Purchase Order

Brookhaven National Laboratory

Brookhaven National Laboratory
Upton, NY 11973-5000

Purchase Order	Date	Revision	Page
BNL-0000477787	TBD		1
Payment Terms	**Freight Terms**		**Ship Via**
TBD	TBD		TBD
Contractual Representative	**Phone**		**Currency**
SMITH,CASSANDRA L	(907)888-3142		USD

DRAFT

Vendor:
SAM UEI:
ANY VENDOR
ANY ADDRESS
ANY STATE, ANY STATE, ANY ZIP

Bill To: Brookhaven National Lab
Fiscal Division Building 400-D
PO Box 5000
Upton, NY 11973-5000
APinvoices@bnl.gov

Ship To: Brookhaven National Lab
Ref PO#: 0000477787
Receiving: Bldg 98 Rochester St
Upton, NY 11973

Brookhaven Science Associates (BSA), LLC is placing this Purchase Order under its Prime Contract with the U.S. Department of Energy and is pursuant to the General and/or Supplemental terms and conditions which can be viewed via the internet at: https://www.bnl.gov/ppm/terms-and-conditions.php Should contractor have any questions and/or not have access to these terms and conditions, contact the contractual representative immediately.

Tax Exempt? Y **Tax Exempt** **NYS216880** **Replenishment Option:** Standard

Line-Sch	Item/Description	Mfg ID	Quantity UOM	PO Price	Extended Amt	Due Date
1- 1	System Configuration - 564A / 80V Designation C		1.000EA	TBD	TBD	TBD
			Schedule Total		TBD	
	QA Paragraph(S): 3.1.4					
	ESH&Q Risk Level: A3 - Minor					
			Item Total		TBD	
2- 1	System Configuration - 564A / 80V Designation B		2.000EA	TBD	TBD	TBD
			Schedule Total		TBD	
	QA Paragraph(S): 3.1.4					
	ESH&Q Risk Level: A3 - Minor					
			Item Total		TBD	

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Line-Sch	Item/Description	Mfg ID	Quantity UOM	PO Price	Extended Amt	Due Date
3- 1	System Configuration - 550A / 150V Designation A		1.000EA	TBD	TBD	TBD
			Schedule Total		TBD	
	QA Paragraph(S): 3.1.4					
	ESH&Q Risk Level: A3 - Minor					
			Item Total		TBD	
4- 1	System Configuration - 400A / 50V Designation F		1.000EA	TBD	TBD	TBD
			Schedule Total		TBD	
	QA Paragraph(S): 3.1.4					

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	ESH&Q Risk Level: A3 - Minor					
			Item Total		TBD	
5- 1	System Configuration - 376A / 80V Designation E		1.000EA	TBD	TBD	TBD
			Schedule Total		TBD	
	QA Paragraph(S): 3.1.4					
	ESH&Q Risk Level: A3 - Minor					
			Item Total		TBD	
6- 1	System Configuration - 282A / 80V Designation G		2.000EA	TBD	TBD	TBD
			Schedule Total		TBD	
	QA Paragraph(S): 3.1.4					

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	ESH&Q Risk Level: A3 - Minor					
				Item Total	TBD	
7- 1	System Configuration - 375A / 40V Designation H		2.000EA	TBD	TBD	TBD
				Schedule Total	TBD	
	QA Paragraph(S): 3.1.4					
	ESH&Q Risk Level: A3 - Minor					
				Item Total	TBD	

PURCHASE ORDER TERMS AND CONDITIONS

This is a Firm Fixed Price Purchase Order (PO). The total PO amount constitutes full compensation for all services and/or items provided under this PO. The total PO amount shall not be exceeded without an executed change order.

Total Amount

The total amount of **$TBD** shall not be exceeded and covers all work required under *Attachment 1, Statement of Work dated 06/10/2026*.

Period of Performance

TBD

POINTS OF CONTACT

BSA Contractual Representative
All contractual inquiries shall be directed to Cassandra Smith at (907) 888-3142, or via email at csmith2@bnl.gov. The BSA Contractual Representative is the sole authority authorized to make changes to this PO.

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BSA Technical Representative
All technical inquiries shall be directed to TBD at TBD, or via email at TBD. The BSA Technical Representative is not authorized to make changes to this PO.

TERMS AND QUALITY REQUIREMENTS

The provisions of Brookhaven Science Associates, LLC General Terms and Conditions for Commercial Items and Services, Rev. 24.0 (April 2026), are incorporated herein by reference and made a part of this Purchase Order.

The Brookhaven National Laboratory Supplier Quality Assurance Requirements, BNL-QA-101, are incorporated herein by reference. In addition to all applicable General Provisions, the Contractor agrees that all materials delivered and/or services performed under this Purchase Order shall conform to the Quality Assurance requirements identified in the applicable line-item descriptions.

SHIPPING REQUIREMENTS

North American Shipments: FOB Destination, Freight Prepaid
International Shipments: Delivered Duty Paid

Important Shipping Instructions:
DO NOT insure the shipment or declare a value.
All shipments must be delivered to Receiving Building 98.

PO Number 472719 must appear on all outside labels, packing slips, and invoices. Failure to comply may result in delayed receipt, delayed payment, and issuance of a Non-Conformance Report (NCR).

Early delivery is encouraged and appreciated.

INSPECTION, ACCEPTANCE, AND PAYMENT

In addition to the clauses entitled “Inspection and Acceptance” and “No Waiver” contained in BSA’s General Terms and Conditions, the following provisions apply:
A. Within thirty (30) days of receipt of the material (or as otherwise specified in the Purchase Order), the Buyer shall conduct inspections and tests deemed necessary to verify compliance with technical requirements.
B. Acceptance shall occur upon successful completion of final inspection by the Buyer.
C. Payment shall be made upon acceptance of the material and receipt of a properly executed invoice. Upon acceptance, the payment terms specified in the Purchase Order shall apply.
D. If material is rejected due to nonconformance, damage in transit, or other causes, the provisions of paragraph C shall apply to replacement material.
E. The date checks are issued by BSA and made payable to the Seller shall be considered the date of payment.

INVOICING

Electronic invoice submission is preferred.
Invoices shall:
Be submitted in PDF format
Include PO Number, price, and description
Be emailed to APINVOICES@BNL.GOV
The Contractor shall clearly mark the final invoice as “FINAL.”

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Total PO Amount TBD

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SPECIAL INSTRUCTIONS:

-This Purchase Order does not bind or purport to bind the U.S. Government or the DOE.

-Prices are firm unless otherwise indicated.

-The total Purchase Order dollar amount listed herein shall not be exceeded without a signed change order known as a modification to the Purchase Order. This modification must be issued by a Brookhaven National Lab Procurement Individual.

-Purchase Order Number must appear on all correspondence, invoices, shipping papers and packages.

-Invoices sent anywhere other than to the Fiscal Division, Bldg. 400-D, or to the email APinvoices@bnl.gov, are not deemed to be officially received for payment term purposes.

-Address all correspondence concerning this Purchase Order to the above named person.

DELIVERY LOCATION AND HOURS:

Deliveries to Brookhaven National Laboratory (BNL) are accepted between the hours of 8:00 am–12:00 pm or 1:00-4:00 pm EST, Monday through Friday. Unless otherwise noted on the Purchase Order, all deliveries to Brookhaven National Laboratory (BNL) shall be made to building 98 or to the satellite stockrooms in buildings 452, 510, 729, 740 or 918.

ADVANCE NOTIFICATION OF DELIVERY:

If a shipment is heavier than 3,000 lbs., longer than 8 feet in any direction, or has a high center of gravity, it will require rigging upon receipt and the shipper shall provide a minimum of 3 days advance notice of delivery to BNL's Receiving department via email to WarehouseOperations@bnl.gov. The shipper must obtain acknowledgement from BNL that delivery notification was received. Failure to contact BNL will result in delays during delivery and any resulting demurrage will beat the shipper's expense.

UNACCEPTABLE PACKING MATERIAL:

Do not use vermiculite as a packaging material inside any shipments to BNL unless required by shipping regulation.
All shipments containing vermiculite must be accompanied by document stating that the vermiculite used is certified asbestos free. This documentation must be affixed to the outside of the package.

A. Vermiculite used as a packaging material in shipments must be determined to be free of asbestos (<1% chrysolite, amosite, crocidolite, tremolite, anthophyllite, and actinolite).
B. Vermiculite is defined in this specification means the hydrous, silicate mineral classified as a Phyllosilicate that has been expanded by heating.
For further shipping instructions, please go to the following link: https://www.bnl.gov/shipping/

Authorized by:

Purchase Order

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Upton, NY 11973-5000

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BROOKHAVEN NATIONAL LABORATORY
SUPPLIER QUALITY ASSURANCE REQUIREMENTS
BNL-QA-101

3.0 GENERAL REQUIREMENTS Unless otherwise specified in the procurement documentation, the following General Requirements apply:

3.1.1 A quality system certified/registered to the ISO 9001 standard: (Latest revision as of the date of issuing the procurement documentation).

3.1.2 A quality system that meets the requirements of the ISO 9001 standard: "Quality Management Systems - Requirements" (Latest revision as of the date of issuing the procurement documentation).

3.1.3 Conformance to Supplier's/Manufacturer's quality program or system.

3.1.4 Other: Refer to procurement documentation (PO, Statement of Work [SOW], specifications, drawings) for quality requirements.

3.2 Assessment by Buyer: The Supplier's Quality system is subject to assessments by the Buyer's Representative(s) for conformance with the requirements of the PO. Supplier or Distributor shall allow BSA representatives, BSA customers, and regulatory agencies right of entry into Supplier's facilities to determine and verify product, processes, records, personnel, material, procedures, and systems.

3.3 Change Approval: No change(s) shall be made to any Buyer requirements (e.g. part number, model number, etc.) without the prior written approval of Buyer.

3.4 Responsibility for Subcontractors: It is the responsibility of the Supplier to impose applicable requirements from this document upon their subcontractors. Additionally, the Buyer reserves the right to disapprove, in writing, any subcontractor.

3.5 Responsibility for Conformance: The Supplier is responsible to provide items that conform to the requirements of the PO regardless of any assessments, surveillances, inspections and/or tests by the Buyer or its representatives at either the Supplier's or the Buyer's facility. The Buyer reserves the right to request failure analysis and corrective action for non-conforming articles or items submitted or supplied to the Buyer. The Supplier is responsible for notifying the Buyer of any recalls or alerts associated with this PO.

3.6 Protection of Material and Equipment: The Supplier shall employ procedures that assure adequate protection of material and equipment during shipment and while in storage. Such protection shall include special environmental packaging, as necessary. All items shipped (originally packaged or repackaged) to BNL or other locations cited in the PO or contract, shall comply with the requirements for preservation, packaging and marking as stated in the latest revision of ASTM Standard D 3951 Standard Practice for Commercial Packaging.

3.7 Measuring and Test Equipment (M&TE) Calibration: The Supplier shall calibrate any M&TE used in the fulfillment of the PO requirements against certified standards that are traceable to the National Institute of Standards and Technology (NIST), or some other recognized national or international standard, or physical constant. The Supplier shall notify the Buyer of any condition found during the calibration, servicing or repair of measuring and test equipment that can affect the end item requirements.

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3.8 Suspect Counterfeit Parts: The supplier shall verify the procurement source and associated certifying paperwork. Appropriate incoming inspection test methods shall be used to detect potential counterfeit parts and materials. The supplier shall flow this requirement down to all sub-tier suppliers to prevent the inadvertent use of counterfeit parts and materials. Distributors shall not modify, rework or repair material shipped on this order. For more information refer to the following Department of Energy website: https://www.energy.gov/ehss/corporate-reporting-analysis/databases/suspectcounterfeit-and-defective-items.

3.9 Electrostatic Discharge Control: Items that are susceptible/ sensitive to electrostatic discharge (ESDS) shall be handled and packaged to protect them from damage. Items and/or packages shall be labeled to indicate the susceptibility to electrostatic discharge.

3.10 Electrical, Fire Protection, or Scaffolding Equipment, Material, and Systems: All electrical, fire protection or scaffolding equipment, material, and systems delivered to BNL shall be certified, listed, or labeled by a Nationally Recognized Testing Laboratory (NRTL). The CE mark is NOT a recognized NRTL certification mark. (For a listing of OSHA-recognized NRTLs, refer to http://www.osha.gov/) For electrical, fire protection, or scaffolding equipment, material, and systems which no NRTL accepts, certifies, lists, labels, or otherwise determined to be safe, the Supplier shall determine the equipment to be safe for its intended use. The determination must be made on the basis of test data. The determination and test data documents shall be made available to BSA prior to or upon delivery for review and acceptance by the applicable BSA Authority Having Jurisdiction (AHJ). In accordance with 29 CFR 1910.147(c)(2)(iii) whenever new machines or equipment are provided with energy isolating devices, those devices shall be designed to accept a lockout device.

3.11 Hoisting and Rigging Equipment: All hoisting and rigging equipment used at BNL shall meet the requirements of the latest applicable OSHA Regulations and ASME B30 Series standards for design, construction, markings, and proof load testing.

3.12 Deleted

3.13 Powered Machine Shop Equipment: All Powered Machine Shop equipment (e.g., Lathe) delivered to BNL shall meet the requirements of the latest applicable OSHA 1910 Regulations (e.g., Part Subpart O). Equipment purchased must include an integrated NFPA 79 compliant emergency stop and anti-restart device.

3.14 Vehicle-Mounted Elevating and Rotating Aerial Devices All vehicle-mounted and rotating aerial devices equipment used at BNL shall meet the requirements of ANSI A92.2.

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3.15 Self-propelled Elevating Work Platform Equipment All self-propelled elevating work platform equipment (e.g., scissor lift) used at BNL shall meet the requirements of ANSI A92.6.

3.16 Manually Propelled Elevating Aerial Platform Equipment All manually propelled elevating aerial platform equipment used at BNL shall meet the requirements of ANSI 92.3.

3.17 Boom Supported Elevating Work Platform Equipment All boom supported elevating work platform equipment used at BNL shall meet the requirements of ANSI

3.18 Powered Industrial Trucks and Attachments: Powered industrial trucks (e.g. forklifts, hi-lows) shall meet the requirements of the ANSI/ITSDF B56 series for design, construction, markings, and test loading. Industrial truck attachments shall be approved by the truck manufacturer and supplied with an attachment data plate indicating the new truck capacities.

3.19 Used Industrial Equipment: For used industrial equipment (e.g. scissor lifts, fork lifts, etc.), A Certificate of conformance as defined in clause 4.16, must be provided as objective evidence and must additionally state that all maintenance and manufacturing alerts have been screened and all required repairs and improvements have been completed. The supplier shall provide records of the last year of maintenance.

3.20 Global Harmonized System Compliance: The supplier of chemicals shall deliver the chemical in full compliance with the Department of Labor, Occupational Safety & Health Administration (OSHA)'s Globally Harmonized System (GHS) Hazard Communication Standard (29CFR1910.1200), available at: https://www.osha.gov/dsg/hazcom/HCSFinalRegTxt.html. All hazardous chemicals delivered to BNL shall be accompanied by an GHS Safety Data Sheets (SDS) with the format and content specified in 29CFR1910.1200. For information on the GHS SDS see OSHA Brief- Hazard Communication Standard: Safety Data Sheets Publication 3514 available at: https://www.osha.gov/Publications/OSHA3514.pdf. All hazardous chemicals delivered to BNL after 12/01/2015 shall have a label with the elements specified in 29CFR1910.1200 [product identifier; pictograms; signal words; hazard statement(s); precautionary statement(s); and manufacturer, importer, or distributor's name, address, and telephone number]. For information on the GHS label, see OSHA Brief- Hazard Communication Standard: Labels and Pictograms Publication 3636 available at: https://www.osha.gov/Publications/OSHA3636.pdf

3.21 Age/Shelf Life and Storage Control:The Supplier shall have an effective storage and age control system for items where acceptability is limited by the age or manner of storage of the item. The system must include a method of identifying the expiration date on the containers in which material is delivered to the Buyer. Special handling conditions shall be recorded on certifications and shipping documents covering the material delivered to the Buyer. At the time of receipt, the material shall not have less than three-quarters of its shelf life remaining, without prior written approval from the Buyer for each shipment.

3.22 Product Recalls/Product Bulletins/Safety Alerts: Any and all product recall alerts, product bulletins, or safety alerts should be communicated by email directly to ProductRecallAlert@BNL.gov. Provide the Purchase Order Number(s) and names of purchasers with notification to assist BNL in locating and identifying the subject material.

STATEMENT OF WORK (SOW)

Air-Cooled, Switched-Mode Dipole Magnet Power Supply Systems with Embedded Digital Control and DCCT Feedback

June 10, 2026

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1. OBJECTIVE

Brookhaven National Laboratory (BNL) requires the procurement, delivery, and commissioning of high-stability dipole magnet power supply systems for the Tandem Van de Graaff accelerator.

Each system shall be:-

- Air-cooled
- Switched-mode power conversion
- Digitally regulated
- Closed-loop controlled using DCCT-based current feedback
- Equipped with embedded control, diagnostics, and monitoring capabilities

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2. SCOPE OF WORK

The Vendor shall:

- Design, manufacture, test, deliver, and support magnet power supply systems
- Provide complete turn-key assemblies including:
    - Power conversion hardware
    - Digital controller
    - DCCT current sensing
    - Protection and interlock systems
    - Embedded diagnostics and monitoring
- Perform Factory Acceptance Testing (FAT)
- Support Site Acceptance Testing (SAT) at BNL

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3. SYSTEM ARCHITECTURE REQUIREMENTS

3.1 Power Conversion Topology

Each system shall be:

- **Air-cooled only** (no facility water required)
- **Switched-mode (PWM or equivalent)**
- Rated for continuous operation at full load

The system shall maintain performance across the full operating envelope without thermal derating.

3.2 Regulation Method

Each system shall use:

- **Closed-loop digital regulation**
- **DCCT-based current feedback** as the primary regulation signal

The system shall:

- Maintain stable regulation across inductive dipole magnet loads
- Require **no manual tuning or adjustment** for:
    - Different magnet loads
    - Different operating currents

Shunt-only regulation architectures are **not acceptable**.

3.3 Digital Control System

Each power supply shall include an embedded digital controller with:

- High-speed regulation loop (≥100 kHz or equivalent performance)
- ≥24-bit resolution for current/voltage measurement
- Deterministic control (FPGA or equivalent)

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Controller shall support:

- Constant Current (CC) and Constant Voltage (CV) modes
- Fast transient response with inductive loads

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4. EMBEDDED FUNCTIONALITY

Each system shall include integrated embedded features enabling full standalone operation without external instrumentation.

4.1 Embedded Diagnostics

- Real-time monitoring of:
    - Output current
    - Output voltage
    - Internal temperatures
    - Interlock status
- Continuous data logging capability

4.2 Embedded Oscilloscope / Monitoring

- Minimum 2-channel real-time monitoring capability
- Ability to observe:
    - Current
    - Voltage
    - Control signals

4.3 Embedded Waveform Generation

- Ability to:
    - Generate programmable current or voltage profiles
    - Perform step response testing

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- Support ramping and cycling operations

4.4 Embedded Network Interface

- Ethernet (TCP/IP or UDP)
- Web-based interface for:
  - Configuration
  - Monitoring
  - Diagnostics

4.5 Control System Integration

- Native or supported EPICS integration
- Remote command and readback capability

4.6 Synchronization Capability

- Ability to synchronize multiple power supplies
- External trigger input/output

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5. PERFORMANCE REQUIREMENTS

5.1 Stability

- ≤10 ppm over:
  - 8-hour operation
  - Full load range
  - Nominal ambient variation

5.2 Regulation

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- Line regulation: ≤0.0005% FS
- Load regulation: ≤0.0005% FS

5.3 Repeatability / Multi-Load Operation

System shall:

- Operate across all specified dipole magnet loads
- Require no retuning or reconfiguration

5.4 Ripple and Noise

Vendor shall provide guaranteed:

- RMS ripple
- Peak-to-peak noise
- Performance under inductive loads

5.5 Transient Response

Vendor shall specify:

- Step response performance
- Recovery time
- Overshoot/undershoot characteristics

5.6 Thermal Performance

- Full rated output under air cooling
- No degradation of stability or regulation

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6. INTERLOCKS AND PROTECTION

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6.1 Internal Protections

- Overcurrent
- Overvoltage
- Overtemperature
- DCCT fault detection

6.2 External Interlocks

- Dry contact inputs
- PLC-compatible (24 VDC)
- Fast shutdown capability

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7. SYSTEM CONFIGURATIONS

Designation	Output	Max Input voltage*	Cooling	Quantity
A	550 A / 150 V	480 AC 3 Phase	Air Cooled	1
B	564 A / 80 V	480 AC 3 Phase	Air Cooled	2
C	564 A / 80 V	480 AC 3 Phase	Air Cooled	1
E	376 A / 80 V	480 AC 3 Phase	Air Cooled	1
F	400 A / 50 V (polarity inverter)	480 AC 3 Phase	Air Cooled	1
G	282 A / 80 V	480AC 3 Phase	Air Cooled	2
H	375 A / 40 V (polarity inverter)	208 AC 3 Phase	Air Cooled	2

*may be lower power input voltage

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8. TURN-KEY REQUIREMENT (CRITICAL)

Each system shall be delivered:

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- Fully assembled
- Fully configured
- Pre-calibrated
- Verified under load

The following are **not acceptable**:

- Internal manual tuning (potentiometers, trim adjustments)

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9. FACTORY ACCEPTANCE TEST (FAT)

Vendor shall demonstrate:

- ≤10 ppm stability
- Operation across inductive loads
- Ripple/noise measurements
- Step response
- Interlock functionality
- Embedded system functionality

FAT report required prior to shipment.

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10. SITE ACCEPTANCE TEST (SAT)

At BNL:

- Verification on dipole magnets
- Interlock validation

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11. DOCUMENTATION REQUIREMENTS

Vendor shall provide:

- Electrical schematics
- Wiring diagrams

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- Control interface documentation
- Embedded system documentation
- FAT results
- Calibration data

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12. WARRANTY AND SUPPORT

- Minimum 5-year warranty
- Firmware/software updates

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