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Title:	HILL: The High-Intensity Laser Laboratory Core Teamâ€™s Reply to Questions from the NNSA Experimental Facilities Panel
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HILL: The High-Intensity Laser Laboratory
Core Team's Reply to Questions from the NNSA Experimental Facilities Panel
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1. The type of physics regimes that HILL can access for weapons studies is quite interesting. The question that arises for the proposal team is what priority does this type of experimental data have versus data that can be obtained with NIF, and Z. How does HILL rank in priority compared to MARIE 1.0 in terms of the experimental data it will provide?

We reiterate that isochoric heating experiments to be conducted with HILL are *complementary* to the high energy density physics experiments at NIF and Z and uniquely access states of matter that neither other facility can access. It is our belief that HILL will enable several important questions, e.g., as related to mix morphology, radiation transfer from corrugated surfaces, and equations of state, to be run to ground through carefully diagnosed, "unit-physics" experiments. Such experiments will substantially improve confidence in our computer models and provide a rigorous science basis for certification.

In terms of priorities, because of the far larger breadth and scope of the NIF, Z, and MaRIE 1.0 facilities, it is inevitable that the data obtainable with these larger facilities would be deemed of higher overall priority to the weapons complex. *Nevertheless, HILL fills a gap by accessing and diagnosing weapons-relevant states of matter that none of these other facilities can attain*.

2. A secondary question relates to the interests of LLNL and SNL in the physics that HILL can address. This should be spelled out clearly. I would like to see the other labs be part of the discussion regarding how important this capability would be if built.

Both sister Labs have a keen interest in the physics enabled by high-intensity, high-energy lasers, as evinced by the Z Petawatt and NIF ARC upgrades to their signature facilities. LANL scientists have teamed with scientists from both Laboratories in high-intensity laser "first experiments" envisioned for HILL and we fully intend to continue these profitable discussions going forward. In the preparation of the HILL proposal, feedback was solicited from the broader HEDP and weapons science communities. The consensus view was that HILL filled a critical gap and that there was a need for a facility like HILL to address outstanding questions in weapons science. It was recognized that co-location of HILL with a facility such as MaRIE 1.0, Z, NIF, or Omega may offer additional advantages and we would expect these to be explored and evaluated during the CD process.

3. A laser/optics experts group should review this proposal to ensure the level of R&D is reasonable to provide a sufficient chance of success (>50%).

In the preparation of the HILL proposal, we sent our proposal and cost estimates to

laser designers/scientists across the complex. Though risks were identified with our design, the prevailing view of those we engaged was that the risks were appropriately represented by the TRL levels assigned and that the enabling R&D planned in our proposal was adequate for risk mitigation. We remind the panel that the design of HILL is comparatively low-risk, being based on an existing laser facility upgrade in the UK that is at the CD-2 stage. Certainly, if HILL were to go to CD-0, we would engage the broader laser/optics communities through workshops and meetings and would vet our designs more thoroughly and formally.

4. More data and peer review [is needed] from its sister facilities around the world.

It is our specific intent to conduct both scientific and technical workshops with the user community if the High Intensity Science field is further encouraged as part of the NNSA Roadmap.

5. Does HILL have to be co-located with MARIE 1.0? Is that feasible from the point of view of TA-53 real estate?

Multiple siting options were considered for HILL, including co-location with MaRIE 1.0 (the most cost-effective and flexible option), as well as in a separate, stand-alone building and in a retro-fitted existing building. The cost estimate included these contingencies and candidate locations for HILL in TA-53 were identified. There is actually significant space at TA-53 on the hill in the northeast end of the mesa.

6. What would be the impact on the weapons program if this facility were NOT built?

An inability to elucidate aspects of weapons science in the dense plasma regime and validate computer models for same. This will lead to reduced confidence in the computer tools used for certification.

7. Will HILL allow some of the x-ray vulnerability studies proposed by SPARC? If so what does Sandia's vulnerability group think of this method versus SPARC.

It is possible that some of the scope envisioned for SPARC could be achieved on HILL, although likely that the energy produced at HILL not being at all close to requirements. We would welcome these discussions with our SNL colleagues.

8. The committee had the opinion that present laser facilities could better be modified to meet this mission need.

HILL satisfies a mission need for rapid isochoric heating of materials into conditions relevant to boost with quantitative control of the variables. This is accomplished through particle generation and acceleration mechanisms that require ultra-short

(sub-100 femtosecond, we estimate actually sub-30 femtosecond) laser pulses. To generate such very short pulses, high bandwidth is required in the laser system. However, such bandwidth is not possible with current high-energy glass laser systems, so new lasers must be built to meet this requirement.

The committee also had general comments for all of the proposals on issues of risks, plans for enabling R&D, separating costs for conventional facilities from programmatic equipment, basis of estimate for costs, and alternative facility analysis. All of these particular issues were dealt with in our original written proposal for HILL.