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LIFE Plant Capital Cost / Response to a question raised by the Target Physics Panel of the NRC Review of Inertial Fusion Energy

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LIFE Plant Capital Cost –

Response to a question raised by the Target Physics Panel of the NRC Review of Inertial Fusion Energy

T. Anklam and M. Dunne, 10 May 2011

SUMMARY

A question was asked as to the costs of the “balance of plant” compared to the laser hardware.

The “first of a kind” LIFE Plant capital cost is estimated to be in the range of \$4B to \$6B including indirect costs, fees, etc. Of this, the laser accounts for about 35% of the cost and the “thermal plant” 65% (see Figures 1,2). Taken together, the fusion specific hardware (i.e. excluding costs for buildings and power conversion equipment) accounts for ~62% of the plant cost.

The detailed cost balance obviously depends on the specific plant design, technology choices, the costs of certain high impact components (e.g. diodes), and the assumed procurement and delivery models. All these terms are still evolving. Indeed – cost information is used as a key determinant in the design iteration process. However, the figures quoted below are typical of the relative contribution between conventional plant equipment, buildings and groundwork, and specialized fusion equipment.

METHODOLOGY

The LIFE plant is divided into ~ 50 cost centers. Laser system costs are estimated using a bottom up methodology. Unit costs are derived from vendor quotes and data from the NIF project (component costs and learning rates associated with volume production).

Costs for the fusion engine and tritium plant are taken from studies in the literature and scaled to the LIFE operating point using standard scaling relations.¹⁻⁵ Costs for the power conversion systems have been estimated from these studies and consultation with vendors.

Fusion target unit costs are derived from a target manufacturing study.⁶

Annual non-fuel operations, maintenance and incremental capital costs are assumed to scale as percentages of the plant total capital cost. Percentages were derived from the 2009 MIT publication on the Future of Nuclear Power.⁷

Indirect cost multipliers come from the Gen IV cost estimating guidelines.⁸ Capital and indirect cost differentials between nuclear grade and conventional systems and structures were taken from a General Atomic study.⁹ Plant availability for a 10th of a kind plant is set to 92%; high availability is enabled by the modular architecture of the plant design.

Cost of electricity is calculated using the discounted cash flow methodology described in the 2009 MIT report.⁷

Figure 1 - Site layout of the LIFE plant

Figure 2 - Components of the plant and their relative capital costs

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