APPENDIX A

STATEMENT OF WORK

"Medium-Voltage Direct Current Filter"

April 29, 2026

1. BACKGROUND

The National Laboratory of the Rockies (NLR) is the U.S. Department of Energy's primary national laboratory for energy systems research and development. As the energy systems laboratory, NLR's unique strength lies in developing and integrating a broad array of energy technologies into robust, resilient systems - bridging foundational research with practical applications to lower energy costs, drive economic growth, bolster national security, and deliver abundant and reliable energy.

A Medium-Voltage (MV) Direct Current (DC) source is a powerful tool in power electronics and energy systems research. Our Controllable Grid Interface (CGI-2) is equipped with power electronics and software to enable that capability. A MV-DC filter is a necessary piece to enable smooth voltage and low current ripples output.

This project seeks to add an MV-DC Filter within the CGI-2 Yard at NLR's Flatiron's Campus. This setup will open a wide range of research opportunities, especially in the context of modern power systems and renewable energy integration. Key research areas include power quality improvement, grid-forming and grid-following control, advanced control algorithms, DC microgrid research, and hardware-in-the-loop simulations.

2. OBJECTIVE

The objective of this effort is to have a Subcontractor design and build an MV-DC Filter that will safely integrate with the existing CGI-2 E-House (ABB ACS6000). This filter will be powered by the existing DC output available in the ABB ACS6000 converter unit, which includes two 9MVA Inverter units. The MV-DC Filter will support 0-4,000 Amp / 0-5kV (0-18MW) capacity. The filter should be packaged in an outdoor rated enclosure, similar to a shipping container. A control cabinet shall accept the conduit stub-ups that are existing in the installation location. All electrical components shall comply with UL or NEC ratings.

3. SCOPE OF WORK

To meet the objective, the Subcontractor shall design a packaged system that integrates with NLR's existing infrastructure, namely the ACS6000 converter unit. It is preferred to minimize the size of the system and thus the footprint of the enclosure.

The Subcontractor shall design, build, test, deliver, and commission the system. NLR will have a high-level design review with the Subcontractor, bill or materials review, final design review, and Factory acceptance demonstration ahead of system delivery and commissioning by the Subcontractor.

The Subcontractor shall provide final documentation for the system.

The following lists the features for a 4,000A capacity bidirectional filter with the desired DC filter topology, integration of passive filter components, and ancillary components packaged in an environmental enclosure (see **Technical Specifications** document for more details on each item):

- 3.1 Filter Topology – L-cmc-C
- 3.2 Filter Passives: 6x 2mH inductors
  - 3.2.1 2mH inductors
  - 3.2.2 DC resistance
- 3.3 Filter Passives: 2 windings common mode choke (2cmc)
- 3.4 Filter Passives: Mid-Point Grounding (R8, R9, C8, C9)
- 3.5 Ancillary Components
  - 3.5.1 DC Distribution
  - 3.5.2 DC Protection
    - 3.5.2.1 Fuse/breaker curve
    - 3.5.2.2 Filter capacitor branch protection
    - 3.5.2.3 LV OV Surge protection
  - 3.5.3 Sensing and Control
    - 3.5.3.1 Protection, Thermal, and Other System measurements
    - 3.5.3.2 Control integration with NLR's CGI
  - 3.5.4 Thermal management
- 3.6 System Layout and Electrical Interfaces
- 3.7 Environmental Conditions

4. TASKS

4.1. Design

The Subcontractor shall be responsible for designing a solution for a containerized MV-DC Filter, in accordance with the Technical Specifications e. The solution shall be a system that incorporates all technical requirements and auxiliary components for safe operation, as specified in the Technical Specifications.

4.2. Build

The Subcontractor shall be responsible for procuring all components necessary to fabricate and assemble the containerized MV-DC Filter, including all software modules necessary as the controls interface for safe operation of the equipment. The Subcontractor shall fabricate and assemble the MV-DC Filter in accordance with the Technical Specifications, provided as Attachment 1 to Appendix A.

4.3. Factory Test

The Subcontractor shall be responsible for demonstrating initial power-up and basic function of MV-DC Filter within their factory setting at Subcontractor's premises.

4.4. Delivery

The Subcontractor shall be responsible for delivering the containerized MV-DC Filter to NLR's Flatirons Campus. NOTE: NLR is responsible for offloading the filter, installation, and making all electrical and communications connections to external sources.

4.5. Commissioning

Upon completion of installation by NLR, the Subcontractor shall perform system commissioning of the MV-DC Filter.

4.6. Documentation

The Subcontractor shall be responsible for providing all digital models and power curves for the system, as well as providing NLR the ability to debug code, as applicable. Documentation submittals include 12-month warranty description and instruction manuals which clearly describe how to operate, maintain, and adjust settings on the system.

5. REVIEW MEETINGS AND TRAVEL REQUIREMENTS

- Project Kickoff Meeting - virtual.
- Bi-weekly progress meetings for design & production - virtual.
- Meetings for design review milestones at 50% and 100% - virtual.
- Factory Acceptance demonstration – on-site at Subcontractor location with attendance by NLR staff either physically or virtual.
- On-site commissioning of system by Subcontractor at NLR's Flatirons Campus: 19001 W 119th Ave, Arvada, CO 80007

6. DELIVERABLES

The Subcontractor shall provide the following deliverables by the due date as indicated ("project start" shall mean period of performance start date):

Deliverable No.	Associated Task No.	Deliverable Description	Due Date
6.1	4.1	Initial Bill of Materials	1 month after project start
6.2	4.1	50% Design Drawings	2 months after project start

Deliverable No.	Associated Task No.	Deliverable Description	Due Date
6.3	4.1	100% Design Drawings	3 months after project start
6.4	4.3	Factory Acceptance Demonstration report	14 months after project start
6.5	4.4	Delivery of system	15 months after project start
6.6	4.5	Complete system commissioning report	18 months after project start
6.7	4.6	Closeout Documentation (as-built drawings, warranty information, operations and maintenance instructions)	20 months after project start

DELIVERABLE ADDRESS:

The Subcontractor shall clearly label all deliverables to include:

- The subcontractor's name
- NLR's subcontract number
- NLR Technical Monitor's name
- Deliverable date, and
- Deliverable description.

Electronic deliverables shall be sent via email to the Technical Monitor as follows:
Przemyslaw Koralewicz , Technical Monitor
e-mail: Przemyslaw.Koralewicz@nlr.gov

- One (1) master electronic version, including graphics

Deliverable No. 6.5 shall be shipped to:
National Laboratory of the Rockies
Attn: Aaron Delgado (FC S&R Lead) Aaron.Delgado@nlr.gov; 720-436-4292
19001 W. 119th Ave.
Arvada, CO 80007

DELIVERY OF DATA

A copy of all data (as that term is defined in this Subcontract) first produced in the performance of this Subcontract is an additional deliverable of this Subcontract and shall be provided to the technical monitor as a condition of final payment, in accordance with the Subcontract. **For all deliverables, make particular note of the requirements provided in the Rights in Data clause of this Subcontract regarding data not first produced in the performance of this Subcontract.**

7. ELECTRONIC REPORTING REQUIREMENTS FOR SUBCONTRACT REPORT DELIVERABLES

It is NLR's intention to publish subcontract report deliverables containing publicly available information (e.g. non-confidential, non-protected, non-proprietary information) for distribution on the internet.

The subcontractor shall provide the final approved version of report deliverables in accordance with the electronic reporting requirements described below.

The technical monitor may specifically direct the subcontractor to provide reports in one or more of the file format standards provided below:

7.1. The subcontractor shall submit all report deliverables (including status, annual, or final reports) as electronic files in Adobe .pdf format, preferably with all graphics and images embedded within the document.

7.2. All final approved version submissions shall be delivered to NLR via e-mail to the NLR Technical Monitor.

7.3. If it is not possible to include all of the graphics and images (figures, illustrations, and photographs) in the same file as the text, NLR will accept the text in Adobe .pdf formats and the graphics and images as separate electronic graphic or image files*.

7.4. The accepted standard for page layout and graphics is the Adobe Creative Suite of programs.

7.5. *The acceptable graphic or image file formats are: .eps, .tif, .gif, .jpg, .wmf, .emf, .pct, .png, .bmp, .psd, .ai, .fh, .qif, .fpx, cdr. The preferred resolution for graphics or images is 300 dpi. Include all fonts used in creating the file.

7.6. For animation, video, or multi-media elements, CD-ROM, DVR and thumb drive are acceptable technical deliverable media.

7.7. For all calculations in support of subcontract reports that are conducted in ASPEN+, an electronic copy of INPUT, REPORT and BACKUP (if Model Manager is used) must be submitted with all reports. Additionally, if costing or sizing calculations are conducted in a spreadsheet [no process calculations (heat and material balances) in spreadsheet format are permitted], a copy of the fully documented MS Excel file shall be supplied.

7.8. A fully executed model release shall be supplied to NLR with all photographs and images, regardless of whether such photographs or images are delivered to NLR electronically or in hard copy. Such model release shall certify that the Alliance for Energy Innovation, LLC, Management and Operating Contractor for the National Laboratory of the Rockies for the U.S. Department of Energy is granted a non-exclusive, paid-up, irrevocable, worldwide license to publish such photographs in any medium or reproduce such photographs or allow others to do so for United States Government purposes. Model releases are required in all situations in which a reasonable person would respond in the affirmative to the question – could someone, other than the model himself/herself, recognize the person in this photograph or image? All model releases shall be provided to the subcontract associate as a condition of final payment, in

accordance with the subcontract. To obtain a Subcontractor Model Release form, please contact images@nlr.gov

8. ACKNOWLEDGEMENTS IN SUBCONTRACTOR PUBLICATIONS

In any scientific or technical report or article, conference paper, journal article, etc. based on or containing data first produced in the performance of this subcontract and published in academic, technical or professional journals, symposia proceedings or similar works, the subcontractor shall use this acknowledgement stating, "This [article, conference paper, journal article, etc.] was developed based upon funding from the National Laboratory of the Rockies for the U.S. Department of Energy under Contract No. DE-AC36-08GO28308."

9. COPYRIGHT PERMISSION/AUTHORIZATIONS

The subcontractor is responsible for obtaining copyright permissions and/or authorizations for all information and/or data, as applicable that is incorporated into all final technical reports. Electronic copies of these copyright permissions and/or authorizations shall be provided to the Technical Monitor at the email address provided above. The subcontractor shall also provide a written certification to the Technical Monitor as to such permissions and/or authorizations as a condition of final payment. The subcontractor's (including all lower tier subcontractors, as applicable) certification shall specify that "I have obtained all necessary and legally required copyright permissions and/or authorizations for any and all information, data, graphs, images, etc., as applicable, that is incorporated into the final Technical Report titled _____, delivered under this Subcontract No._____. Copies of these permissions and/or authorizations are attached."