

AGREEMENTACT00001.0 – VARIANT 4

BETWEEN

LAWRENCE LIVERMORE NATIONAL SECURITY, LLC

AND

FYZIKÁLNÍ ÚSTAV AV ČR, V. V. I. (Institute of Physics at the Academy of Sciences of the Czech Republic, a public research institution)


Registered in the public research institutions registry maintained by the Ministry of Education, Youth and Sports of the Czech Republic,

Na Slovance 2 182 21 Praha 8

IČO: 683 78 271

DIČ: CZ68378271

**Represented by: doc. Jan Řídký, DrSc., Director
(hereinafter the "Agreement")**



This Agreement is entered into by and between **Lawrence Livermore National Security, LLC (LLNS)**, a limited liability company organized in the State of Delaware and the management and operating contractor for the Lawrence Livermore National Laboratory (LLNL) under its Prime Contract DE-AC52-07NA27344 (hereinafter the "Prime Contract") with the U.S. Department of Energy (DOE), having an administrative office at 2300 First Street, Suite 204, Livermore, CA 94550, and Fyzikální ústav AV ČR, v. v. i., (**IOP, CLIENT**), located at Na Slovance 2, 182 21 Praha 8. **LLNS** and **CLIENT** are hereinafter collectively referred to as the "Parties", and each a "Party". **LLNS** has been selected as the winner of a public procurement procedure announced by **CLIENT** in accordance with Czech Republic Act No. 137/2006 Coll., on Public Procurement, as amended (hereinafter the "Public Procurement Act"), for the engagement called "High Repetition Rate Advanced Petawatt Laser Beamline" (hereinafter the "Procurement Procedure"). The contractual terms agreed within the Procurement Procedure reflect namely: (i) the specific nature of the subject of this agreement which includes development of the state-of-the-art technology, currently not available even in world-leading laboratories; (ii) the specific nature of **LLNS** who is a company under direct control of DOE regulated by dedicated regulations and not generally being able to enter into agreements under standard business agreement type conditions and (iii) the specific nature of the ELI-Beamlines project, which is a project funded within the Research and Development for Innovations Operational Programme with specific set of regulations pertaining to this Agreement and imposing strict time schedule, output criteria and budget restrictions for the delivery of Deliverables D1 to D8 under this agreement. **LLNS** agrees to provide to **CLIENT** technical/research services with the aim of achieving the Deliverables as identified in Article 4.A of this Agreement and in accordance with the Statement of Work attached hereto as Appendix A (the "Project") and incorporated herein, and with Clause H-41 of **LLNS**' Prime Contract, under the following terms and conditions:

1. TERM OF THE AGREEMENT

The term of this Agreement shall commence upon the latter date of (1) date of last signature, or (2) the receipt of the initial payment as required under Article 4 and shall remain in effect for fifty-one(51) months or until due delivery of the Deliverable D8, whichever occurs later, unless extended in writing by the Parties.

2. NATURE OF DELIVERY

CLIENT agrees that **LLNS** is an independent contractor and specifically acknowledges that **LLNS** is not a manufacturer or supplier of commercial products. **LLNS'** performance under this Agreement shall consist of acting with due professional care with the aim of achieving the Deliverables as identified in Article 4. A of this Agreement. **CLIENT** retains all final decision making authority and all responsibility for the formulation, design, manufacture, assembly, packaging, marketing and sale of **CLIENT'S** products, processes and services, including, without limitation, product labeling, warnings, instructions to users, and for obtaining any governmental or other pre- or postmarked approvals, certifications, registrations, licenses, or permits. The work conducted under this Agreement must not interfere with or adversely affect projects and programs that **LLNS** conducts on behalf of the U.S. Government and **CLIENT** understands and agrees that the U.S. Government work may take precedence over the work performed by **LLNS** under this Agreement. **LLNS** and the U.S. Government shall have the right to perform similar services in the Statement of Work for other parties as authorized by **LLNS'** Prime Contract with the DOE as long as any Proprietary Information (as defined herein) generated by **CLIENT** under this Agreement and formally designated as such is not used.

3. STANDARD OF PERFORMANCE - DUE PROFESSIONAL CARE

The standard of Due Professional Care shall be construed for the purpose of this Agreement as the standard applicable to a world-leading research facility performing work that is experimental and developmental in nature (hereinafter the "Due Professional Care"). **LLNS** is confident that it can perform the work and will use Due Professional Care with the aim of delivering an output that complies with the technical specifications and schedule. However, the Parties recognize that **LLNS** cannot guarantee that the technical specifications and schedule will be met, and that **LLNS'** obligation is to perform the Statement of Work using Due Professional Care.

4. FINANCIAL TERMS

A. Funding Level and Payment Schedule

The funding level to **LLNS** for the work to be performed under this Agreement is not to exceed forty-six million and two hundred thousand U.S. Dollars (\$46.2M USD) (hereinafter the "Funding Level"). The Funding Level covers the delivery of Deliverables D1 to D8 (Phases 1 and 2 – hereinafter the "Deliverables"). The Parties understand and agree that the services to be performed and goods to be delivered hereunder are in the nature of research and development, consistent with Article 3 above. **CLIENT** shall make scheduled payments in accordance with the payment schedule below.

In the case of **CLIENT'S** activation of one of the Variants described in Appendix G to this agreement the Funding Level shall also include either of the following:

Funding for the Pump Laser Performance Ramping Variant (Appendix G1)	\$10.0M USD (included in bid)
Funding for the Pump Laser Performance Ramping Variant (Appendix G2)	\$2.0M USD (included in bid)

Additional funding may be incurred only in cases of the use of the contractual options described in Appendices D, E and F to this agreement (hereinafter the "Additional Funding"). These shall not exceed the following caps.

Funding for the Spare Parts Contractual Option (Appendix D1)	\$3.8M USD (included in bid)
Funding for the Additional Parts for Alternative Use Contractual Option (Appendix D2)	\$4.1M USD (included in bid)
Funding for the Service Level Agreement Contractual Option (Appendix E)	\$0.3M USD (included in bid)
Funding for the Additional Work Statutory Option (Appendix F)	\$2.3M USD (not included in bid)
Total Additional Funding	\$10.5M USD

Deliverable	Description	To be documented by	Completion Date	Phase	Payment (to fund follow-on work)	Proposed Payment Date
	Sign Agreement	Agreement		1	\$ 8,550,000	7-Sep-2013
D1	Conceptual technical design of the laser beamline, detailed Project Execution Plan (PEP - as defined in Appendix A Statement of Work), interface definition with the ELI-Beamlines building	Submission of a technical design report including: beamline technology description; detailed PEP; specific roles, responsibilities and interfaces for LLNS and IOP staff; and description of items with long-lead procurements Acceptance Certificate	30-Nov-2013	1	\$ 9,737,500	31-Dec-2013
D1A	Technical approach for end-to-end dispersion management in the short pulse chain, including design of the stretcher and compressor sub-systems	Submission of a technical report detailing the solution for achieving high fidelity short pulses – addressing one of the critical issues for design and operation of the HAPLS (as defined in Appendix A Statement of Work) beamline Acceptance Certificate	31-Jan-2014	1	\$ 7,220,000	28-Feb-2014
D1B	Critical progress review of the Procurement Plan for major components and sub-systems for HAPLS. Update to PEP	Submission of a technical progress report on the status of the Procurement Plan – noting status of orders and vendor response, along with impacts on the PEP and mitigation action undertaken Acceptance Certificate	30-Apr-2014	1	\$ 6,270,000	31-May-2014
D2	Operational qualification of the short pulse front end, updated technical design of the beamline	Submission of a technical progress report on assembly of the HAPLS front end up to the broadband preamplifier(s), including results of the validation tests and their analysis with respect to the design requirements	31-Oct-2014	1	\$ 5,085,000	30-Nov-2014

		Acceptance Certificate				
D3	Assembly of key subsystems of the pump laser	Submission of a technical progress report on acquisition, fabrication and assembly of key components and/or subsystems of the HAPLS. The report shall also include the assembly and the validation of alignment of the optical transport system for pumping the broadband power amplifier	30-Apr-2015	1	\$ 5,470,000	31-May-2015
		Acceptance Certificate				
PHASE 1 REPORT	Summary of Phase 1 achievements	Submission of a technical progress report, with detailed inventory of purchased and commissioned equipment.	31-Aug-2015	1	Nil	N/A
		Acceptance Certificate				
D4	Acceptance test of the HAPLS pump laser including Pump Laser Readiness Criteria (PLRCs - as defined in Appendix A Statement of Work)	Demonstration to CLIENT and submission of a technical report that the HAPLS pump laser meets the specific PLRC. Submission of a confirmatory technical report recording the measured specifications.	31-Jan-2016	2	\$ 2,367,500	31-Jan-2016
		Demonstration Acceptance Protocol				
D5	Readiness of the CLIENT-provided PAD diagnostic with integrated controls and control system for performance testing of the HAPLS short pulse beamline	LLNS acceptance of CLIENT-provided PAD diagnostic with integrated controls and control system	31-Jan-2016	2	Nil	N/A
		LLNS Acceptance Certificate				

D6	Acceptance test of the HAPLS to Project Completion Criteria (PCC as defined in Appendix A Statement of Work)	Demonstration to CLIENT and submission of a technical report confirming that the completed HAPLS meets the PCC and is consistent with the result of D4.	30-Jun-2016	2	\$ 665,000	31-Jul-2016
		Demonstration Acceptance Protocol				
D7	Packaging and shipment of the HAPLS to the ELI-Beamlines facility (contingent on ELI-Beamlines facility readiness) (Incoterms 2010 DAP condition shall apply)	Receipt of HAPLS at the ELI-Beamlines facility	31-Oct-2016	2	\$ 380,000	30-Nov-2016
		Acceptance Certificate				
D7A	Review training status of IOP staff	Submission of a report providing details of the status of IOP staff training on all aspects of the HAPLS system design, commissioning, operation, maintenance, and integration into the ELI-Beamlines facility	31-Mar-2017	2	\$ 380,000	30-Apr-2017
		Acceptance Certificate				
D8	Re-assembly and commissioning of the delivered HAPLS at the ELI-Beamlines facility and demonstration of PCCs and Pump Laser Completion Criteria (PLCCs - as defined in Appendix A Statement of Work)	Demonstration at the CLIENT's site and submission of a technical report confirming that the completed HAPLS is consistent with the results of D6 and meets the PCCs, including the pump lasers achievement of PLCC. Based on achieved performance, LLNS will submit recommendations for operation of the HAPLS at full Performance Requirements.	30-Sep-2017	2	\$ 75,000	31-Oct-2017
		Demonstration Acceptance Protocol				

(Hereinafter the "Payment Schedule" and the "Delivery Schedule")

In the event that during acceptance testing, the HAPLS does not meet all of the performance requirements of the PCC, PLRC or PLCC as defined in the Statement of Work, or if meeting the PCCs, PLRCs or PLCCs takes longer than anticipated, because of principal technical issues that could not have been anticipated even with state-of-the-art expert knowledge and despite the exercise of Due Professional Care, based on recommendation of the Expert Panel (as defined in Appendix A Statement of Work) established in accordance with Section 5.7 of the Statement of Work the Parties agree that the Deliverable acceptance criteria will be fulfilled by achieving such technical parameters that can reasonably be achieved with Due Professional Care within the Funding Level. In such case, the delivery of Deliverables with such technical parameters that can be reasonably achieved shall not constitute a breach of this Agreement.

Each payment will be made by CLIENT to LLNS upon an invoice from LLNS in accordance with the Proposed Payment Dates subject to satisfactory fulfillment of the corresponding Deliverable criteria specified (where the corresponding Deliverable means the Deliverable shown on the same line as the Proposed Payment Date in the Payment Schedule). In cases where the Deliverable criteria were not met (i.e. issue of Acceptance Certificate is delayed due to reasons on the part of LLNS), LLNS would be entitled to submit a claim only for a partial payment of the following scheduled payment. The amount shall be limited by CLIENT considering the following criteria: (i) value of the work performed toward completion of the corresponding and/or preceding Deliverables, (ii) plan submitted by LLNS addressing anticipated completion of the corresponding and/or preceding Deliverables and (iii) risks connected with delay of payment with regards to fulfilling future Deliverables on time. This would provide a mechanism whereby funding for further development activities may be released whilst work continued towards completion of a delayed Deliverable, whilst demonstrating an appropriate level of governance of disbursement of public funds subject to satisfactory performance. In case of any delays caused on the part of the CLIENT (including delays with the signing of this Agreement or delays with the payments in accordance with the Payment Schedule) the Proposed Payment Dates shall be postponed for a period of the CLIENT's delay.

If in the event that modifications to the Payment Schedule within the total Funding Level are required in order to execute the Statement of Work, as determined by LLNS' project forward planning process and internal LLNS accounting procedures, then LLNS shall promptly notify CLIENT. Every attempt will be made to provide as much notice as possible, and will in all cases be no shorter than 60 days. At CLIENT's sole discretion, changes to the Payment Schedule may be enacted, but at no time shall the total funds exceed the maximum Funding Level shown in this Article. For changes required at or near the minimum notice period of 60 days, changes will be limited to 10% of the upcoming payment amount. In the case any such modifications to the Payment Schedule shall be requested by LLNS, the following restrictions to any changes to the table above shall apply:

- a) until payment associated with D4, CLIENT shall retain at least 5% of the cumulative amount of payments associated with Deliverables D1 to D4 (including initial payment upon signing); and
- b) until payment associated with deliverable D8 CLIENT shall retain at least 5% of the cumulative amount of payments associated with Deliverables D5 to D8.

B. Costs and Fee Included in Funding Level

Project costs include all direct labour and travel, supplier and materials costs, overhead/indirect costs (charged according to the rates approved by the NNSA for performance of work for other non-U.S. Government customers at LLNL), costs of third party claims and disputes, NNSA facility charges, project-related insurance costs as well as costs arising in connection with the generating of any intellectual property and acquiring and maintaining its protection, and a fixed fee as defined in the bid package.

C. No Obligation to Continue Performance

LLNS shall not be obligated to continue performance under this Agreement or otherwise to incur costs and fee in the case (i) where the aggregate amount of the Project costs spent by LLNS (as liquidated in accordance with provisions of Section 4D subsection iii. hereof) plus fee charged by LLNS (in accordance with the bid package) equals the total of scheduled payments as paid by the CLIENT, except in the case of Deliverable D8 in which case LLNS's entitlement to cease performance shall arise when LLNS has spent the amount of the funding paid by the CLIENT plus \$75,000; or (ii) where scheduled payment is delayed or reduced in breach of this Agreement by the CLIENT.

D. Invoicing and Payment

i. Invoicing of Scheduled Payments

LLNS may submit invoices for scheduled payments to the following e-mail addresses: epodatelna@fzu.cz and cc invoicing@eli-beams.eu.

The last invoice of each calendar year must be delivered by LLNS to CLIENT's mail room no later than December 15th of that calendar year. Should an invoice not be issued in compliance with the payment terms described herein or should it not meet the statutory requirements, or should it not be delivered to CLIENT by the deadlines set forth hereunder, CLIENT is entitled to return the invoice back to LLNS as incomplete or incorrectly issued, for its correction, or re-issue, within five (5) business days from the date of its delivery to CLIENT. In such a case, CLIENT shall not be in default of the remittance of the payment or any portion thereof, and LLNS shall issue a corrected invoice with a new identical due date which shall commence to run on the day of delivery of the corrected or re-issued invoice to CLIENT.

ii. Payment

Scheduled payments not received by LLNS within 30 days of receipt of invoices by CLIENT shall accrue interest at a rate of zero point seventy five percent (0.75%) per month and LLNS may, at its option, suspend work on the Project.

Payment by U.S. Mail shall be transmitted to:

Lawrence Livermore National Security, LLC
 Finance Office – Cash Applications L-435
 7000 East Avenue
 Livermore, CA 94551-5516

For Electronic Funds Transfers, or Wire Transfers, payment shall be made to the following:

Bank:	US Bank
SWIFT Code:	USBKUS44IMT
Account Number:	1-534-9510-1062
ABA Routing Number:	121122676
Bank Address:	555 S. W. Oak St. Suite 400, Portland OR
Account Name:	Lawrence Livermore Natl Security LLC

Please reference the Agreement Number ACT00001.01 and the Invoice Number in "comments" section of Electronic Funds Transfer.

It is the responsibility of CLIENT to pay VAT.

A payment of the amounts invoiced shall be understood to be effected on the day such are remitted to the bank account of LLNS. The invoices issued by LLNS hereunder shall be in compliance with all applicable legal regulations of the Czech Republic include especially the following data:

- a) Commercial name and seat of **CLIENT**
- b) Tax identification number of **CLIENT**
- c) Commercial name and seat of **LLNS**
- d) Tax identification number of **LLNS**
- e) Number of the invoice
- f) Quantity (extent) and nature of performance to be supplied or services to be rendered
- g) The date of issue of the invoice
- h) The day of the supply of goods or services or the date of the payment on account, whichever comes sooner, in so far as they differ from the date of issue of the invoice
- i) Due date
- j) The price
- k) Statement that the performance is provided in connection with the "ELI: EXTREME LIGHT INFRASTRUCTURE" Project, Reg. No. CZ.1.05/1.1.00/02.0061, according to the respective Order, or instruction in writing from **CLIENT** and, furthermore, the invoices shall also be in compliance with agreements on avoidance of double taxation, if applicable in particular cases.

iii. Cost Liquidation/Work Acceptance

LLNS and **CLIENT** agree that LLNS will prepare a monthly report of all tasks performed and total costs incurred and fixed fee charged in that month, which will be delivered to **CLIENT** by the 10th day of the succeeding month. Upon receipt, **CLIENT** will have 20 working days to review the report and identify any discrepancies or concerns in writing, whereupon LLNS will have 10 working days to correct any noted deficiencies and resubmit the report. Any report not acted upon by **CLIENT** within 20 working days of receipt will be deemed accepted and the work and costs stated therein approved. Upon Project completion or Termination and exchange of a mutual waiver and release, any scheduled payments made but not liquidated for Project work or termination costs will be refunded by LLNS to **CLIENT** unless other arrangements are made in accordance with Section 6 of the Statement of Work.

5. RISK OF LOSS AND DELIVERY

LLNS shall have risk of loss for the goods prior to delivery to **CLIENT**'s facility, and thereafter risk of loss for the goods shall transfer to **CLIENT**. Insurance for the value of the goods while LLNS has risk of loss, including during transportation to the **CLIENT**'s facility, shall be included in the Funding Level.

6. INSURANCE

A. Insurance Generally

LLNS will be responsible to provide insurance for transportation, risk of loss, or other related reasons as determined by LLNS. Funding for this insurance is included in the Funding Level. In the event of a successful insurance claim with regard to cargo and equipment damage, **CLIENT** may elect in writing to LLNS that the full net value of any insurance payment or its appropriate part will be passed from LLNS to **CLIENT**.

All insurance policies shall be maintained intact and in full force through the term of this Agreement. A minimum of thirty (30) days' written notification shall be provided with respect to any material change or cancellation affecting any certificates or policies of insurance under this Agreement. Each

Party shall use its best efforts to add the other Party as an additional insured on its insurance policies.

B. Product Liability Hold Harmless and Indemnification

Parties acknowledge that the Project and any performance carried out by LLNS under this Agreement shall not result in and shall not be construed as a product within the meaning of the Act 59/1998 Coll. or other regulations concerning product liability. Upon delivery to CLIENT in accordance with Article 13, CLIENT shall accept responsibility for all work carried out under this Agreement and any result of that work and CLIENT shall be solely liable to any third party for any damage incurred by such party in connection with or as a result of the performance of the Project under the Agreement or caused by the result of that work, except that CLIENT shall not be so liable if the damage is solely attributable to a failure of LLNS to perform the work with Due Professional Care. In connection with LLNS' performance of this Agreement, CLIENT agrees to indemnify and hold LLNS and the U.S. Government harmless from any and all liabilities, duties, claims, demands, and damages, and all costs and expenses in connection therewith, in any manner relating to the Agreement, its performance, processes, products or services derived therefrom, asserted by third parties from any cause whatsoever. For the avoidance of doubt, the undertaking to indemnify LLNS and hold it harmless does not relate to injury or damage occurring prior to the delivery to CLIENT in accordance with Article 13 during performance of the Project on the premises of the LLNS where fault of CLIENT is not a contributing cause.

7. INTELLECTUAL PROPERTY GENERALLY

A. Acknowledgement of Background Intellectual Property

The Parties acknowledge that while the Project entails research and development activities funded by CLIENT, the deliverables are predominantly based on LLNS' Background Intellectual Property (as defined in Article 8 below).

B. Copyright and Nondisclosure of Generated Information

In the event that in connection with the execution of this Agreement the Project as a whole or any Deliverable thereof shall constitute a copyrighted work within the meaning of the Act No. 121/2000 Coll., on Copyrights, Rights Related to Copyright and on amendment of certain other Acts, as amended (hereinafter referred to as the "Copyright Act"), such will be considered as the work under commission as defined in § 61 of the Copyright Act. In these cases LLNS shall grant to CLIENT a non-exclusive, royalty-free license to use the copyrighted work (or any of its parts), subject to Article 9 herein, for the purposes defined herein and/or for the purposes of research and education activities, for the entire period of validity of copyright to copyrighted works in the territory of the European Union. Should such work or any part thereof be the result of joint activities of both LLNS and CLIENT, CLIENT shall be entitled to a reasonable share of such copyright. CLIENT's share shall be agreed in each such specific case by mutual agreement of the Parties hereto taking into consideration the level of contribution of the Parties to the creation of such work including intellectual property background invested into the Project by the Parties.

Unless stipulated otherwise herein, CLIENT shall not disclose Generated Information (as defined in Article 9 below) to any other Party without prior written approval from LLNS.

C. Right to Use of HAPLS

LLNS hereby grants to CLIENT a non-exclusive, royalty-free right to use of the HAPLS, subject to

the export control provisions set forth in Article 16 herein. **CLIENT** may use the HAPLS solely for the purposes of (a) this Agreement, (b) the ELI-Beamlines Project and (c) its research and educational activities and research and educational activities of the HAPLS users. The HAPLS shall only be operated within the ELI-Beamlines facility.

The Parties agree that any **LLNS** costs of creation of any intellectual property the use rights of which are granted to **CLIENT** in this Article have been included in the Funding Level; no further remuneration shall be due.

This right to use includes the **CLIENT**'s right to submit on a confidential basis any and all necessary documents created as part of **LLNS**' delivery under this Agreement, whether or not the Agreement was subject to early termination, for the purposes of servicing of HAPLS, conducting experiments using HAPLS, and development of HAPLS or HAPLS connected technologies within the ELI-Beamlines facility, subject to the export control provisions set forth in Article 16 herein.

No other use rights or license rights, whether express or implied, are granted by **LLNS** under this Agreement or as a result of the Project performed hereunder.

D. Successor in Interest

The intellectual property rights set forth in this Article shall pass to the legal successor of **CLIENT** or the operator of the ELI-Beamlines facility, for the duration of the protection period granted to that particular patent right and/or period of existence of ownership rights to copyrighted work in the territory of the European Union.

E. Enforcement

In the event of a violation of the rights pertaining to the intellectual property created under this Agreement, their owner/proprietor shall be entitled to enforce these rights before the competent authorities. If a Party becomes aware of any breach of a Party's intellectual properties rights, such Party shall promptly notify the Party thereof.

F. Patent Rights and Rights in Technical Data

Articles 8 (Patent Rights) and 9 (Rights in Technical Data) below set forth the DOE's requirements for patent and technical data rights pursuant to Clause H-41 of the Prime Contract.

G. Survival

The terms and conditions of this Article 7 shall survive this Agreement, in the event that this Agreement is terminated before completion of the Statement of Work.

8. PATENT RIGHTS

A. Definitions

The following definitions shall be used for Article 7, this Article 8 and Article 9 below.

- a. "Subject Invention" means any invention or discovery of **LLNS**, either as Facility Contractor or Contractor-P, or, to the extent **CLIENT** or a **LLNS** subcontractor is performing any work under this Agreement, of **CLIENT** or **LLNS** subcontractor respectively, conceived in the course of, or under this Agreement or, in the case of an invention previously conceived by Contractor-P, **CLIENT** or **LLNS** subcontractor, first actually reduced to practice in the course of or under this

Agreement. "Subject Invention" includes any art, method, process, machine, manufacture, design or composition of matter, or any new and useful improvement thereof, or any variety of plant, whether patented under the Patent Laws of the United States of America or any foreign country, or unpatented.

- b. "Facility Contractor" means LLNS as M&O contractor for LLNL, operating under Prime Contract or any successor contractor thereof.
- c. "Contractor-P" means Facility Contractor's private capacity in which it is not acting in its capacity as M&O contractor for LLNL.
- d. "ACT Participant" means a non-Federal entity that is a signatory to this Agreement, including Contractor- P.
- e. "Background Intellectual Property" means the Intellectual Property set forth in Appendix B, Background Intellectual Property of the Agreement, which was in existence prior to or is first produced outside of the Agreement, except that in the case of inventions in those identified items, the inventions must have been conceived outside of the Agreement and not first constructively reduced to practice under the Agreement to qualify as Background Intellectual Property.

B. Facility Contractor Subject Inventions

Any Subject Invention made by the Facility Contractor under this Agreement will be governed by the provisions of the Prime Contract.

C. ACT Participant/LLNS Subcontractor Subject Inventions

The ACT Participants and LLNS subcontractor(s), as applicable, may retain title to their own Subject Inventions, subject to the U.S. Government retaining a non-exclusive, nontransferable, irrevocable, paid-up license to practice or have practiced by or on behalf of the United States the Subject Inventions throughout the world, a requirement to report their Subject Inventions to DOE within 6 months after conception or first actual reduction to practice, whichever occurs first, in the course of or under this Agreement, U.S. Preference (35 U.S.C. § 204), and such other conditions consistent with DOE patent waiver policy. For Subject Inventions conceived under this Agreement which are jointly developed by the ACT Participants, title to such Subject Inventions shall be jointly held by the ACT Participants.

D. Background Intellectual Property

For avoidance of doubt, Facility Contractor and the ACT Participants shall each retain ownership of, and all right, title and interest in and to, its own Background Intellectual Property, and no license therein, whether express or implied, is granted by this Agreement or as a result of the Project performed hereunder. Notwithstanding the foregoing, CLIENT shall retain a non-exclusive, royalty-free right to use of the HAPLS as set forth in Article7(C) of this Agreement.

E. Subject Invention with CLIENT's monetary contribution

To the extent an ACT Participant generates a Subject Invention that is subsequently marketed for commercial licensing purposes with the anticipation of the generation of licensing royalties, the ACT Participants shall negotiate in good faith the terms of a potential royalty-splitting arrangement.

F. Survival

The terms and conditions of this Article 8 shall survive this Agreement, in the event that this Agreement is terminated before completion of the Statement of Work.

9. RIGHTS IN TECHNICAL DATA

A. Definitions

The following definitions shall be used for this Article.

1. "Generated Information" means information produced in the performance of this Agreement or any LLNS subcontract under this Agreement.
2. "Proprietary Information" means information which is developed at private expense, is marked as Proprietary Information, and embodies: (1) trade secrets; or (2) commercial or financial information which is privileged or confidential under the Freedom of Information Act (5 USC 552 (b)(4)).
3. "Unlimited Rights" means the right to use, disclose, reproduce, prepare derivative works, distribute copies to the public, and perform publicly and display publicly, in any manner and for any purpose, and to have or permit others to do so.

B. Information Furnished to LLNS Generally

For the work to be performed at LLNL, the Parties agree to furnish to the Facility Contractor or leave at LLNL that information, if any, which is: (1) essential to the performance of work by the Facility Contractor personnel; or (2) necessary for the health and safety of such personnel in the performance of the work. Any information furnished to the Facility Contractor shall be deemed to have been delivered with Unlimited Rights unless marked as Proprietary Information. The Party furnishing the Proprietary information agrees that it has the sole responsibility for appropriately identifying and marking all documents containing Proprietary Information.

C. Generated Information

CLIENT, LLNS, either as Facility Contractor or Contractor-P, and the U.S. Government shall have Unlimited Rights in all Generated Information, except for information which is disclosed in a Subject Invention disclosure being considered for patent protection.

D. Marking of Proprietary Information

The Facility Contractor agrees not to disclose properly marked Proprietary Information without written approval of the disclosing party, except to U.S. Government employees who are subject to the statutory provisions against disclosure of confidential information set forth in the Trade Secrets Act (18 USC 1905).

E. Removal/Incorporation of Proprietary Information

CLIENT is solely responsible for the removal of all of its Proprietary Information from LLNL by or before termination of this Agreement. The U.S. Government and Facility Contractor shall have Unlimited Rights in any information which is not removed from the facility by termination of this Agreement. The U.S. Government and Facility Contractor shall have Unlimited Rights in any

Proprietary Information which is incorporated into the facility or equipment under this Agreement to such extent that the facility or equipment is not restored to the condition existing prior to such incorporation.

F. Government Rights

The U.S. Government shall have Unlimited Rights in all Generated Information produced or information provided to the Facility Contractor by **CLIENT** under this Agreement, except for information which is disclosed in a Subject Invention disclosure being considered for patent protection, or which is marked as being Proprietary Information.

G. Copyrights

The ACT Participants may assert Copyright in any of their Generated Information. Subject to the other provisions of this Article, and to the extent copyright is asserted, the U.S Government reserves for itself and others acting in its behalf, a paid-up, world-wide, irrevocable, non-exclusive license for Governmental purposes to publish, distribute, translate, duplicate, exhibit, prepare derivative works, and perform any such copyrighted works.

H. Survival

The terms and conditions of this Article 9 shall survive this Agreement, in the event that this Agreement is terminated before completion of the Project.

10. NOTICE AND ASSISTANCE REGARDING PATENT AND COPYRIGHT INFRINGEMENT

CLIENT shall report to the DOE and LLNS, promptly and in reasonable written detail, each claim of patent or copyright infringement based on the performance of this Agreement of which **CLIENT** has knowledge. **CLIENT** shall furnish to the DOE and LLNS, when requested by the DOE or LLNS, all evidence and information in the possession of **CLIENT** pertaining to such claim.

11. NO ENDORSEMENT/LITIGATION

LLNS does not endorse products or services. Therefore, **CLIENT** agrees that it will not use or imply LLNS', LLNL's or the DOE's name, or use LLNS' reports, for advertising, promotional purposes, raising of capital, recommending investments, or in any way that implies endorsement by LLNS, except with the prior written approval of LLNS.

LLNS does not undertake projects for the purpose of litigation or to assign fault or blame and does not provide expert witness services. Therefore, **CLIENT** agrees not to use any Project results in any dispute, litigation, or other legal action.

12. DISCLAIMER OF WARRANTIES, DAMAGES WAIVER AND LIABILITY CAP

A. Disclaimer of Warranties

LLNS makes no express or implied warranty as to the condition of the research or any intellectual property, generated information, or product made or developed under this agreement, or the ownership, merchantability, or fitness for a particular purpose of the research or resulting product; that the goods, services, materials, products, processes, information, or data to be furnished hereunder will

The Funding Level includes items including construction spares and engineering allowances to provide for events such as equipment damage during the development of HAPLS and implementation of reasonable comments within acceptance of Deliverables D1 to D8.

To the maximum extent permitted under applicable law, in no event shall **LLNS'** total cumulative liability to **CLIENT** exceed two million (\$2M) USD, whatever the source of the liability, however caused and under any and all claims theory of any nature whatsoever by **CLIENT**, including negligence, tort, strict liability, breach of contract or any other provision of law, and including but not limited to the following remedies:

- (a) re-performance of work or costs overruns arising as a result of **LLNS** breach of its duty to exercise Due Professional Care in the performance of any work required under the Agreement, or
- (b) any damages incurred by **CLIENT** for unexcused delivery delays.

By way of clarification, **LLNS** shall only be liable for overruns of Project costs to the extent resulting from **LLNS'** failure to exercise Due Professional Care or to the extent covered by insurance proceeds received under insurances which **LLNS** is required to arrange under this Agreement.

In the event of any disputes, the Parties may attempt resolution informally, however ultimately Article 20 (Dispute Resolution) shall govern.

The parties declare that they consider the Liability Cap, taking into account other risk mitigation mechanisms, is an appropriate upper bound to all reasonably predictable scenarios, namely whereby accidental damage is suffered through an act, error or omission of an employee or agent of **LLNS** whilst the HAPLS is being developed and in **LLNS** care and custody.

LLNS agrees that it will communicate with the **CLIENT** as soon as reasonably possible if there is an event or loss whose mitigation requires unforeseen expenditure. The Parties recognize that such notification is not intended to cure, and will not cure, the event or loss. The notification will allow the Parties to engage in possible further mitigation, reprogramming of funding, adjustment of Payment Schedule and Delivery Schedule, or other similar measures in order to avoid the Liability Cap implementation. This will further allow the **CLIENT** to better manage the issue no matter how unlikely the scenario, and no matter how high (or low) the probability risk factor at the time.

13. CLIENT PROPERTY

Any personal property or equipment produced or acquired with **CLIENT's** funds under this Agreement will be owned by **LLNS** until final transfer is made to **CLIENT**. Property or equipment produced or acquired as part of this Agreement will be accounted for and maintained by **LLNS**. Title and responsibility for the property shall be transferred upon delivery to **CLIENT** at the ELI-Beamlines facility.

LLNS will not be held liable for delays associated with transfer through international customs that are not reasonably within its ability to control.

14. FORCE MAJEURE

Neither **CLIENT** nor **LLNS** shall be liable in any way for failure to perform any provision of this Agreement (except payment of monetary obligations) if such failure is caused by any cause beyond the control of the Party in default, including but not limited to Acts of God, acts or omissions of any government or agency thereof, compliance with requirements, rules, regulations, or orders of any

governmental authority or any office, department, agency, or instrumentality thereof, fire, storm, flood, earthquake, accident, acts of the public enemy, war, rebellion, insurrection, riot, sabotage, invasion, quarantine, restriction, transportation embargoes or failures or delays in transportation.

15. TERMINATION

A. Termination Generally

Performance of work under this Agreement may be terminated at any time by either Party, without liability, only for the stated reason(s) below, upon giving written notice to the other Party. Such notice shall provide the stated reason for the proposed termination, and shall start a 30 working-days period to allow the Parties to meet (if requested) and to allow the other Party to correct the stated basis for termination.

LLNS may terminate this Agreement for the stated reason(s) of withdrawal of Project funding, closure of essential necessary facilities, or inability to perform due to catastrophic loss of a significant number of key personnel.

CLIENT may terminate this Agreement for the stated reason which is inability to supply the funding required to complete the Project.

In the event of **CLIENT's** termination due to other reasons than breach of contract on the part of **LLNS**, **LLNS** shall be entitled to payment of its actual costs of performance through the date of termination (including costs incurred by or on account of its subcontractors) plus the costs of winding down the Agreement and the **LLNS** workforce, within thirty (30) days of receipt of a final invoice, but in no event will **CLIENT's** cost responsibility exceed the Funding Level. **LLNS** agrees to provide the **CLIENT** with verifying records to support **LLNS** incurred costs as described above, consistent with the process described in Article 4D (iii) above.

In the event of **LLNS** termination, **LLNS** shall be entitled to payment of its actual costs of performance through the date of termination (including costs incurred by or on account of its subcontractors) up to the value delivered to the **CLIENT**. In no event will **CLIENT's** cost responsibility exceed the Funding Level. **LLNS** agrees to provide the **CLIENT** with verifying records to support **LLNS** incurred costs as described above, consistent with the process described in Article 4D (iii) above.

Upon termination of this Agreement **LLNS** will immediately notify its subcontractors and, where requested by the **CLIENT**, terminate their subcontracts relating to this Agreement. Costs associated with such termination shall be apportioned to **CLIENT** or **LLNS** as per this termination section depending upon the type of termination. In terminating its subcontracts **LLNS** shall make all reasonable efforts to provide completed products or items to **CLIENT** and will consult with **CLIENT** as necessary to determine the most cost effective way to provide such items given the circumstances existing at the time.

B. Termination for Convenience (U.S. Government required)

If, due to direction from the U.S. Government (hereinafter the "USG"), **LLNS** is required to delay or stop work on the Project, either Party may terminate the Agreement for convenience (USG required) upon ten (10) days' written notice. The USG is entitled to direct **LLNS** to delay or stop work on the Project for reasons of national need, either natural (such as earthquake or hurricane) or man-made (such as war, terrorist attack, or nuclear event.) The USG may also provide such direction to **LLNS** for business reasons such as withdrawal of research funding or the closure of essential facilities. If the

Agreement is terminated for convenience (USG required) LLNS shall be entitled to payment of its actual costs of performance through the date of termination (including costs incurred by or on account of its subcontractors) up to the value delivered to the CLIENT, but in no event will CLIENT's cost responsibility exceed the Funding Level. Actual costs shall mean all costs directly related to the Project which involves delivering CLIENT-owned property to the CLIENT including the costs of disassembly, packing and shipping necessary to such delivery. These costs shall further include providing Project Deliverables to the extent complete to the CLIENT, delivering Project outputs such as hardware (used and unused), reports, and manuals, and Project-related miscellaneous costs such as subcontractor close-out costs of the same type, and final testing of any operational or near operational Project subcomponents. These costs shall exclude legal, accounting or administrative personnel costs of winding up this Agreement not directly related to provision to CLIENT of the above deliverables.

Upon termination of this Agreement LLNS will immediately notify its subcontractors and, where requested by the CLIENT, terminate their subcontracts relating to this Agreement. In terminating its subcontracts LLNS shall make all reasonable efforts to provide completed products or items to CLIENT and will consult with CLIENT as necessary to determine the most cost effective way to provide such items given the circumstances existing at the time.

C. Termination at the end of Phase 1

The CLIENT and LLNS understand that CLIENT funding is provided in two phases, before and after 1 October 2015, as described in the Appendix A, Statement of Work, Section 1.4 and agree that Phase 2 may not be funded, in whole or in part, and that a lack of funding will signify the end of the contract upon notice from the CLIENT that Phase 2 funding will not be forthcoming. If Phase 2 is not funded LLNS shall be entitled to reimbursement for services provided to the time of such notice and reasonable costs to conclude operations (see Article 15(A), TERMINATION GENERALLY) including the shipping and return of all equipment to CLIENT (see Article 5, RISK OF LOSS AND DELIVERY and Article 13, CLIENT PROPERTY). CLIENT agrees that shipping costs are not included in the funds for Phase 1 and so additional funding will be provided by CLIENT to accomplish any required shipping.

16. U.S. EXPORT CONTROL

CLIENT agrees that it shall comply with all U.S. laws and regulations applicable to export of items or information. CLIENT agrees not to export or re-export any technical data, product(s), or the direct product of technical data received from LLNS, unless CLIENT has obtained all required authorizations from the U.S. Government.

17. CLIENT PRODUCT LIABILITY, U.S. GOVERNMENT DISCLAIMER AND LEGAL NOTICE

A. CLIENT Product Liability

CLIENT assumes responsibility for its use, misuse, or inability to use information or items delivered to CLIENT under the Project.

B. U.S. Government Disclaimer

This Agreement is solely between LLNS acting in a private capacity and Fyzikální ústav AV ČR, v. v. i. The United States Government is not a party to this Agreement, this Agreement does not create any obligations or liability on behalf of the Government and the Government makes no express or implied warranty as to the conditions of the research or any intellectual property, generated

information, or product made or developed under this Agreement, or the ownership, merchantability, or fitness for a particular purpose of the research or resulting product; that the goods, services, materials, products, processes, information, or data to be furnished hereunder will accomplish intended results or are safe for any purpose including the intended purpose; or that any of the above will not interfere with privately owned rights of others. The Government shall not be liable for special, consequential, or incidental damages attributed to such research or resulting product, intellectual property, generated information, or product made or delivered under this Agreement. This disclaimer does not affect any rights the Government may have against third parties arising from work conducted in connection with this Agreement.

C. Legal Notice

The Parties agree that the following legal notice will be affixed to each report furnished to **CLIENT** under this Agreement and to any report resulting from this Agreement which may be distributed by **CLIENT**:

"DISCLAIMER

This document may contain research results that are experimental in nature, and neither the United States Government, any agency thereof, Lawrence Livermore National Security, LLC, nor any of its employees makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not constitute or imply an endorsement or recommendation by the U.S. Government or Lawrence Livermore National Security, LLC. The views and opinions of authors expressed herein do not necessarily reflect those of the U.S. Government or Lawrence Livermore National Security, LLC and will not be used for advertising or product endorsement purposes."

18. SOURCE OF FUNDS

CLIENT hereby warrants and represents that none of the funding it brings to this Agreement is from U.S. Federal sources.

19. ENTIRE AGREEMENT

This Agreement, including all exhibits hereto, represents the entire agreement of the Parties and supersedes any prior discussions or understandings, whether written or oral, relating to the subject matter hereof. This Agreement may be modified or amended only by mutual agreement in writing. No course of dealing, usage of trade, waiver, or non-enforcement shall be construed to modify or otherwise alter the terms and conditions of this Agreement. In the event of any conflict or inconsistency between these terms and conditions and the Statement of Work, these terms and conditions shall control.

This Agreement consists of the following additional documents which are included as Appendices:

- Appendix A: Statement of Work
- Appendix B: Background Intellectual Property
- Appendix C: CLIENT Roles and Responsibilities
- Appendix D: Spare Parts Option
- Appendix E: Service Level Agreement Option
- Appendix F: Additional Work Option
- Appendix G: Pump Laser Demonstration Variants

The options and Variants described in Appendix D, Appendix E, Appendix F and Appendix G must be exercised by the **CLIENT** on or before the date(s) shown in each Appendix. Each option may be exercised individually or in part, as specified in accordance with Article 23 hereof. The price for each option is declared in each Appendix.

20. APPLICABLE LAW AND DISPUTE RESOLUTION

The negotiated procedure "High Repetition Rate Advanced Petawatt Laser Beamline" has been conducted in accordance with Czech Law and the place of delivery is Czech Republic. Therefore and with respect to the agreed Dispute Venue hereof, the Parties mutually acknowledge that this agreement is manifestly more closely connected to the Czech Republic and unless stipulated otherwise should be ruled by the Czech law, in particular the Act No. 513/1991 Coll., the Commercial Code.

Alternative Dispute Resolutions

The Parties may at any time, without prejudice to any other proceedings, seek to settle any dispute arising out of or in connection with the present Agreement in accordance with the ICC Alternative Dispute Resolution Rules.

Obligation to consider Alternative Dispute Resolution

In the event of any dispute arising out of or in connection with the present Agreement, the Parties agree in the first instance to discuss and consider submitting the matter to settlement proceedings under the ICC Alternative Dispute Resolution Rules.

Obligation to submit dispute to Alternative Dispute Resolution, followed by arbitration if required

If the above discussions do not provide for settlement within forty-five (45) days following the Parties' first notification of discussions the Parties agree to submit the matter to settlement proceedings under the ICC Alternative Dispute Resolution Rules. If the dispute has not been settled pursuant to the said Rules within forty-five (45) days following the filing of a Request for Alternative Dispute Resolution or within such other period as the Parties may agree in writing, such dispute shall be finally settled by binding arbitration under the Rules of Arbitration of the International Chamber of Commerce by one or more arbitrators appointed in accordance with the said Rules of Arbitration.

Dispute Venue: Vienna

Language: English

Panels shall consist of three judges: Each Party shall select one judge, and the third judge will be selected by agreement between the two selected judges

Proceedings costs: Each Party bears its own proceedings and legal representation costs, no success based reimbursements shall apply.

21. STOPWORK

The **CLIENT** may order **LLNS**, in writing, to suspend, delay, or interrupt all or any part of the work of this Agreement for the period of time that the **CLIENT** determines appropriate due to schedule delays, safety or other risk management concerns of the **CLIENT**. During this time all payments to **LLNS** shall cease, and shall not be recoverable by **LLNS**.

If the performance of all or any part of the work is, for an unreasonable period of time, suspended, delayed, or interrupted by an act of the **CLIENT** in the administration of this Agreement, or by the

Client's failure to act within the time specified in this Agreement (or within a reasonable time if not specified), then **LLNS** shall nonetheless be entitled to payment for this period.

22. EXCEPTIONAL CASES

In the exceptional case where **LLNS** shall be able to provide specific substantial objective reasons (not caused by **LLNS** and not known at the time of execution hereto), and in the case these reasons shall be approved by the Expert panel nominated in accordance hereto, the Parties may agree in written form on an amendment to one or more of the appendices and/or the Agreement.

23. CLIENT'S USE OF OPTIONS AND ACTIVATION OF VARIANTS

Unless stipulated otherwise or unless required by the Public Procurement Act that a dedicated procedure has to be undertaken, the Options and Variants defined herein are activated under the condition defined herein on sole **CLIENT** discretion by a written order delivered to **LLNS**. **LLNS** can only refuse such order in the case such order is contrary to this Agreement.

The Activation of Variants described in Appendix G shall be made taking into account the following considerations:

- a) overall value for money achieved for the **CLIENT**;
- b) availability of funds and employees to the **CLIENT**;
- c) early usability of **HAPLS** for experiments for the **CLIENT/ELI-DC/ELI-ERIC** and the prospective **HAPLS** users ;
- d) other external factors (**ELI-DC/ELI-ERIC**, Managing Authority, European Commission considerations).

24. MISCELLANEOUS

This Agreement may not be assigned in whole or in part without the prior written approval of both Parties. In any event, this Agreement shall be binding upon, inure to the benefit of, and be enforceable by and against the successors, assigns and transferees of the Parties. If any part of this Agreement shall be held invalid or unenforceable, such invalidity and unenforceability shall not affect any other part of this Agreement. Captions used as headings in this Agreement are for convenience only and are not to be construed as a substantive part of this Agreement.

FYZIKÁLNÍ ÚSTAV AV ČR, V. V. I. (Institute of Physics at the Academy of Sciences of the Czech Republic) [CLIENT]	LAWRENCE LIVERMORE NATIONAL SECURITY, LLC [LLNS]
By <u><i>Jan Ridky</i></u>	By <u><i>Paul Albright</i></u>
Name <u>Jan Ridky</u>	Name <u>PENROSE C ALBRIGHT</u>
Title <u>Director</u>	Title <u>PRESIDENT</u>
Date <u>16 SEPT 2013</u>	Date <u>11 SEPT 2013</u>

APPENDIX A -- VARIANT 4**AGREEMENTS FOR COMMERCIALIZATION OF TECHNOLOGY (ACT)
STATEMENT OF WORK****TITLE:**

Delivery of a High Repetition Rate Advanced Petawatt Laser System (HAPLS) into the L3 beamline of the Extreme Light Infrastructure ELI-Beamlines facility

ABSTRACT:

The Czech Republic (CZ) has funding allocated from their domestic and European Union strategic investment funds to build a large-scale laser facility known as the "Extreme Light Infrastructure" (ELI). This facility, to be constructed from 2012 to 2017, is part of a wider project based in Hungary and Romania as well as CZ. In response to an international competitive tender, LLNS has been selected to develop a major laser system that is designed to revolutionize the area of high intensity laser-plasma interaction science. This Agreement is to work on the design, construction, installation and commissioning of that laser beamline.

STATEMENT OF WORK:**PREAMBLE**

The **CLIENT** [Fyzikální ústav AV ČR, v. v. i. (Institute of Physics (IOP) at the Academy of Sciences of the Czech Republic, a public research institution)] is the recipient of funding provided by the Ministry of Education, Youth and Sports of the Czech Republic for the Project "ELI: EXTREME LIGHT INFRASTRUCTURE", Reg. No. CZ.1.05/1.1.00/02.0061, granted within the framework of the Operational Program Research and Development for Innovation ("OP RDI"), Priority Axis I European Centers of Excellence, Area of Intervention 1.1. European Centers of Excellence (hereinafter the "ELI-Beamlines Project").

The aim of the ELI-Beamlines Project is to construct and operate an international research laboratory (research facility) using the latest generation of laser technology and to subsequently implement a number of future projects in basic and applied research. The objectives, extent and aims of the ELI-Beamlines Project are given in more detail in the European Commission Decision dated 20.4.2011, Ref. No. C (2011) 2753 on major project "ELI: EXTREME LIGHT INFRASTRUCTURE" and in the decision of the Ministry of Education, Youth and Sports of the Czech Republic dated 2.8.2011, Ref. No. 26310/2009-45 and in the documents related to these decisions. At the same time, the ELI-Beamlines Project forms an integral part of the Czech roadmap of large infrastructures for research, development and innovations, approved by the Government of the Czech Republic.

The ELI-Beamlines Project is one of the pillars within the so-called ESFRI Roadmap created by the European Strategy Forum on Research Infrastructures which was formed at the behest of the European Commission to establish a network of pan-European research centres at the most advanced scientific levels whose aim is to facilitate, within the framework of specific scientific focus of each such research centre, a fully open access into these facilities to scientific workers exclusively on the basis of their scientific excellence (i.e. without regard to the legal or commercial status of institutions or corporations they may come from).

In order to successfully implement the ELI-Beamlines Project it will be necessary to execute certain work according to this Agreement. The executed work shall form an integral part of the infrastructure for research, development and innovations of ELI-Beamlines in Dolní Břežany (hereinafter the "ELI-Beamlines Infrastructure" or "ELI-Beamlines research centre") and shall be further used to implement research projects in the area of interaction of highly intensive laser radiation with materials.

LLNS was selected as the winner of a public procurement procedure announced by **CLIENT** in accordance with

ct No. 137/2006 Coll., on Public Procurement, as amended, for the engagement called "High Repetition Rate Advanced Petawatt Laser Beamline". The Procurement Procedure forms a basis for conclusion of an Agreement with one bidder.

LLNS declares that it possesses all professional qualifications to execute the work; it is authorized to carry out activities foreseen hereunder; and anticipates there are no obstacles on its part that would prevent it from executing the work contracted hereunder.

LLNS is aware that the deadlines for the delivery of the work or its parts as imposed hereto are vital for CLIENT with regard to the ELI-Beamlines project tie-in Projects deadlines. LLNS shall be responsible for using Due Professional Care to meet all deadlines for delivery of the Project. The Parties acknowledge that the utmost priority of CLIENT is to complete the Project as soon as possible and to be able to ramp up the performance of the HAPLS to the target technical specifications as soon as possible.

CLIENT AND LLNS HAVE AGREED TO THE FOLLOWING STATEMENT OF WORK:

1. OVERVIEW: Design, Construction, Testing and Transfer of the HAPLS

- 1.1. LLNS will work on the design, construction and commissioning of a High Repetition Rate Advanced Petawatt Laser System (hereinafter the "HAPLS"), tested to a set of Project Completion Criteria and consistent with a set of Performance Requirements, all as detailed in Section 2.
- 1.2. Upon receipt of the HAPLS by CLIENT personnel, LLNS' personnel will assist in its reassembly and activation at the ELI Beamlines facility, as described in Section 3.
- 1.3. The Project work shall be provided through partial Deliverables D1-D8 defined in Section 4, based on Acceptance procedure defined in Section 5, subject to the Early Completion Option of Section 6, and consistent with the interfaces between CLIENT and LLNS laid out in Section 7 and the procurement process laid out in Section 8.
- 1.4. This Project will be carried out in two "Phases", with objectives for each Phase defined in Section 4, with the end of Phase 1 set at 30 September 2015, and Project completion at the date specified for Deliverable D8.
- 1.5. LLNS will train CLIENT personnel as described in Section 9.
- 1.6. This Project will be documented in accordance with Section 10, and managed in accordance with Section 11.

1.7. A schematic of the HAPLS is shown in Figure 1.

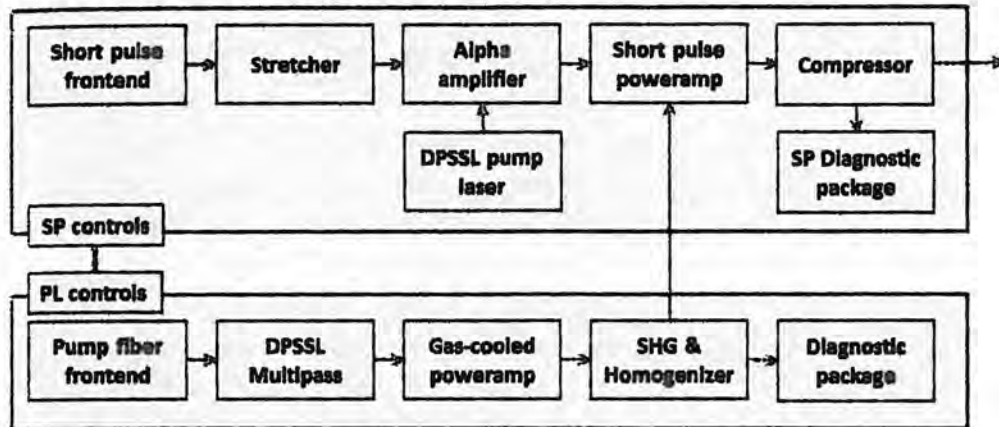


Figure 1: Schematic showing the major technical components of the HAPLS (PL = Pump Laser, SP = Short Pulse laser; SHG = Second Harmonic Generator; DPSSL = Diode Pumped Solid State Laser).

2. Performance Requirements and technical risk mitigation for the HAPLS beamline

- 2.1. The HAPLS shall be designed to be consistent with achieving the following **Performance Requirements**, once installed into the L3 beamline of the ELI Beamlines facility, and following operational ramp-up and testing in that facility.
- 2.2. The Performance Requirements are as follows:

Parameter	Value
Short pulse energy after compression	20-50J
Pump energy 1st harmonic	200 J
Pulse duration	20-50fs*
Peak power	1.5 PW*
Repetition rate	10 Hz
Energy stability	Better than 0.6% rms
RMS pointing stability **	Better than 10 μrad
Beam quality (encircled energy in diffraction limited spot)	0.5 ***
Equivalent focused intensity ****	10 ²³ Wcm ⁻²
Pre-pulse suppression (power contrast) @ 50ps at ELI-Beamlines facility	1x10 ⁻¹¹
Minimum sustained operation time over which all above parameters must be maintained	>1 hour with maximum non-operating interval of 4 hours excluding major maintenance periods

* Based on front-end choice by CLIENT

** To meet the RMS pointing stability, the ELI-beamline facility top-of-foundation ambient vibration specification for laser systems module placements require the following PSD Broadband inputs: Average < 10⁻¹⁰ g²/Hz for frequencies 0-200 Hz

No peaks $> 10^{-5} \text{ g}^2/\text{Hz}$ for frequencies 0-200 Hz

*** Fraction of total output energy before compression which is within diffraction limited spot width = $2.44 \cdot \lambda \cdot F\#$, where F is the focal length divided by beam diameter before focusing

**** Based on F#1 focusing system and measurement of focal spot size full beam equivalent plane, pulse energy, and pulse duration

2.3. The pump laser shall exhibit the following performance characteristics:

- a) Pulse energy at fundamental wavelength, at 10 Hz operation: 200J
- b) Pulse repetition rate: 10Hz, readily scalable to 20Hz
- c) Beam spatial profile: supplier to propose
- d) Beam quality: supplier to propose a beam quality compatible with potential use of the pump beam for laser plasma generation
- e) Pulse duration: supplier to propose
- f) Pulse-to-pulse RMS energy stability: $< 0.6\%$
- g) Pulse-to-pulse RMS beam pointing stability: $< 10 \mu\text{rad}$
- h) Minimum expected diode lifetime (number of full energy shots): $> 2 \times 10^8$ with reasonable expectation of 10^9
- i) Conversion efficiency to the 2nd harmonic frequency: supplier to propose

2.4. Consistent with best practice for protection of investment in a scientific facility, this operational ramp-up will necessarily extend significantly beyond the duration of this Agreement, and will be subject to appropriate configuration and operation of the ELI Beamlines facility by CLIENT. For the purposes of this Agreement, the consistency of these Performance Requirements with the HAPLS design will be accessed via the peer review process outlined in Section 5.7, and informed by the Project Completion Criteria and Pump Laser Completion Criteria listed below.

2.5. The following **Project Completion Criteria (PCC)** define the milestones that are the subject of acceptance testing at LLNL to establish the initial operational performance of the laser system, bearing in mind the goal of achieving the Performance Requirements. Measurement techniques are listed where appropriate.

Parameter		Criterion	Assurance Method
Stretched pulse energy*		$> 14 \text{ J}$	Measured with Power amplifier diagnostics (PAD)
Autocorrelation pulse duration divided by convolution factor*		40 fs FWHM	<ul style="list-style-type: none"> • Measured with PAD • Autocorrelation convolution factor calculated from spectral shape measurement
Pulse repetition rate	Full system*	3 Hz	Laser pulse repetition rate measured at required energy from power amplifier
	Petawatt front end	10 Hz	Laser pulse repetition rate measured at full functional energy requirement.
Spectral bandwidth at power amplifier output*		$> 48 \text{ nm}$ FWHM	Spectral bandwidth measured at FWHM with PAD
Continuous operation at specified energy*		1 hr	Measured continuous time of laser operation at specified energy and full system rep rate, meeting PCCs on 95% of shots

Major laser performance requirements marked () will be measured simultaneously

Criterion	Description
Laser equipment	Built and acceptance tested, ready for shipment to ELI-Beamlines
Power amplifier diagnostics (PAD)	<ul style="list-style-type: none"> • Diagnostics installed sufficient to demonstrate laser performance requirements • Temporal diagnostics: <ul style="list-style-type: none"> - Subscale aperture, diffraction grating compressor for pulse compression of sampled beam from power amplifier - Background free, dispersion balanced autocorrelator - Spectrometer with at least 180 nm spectral bandwidth - Optical power diagnostics - Third order scanning cross-correlator with >100dB dynamic range • Spatial diagnostics: <ul style="list-style-type: none"> - Full beam near field (12 bit CCD) - Far field and pointing diagnostics (12 bit CCD) - Full beam aperture energy meter (Joule meter) - Full beam wavefront diagnostics with resolution of at least $\lambda/10$ peak-to-valley for adaptive optics control loop
Final laser pulse compressor	<ul style="list-style-type: none"> • Power amplifier to compressor beam transport system installed and performance qualified • Gratings manufactured and fully characterized: diffraction efficiency map, wavefront and holographic error, R/1 damage testing on witness sample completed
Adaptive optical systems	<ul style="list-style-type: none"> • Adaptive mirror installed and functional • Spectral phase corrector installed and functional
Documentation	In hardcopy and electronic format

The pump laser constitutes a major subsystem of the HAPLS. Therefore pump laser readiness criteria (**Pump Laser Readiness Criteria, PLRC**) are defined to assess its readiness to be integrated into the HAPLS beam line. Pump Laser Readiness Criteria are as follows:

Parameter	Criterion	Assurance Method
Energy at fundamental wavelength	>60 J	Measured with pump laser diagnostics
Energy at second harmonic	>35 J	Measured with pump laser

wavelength		diagnostics
Pulse duration	20ns<t<40ns FWHM	Measured with pump laser diagnostics
Pulse repetitio n rate	Full system	3 Hz Measured with pump laser diagnostics
	Pump laser front end	10 Hz Measured with pump laser diagnostics
	Pump laser diode arrays	10 Hz Measured with pump laser diagnostics

Following demonstration of the PLRC, the pump laser will be ramped in performance at a rate that is consistent with optimal achievement of the full Performance Requirements in section 2.3. This ramping process will be tempered by the balanced project need to achieve timely commissioning of the integrated HAPLS system to PCC and PLCC levels.

2.6. The ELI Beamlines facility exists to provide world-leading technology and scientific capability to the international community. The HAPLS has been specified and designed with this in mind, and as such represents a substantial advancement over the state-of-the-art technology. Development and delivery of the HAPLS consequently carries a certain level of technical risk that is impossible to quantify fully. In recognition of the inherent technical ambition and risk, the following approach will be adopted:

2.6.1. LLNS recognizes that CLIENT has allocated specific funding for this Work, payable according to the schedule defined by the Agreement. LLNS undertakes to optimize its allocation of resources to minimize delivery risk of the HAPLS to CLIENT, consistent with the technical specifications and the available funding. The Work will include a range of risk mitigation steps to minimize the potential for technical shortfalls, reduce the delivery time, and optimize the value of the Work to CLIENT.

2.6.2. LLNS will procure a set of essential spare components for the construction phase, consistent with risk-managed development of the HAPLS. These will be shipped to CLIENT as laid out in the Agreement.

2.6.3. LLNS shall develop a detailed Risk Management Plan, to be reviewed at any time by CLIENT and at a minimum at 6monthly intervals. Allocation of resources within the Work shall be responsive to ongoing update and evaluation of this Risk Management Plan.

2.6.4. LLNS will respect any feedback to the Risk Management Plan received from CLIENT, i.e. either accept it or substantiate in writing the reasons why the feedback may not be accepted.

3. Commissioning and Facility Support

3.1. Under the management of CLIENT staff, LLNS will assist in the unpacking, assembly, start-up and early operation of the HAPLS at the ELI Beamlines facility, provided that access is granted to the facility on a timescale consistent with the overall Project schedule outlined in Section 4.

3.2. The objective of the commissioning period will be to integrate the HAPLS into the ELI Beamlines facility (utilities and other interfaces), such that all subsystems are installed and operation of the integrated system is demonstrated

3.3. LLNS agrees to provide CLIENT with the following services and assurances associated with ongoing operation of the HAPLS beamline:

- 3.3.1 Labor: LLNS agrees to provide expert technical support to CLIENT for the HAPLS by making LLNS scientific and technical expert laser staff available to support the functioning of the beamline components supplied under this contract. LLNS will make these staff available at the current US Government approved rates and associated travel costs at the time they are requested using a contract to be negotiated for work at that time. This agreement is in addition to the optional Service Level Agreement described in Appendix E to the Agreement.
- 3.3.2 Parts: LLNS agrees to provide to CLIENT all parts purchased with contract funds (excluding consumables), along with associated control system software, technical assembly drawings and system documentation. LLNS will work with its suppliers to ensure the maximum supplier parts and equipment warranties are in effect at the time of transfer.

4. Deliverables

- 4.1. The Delivery Schedule is as stipulated in and in Art. 4.A of the Agreement, i.e. it consists of the following Deliverables:

Deliverable	Description	To be documented by
D1	Conceptual technical design of the laser beamline, detailed Project Execution Plan (PEP), interface definition with the ELI-Beamlines building	Submission of a technical design report including: beamline technology description; detailed PEP; specific roles, responsibilities and interfaces for LLNS and CLIENT staff; and description of items with long-lead procurements. Acceptance Certificate
D1A	Technical approach for end-to-end dispersion management in the short pulse chain, including design of the stretcher and compressor sub-systems	Submission of a technical report detailing the solution for achieving high fidelity short pulses – addressing one of the critical issues for design and operation of the HAPLS beamline Acceptance Certificate
D1B	Critical progress review of the Procurement Plan for major components and sub-systems for HAPLS. Update to the PEP	Submission of a technical progress report on the status of the procurement plan – noting status of orders and vendor response, along with impacts on the PEP and mitigation action undertaken. Acceptance Certificate
D2	Operational qualification of the short pulse front end, updated technical design of the beamline	Submission of a technical progress report on assembly of the HAPLS front end up to the broadband preamplifier(s), including results of the validation tests and their analysis with respect to the design requirements. Acceptance Certificate

Deliverable	Description	To be documented by
D3	Assembly of key subsystems of the pump laser	Submission of a technical progress report on acquisition, fabrication and assembly of key components and/or subsystems of the HAPLS. The report shall also include the assembly and the validation of alignment of the optical transport system for pumping the broadband power amplifier. Acceptance Certificate
PHASE REPORT	1 Summary of Phase 1 achievements	Submission of a technical progress report, with detailed inventory of purchased and commissioned equipment. Acceptance Certificate
D4	Acceptance test of the HAPLS pump laser including Pump Laser Readiness Criteria (PLRCs - as defined below) and	Demonstration to CLIENT and submission of a technical report that the HAPLS pump laser meets the specific PLRC. Submission of a confirmatory technical report recording the measured specifications. Demonstration Acceptance Protocol
D5	Readiness of the CLIENT-provided PAD diagnostic with integrated controls and control system for performance testing of the HAPLS short pulse beamline	LLNS acceptance of CLIENT-provided PAD diagnostic with integrated controls and control system. LLNS Acceptance Certificate
D6	Acceptance test of the HAPLS to Project Completion Criteria (PCCs – as defined below)	Demonstration to CLIENT and submission of a technical report confirming that the completed HAPLS meets the PCCs and is consistent with the result of D4. Demonstration Acceptance Protocol
D7	Packaging and shipment of the HAPLS to the ELI-Beamlines facility (contingent on ELI-Beamlines facility readiness) (Incoterms 2010 DAP condition shall apply)	Receipt of HAPLS at the ELI Beamlines facility. Acceptance Certificate
D7A	Review training status of CLIENT staff	Submission of a report providing details of the status of CLIENT staff training on all aspects of the HAPLS system design, commissioning, operation, maintenance, and integration into the ELI-Beamlines facility Acceptance Certificate

Deliverable	Description	To be documented by
D8	Re-assembly and commissioning of the delivered HAPLS at the ELI-Beamlines facility and demonstration of PCCs and Pump Laser Completion Criteria (PLCCs – as defined below)	Demonstration at the CLIENT's site and submission of a technical report confirming that the completed HAPLS is consistent with the results of D6 and meets the PCCs, including the pump laser's achievement of PLCCs. Based on achieved performance, LLNS will submit recommendations for operation of the HAPLS at full Performance Requirements. Demonstration Acceptance Protocol

- 4.2. LLNS is aware that the deadlines for the delivery of the Project or its parts as imposed in Art.4.A of the Agreement are vital for CLIENT with regard to the ELI-Beamlines project tie-in Project deadlines. LLNS shall be responsible for using Due Professional Care to meet all deadlines for delivery of the Project. The Parties acknowledge that the utmost priority of CLIENT is to complete the Project as soon as possible and to be able to ramp up the performance of the HAPLS to the target technical specifications as soon as possible.
- 4.3. Integration and commissioning of the short pulse beam line to rep-rated operation (Deliverable D6) is subject to CLIENT completing the PAD and short pulse beamline integrated controls. LLNS will not be held responsible for delays associated with PAD and short pulse integrated controls readiness.
- 4.4. Installation and commissioning of the HAPLS into the ELI Beamlines facility is subject to the facility being suitably configured for laser equipment installation. LLNS will not be held responsible for delays associated with beneficial occupancy of the ELI Beamlines facility.

5. Acceptance procedure

- 5.1. The acceptance of Deliverables shall proceed through the procedures defined in this Section 5. As a general rule, as part of the acceptance procedure, the consistency of each Deliverable with the preceding Deliverables and with the bid package shall be verified as part of the acceptance procedure. Deviations shall be acceptable only where substantial reasons for deviation are given by LLNS.
- 5.2. Acceptance of Technical Reports and Proposals within the framework of Deliverables D1, D1A, D1B, D2, D3 and D7A.
- 5.2.1. Preliminary assessment
- 5.2.1.1. In order to preliminarily assess the results of LLNS's Deliverables, LLNS undertakes to provide CLIENT with the draft report or draft proposal relating to individual Deliverables.
- 5.2.1.2. CLIENT shall provide LLNS with his comments to the submitted draft reports or draft proposals, which LLNS shall be obliged to take into account, i.e. LLNS shall accept all justified and materially correct comments and requirements made by CLIENT. Should LLNS consider some of the comments or requirements made by CLIENT as materially incorrect or unacceptable, LLNS shall specify his reasons for refusing to accept such in writing.
- 5.2.1.3. Should CLIENT reach a conclusion that a personal meeting with LLNS is required in order to properly execute any Deliverable, CLIENT shall invite LLNS to attend such a meeting at CLIENT's registered offices or via VTC or other means of communication. LLNS shall be obliged to attend such meeting at CLIENT's registered offices, at least once in connection with execution of each Deliverable D1, D2, and D3. The Contractual Parties shall prepare a protocol documenting every such meeting. Should the protocol contain comments, LLNS shall be

obliged to follow the procedure outlined in the subsection above.

5.2.2. Acceptance Certificate

5.2.2.1. Should the reports and / or proposals comply with the expert requirements of **CLIENT** and contain essentials as set forth herein, **CLIENT** shall issue to **LLNS**, without undue delay, a confirmation attesting to their acceptance (hereinafter the "Acceptance Certificate").

5.3. Acceptance of Deliverables D4 and D6

5.3.1. Test operation

5.3.1.1. **LLNS** shall invite **CLIENT** to attend testing of functionality of the HAPLS at the normal place of business of **LLNS** in advance (at least 21 days in advance)

5.3.1.2. Assessment of the completion of Deliverable D4 and D6 shall use the Peer Review procedure outlined in Section 5.7.

5.3.1.3. The course of and results of the testing of the functionality of the HAPLS shall be subject to a written report prepared by **LLNS** (hereinafter the "Preliminary Tests Certificate"), which shall contain the statement of **CLIENT** to the results achieved along with his comments and requirements including scalability within the meaning of the Project Completion Criteria, Pump Laser Readiness Criteria (Deliverable D4) and the Performance Requirements defined above, to which **LLNS** shall be bound to respond i.e. **LLNS** shall accept all reasonable comments and requirements made by **CLIENT**. Should **LLNS** deem any of **CLIENT**'s comments or requirements unacceptable for the Work, he shall be obliged to specify in writing the reasons for such refusal. The Preliminary Tests Certificate shall form a part of the technical report.

5.3.2. Acceptance Protocol

5.3.2.1. **CLIENT** shall issue to **LLNS**, without undue delay, a confirmation on the due execution of Deliverable D4 and D6 (hereinafter the "Demonstration Acceptance Protocol") provided that the results of the demonstrated test operation correspond to **CLIENT**'s requirements according to this Contract as specified in the Project Completion Criteria and Pump Laser Readiness Criteria (Deliverable D4) including scalability to the Performance Requirements.

5.3.3. Fulfillment of the obligation

5.3.3.1. The Deliverable D4 and D6 shall be deemed to have been delivered by the issue of the Demonstration Acceptance Protocol.

5.4. Acceptance of Deliverable D5

5.4.1. Test operation

5.4.1.1. **CLIENT** shall invite **LLNS** to attend functionality testing of the **CLIENT**-provided PAD diagnostic with integrated controls and control system (at least 21 days in advance).

5.4.1.2. The course of and results from the testing of the functionality of the PAD diagnostic shall be documented in a written report prepared by **CLIENT** (hereinafter the "Preliminary Tests Certificate"), which shall contain a statement of results achieved along with comments and requirements within the meaning of the Project Completion Criteria, to which **CLIENT** shall be bound to respond i.e. **CLIENT** shall accept all reasonable comments and requirements made by **LLNS**. Should **CLIENT** deem any of **LLNS**'s comments or requirements unacceptable for the Work, he shall be obliged to specify in writing the reasons for such refusal. The Preliminary Tests Certificate shall form a part of the technical report. Based on the written test results, **LLNS** shall provide the **CLIENT** an evaluation of the results, and issue an acceptance report verifying the readiness of the PAD diagnostic and associated controls for performance testing with the HAPLS short pulse beamline.

5.4.2. Acceptance Protocol

5.4.2.1. **LLNS** shall issue to **CLIENT**, without undue delay, a confirmation on the due execution of Deliverable D5 (hereinafter the "LLNS Acceptance Certificate") provided that the results of the test operation and the readiness for performance testing of the PAD diagnostic correspond to **LLNS'** requirements according to this Contract as specified in the Project Completion Criteria.

5.4.3. Fulfillment of the obligation

5.4.3.1. The Deliverable D5 shall be deemed to have been delivered by the issue of the LLNS Acceptance Certificate.

5.5. Acceptance of Deliverable D7

5.5.1. Delivery of the HAPLS at the ELI-Beamlines facility

5.5.1.1. **LLNS** shall deliver to **CLIENT**, within the deadline set forth in Section 4, the components of the HAPLS. The delivery shall be deemed to be completed by:

5.5.1.1.1. Delivery of the HAPLS components and its handover to **CLIENT** in accordance with Incoterms 2010 DAP;

5.5.1.1.2. Handover of the complete technical documentation.

5.5.2. Acceptance Certificate

5.5.2.1. **CLIENT** shall issue to **LLNS**, without undue delay, a confirmation on the due execution of this Deliverable D7 (hereinafter the "Acceptance Certificate") provided that **LLNS** delivers the completed equipment pursuant to the agreed delivery schedule.

5.5.3. Fulfillment of the obligation

5.5.3.1. The Deliverable D7 shall be deemed to have been delivered by the issue of the Acceptance Certificate.

5.6. Acceptance of Deliverable D8

5.6.1. Preliminary assessment

5.6.1.1. **LLNS** shall inform **CLIENT** of readiness for demonstration testing of functionality of the HAPLS at the ELI Beamlines facility in advance.

5.6.1.2. Assessment of the completion of Deliverable D8 shall use the Peer Review procedure outlined in Section 5.7.

5.6.1.3. The course of and results of the testing of the functionality and scalability of the HAPLS shall be subject to a written report prepared by **LLNS** (hereinafter the "Preliminary Tests Certificate"), which shall contain the statement of **CLIENT** to the results achieved along with his comments and requirements within the meaning of the Completion Criteria and Performance Requirements defined above, to which **LLNS** shall be bound to respond i.e. **LLNS** shall accept all reasonable comments and requirements made by **CLIENT**. Should **LLNS** deem any of **CLIENT'**s comments or requirements unacceptable for the Work, he shall be obliged to specify in writing the reasons for such refusal. The Preliminary Tests Certificate shall form a part of the technical report.

5.6.2. Acceptance Protocol

5.6.3. **CLIENT** shall issue to **LLNS**, without undue delay, a confirmation on the due execution of Deliverable D8 (hereinafter the "Demonstration Acceptance Protocol") provided that the results of the demonstrated test operation correspond to **CLIENT'**s requirements according to this Contract as specified in the Project Completion Criteria including scalability to the Performance Requirements.

5.6.4. Fulfillment of the obligation

5.6.4.1. The Deliverable D8 shall be deemed to have been delivered by the issue of the Demonstration Acceptance Protocol.

5.7. Peer Review of LLNS's performance with regard to the Completion Criteria of Deliverable D4, D6 and D8 shall be conducted as follows:

5.7.1. **CLIENT** and **LLNS** shall set up an expert panel (hereinafter the "Expert Panel") to validate the results of the performance demonstration of the Project Completion Criteria, Pump Laser Readiness Criteria and Pump Laser Completion Criteria. Where possible, the membership of the Expert Panel shall be determined by mutual consent of **CLIENT** and **LLNS**, but **CLIENT** will retain final authority on appointments in the case of disagreement. The Expert Panel will review and assess the delivery of the Project from its technical perspective.

5.7.2. The Expert Panel shall operate through a Chair, appointed by mutual consent of **CLIENT** and **LLNS**, who will seek to achieve consensus from the Expert Panel but who will have final authority in the peer review process.

5.7.3. The Expert Panel shall also provide **CLIENT** with an independent peer review of the consistency of the HAPLS design with the stated objective of achieving the Performance Requirements laid out in Section 2 of the Statement of Work.

5.7.4. The output of the Expert Panel shall be used by **CLIENT** and **LLNS** to inform further measurements and potential modifications to the system design or commissioning plan, consistent with the agreed Payment Schedule and Delivery Schedule of this Agreement.

5.7.5. The Expert Panel will be configured and contracted in such a manner as to protect the Intellectual Property of **CLIENT** and **LLNS**.

5.7.6. **CLIENT** will manage and fund the Expert Panel process.

5.8. Financial inspection by **CLIENT** shall be conducted as follows.

5.8.1 **LLNS** is obliged to cooperate during financial inspections carried out in accordance with Czech Republic Act 320/2001 Coll., on Financial Inspections, as amended, i.e. to allow the Managing Authority of the Operational Program Research and Development for Innovation (hereinafter the "Sponsor") to access also those portions of the tender (bid) submitted within the Procurement Procedure, the Contract, Orders and related documents which may be protected by special legal regulation, given that all requirements set forth by legal regulation with respect to the manner of executing such inspections will have been observed; **LLNS** shall bind any of its sub-contractors to comply with this obligation accordingly. Inspection of **LLNS**'s facilities and property is governed by the U.S. Government. The Livermore Field Office (LFO) is the designated representative for such inspections, and Sponsor will apply and receive approval access from the LFO for all inspection requests.

6. Early Completion Option

6.1. **CLIENT** reserves the right to exercise this option to allow **LLNS** to provide additional enhancement of the deliverable(s) at no extra charge to **CLIENT** upon early Project completion.

6.2. The Parties agree that early completion of this Project is a desirable goal. They further agree that enhancement of the performance of the Project system(s) and equipment, and enhancement of the quality of the Intellectual Property will benefit both **CLIENT** and **LLNS**. This mutual benefit will encourage the Parties to collaborate and cooperate to the utmost to achieve early completion of the Project.

- 6.3. Upon exercise of this option LLNS will use Due Professional Care, within the Funding Level, to complete the Project ahead of the agreed Completion Date set forth in Article 4.A of the Agreement. When LLNS is certain that it will complete performance early it will notify CLIENT and provide the "new completion date". Contractor will further notify CLIENT of the type of enhancements (if any) that Contractor may perform during the period between the new completion date and the agreed completion date.
- 6.4. Upon CLIENT's approval of the enhancement work, CLIENT will allow LLNS to continue work under this contract through to the agreed completion date. Unused Agreement (CLIENT) funding will support this effort. If there is no unused Agreement funding, then the effort will not take place.
- 6.5. CLIENT will exercise this option by selection at the time of the award of the tender, or by issuance of a written, unilateral modification to the Agreement, based on written suggestion by LLNS. When exercised, this option shall become a new Article in the Agreement with the same effect as the pre-existing Articles.
- 6.6. Exercising of the option shall be at the sole discretion of CLIENT based on Contractors written suggestion. Such modification shall be subject to all provisions of this Agreement.

7. Primary interfaces between the HAPLS and the ELI Beamlines Facility

- 7.1. The HAPLS will form part of the L3 beamline at the ELI Beamlines facility.
- 7.2. LLNS-supplied HAPLS will be an integrated table-top system comprising a pump laser, short pulse front-end, short-pulse power amplifier and pulse compressor optics (pulse compression gratings and beam transport optics), consistent with the performance characteristics listed in Section 2, and consistent with CLIENT's responsibilities listed in this section.
- 7.3. The primary work scope interface between LLNS and CLIENT will be between the output of the stretched, short-pulse power amplifier (supplied by LLNS) and the compressor system (compressor vessel, short pulse beamline diagnostics, controls and control system, and timing system) supplied by the CLIENT. This division of responsibilities is shown in Table 1. LLNS is responsible for final short pulse beamline integration, consistent with Deliverable D8.

Table 1: Top level division of responsibilities for the principal subsystems of the HAPLS (PL = pump laser, SP = short pulse)

Subsystem	Responsibility
PL performance	LLNS
PL integration	LLNS
PL control system	LLNS
SP front end	LLNS
SP auto-alignment	LLNS
SP control system	CLIENT
SP DPSSL preamp	LLNS
SP gas-cooled power amp	LLNS
SP diagnostic package (SPDP)	CLIENT
Full system equivalent performance at LLNL	LLNS
SP compressor vessel	CLIENT
SP compressor optics	LLNS
SP compressor mounts	CLIENT
SP compressor integration	CLIENT
Full system integration at ELI-Beamlines	LLNS

- 7.4. Utility systems (power, cooling water, nitrogen purge systems, environmental controls, gas consumables, vacuum systems, etc.) will be supplied by **CLIENT**, consistent with the requirements of the HAPLS specified by **LLNS**.
- 7.5. **CLIENT** will supply an interface to the ELI-Beamlines safety control system and machine control system, consistent with the requirements of the HAPLS specified by **LLNS**.
- 7.6. The ELI Beamlines facility buildings, structures, clean rooms, and related systems will be supplied by **CLIENT**, consistent with Section 4 "ELI-Beamlines Building Environmental Conditions and Services" in the Technical Specification (Annex No. 3 to the Tender Documentation).
- 7.7. There will be no involvement from **CLIENT** that will relieve **LLNS** from the obligations to carry out its responsibilities in the delivery of the **HAPLS** as described in this Statement of Work, assuming the following contributions from **CLIENT** are met. **CLIENT** undertakes to:
 - 7.7.1. Provide the funding as detailed in the Agreement to implement the Project.
 - 7.7.2. Provide information on the ELI Beamlines facility as necessary for the design, installation and commissioning of the HAPLS (e.g. interface requirements to neighboring systems, floor-space for HAPLS, utility provision, and thermal, mechanical and atmospheric environment, etc.).
 - 7.7.3. Provide appropriate access to the ELI Beamlines facility on a timescale consistent with the Project Execution Plan defined in this Agreement, and in a state of completion consistent with the facility interface and commissioning requirements of the HAPLS in the L3 beamline.
 - 7.7.4. Manage the commissioning activities within the ELI Beamlines facility, and all other works based in the Czech Republic.
 - 7.7.5. Deliver to **LLNS** any and all source documents, materials or other information that are necessary for the delivery of the Project and which **LLNS** can reasonably request from **CLIENT**.
 - 7.7.6. Provide sufficient staff to perform work scope responsibilities described in Table 1, Section 7.3 and Appendix C of the Agreement. Appendix C describes the roles and responsibilities of the **CLIENT** with respect to its work scope responsibilities in Table 1, Section 7.3 as well as **CLIENT** responsibilities required to facilitate **LLNS** completion of D8.
 - 7.7.7. The **CLIENT** will perform work scope responsibilities described in Table 1, Section 7.3 and Appendix C of the Agreement by using its own employees and **LLNS** agrees to enable that the **CLIENT**'s employees will at all times remain employees of the **CLIENT** and employment-related instructions shall at all times come from the **CLIENT**. **LLNS** shall only provide technical related guidance and assistance which shall not constitute employment-related instructions. **CLIENT** will maintain for all this staff and for the whole time period of their presence in the U. S. adequate insurance including coverage for health and welfare needs, and general liability insurance coverage for the nature of the activities to be conducted, including general tort liability coverage. **CLIENT** will provide **LLNS** with proof of such insurance and **LLNS** will approve such insurance prior to commencing work or allowing work under this portion of the Agreement. Any delays associated with such insurance approval shall be borne by the **CLIENT**. As the **LLNS** will enable the **CLIENT** to perform work scope responsibilities described in Table 1, Section 7.3. by using own employees, the **CLIENT** agrees to indemnify **LLNS** from any liability associated with the **CLIENT**'s employees activities relating to this Agreement.
 - 7.7.8. **CLIENT** will have no responsibility for the design, development or operation at **LLNL** of **LLNS** supplied components for the HAPLS beamline, other than through the interfaces described above.

8. Components to be procured

- 8.1. LLNS shall be responsible for the conduct of the procurement process of all hardware within the LLNS work scope, and utilize its standard procurement and selection procedures.
- 8.2. A full list of equipment to be supplied to CLIENT will be provided within the Project Execution Plan.
- 8.3. It is understood that there will be sundry purchases of consumables, raw materials and other enabling items that are required for construction of the laser systems but which are not material Deliverables under this Agreement. LLNS will be able to use its discretion to determine what procurements fall into this category.

9. Training of CLIENT personnel

- 9.1. LLNS undertakes to train CLIENT employees (laser, controls, optical and opto-mechanical engineers) in the development, operation and maintenance of the HAPLS. This training will include hands-on training activities at LLNL during the short pulse component installation and validation stage, as well as on-site training for CLIENT personnel at CLIENT facility during installation and commissioning. This training will be performed in such a manner as to ensure that all intellectual property rights are protected. The goal of this training is to ensure that CLIENT staff is ready and capable to safely operate, maintain and troubleshoot the laser system.

10. Documentation and Archiving

- 10.1. LLNS will supply CLIENT with a set of documents as follows:
 - 10.1.1. Detailed technical description of the HAPLS
 - 10.1.2. Electronic assembly drawings package for all hardware built by LLNS
 - 10.1.3. Manuals for operation and maintenance of the HAPLS
 - 10.1.4. Training documentation
 - 10.1.5. Project Execution Plan, as described in Section 11
 - 10.1.6. Monthly Project progress reports, including financial analysis, earned-value analysis, risk management assessment, and technical progress
 - 10.1.7. Full financial information, consistent with CLIENT's auditing requirements.
- 10.2. LLNS undertakes, under the terms and conditions hereof, in accordance with instructions issued by CLIENT and using all necessary professional care, to duly archive all written material prepared in connection with the delivery of the Project and to provide access to CLIENT to these archived documents until 2021. CLIENT shall be entitled to take possession of these documents after ten years from the completion of the Work from LLNS free of charge.
 - 10.2.1. As an alternative, LLNS may supply an annual compilation of the required documentation to CLIENT to be archived by CLIENT.

11. Management Structure and Notices

- 11.1. For the purpose of undertaking this Work, LLNS shall form a Project Team of a form and scale it deems appropriate, headed by a LLNS-designated Project Manager. The Project Team will have a Project Execution Plan, prepared with the involvement of CLIENT, which will describe the organization and distribution of management and other responsibilities of the Project Team effort in support of the Work. Any changes to key members of the Project Team with respect to the original bid package are subject to CLIENT's approval. Such approval shall not be unreasonably withheld, should

LLNS suggest corresponding replacement.

- 11.2. The Project Execution Plan shall incorporate safety, environmental and health management components in accordance with **LLNS's** normal practice, including any work performed by **LLNL** personnel at the ELI Beamlines facility, as well as any work performed by **CLIENT** personnel at **LLNL**.
- 11.3. The Project Execution Plan shall be updated by **LLNS** on regular basis at least once upon 6 months. **LLNS** shall inform the **CLIENT** about any updates of the Project Execution Plan.
- 11.4. **LLNS** shall prepare a Risk Management Plan the purpose of which shall be timely assessment and management of Project risks. Risk Management Plan shall be updated on regular basis at least once upon 6 months. **LLNS** shall inform the **CLIENT** about any updates of the Risk Management Plan.
- 11.5. **LLNS** shall designate a Project Manager and **CLIENT** shall designate a Deputy Project Manager to ensure the effective coordination and performance of all technical, financial and procurement activities related to the implementation of this Work.
- 11.6. Execution of the Work shall be under the management of **LLNS**. **CLIENT** shall not be involved in managing the execution of the Work, except as detailed in Section 7.
- 11.7. **LLNS** shall make annual reports containing list of its Subcontractors the payments to which exceeded 5% of the payments received from **CLIENT** in the past Calendar year. These Reports shall be submitted no later than on 28th of February of each Calendar year of the duration of the Agreement
- 11.8. **LLNS** shall keep a list of commercially available components used for the completion of the Work the price of which exceeds 5,000 USD (five thousand US dollars). The list shall contain the item description, price and supplier identification, and, where applicable, price justification (note: ideally based on stating higher prices of competitive products or comments regarding quality, supply time etc.). An updated list shall be submitted to **CLIENT** on annual basis no later than on 28th of February of each Calendar year of the duration of the Agreement. The submission of this list shall be subject to a declaration by **CLIENT** on non-disclosure of this information (drafted by **LLNS** with respect to safeguarding of sensitive /confidential information of its **CLIENTs**) for other purposes than justification of **CLIENTs** costs within the ELI-Beamlines project according to the RDI OP rules and or inspections and audits binding for **CLIENT**. Such Declaration shall also not limit **CLIENT** in fulfilling its archiving obligations.

APPENDIX B: BACKGROUND INTELLECTUALPROPERTY

BACKGROUND INTELLECTUAL PROPERTY

1. The following background intellectual property was in existence prior to this where the numbers refer to LLNL IP reference numbers:

11818, 11836, 11918, 12031, 12035, 12036, 12069, 12082, 12123, 12126, 12137, 12169, 12183, 12202, 12246, 12251, 12291, 12302, 12303, 12306, 12308, 12336, 12340, 12342, 12351, 12356, 12386, 12503, 12504, 12580, 12582, 12647, 12691

APPENDIX C: CLIENT ROLES AND RESPONSIBILITIES

1. OVERVIEW OF PROPOSED IOP WORK WITH REGARD TO L3-HAPLS SHORT PULSE LASER SYSTEM INTEGRATION

A. Introduction: Short pulse beamline architecture

The short pulse amplification chain (SPAC) of the high repetition rate advanced Petawatt laser system (HAPLS) consist of the short pulse laser front-end, an optional pulse-cleaning stage, a pulse stretcher, alpha amplifier and the final gas-cooled Ti:Sapphire (Ti:Sa) power amplifier. The alpha amplifier is pumped by a ~2J DPSSL system, and the Ti:Sa power amplifier is pumped by pulses from the 200J Nd:GlassDPSSL system converted to the second harmonic. The stretched pulses from the Ti:Sa power amplifier are magnified and transported to the vacuum pulse compressor. The pulse compressor consists of four diffraction gratings in series. After pulse compression the beam is transported to the target area. Laser pulses are characterized in the short pulse diagnostic package (SPDP) subsequent to the pulse compressor. Part of the SPDP is the power amplifier diagnostic (PAD). The SPDP data is used for closed loop controls of the short pulse laser frontend. Laser pulses can be fed in two ways to the SPDP: either by a lower power pick off after the main pulse compressor, or directly by a lower power pick off beamline after the Ti:Sa power amplifier. Part of the SPDP is the diagnostic pulse compressor (aperture scaled pulse compressor in air to accommodate a ~20mm FWHM beam from the power amplifier) to remove the residual chirp from the pulse. The SPDP with its diagnostic pulse compressor is used to verify the PCCs.

B. Timing System (Work package #1)

Background: Timing requirements for the HAPLS Pump Laser and its Short Pulse Beam Line (SPBL) are well understood by LLNS. Timing requirements for the short pulse diagnostics and the integration of the entire laser system into the ELI Beamlines facility requires further definition of requirements and interfaces. It is our proposal that the ELI Beamlines facility provide timing triggers to the HAPLS system (Pump & SPBL), enabling the entire system to fire with the required precision to integrate HAPLS into the balance of the ELI facility.

IOP Work Package

- Design the timing backbone to meet HAPLS and the wider ELI facility requirements.
- In conjunction with LLNS, develop an Interface Control Document (ICD) that delineates the details needed for the wider ELI facility and HAPLS to proceed with system development.
- Provide a surrogate timing backbone to LLNS to allow work to proceed on pump and SPBL development.

Level of Effort for IOP

- Total effort: two controls engineers for 6 months

C. Short Pulse Diagnostic Package (Work package #2)

Background: LLNS will build the SPAC and the associated pump laser. The CLIENT will design, construct, commission, test and integrate the SPDP and the diagnostic beam transport system. CLIENT will develop the software to interface to the SPDP and the integrated controls for short pulse laser beamline providing automated operation. LLNS will consult and advise on SPDP and diagnostic subsystems. An interface control document will be developed between CLIENT and LLNS in the first 3 months after project start specifying beamline interfaces, mechanical and opto-mechanical interfaces, software interfaces and requirements. The SPDP includes:

- Short pulse diagnostic beamlines (PA and compressor output)
 - SPDP pulse distribution system (provides samples of the SPDP input to all diagnostic subsystems)
 - Single shot, 10 Hz repetition rate* performance diagnostics:
 - Full scale calorimeter (for energy calibration)
 - Short pulse energy (using integrating sphere)
 - Optical power diagnostics (Photodiode + oscilloscope)
 - Pulse spectrum covering a minimum of 180 nm bandwidth and <0.2 nm resolution
 - SPIDER, FROG (not Grenouille) or equivalent single shot pulse duration measurement (12-70 fs measurement window)
 - Second-Harmonic-Generation autocorrelator
 - Full beam, 12 bit (16-bit suggested) dynamic range, high resolution (>1 MPix) far field camera
 - Full beam, 12 bit dynamic range, high resolution (>1 MPix) near field camera
 - Full beam wavefront diagnostics with resolution of at least $\lambda/10$ peak-to-valley for adaptive optics control loop
- *includes time for data acquisition and data processing
- Scanning short pulse laser diagnostics:
 - Third-order cross-correlator with >100dB of dynamic range (power)

IOP Work Package

- Design, develop, commission and calibrate SPDP at IOP/ELI Beamline facility
- Design, develop, commission and calibrate diagnostic beam paths
- Develop failure mode effect analysis for SPDP
- In coordination with LLNS, develop hardware control interface document delineating the details needed for the wider ELI facility and HAPLS to proceed with system development
- Develop control interface document with short pulse control system development team and LLNS team including definition of electrical and optical interfaces, type of experimental data, control points, etc.
- Develop trigger points for machine safety controls
- Document SPDP and develop operating procedures

Level of Effort for IOP

- Total effort: one senior scientist and one laser-electro optical technician for 12 months. Mechanical designer/optical engineer recommended for documentation

D. Short Pulse Diagnostic Compressor (Work package #3)

Background: LLNS will be activating and qualifying the final stage of the petawatt amplifier during the last third of the LLNS construction schedule. While the HAPLS is at LLNL the SPAC performance will be assessed using a lower power pick off of from the output of the short pulse power amplifier. **CLIENT** will construct the diagnostic pulse compressor to undo the frequency chirp and feed the pulse into the SPDP for characterization and performance optimization of the HAPLS.

IOP Work Package

- Design and build a diagnostic compressor operated in air utilizing the small low power pick off of the output from the SPAC. Compressor shall utilize the same optical grating design and transmission specification as the main beamline pulse compressor
- Test and validate performance using the completed diagnostic package on a surrogate short pulse laser system at IOP

Level of Effort for IOP

- Total effort: one junior laser scientist and one LEOT for 3 months

E. Short Pulse Diagnostics & Integration (Work package #4)

Background: LLNS will build the Pump laser and the Short Pulse beamline up to the compressor. Proof of required operation will be provided at LLNL using a lower power pick off of the output from the SPBL. The **CLIENT** (IOP) will provide the short pulse diagnostics and the controls for those diagnostics. The controls and results of these diagnostics will need to be integrated with the LLNS controls for the SPBL.

IOP Work Package

- Develop Control interface document with Short Pulse Diagnostic Package (SPDP) development team and LLNS
- Develop controls for the SPDP that are consistent with the controls for the SPBL
- Develop a genetic algorithm for dispersion control in the short pulse front end to optimize pulse fidelity
- Integrate the results of the short pulse diagnostics and genetic algorithm into the overall control architecture for the Pump Laser and the SPBL.
- All software to be developed within the LabVIEW environment, without the use of Object Oriented (OO) coding.
- Closed loop operation of the deformable mirror with wavefront sensor

Level of Effort for IOP

- Total effort: two controls engineers for 15 months

F. Short Pulse Diagnostic Integration at LLNL(Work package #5)

Background: The SPDP provides data for the feedback closed loop controls of the short pulse laser frontend. The SPDP hardware must be integrated with the lower power pickoff of the final SHAC power amplifier, the diagnostic beam path and the short pulse diagnostic compressor. Basic controls must provide data acquisition capability for each SPDP subsystem. This hardware will be integrated with the IOP Controls work package.

IOP Work Package

- Package and ship diagnostic pulse compressor and SPDP from ELI Beamline facility to LLNS
- Install and reactivate SPDP at LLNL
- Commission SPBL dispersion management system
- Demonstrate pulse width control and equivalent 40 fs PCC with PAD diagnostic
- Assist LLNS staff with ramping SPBL towards design performance levels

Level of Effort for IOP

- Total effort: one senior scientist and one LEOT for 15 months

G. Integrated Operations(Work package #6)

Background: LLNS will commission the HAPLS integrated system during the final phase of the LLNS construction schedule. Full performance of the HALPS requires integrated controls for both pump laser and short pulse laser beamline. This includes but it not limited to automated dispersion management feedback loops from SPDP to short pulse frontend, pulse width adjustment, energy controls, timing controls, etc. ELI beamline personnel will train LLNS personnel on operation of the SPDP and use of the short pulse laser controls. LLNS personnel will train ELI beamline personnel on the HAPLS operation and pump laser integrated control system so both parties will be proficient operators and stewards of the HAPLS.

IOP Work Package

- Assist in the development of failure mode effect analysis
- Study and learn the identified failure modes and effects analysis, commissioning test procedures, and operational checklists/controls
- Develop integrated control system for the short pulse laser beamline for integration with the HAPLS control system
- Apprentice with scientists and engineers in standard protocols, maintenance, and alignment procedures
- Participate in operations campaigns

Level of Effort for IOP

- Total effort: one senior laser scientist, one junior laser scientist, and one LEOT for 6 months

H. Integrated Controls and Sequencing(Work package #7)

Background: Integrated controls provide closed loop operation of the SPBL and automated operations. The sequence engine enables the execution of custom designed scripts to operate complex control system. This sequence engine turns hardware on and off, waits for external hardware to complete required tasks, interacts with the operator and allows for different operating procedures without writing custom LabVIEW code. The Sequence Engine is designed to operate across multi-processor control systems. This sequence engine has been used on numerous other projects and will be a key element of the HAPLS control system.

IOP Work Package

- Learn the fundamentals of the Sequence Engine including the script editor and command logging system.
- Learn how to include new commands as requirements dictate
- Develop sequences (aka scripts) that will allow operation of the short pulse diagnostics within the LLNS sequence language for the laser.

Level of Effort for IOP

- Total effort: two controls engineers for 3 months

I. Manuals(Work package #8)

Background: Ultimately the ELI Beamlines personnel will need to be able to operate the control system as well as adapt the control system to the evolving needs of the experimental system that the HAPLS Laser is used in. At a minimum, two key pieces of documentation for the control system will be required. The first is a "Theory of Operation" manual and the second is an "Operator's Manual". The first document is targeted toward the software engineer whose responsibility it will be to adapt the system to the evolving needs of the experiment and will be a road map to the control system architecture. The second manual will be targeted toward the people tasked with day to day operation of the laser system.

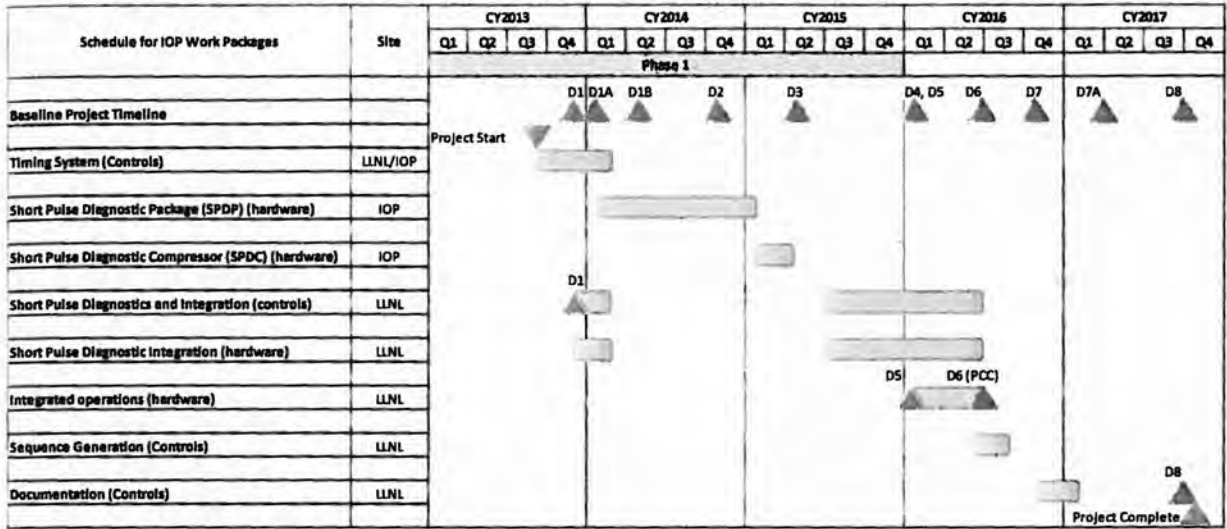
IOP Work Package

- Theory of Operation – Understand the overall architecture of the control system and capture that understanding into a formal document.
- Operator's Manual – Generate a manual that describes in detail the front panel controls provided at completion of the control system development. This manual should include detailed procedures for common control functions of the laser system including start-up and shut-down. These procedures can be written into scripts that will operate in the sequence engine (see Work Package #3).

Level of Effort for IOP

- Total effort: two controls engineers for 3 months

J. Schedule for IOP Work Packages



2. REQUIRED IOP SUPPORT FOR DELIVERABLE D8 COMPLETION AT THE ELI BEAMLINES FACILITY

Describe the capabilities that IOP must have in place in order to begin and complete the D8 demonstration at ELI-Beamlines facility.

- Staff as described above
- ELI-Beamlines facility readiness for operations
- Utilities (e.g., appropriate power, chilled water, N2, vacuum) the details of which will be specified in the interface control document provided in Deliverable D1.
- Material handlers, riggers with cranes, forklifts, and pallet jacks
- Appropriate tools (e.g., alignment lasers, power meters)

APPENDIX D: SPARE PARTS OPTION

1. OPERATIONAL SPARE PARTS

The **CLIENT** reserves the right to exercise an option for additional terms for **LLNS** to supply operational spare parts, in whole or in part.

Upon exercise of this option **LLNS** will provide spare parts critical for operation of the laser system at the ELI-Beamlines facility with minimal downtime. Critical spare parts are considered as those with long lead times (typically 6 months or more) and those typically not stocked at vendors, those which represent a higher risk for laser downtime due to single point failures and thus critically important for the continuous operation of the laser, and those with more frequent maintenance cycles.

Subject to vendor availability, the list of recommended spare parts, latest option exercise month from start date, and individual price, comprises, but is not limited to:

	Project Month	Cost (USD)
- Replacement pump laser high energy amplifier laser diode DC pulsers	30-Apr-2014	\$283k
- Replacement laser diode spare array	30-Aug-2014	\$844k
- Replacement power pump amplifier gain media (full set for both amplifiers)	30-Nov-2013	\$37k
- Replacement critical optics for the pump laser high energy beamline optics	30-Aug-2014	\$322k
- Replacement Pockels cell head for high energy section in pump laser	30-Aug-2014	\$48k
- Replacement pump laser frequency converter nonlinear crystal(s)	30-Aug-2014	\$103k
- Replacement pump laser beam homogenizer	30-Nov-2013	\$31k
- Replacement Ti:sapphire gain media for power amplifier slabs (full set)	30-Nov-2013	\$223k
- Replacement Ti:sapphire gain media for alpha amplifier	30-Nov-2013	\$9k
- Replacement critical optics for the short pulse high energy beamline (up to compressor)	30-Aug-2014	\$366k
- Replacement diffraction gratings for the short pulse compressor (set of 4)	30-Nov-2014	\$691k
- Replacement parts for critical control and diagnostics components	30-Aug-2014	\$177k

Exercising of all or part of the option shall be at the sole discretion of **CLIENT** and shall be subject to all provisions of this Agreement.

The prices shown above represent the best available figures at the time of the contract, based on vendor quotes, but allowance needs to be made for potential cost escalation. As such, the maximum funding limit for this option is set at \$3.8M USD.

2. ADDITIONAL PARTS FOR ALTERNATIVE USE

The **CLIENT** reserves the right to exercise an option for additional terms for **LLNS** to supply additional parts for alternative use within the ELI Beamlines Facility.

Subject to vendor availability, the list of additional parts for alternative use, option exercise date, and individual price comprises, but is not limited to:

	<u>Project</u>	<u>Cost</u>
	<u>Month</u>	<u>(USD)</u>
- Short pulse front end	28-Feb-2014	\$1,517k
- Alpha amplifier assembly	30-Nov-2013	\$118k
- Pump laser assembly	28-Feb-2014	\$649k
- Diffraction gratings	30-Aug-2014	\$739k
- Short pulse diagnostics	28-Feb-2014	\$409k

Exercising of all or part of the option shall be at the sole discretion of **CLIENT** and shall be subject to all provisions of this Agreement.

The prices shown above represent the best available figures at the time of the contract, based on vendor quotes, but allowance needs to be made for potential cost escalation. As such, the maximum funding limit for this option is set at \$4.1M USD.

APPENDIX E: SERVICE LEVEL AGREEMENT OPTION

For support to on-going commissioning and operations beyond the duration of this Agreement, **LLNS** agrees to enter into a Service Level Agreement (SLA) with **CLIENT**. This SLA sets forth the agreement between **CLIENT** and **LLNS** for services herein described to be performed under the following conditions.

LLNS will provide the services of Field Service Specialists (FSS) to **CLIENT** for general servicing of the **HAPLS**, troubleshooting performance, addressing any issues arising from the system's original build quality, and performance ramping of the system. Such services will be provided for up to 12 weeks, over a 2 year period, commencing with the completion of D8 described in Section 4 of the Statement of Work. Any additional optional services requested will be billed according to **LLNS's** service schedule.

CLIENT will meet with **LLNS** in advance to determine the service schedule needed. The schedules must be approved by **CLIENT's** Project Manager and **LLNS's** Project Manager

CLIENT will ensure that a representative is on site during the performance of service work. **CLIENT's** authorized representative will certify with the FSS that the equipment is in normal operating condition at the completion of service.

If maintenance for the **HAPLS** is requested because of causes other than normal wear and use, the service will be provided at **LLNS's** Service rates and will be invoiced to **CLIENT**.

All charges for this service period are included in the bid price as an option. Services beyond this point will be billed according to **LLNS's** service schedule.

This SLA does not include consumables or spare parts for servicing of any equipment. These are to be provided by **CLIENT**.

Additional services beyond those provided for under this Agreement are fully chargeable to **CLIENT** at **LLNS's** prices and terms in effect at the time of occurrence.

LLNS is not responsible for failure to render service due to causes beyond its control including, but not limited to, act of nature, act of government, labor disputes, delay in transportation, delays in delivery, or action thereon, that may inhibit **LLNS's** ability to render services. **CLIENT** may terminate this agreement if service is interrupted for thirty (30) days and **LLNS** is unable to resume service within thirty days of such interruption at no further cost or obligation to **CLIENT**.

These SLA work services are fully chargeable to **CLIENT** at **LLNS's** prices and terms in effect at the time of occurrence. The indicative cost for three (3) representative, full-time equivalent staff (1 senior physicist, 1 senior engineer, 1 senior technician) for a period of six weeks per year at the **CLIENT's** facility is \$257K USD. The actual cost of these work services will depend on the experience and skill of the required and designated **LLNS** staff member. This indicative cost does not include any dislocation or travel expense, as might be applicable. As such, the maximum funding limit for this SLA option is set at \$300K USD.

Exercising this option shall be at the sole discretion of **CLIENT** and shall be subject to all provisions of this Agreement.

CLIENT will exercise this option on or before 6 months prior to the end of the contract period of performance.

APPENDIX F: ADDITIONAL WORK OPTION

The **CLIENT** reserves the right to exercise an option (not included in bid) in accordance with applicable law to purchase from **LLNS** additional work services and equipment deemed necessary for the successful delivery of Deliverables D1 to D8 as set forth in this Agreement.

CLIENT will meet with **LLNS** in advance to determine the additional work scope and/or equipment needed and must be approved by **CLIENT**'s Project Manager and **LLNS**'s Project Manager.

The additional work services are fully chargeable to **CLIENT** at **LLNS**'s prices and terms in effect at the time of occurrence. The indicative cost for three (3) representative, full-time equivalent staff (1 physicist, 1 engineer, 1 technician) for a one-week (5-day, 40-hour) period at LLNL is in the range \$14K - \$19K USD. The actual cost of these work services will depend on the experience and skill of the required and designated **LLNS** staff member. This indicative cost does not include any dislocation or travel expense should **CLIENT** require services on-site at their location.

Any additional equipment will be subject to vendor availability and pricing in effect at the time of occurrence.

Charges for this optional activity are not included in the bid price.

CLIENT will exercise this option on or before the end of the contract period.

APPENDIX G: PERFORMANCE RAMPING VARIANTS

G1. PERFORMANCE RAMPING – VARIANT 1

PUMP LASER SYSTEM TO ACHIEVE PERFORMANCE CONSISTENT WITH THE HAPLS PERFORMANCE REQUIREMENTS

1. The **CLIENT** reserves the right to activate this Variant for additional terms for **LLNS** to undertake further performance ramping of the pump laser.
2. This Variant shall be activated or abandoned by the **CLIENT** on or before 31 October 2014. The activation of this Variant shall be at the sole discretion of the **CLIENT** and shall be subject to all provisions of the Agreement. Upon activation of this Variant I, the respective provisions of the Agreement shall be replaced by the provisions of this Section G1
3. Upon activation of this Variant, **LLNS** will undertake an additional set of tasks in the period leading up to Deliverable D6, consistent with the schedule defined in the table below, with the following objectives:
 - a. **LLNS** will ramp the output performance of the pump laser from the Pump Laser Readiness Criteria (PLRC) defined in "Appendix A section 2.5 to a higher level of performance, to be known as the Pump Laser Completion Criteria (PLCC). The PLCC will be consistent with the short pulse system Performance Requirements defined in "Appendix A section 2.2.
 - b. The principal driving factor in determining the PLCC is the set of Performance Requirements listed in Appendix A section 2.2, and in particular the requirement for >30 J short pulse laser energy output of the compressor system at 10 Hz repetition rate (for a 30 fs pulse duration). All other parameters, such as the pump energy required at the fundamental wavelength (1ω) and second harmonic (2ω) are derivative of these Performance Requirements. In order to achieve the above objective, **LLNS** will use its technical judgment to balance appropriately the performance of the pump laser in order to achieve the full-system Performance Requirements of HAPLS and maximize its operational robustness for user operations. The nominal values for balanced operation are 160-200J at 1ω and 100J at 2ω to achieve >30 J short pulse energy at the output of the compressor system.
 - c. In addition to the above tasks, **LLNS** will undertake to ramp the pump laser performance at the fundamental wavelength (1ω) to 200J at 10 Hz repetition rate in order to demonstrate this upper limit in energy and average power capability.
 - d. As detailed in the following Payment Schedule (and Delivery Schedule), **LLNS** will provide additional technical progress reports on or before 31 August 2015 and on or before 30 September 2016, and will provide a final progress report in relation to this activity as part of Deliverable D6.
4. The maximum funding limit for this Variant plus the baseline as set forth in Appendix A, Statement of Work is 56.2 M\$.

5. Upon activation of this Variant, the Payment Schedule (and Delivery Schedule) in Article 4 of the Agreement shall be replaced by the following Payment Schedule (and Delivery Schedule):

Deliverable	Description	To be documented by	Completion Date	Phase	Payment (to fund follow-on work)	Proposed Payment Date
	Sign contract	Contract		1	\$ 8,550,000	Month 0
D1	Conceptual technical design of the laser beamline, detailed Project Execution Plan (PEP – as defined in Appendix A Statement of Work), interface definition with the ELI-Beamlines building	Submission of a technical design report including: beamline technology description; detailed PEP; specific roles, responsibilities and interfaces for LLNS and IOP staff; and description of items with long-lead procurements	30-Nov-2013	1	\$ 9,737,500	31 Dec-2013
		Acceptance Certificate				
D1A	Technical approach for end-to-end dispersion management in the short pulse chain, including design of the stretcher and compressor sub-systems	Submission of a technical report detailing the solution for achieving high fidelity short pulses – addressing one of the critical issues for design and operation of the HAPLS beamline	31-Jan-2014	1	\$ 7,220,000	28-Feb-2014
		Acceptance Certificate				
D1B	Critical progress review of the Procurement Plan for major components and sub-systems for HAPLS. Update to the PEP	Submission of a technical progress report on the status of the Procurement Plan – noting status of orders and vendor response, along with impacts on the PEP and mitigation action undertaken	30-Apr-2014	1	\$ 6,270,000	31-May-2014
		Acceptance Certificate				

APPENDIX G1 VARIANT DECISION	Decision to proceed with Appendix G (Performance Ramping) Variant 1	Written instruction from CLIENT to LLNS	31 Oct 2014	1	\$ 3,415,000	30 Nov-2014
		Acceptance Certificate				
D2	Operational qualification of the short pulse front end, updated technical design of the beamline	Submission of a technical progress report on assembly of the HAPLS front end up to the broadband preamplifier(s), including results of the validation tests and their analysis with respect to the design requirements	31-Oct-2014	1	\$ 4,085,000	30-Nov-2014
		Acceptance Certificate				
D3	Assembly of key subsystems of the pump laser	Submission of a technical progress report on acquisition, fabrication and assembly of key components and/or subsystems of the HAPLS. The report shall also include the assembly and the validation of alignment of the optical transport system for pumping the broadband power amplifier	30-Apr-2015	1	\$ 4,000,000	31-May-2015
		Acceptance Certificate				
APPENDIX G1 PHASE 1 REPORT	Summary of Phase 1 achievements	Submission of a technical progress report, with detailed inventory of purchased and commissioned equipment.	31-Aug-2015	1	\$ 5,000,000	30-Sep-2015
		Acceptance Certificate				

D4	Acceptance test of the HAPLS pump laser including Pump Laser Readiness Criteria (PLRCs - as defined in Appendix A Statement of Work)	Demonstration to CLIENT and submission of a technical report that the HAPLS pump laser meets the specific PLRCs. Submission of a confirmatory technical report recording the measured specifications.	31-Jan-2016	2	\$ 4,000,000	31-Jan-2016
		Demonstration Acceptance Protocol				
D5	Readiness of the CLIENT-provided PAD diagnostic with integrated controls and control system for performance testing of the HAPLS short pulse beamline	LLNS acceptance of CLIENT-provided PAD diagnostic with integrated controls and control system	31-Jan-2016	2	Nil	N/A
		LLNS Acceptance Certificate				
APPENDIX G1 INTERMEDIATE REPORT	Progress report on performance ramping of the Pump Laser	Submission of a technical progress report on the operational performance of the pump laser.	30-Sep-2016	2	\$ 2,422,500	31 Oct 2016
		Acceptance Certificate				
D6	Acceptance test of the HAPLS to Project Completion Criteria (PCC – as defined in Appendix A Statement of Work and Appendix G1) and the Pump Laser Completion Criteria (PLCC as defined in Appendix A Statement of Work and Appendix G1)	Demonstration to CLIENT and submission of a technical report confirming that the completed HAPLS meets the PCCs and a final report confirming that the pump laser meets the PLCCs.	30-Sep-2017	2	\$ 665,000	31-Oct-2017
		Demonstration Acceptance Protocol				

D7	Packaging and shipment of the HAPLS to the ELI-Beamlines facility (contingent on ELI-Beamlines facility readiness) (Incoterms 2010 DAP condition shall apply)	Receipt of HAPLS at the ELI-Beamlines facility	31-Jan-2018	2	\$ 380,000	28-Feb-2018
		Acceptance Certificate				
D7A	Review training status of IOP staff	Submission of a report providing details of the status of IOP staff training on all aspects of the HAPLS system design, commissioning, operation, maintenance, and integration into the ELI-Beamlines facility	30-Jun-2018	2	\$ 380,000	31-Jul-2018
		Acceptance Certificate				
D8	Re-assembly and commissioning of the delivered HAPLS at the ELI-Beamlines facility and demonstration of PCCs	Demonstration at the CLIENT's site and submission of a technical report confirming that the completed HAPLS is consistent with the results of D6 and meets the Project Completion Criteria. Based on achieved performance, LLNS will submit recommendations for operation of the HAPLS at full Performance Requirements.	31-Dec-2018	2	\$ 75,000	31-Dec-2018
		Demonstration Acceptance Protocol				

G2. PERFORMANCE RAMPING – VARIANT 2***PUMP LASER SYSTEM TO ACHIEVE 100 J AT 10 HZ (WITH INTEGRATED OPERATION AT 2 ω)***

1. The **CLIENT** reserves the right to activate Variant for additional terms for **LLNS** to undertake further performance ramping of the pump laser.
2. This Variant shall be activated or abandoned by the **CLIENT** on or before 31 October 2014. The activation of this Variant shall be at the sole discretion of the **CLIENT** and shall be subject to all provisions of this Agreement. Upon activation of this Variant II, the respective provisions of the Agreement shall be replaced by the provisions of this Section G2.
3. Upon activation of this Variant, **LLNS** will undertake an additional set of tasks in the period leading up to Deliverable D6, consistent with the schedule defined in the table below, with the following objectives:
 - a. **LLNS** will ramp the output performance of the pump laser from the Pump Laser Readiness Criteria (PLRC) defined in "Appendix A section 2.5 to a higher level of performance, defined as the Pump Laser Completion Criteria (PLCC), as follows:

Parameter		Criterion	Assurance Method
Energy at fundamental wavelength		100 J	Measured with pump laser diagnostics
Energy at second harmonic wavelength		60 J	Measured with pump laser diagnostics
Pulse duration		20ns<t<40ns FWHM	Measured with pump laser diagnostics
Pulse repetition rate	Full system	10 Hz	Measured with pump laser diagnostics
	Pump laser front end	10 Hz	Measured with pump laser diagnostics
	Pump laser diode arrays	10 Hz	Measured with pump laser diagnostics

- b. **LLNS** will provide a final progress report in relation to this activity as part of Deliverable D6.
4. The maximum funding limit for this Variant plus the baseline as set forth in the Statement of Work in Appendix A is 47.2 M\$, subject to the provision that **CLIENT** supplies additional personnel (see also Paragraph 5 below) as follows:
 - a. 3 senior staff (see skills matrix below) for 8 months' work at LLNL, and 8 months' work at the ELI Beamlines facility during HAPLS commissioning.
 - b. These **CLIENT** employees will work during this time under the technical direction of **LLNS**. They will be required to participate at a senior technical level in **LLNS**'

development, integration and performance ramping of the short pulse beam line to achieve the Project Completion Criteria (PCC). Specific packages of work will include:

- i. Assemble short pulse beam line subsystem components.
 - ii. Commission, operate, troubleshoot, characterize, and optimize performance of the short pulse frontend (including the Joule-class alpha amplifier).
 - iii. Assist in characterizing and optimizing the high average power pump laser beam for pumping the gas-cooled short pulse power amplifier.
 - iv. Assist in assembly, commissioning, operation, troubleshooting, characterization, and optimizing performance of the gas-cooled short pulse power amplifiers to achieve robust operation.
 - v. Assist in identification, documentation and mitigation of failure modes; coordinate with the short pulse controls team to identify control systems parameters for robust and safe operations.
- c. All **CLIENT** personnel visiting and working at the LLNL site must comply with DOE Foreign National visitor requirements.
- d. The skills, knowledge and abilities (SKA) requirements for these 3 staff shall be as provided in the following table:

FTE	Education	Expertise
Senior short pulse laser PhD physicist experienced in large aperture TiSa broadband amplification	PhD in Laser technology plus 5 years' experience (or equivalent)	<p>Minimum 8 years substantial hands-on expertise in:</p> <ul style="list-style-type: none"> • Strong background in laser science and technology • Design, development, building and commissioning of high peak power lasers (200 TW and beyond) • Short pulse amplification in and 526nm-532nm pumping of large aperture (>5cm²) Ti:Sa crystals • ASE management and temporal and transverse gain effects in large aperture (>5cm²) Ti:Sa crystals • Laser beam homogenization • CPA in Ti:Sa with >10J output energy • Short pulse generation and broadband amplification of pulses with duration <40fs • Extensive knowledge in short pulse optics, optical coatings and optical materials performance at high fluence (>2 J/cm²) and large beamsize • Measuring and analyzing short pulses with SPIDER or FROG techniques, and high dynamic range scanning cross-correlator • Strong background in function and operation of general laser components (e.g., laser amplifier, pump cavities, pockels cells, spatial filters, diffraction gratings, front-ends, timing and controls systems) • Review and revision of laser operation procedures and manuals • Laser safety
Senior laser PhD physicist experienced in average power	PhD in Laser technology plus 5 years' experience (or equivalent)	<p>Minimum 8 years substantial hands-on expertise in:</p> <ul style="list-style-type: none"> • Strong background in laser science and technology • High average power laser research and development (general laser systems with average power output >300W) • High average power laser research and development of short pulse laser systems with average power output >10W and energy >1J per pulse • Laser beam homogenization • Short pulse generation and broadband amplification of pulses with duration <40fs • Review and revision of laser operation procedures and manuals • Laser safety

Senior Laser Electro Optical Technician (LEOT)	BS or equivalent	<p>Minimum 8 years substantial hands-on expertise in:</p> <ul style="list-style-type: none">• Operation of energetic, high repetition rate laser systems (>2J, >10Hz)• Assembly, operation, and performance optimization of CPA laser systems• Handling, preparation, cleaning of delicate optics and optical materials• Assembly of opto-mechanical components and systems• Alignment techniques and precision optical alignment of optical systems• Design and installation of primary laser sensors and actuators (e.g., CCDs, spectrometer, step motors, energy and power heads, fiber pickoffs)• General knowledge and understanding principle of operation for general laser components (e.g., laser amplifier, pump cavities, spatial filters, diffraction gratings, front-ends)• Design, building, installation, and commissioning of large (>1m³) vacuum vessels• Development of laser operation procedures and manuals• Laser safety
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5. To the extent that **CLIENT** is unable to supply the above required personnel to the satisfaction of **LLNS**, the maximum funding limit for this Variant plus the baseline as set forth in the Statement of Work in Appendix A shall be 48.2 M\$.
6. Upon activation of this Variant, the Payment Schedule in Article 4 of the Agreement shall be replaced by the following Payment Schedule:

Deliverable	Description	To be documented by	Completion Date	Phase	Payment (to fund follow-on work)	Proposed Payment Date
	Sign contract	Contract		1	\$ 8,550,000	Month 0
D1	Conceptual technical design of the laser beamline, detailed Project Execution Plan (PEP – as defined in Appendix A Statement of Work), interface definition with the ELI-Beamlines building	Submission of a technical design report including: beamline technology description; detailed PEP; specific roles, responsibilities and interfaces for LLNS and IOP staff; and description of items with long-lead procurements	30-Nov-2013	1	\$ 9,737,500	31 Dec-2013
		Acceptance Certificate				
D1A	Technical approach for end-to-end dispersion management in the short pulse chain, including design of the stretcher and compressor sub-systems	Submission of a technical report detailing the solution for achieving high fidelity short pulses – addressing one of the critical issues for design and operation of the HAPLS beamline	31-Jan-2014	1	\$ 7,220,000	28-Feb-2014
		Acceptance Certificate				
D1B	Critical progress review of the Procurement Plan for major components and sub-systems for HAPLS. Update to the PEP	Submission of a technical progress report on the status of the procurement plan – noting status of orders and vendor response, along with impacts on the PEP and mitigation action undertaken	30-Apr-2014	1	\$ 6,270,000	31-May-2014
		Acceptance Certificate				

APPENDIX VARIANT DECISION	G2 Decision to proceed with Appendix G (Performance Ramping) Variant 2	Written instruction from CLIENT to LLNS	31 Oct 2014	1	\$ 1,000,000 ***	30 Nov-2014
		Acceptance Certificate				
D2	Operational qualification of the short pulse front end, updated technical design of the beamline	Submission of a technical progress report on assembly of the HAPLS front end up to the broadband preamplifier(s), including results of the validation tests and their analysis with respect to the design requirements	31-Oct-2014	1	\$ 5,085,000	30-Nov-2014
		Acceptance Certificate				
D3	Assembly of key subsystems of the pump laser	Submission of a technical progress report on acquisition, fabrication and assembly of key components and/or subsystems of the HAPLS. The report shall also include the assembly and the validation of alignment of the optical transport system for pumping the broadband power amplifier	30-Apr-2015	1	\$ 5,470,000	31-May-2015
		Acceptance Certificate				

PHASE REPORT	1	Summary of Phase 1 achievements	Submission of a technical progress report, with detailed inventory of purchased and commissioned equipment.	31-Aug-2015	1	Nil	N/A
			Acceptance Certificate				
D4		Acceptance test of the HAPLS pump laser including PLRCs	Demonstration to CLIENT and submission of a technical report that the HAPLS pump laser meets the specific PLRCs. Submission of a confirmatory technical report recording the measured specifications.	31-Jan-2016	2	\$ 2,367,500	31-Jan-2016
			Demonstration Acceptance Protocol				
D5		Readiness of the CLIENT-provided PAD diagnostic with integrated controls and control system for performance testing of the HAPLS short pulse beamline	LLNS acceptance of CLIENT-provided PAD diagnostic with integrated controls and control system	31-Jan-2016	2	Nil	N/A
			LLNS Acceptance Certificate				
D6		Acceptance test of the HAPLS to Project Completion criteria (PCC as defined in Appendix A Statement of Work and Appendix G2) and the Pump Laser Completion Criteria (PLCC as defined in Appendix A Statement of Work and Appendix G2)	Demonstration to CLIENT and submission of a technical report confirming that the completed HAPLS meets the PCC and a final report confirming that the pump laser meets the PLCC.	31-Oct-2016	2	\$ 665,000	30-Nov-2016
			Demonstration Acceptance Protocol				

D7	Packaging and shipment of the HAPLS to the ELI-Beamlines facility (contingent on ELI-Beamlines facility readiness) (Incoterms 2010 DAP condition shall apply)	Receipt of HAPLS at the ELI-Beamlines facility	28-Feb-2017	2	\$ 380,000	31-Mar-2017
		Acceptance Certificate				
D7A	Review training status of IOP staff	Submission of a report providing details of the status of IOP staff training on all aspects of the HAPLS system design, commissioning, operation, maintenance, and integration into the ELI-Beamlines facility	30-Jun-2017	2	\$ 380,000	31-Jul-2017
		Acceptance Certificate				
D8	Re-assembly and commissioning of the delivered HAPLS at the ELI-Beamlines facility and demonstration of PCCs	Demonstration at the CLIENT's site and submission of a technical report confirming that the completed HAPLS is consistent with the results of D6 and meets the Project Completion Criteria. Based on achieved performance, LLNS will submit recommendations for operation of the HAPLS at full Performance Requirements.	31-Jan-2018	2	\$ 75,000	28-Feb-2018
		Demonstration Acceptance Protocol				

*** In the event that CLIENT is unable to supply the required personnel to the satisfaction of LLNS, the payment on 30 November 2014 shall increase from \$1,000,000 to \$ 2,000,000.