

## National Ignition Facility Vacuum Systems

Igor Maslennikov, LLNL

To be presented at Operation of Large Vacuum Systems (OLAV III) Workshop at ORNL, July 11-14, 2011

LLNL-ABS-485211

### Abstract:

National Ignition Facility (NIF) is a high power laser facility currently under operation at Lawrence Livermore National Laboratory in Livermore, CA. NIF's 192 laser beams will focus up to 1.8 MJ of ultraviolet laser light on a few millimeter diameter target in the center of a 10-meter diameter target chamber. NIF is currently conducting experiments aimed at demonstrating inertial confinement fusion (ICF) ignition for the first time in the laboratory.

NIF consists of several vacuum systems, which can be divided by location on two major groups – Laser Bay vacuum systems and Target Bay vacuum systems.

The Spatial Filter Vacuum system is the major vacuum system in the Laser Bays. This system consists of 48 large vessels (twenty four vessels are 94,000 liter each and another twenty four vessels are 44,000 liter each). The required pressure for each vessel is less than  $1 \times 10^{-4}$  Torr. It is achieved by using 48 magnetically levitated turbo pumps (one per each vessel). All 48 turbopumps are backed up by a single roughing pump station. Initial evacuation of all the vessels is performed by another pump station. Each pump station is equipped by a booster pump backed up by a dry pump.

Target Bay vacuum systems include three major components - Target Chamber Vacuum (TCV), Diagnostics Vacuum (DIAV), and Final Optics Assembly Vacuum (FOAV) systems.

TCV system is designed to pump a 550,000 liter Target Chamber down to  $5 \times 10^{-6}$  Torr in about 1 hour. The chamber is initially evacuated by a roughing pumps skid to  $\sim 5 \times 10^{-3}$  Torr. The skid includes 6 Roots blowers and 4 "hook-and-claw" type dry pumps. The high vacuum in the chamber is achieved by four 39" cryo pumps.

DIAV provides pumping to all of the diagnostics attached to the Target Chamber by a roughing pump station. The pump station consists of a booster pump backed by a dry pump. The pumping of the diagnostics equipment is achieved through ring headers located on the various levels of the Target Bay. Each ring header equipped with ports to provide vacuum connections to each of the diagnostics.

FOAV is used to pump down and clean dry air purge the Final Optics Assemblies (FOAs). NIF has 48 FOAs, one per 4 laser beams. Each FOA contains a set of the precision optics required to convert the laser light from infra red to ultra violet and then to focus it on a target. FOAs are pumped down by a pair of rough vacuum stations. Each station includes a booster and a backing dry pump. The clean dry air purge is supported by the same roughing pumps skid which is used to evacuate the Target Chamber.

All the Target Bay vacuum systems are connected to the Target Chamber and therefore may be contaminated by tritium. The exhaust of the roughing pumps is routed either to Tritium Processing System (TPS) or Environment Protection System (EPS) depending on the level of contamination.

This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.