowerPoint* slides], Accessed on: May. 7, 2021.

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