



BARC Electric Cooperative Distributed Resource Integration Requirements



BARC Transmission and Distribution System

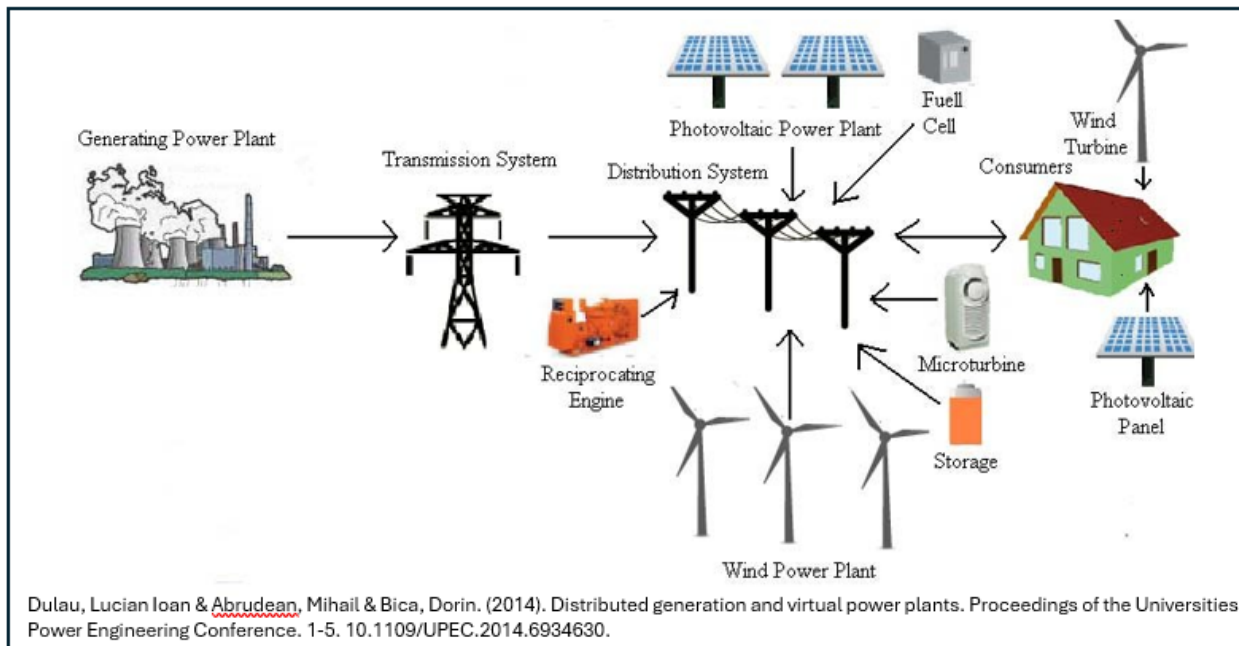


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Introduction

1.0 General Purpose and Topics Addressed

This statement of **BARC Electric Cooperative (BARC)** Distributed Resource Integration Requirements addresses the requirements and sets forth the process for interconnection of member and third-party generation facilities with BARC Transmission and Distribution facilities to ensure the safety of BARC employees and the public, to protect and prevent damage to facilities, and to maintain operational reliability and integrity. These requirements are subject to change at any time. The **Interconnecting Customer (“IC”)** may be subject to new requirements.

These requirements do not replace the need for an accurate and detailed design completed by a licensed and professional engineering consultant (*Licensed in the state of Virginia*) that is selected by the IC, nor do the requirements for interconnection replace the need for a detailed engineering review by BARC to ensure protection of its Transmission and Distribution facilities.

Engineering review by BARC is for the sole purpose of protecting employee and public safety and to maintain the reliability, power quality, and general operating conditions of BARC’s Transmission and Distribution System. The IC shall not rely on the BARC engineering review and shall complete its own independent design and review by licensed engineers to ensure accurate, safe, and proper operation and protection of its **Distributed Resource (“DR”)** installation. The applicable Interconnection Agreement shall prevail for matters of IC liability in the event of mis-operation or failure of the DR.

These standards and requirements apply to any new or any modification to existing DR facility implementing a paralleling electrical connection to BARC’s Transmission and Distribution facilities. DRs using a break before make interconnection scheme that prevents parallel operation with BARC’s Transmission and Distribution facilities are not subject to the technical requirements, as set forth in section 3 herein, nor the Interconnection process of this document though BARC requests a visible disconnect switch that is labeled and accessible and the generator is still subject to all local, state, and federal codes as well as those set forth by the National Electric Code.

This document is necessarily more static than the emerging technologies and resulting designs that may be applicable at the time of the contemplated interconnection, on either BARC’s side or the ICs side, or both. Therefore, each specific interconnection request must be analyzed at the time of request using the most current electrical system characteristics and conditions, regulatory requirements, laws, and industry standards.

This document only covers the interconnecting requirements of BARC. Old Dominion Electric Cooperative (ODEC) is the primary wholesale provider of energy to BARC and DR interconnections may be subject to additional requirements set forth by Affected Systems because BARC’s electric Transmission and Distribution facilities directly interconnect with facilities of Dominion Energy and Shenandoah Valley Electric Cooperative. (Please see System Protection section in following pages for more information on Affected Systems.)

These BARC Distributed Resource Interconnection Requirements cite standards, regulations, and other public domain requirements as those exist at the time this document was last edited. Regardless, the most recent version shall be applicable.

Interconnection Process

2.0 Initiating the Interconnection Process

Application forms, corresponding to the particular applicable Resource Capacity listed later in this document, have been created by the Commonwealth of Virginia. Links to those forms are included in Appendix A.

Prospective ICs interested in interconnecting DR with the BARC Transmission and Distribution Facilities shall complete the appropriate application form for interconnection. Each application contains basic information for the specific site that will allow preliminary discussions with BARC and will facilitate its review of the request.

Contact BARC for assistance with applications. Someone is available to informally discuss interconnection requirements and practices with potential ICs. Applicants should review the BARC website (www.barcelectric.com) for additional information and resources.

There are two distinct and different sets of Virginia statutes and corresponding regulations applicable to generator interconnections: one for interconnections without net metering, and the other for interconnections involving net metering. The two sets of rules do not overlap; each is distinct to the particular category of interconnection, (i.e., with or without net metering). The statutes and regulations for the first category can be accessed at <http://law.lis.virginia.gov/vacode/title56/chapter23/section56-578/> and <http://law.lis.virginia.gov/admincode/title20/agency5/chapter314/>. The second category at <http://law.lis.virginia.gov/vacode/title56/chapter23/section56-594/> and <http://law.lis.virginia.gov/admincode/title20/agency5/chapter315/>.

Please note, historically, there have been provisions for Agricultural Net metering in this document and others like it. **As of July 1, 2019, Agricultural Net Metering CLOSED** in Cooperative Service Territories, Agricultural Net metering has been replaced with a provision titled *Small Agricultural Generators* as described in the Administrative Code of Virginia in 20VAC5-315-75.

<https://law.lis.virginia.gov/admincode/title20/agency5/chapter315/section75/>

Agricultural member businesses who interconnected prior to July 1, 2019 will continue to participate in Agricultural Net Metering for a period not to exceed 25 years from the date of their original generator interconnection.

The applicable regulations contain complete descriptions of the processes. Interconnection either with or without net metering, has attracted a great deal of interest among BARC members. Industrial members often use consultants who are experienced in the process and already knowledgeable about the requirements. Nonindustrial members typically rely on equipment vendors for information as well as the results of their own research, generally without prior personal experience. This document highlights portions of the process set out in the regulations in an effort to direct particular attention to those matters that merit the most and earliest attention and to provide an overview of the process of interconnection. With respect to interconnection both with and without net metering, the applicable regulations take precedence over the description of processes set forth herein. Potential ICs are advised to refer to the applicable regulations after reviewing the material set forth in this document.

Nonindustrial members will wish to carefully compare the requirements addressed in this document and the regulations with information provided by equipment vendors, since the latter may not be tailored to Virginia conditions or requirements.

BARC is available to discuss matters of interconnection if a prospective IC desires general information for the purpose of considering the installation and interconnection of a DR project with the BARC system. The BARC liaison will also guide the prospective IC through the process once an application has been submitted to BARC. The basic information contained in the application will allow BARC to determine the steps necessary for the interconnection process. Interconnection will be evaluated against conditions at the requested interconnection point on the BARC Transmission and Distribution facilities at the time of request and at the queue position relative to other generation requests and their electrical influence. Other considerations include, but are not limited to, affected systems, existing generator interconnections, known loads within the proximity of the interconnection, and other conditions impacting the electrical characteristics of the BARC Transmission or Distribution Facility. It is not practical to include the particular requirements to the myriad interconnection sites and scenarios in this document.

The following pages outline the steps for interconnecting DR with BARC Transmission and Distribution facilities and shall be followed by any DR wishing to interconnect.

2.01 Net Metering: Residential and Non-Residential

The prospective member should complete and submit a Net Metering Interconnection Notification (NMIN) Application and applicable supporting material can be found at <https://barcelectric.com/net-metering/>.

Please note that net metering installations are intended primarily to offset all or part of the members own electricity requirements.

- Per applicable regulations referenced above, the NMIN form shall be submitted to BARC for review and approval prior to starting any construction or installation of any equipment or facilities. This will ensure, prior to the member purchasing the DR, that the desired DR will in fact meet BARC requirements for interconnection.
- As solar or other renewable generation sizes increase and interconnected system density increases on BARC's Transmission and Distribution facilities, pre-approval becomes significantly important to prevent member financial hardships due to the potential for BARC Transmission and Distribution upgrades to accommodate additional renewable generators.

BARC will review the application for the following items:

- Generator output versus historical usage.
- BARC facilities serving the location. (Generator shall not exceed BARC facilities)
- Power quality impacts to the local BARC system. (Please refer to Section 3.0 for a detailed listing of requirements).
- Liability insurance meeting the minimum requirements in 9 VAC 5-315-60.
- All net metering installations, whether residential or non-residential shall meet local, state, and federal laws concerning interconnection. A basic, but not complete, listing of requirements are below. Please reference the current code of Virginia and any subsequent SCC rulings for a comprehensive listing of interconnection requirements.

Residential

Maximum Size (Capacity):	20 kW
Maximum Annual Production:	Equal to Historical Usage
Protection:	IEEE-1547, UL-1741, Manual Disconnect Switch
Power Quality:	All Standards in Section 3.0 apply
BARC Equipment:	Shall not overload or cause imbalance

Non-Residential
Maximum Size (Capacity): 1 MW
Maximum Annual Production: Equal to Historical Usage
Protection: IEEE-1547,
UL-1741,
Manual Disconnect Switch
Power Quality: All Standards in Section 3.0 apply
BARC Equipment: Shall not overload or cause imbalance

- Solar Panels: UL-1703 listed (not a requirement, but advised)
- Manual, utility accessible, knife-blade disconnect switch mounted adjacent to or within ten (10) feet of meter base
- Other Virginia interconnection compliance requirements pursuant to 20VAC5-315 of the Virginia Administrative Code.

*BARC will coordinate installation of the net-meter at the **approved location**.*

2.02 Review paths for Small Generating Facilities/ Level 1, Level 2, and Level 3 Distributed Resources:

Step 1 –Pre-application, Queuing Process and Interdependent Projects

Pre-application: Any IC requesting electric system information prior to submitting an interconnection request form should follow guidelines set forth in section 20VAC5-314-35 of the Virginia Administrative code.

Queuing Process: Projects proposing to interconnect to the existing system are placed in a queue with BARC in order to evaluate the proposal. Queue number and queue position guidelines can be found in section 20VAC5-314-38 of the Virginia Administrative code.

Interdependent Projects: Project Interdependency guidelines can be found in section 20VAC5-314-38 of the Virginia Administrative code.

Step 2 – Interconnection Evaluation Process

Level One: Available to an IC with generation capacity not exceeding 500 kW. For Level one interconnection process requirements please reference the Virginia administrative code, 20VAC5-314-40.

Level Two: Available to an IC with generation capacity not exceeding 2 MW and which does not qualify for Level 1. For Level two interconnection process requirements please reference the Virginia administrative code, 20VAC5-314-60.

Level Three: Available to an IC which does not pass or qualify for the Level One or Level Two processes. For Level three interconnection process requirements please reference the Virginia administrative code, 20VAC5-314-70.

Step 3 - Interconnection Agreements, Construction, and Testing

Agreements:

For Level One interconnections, if the IC complies with the requirements and conditions determined by the studies, then the IC and BARC shall commence the interconnection pursuant to a formal, written agreement. If the IC contends that the requirements and conditions are unreasonable, then at the ICs option, it may either utilize a dispute resolution process described in the regulations at 20VAC5-314-100, or alternatively proceed as a Level Two applicant. For Level One interconnections, the Commonwealth of Virginia does not mandate that a formal Interconnection Agreement exist between the generator and the utility to which the generator interconnects. The standard document, which is called a **Small Generator Interconnection Agreement (SGIA)**, can be found in the regulations. BARC, through operational experience, has found that a formal written agreement avoids miscommunication and misunderstanding and thus is important for Level One interconnections.

For Level Two and Level Three interconnections, the Commonwealth of Virginia requires that a formal Interconnection Agreement exist between the generator and the utility to which the generator interconnects.

- Small Generator Interconnection Agreement (SGIA)
 - The IC and BARC will work together to assemble the SGIA. This document defines many aspects of the relationship between the IC and BARC. Several of the engineering documents will be attached as appendices to the Agreement. The extent of these necessary appendices are dependent on the interconnecting system. Generally, these include:
 - Sequence of Operation (for each and every mode of operation)
 - Relaying and Protection Drawing
 - Relay settings
 - One-Line drawing
- BARC will not execute the SGIA until all deficiencies identified in prior studies (Feasibility, System Impact, and Facilities) have been remedied to the satisfaction of BARC. If BARC permits the IC the option to present alternative solutions to deficiencies identified in prior studies, the solutions must be provided by IC to BARC within 90 days after BARC's willingness to consider alternative solutions.
- BARC will not execute the SGIA until all insurance, liability, and indemnification requirements set forth in section 20VAC5-314-160 of the Virginia administrative code have been met.
- The IC may test any and all systems prior to execution of this SGIA provided the DR does not make a parallel connection with BARC's electrical system.

Construction:

For Levels one and two interconnections, BARC and the IC must reach an agreement on all aspects of the improvements prior to commencement of BARC construction or other technical activities. BARC shall pursue construction and installation of facilities with reasonable speed in accordance with VAC-314 subject to material and labor availability. BARC reserves the right to specify, order, and install any equipment BARC deems necessary for interconnection of DR during agreement negotiations. BARC will not be required to pursue the acquisition of alternate (non-BARC standard) equipment in order to satisfy schedules within the SGIA. For Level Three interconnections, if system improvements are necessary please reference the guidelines set forth in 20VAC5-314-70, Section F of the Virginia Administrative Code.

Commissioning and Performance Testing:

Prior to granting operating privileges, IC-installed DR shall undergo extensive System Commissioning and Performance Testing (SCPT) pursuant to 20VAC5-314-90. After the DR is fully operational and if conditions or operating instances justify, BARC may require retesting

performance of the DR.

- Programming and testing of the utility grade relay at the Point of Common Coupling (PCC) are to be implemented and documented by a testing consultant acceptable to BARC.
- BARC will measure, record, and analyze Power Quality on its relevant Transmission and Distribution Facilities associated with DR interconnection for a period not less than seven (7) days and prior to DR operation in order to establish foundational power quality from which electrical phenomena post DR operation will be measured against for possible DR contribution.
- BARC reserves the right to observe any and all SCPT demonstrations of protection system relays, limits, or other nuances. Testing of all devices shall be coordinated so as to allow for observation. BARC requires trip testing of specific relay systems associated with protection of PCC.
- Commissioning of paralleling abilities shall only be allowed after the execution of the SGIA.
- The IC shall provide a signed and certified relay testing document to BARC showing all relays and protection equipment functioned as designed and specified in the SGIA or IA.
- If the DR changes from the specifications set forth in the SGIA or IA, BARC will need to analyze and approve changes against any and all metrics and will require retesting of system; both at the full cost to the IC. If changes are required to the BARC system, the IC shall be responsible for full cost reimbursement.
- PCC protection must be tested every six (6) years and reported to BARC. Any unsatisfactory conditions found during periodic testing must be remedied prior to any further operation of generation facilities.

Technical Requirements

3.0 Guidelines and Requirements of Interconnecting Facilities

3.01 BARC Transmission and Distribution Standards

BARC's primary **distribution system voltages are (nominal) 7.2/12.47 kV ,14.4/24.9 kV**. BARC operates transmission lines at voltages of 46 kV. These circuits are arranged in a variety of configurations including multi-grounded wye and ungrounded delta.

BARC's protection practices include reclosing on distribution circuits as well as transmission lines. This reclosing can occur in a three-phase simultaneous trip as well as single phase, individual trips all the way to a device lock out. BARC tends to utilize reclosing devices for distribution lines and transmission lines. BARC will consider changes to existing protection schemes to accommodate DR but reserves the right to cancel such measures to avoid the possibility of adverse effects on service continuity and problems to neighboring members. (Any and all allowable changes shall be done at the full cost to the IC.) Changes to a protection scheme are non-negotiable and at the full discretion of BARC.

BARC's distribution circuits vary greatly in available capacity, short circuit current, equipment sizing, equipment capabilities, and many other characteristics. These variables create the need for specific and thorough reviews of each interconnection location.

BARC's substations were designed to meet the standards and codes current at the time of construction given the conditions at the time of design with reasonable growth in the future. Therefore, equipment was sized, protected, and arranged in a manner appropriate prior to the proposed DR. Items such as ground grid, recloser sizing, and protection settings may need to be increased, updated, and improved to allow interconnection of the DR. Any and all electrical system reconfigurations and/or improvement costs required for interconnection of the DR shall be paid by the IC.

BARC recognizes that different DRs require different interconnection considerations. As a part of this Recognition, BARC maintains different interconnection requirements that depend on many factors, one of those being the type (inverter based, rotating machine, etc...) of interconnecting DR.

3.02 BARC General Requirements

It is the policy of BARC to allow any member/owner or IC to operate their generation facility in parallel format with the BARC systems providing this operation can be performed without adverse effects to employee and public safety, BARC facilities, or to other Affected Systems. BARC accepts the interconnection of any and all forms of generation (e.g. solar, wind, hydro, fossil fuels, etc.). Whichever generation source is selected for interconnection, the IC must provide a 60 Hertz, alternating current, sine wave at a voltage compatible with BARC at the point of interconnection. Further details are provided later in this document.

The PCC shall be clearly delineated and defined. An overcurrent device rated to interrupt available fault current shall be located at the PCC as well as a manual disconnect device which can be opened and locked open for necessary safety precautions. The manual disconnecting device must have

contacts that are visually able to be identified as open as well as provisions for lockout/tagout. This device shall be accessible to BARC personnel at all times and be labeled as the disconnecting point.

Specifics of the interconnection of the IC shall be dictated by IEEE-1547 – Standard for Interconnecting Distributed Resources with Electric Power systems. The DR installation and interconnection shall meet all requirements as set forth in IEEE-1547. Any inverter-based resources interconnected with transmission and sub-transmission systems shall meet all requirements set forth in IEEE-2800 and IEEE-1547. In addition, the DR shall also meet all applicable national, state, and local construction and safety codes in addition to all applicable UL, ANSI, and IEEE standards and guidelines. Any inverter-based DR shall be UL-1741 rated.

If the IC intends to operate for power export and sale, the DR is only permitted to access (create Watts to be handled by the BARC Transmission and Distribution facilities) the wholesale market through the substation delivery point (Participant Facility) as identified in their executed, PJM Wholesale Market Participant Agreement.

Requests by the IC to interconnect to BARC-owned distribution (25 kV or 12 kV) shall recognize that BARC operates in a four-wire, multi-grounded neutral electrical configuration. Interconnections to BARC owned Transmission (46kV) shall recognize that BARC operates radial Transmission in an ungrounded delta electrical configuration.

Any and all operation of the DR facilities shall cause no impact, reduction in quality, or other adverse conditions to other BARC members. Conditions here include but are not limited to, harmonics, voltage disturbances, frequency fluctuations, or power outages. *If complaints are received and the source is suspected to be the interconnected DR, generating activities shall cease immediately and be prohibited from resuming until conditions are addressed.*

The DR shall discontinue parallel operation when requested by BARC. Requests for this interruption may be made on the grounds of maintenance activities, emergencies, suspected DR interference, safety, or temporary operating parameters. BARC shall not be responsible for unrealized gains or incurred expenses due to parallel operation shutdown.

Electric System Parameters

In addition to local, state, and federal laws pertaining to Transmission and Distribution grid interconnections, BARC retains standards for acceptable interconnection. The intent of these requirements is to:

- Protect the safety of employees and public.
- Maintain the integrity of specific qualities and quantities associated with BARC's Transmission and Distribution facilities.
- Maintain physical and electrical operating characteristics.
- Maintain the integrity of specific qualities and quantities associated with the affected Transmission Owner's Transmission and Distribution facilities.
- Preserve qualities and quantities for the IC and neighboring members.
- Maintain system capacity of BARC's Transmission and Distribution system.

- Maintain system switching capabilities and operational flexibility.

Power quality and quantities shall normally be detected at the PCC however, there exist conditions necessitating measurements to be taken at other points on BARC's Transmission and Distribution facilities which could result in the need for corrective actions by the DR at the sole expense of the DR.

Voltage: BARC maintains a supply voltage of $\pm 5\%$ of nominal over the entirety of Transmission and Distribution Facilities per our terms and conditions. In order for BARC to successfully manage this supply voltage, DR interconnections must operate with predictable and reliable voltage integrity.

- IC shall not regulate nor impact supply voltage as outlined in the following standards:

Voltage Imbalance:	ANSI C84.1 ($\pm 3.0\%$)
Voltage Flicker:	IEEE 1453 ($\pm 3.0\%$)
	Pst: 0.8
	Plt: 0.6
	IEEE 519
	Fig. 10-3, "Borderline of Visibility Curve"
Voltage Fluctuation:	IEEE 1250
	Distribution and Sub-Transmission: $\pm 3.0\%$
	Transmission: $\pm 1.0\%$
Voltage Harmonic Distortion:	IEEE 519
Voltage Distortions:	IEEE C62.41 and IEEE-1547
- If, after operation of the IC, BARC determines that the IC is causing unanticipated impacts outside of the bounds of any of the above-mentioned standards, BARC will require that DR cease operation until impacts can be resolved by IC.
- DR shall not oppose or regulate changes to BARC's Transmission and Distribution facility voltage. BARC may require DR to provide active VAR management to maintain power quality and power quantities at acceptable operational levels.
- DC voltage injection from inverter-based DR shall be limited to $\leq 0.5\%$ of nameplate output current at PCC.
- In an effort to limit DR from controlling BARC Transmission or Distribution System voltages, BARC requires that any DR interconnection within one (1) mile of the substation Delivery Point (Participant Facility) be interconnected to an express circuit if aggregate DR nameplate capacity exceeds 20% of existing circuit or substation power transformer capacity. While the IC shall bear the full cost of design, installation, and operating the express circuit, doing so shall not constitute ownership by the DR facility nor shall it restrict the use of the express circuit by BARC. BARC reserves the right to connect load and generation to the express circuit if BARC, and solely BARC, deems power qualities and quantities allow.

Current: BARC maintains its system capacity using guidelines specific to individual circuits and substations. Furthermore, BARC's contingency planning often dictates certain amounts of reserve capacity be available in circuits to help with power restoration during events.

BARC's system is analyzed using forecasted values from historical data which is grown in manner consistent with load forecasting studies. Loading is determined based from each circuit's non-coincident peak load. These peak loads are then analyzed individually for normal operation and then together for contingency analysis.

- Circuits will be analyzed with all interconnection generation accounted for or aggregated as necessary to most accurately represent load flows and conditions.
- The DR shall not cause a decrease in available capacity of BARC facilities. Any decrease in available capacity shall be remedied to available capacity prior to interconnection. This remedy shall be paid at full cost by the IC.
- Conductor loading shall not exceed 80% of conductor rating established by BARC
- The DR equipment shall be rated to full load current or full generation current, whichever is greater (not the net of the two).
- The DR shall interconnect with BARC facilities and meet the following standards as related to current.

Current Harmonic Distortion: IEEE 519

Power Factor: BARC maintains a power factor between 0.95 lagging and unity.

- The DR shall be capable of providing kVAR and absorbing kVAR to maintain a power factor between 0.95 lagging and 0.95 leading.
- Considerations for power factor must take into account the type of generation to be interconnected. Inverters shall have active VAR management and synchronous generators shall have reactive power capabilities activated to respond to DR kVAR needs as well as DR voltage needs. Induction generators shall maintain voltage at required levels.

Frequency: BARC maintains a system AC, sine wave frequency of 60 Hz.

- The DR and/or the aggregate DR shall not drive system frequency. The DR must be capable of receiving and reacting appropriately to any frequency fluctuations.
- The DR shall interconnect with BARC facilities and meet the following standards as related to frequency.

Operating Frequency: ANSI C84.1

System Protection: BARC maintains adequate protection on transmission and distribution systems to prevent overcurrent (fault) conditions from causing public safety concerns and/or detrimental impacts to equipment. Protection shall be automated, requiring no human intervention.

- The DR contribution to overcurrent conditions shall minimize any impacts to BARC’s existing system and protect the general public. Any and all costs incurred by BARC to maintain this level of protection and positive coordination shall be paid by DR at full cost. The DR is responsible for protecting its own equipment, BARC’s equipment, and the general public from electrical disturbances.
- The DR protection shall be positively coordinated with BARC protection systems. The DR shall design the system to protect the DR. The BARC analysis of the DR protection scheme is solely to ensure protection of the BARC transmission and distribution system, and not for protecting the DR. Any changes to the DR protection must be approved by BARC.
- The proposed distributed generation facility, in aggregate with other generation on the distribution circuit, shall not cause any distribution protective devices and other equipment including substation breakers, fuse cutouts, and line reclosers on the electric distribution system to be exposed to fault currents exceeding 80% of their short circuit interrupting capability. If interconnecting generator facilities causes fault currents to exceed 80% of short circuit interrupting capability, the IC shall replace the equipment at its own expense.
- The DR shall comply with IEEE-1547, Interconnection Standard.
- The DR shall meet IEEE-1547 requirements in a manner of its choice. Common relaying schemes include the following relays. (The IC shall use “Utility Grade” relays.)
 - Basic Relaying: Overcurrent (Instantaneous and Time Delay)
 Directional current
 Over/Under voltage
 Over/Under Frequency
 Reverse power
 Forward Under power
 Synchronization check and permissive
 - Additional Relaying: Primary and Backup protection required
- IC must recognize that interconnection to BARC Transmission and Distribution Facilities may impact other providers of electric service. These “Affected Systems” may impose requirements on BARC to maintain operational integrity. For example, BARC may be required to install, implement, and maintain protective measures at the direction of the particular Transmission Owner. IC is responsible for all costs associated with any requirements by any and all Affected Systems.

- Transfer Trip: Affected System and BARC will make determination if transfer trip is needed. Typical conditions requiring transfer trip are:
 - Existing DR interconnections on the Transmission or Distribution circuit or bus
 - Ratio of minimum circuit load to circuit aggregate DR nameplate capacity is less than 3:1
 - Transmission and Distribution facilities are operated in a networked configuration
 - Operational considerations for employee safety
- The Transfer Trip communication path and receiving equipment shall be owned and operated by BARC. IC shall pay a monthly fee for operations and maintenance of trip transfer equipment and leased fiber. The monthly fee shall be determined at the time the SGIA is executed.
- IC shall bear all cost and responsibility to permit, purchase, install, test, and operate facilities to accommodate transfer trip signal. This generally starts with the trenching and weather proof enclosure at substation Delivery Point (Participant Facility), includes all of the pole attachments and facilities along communication path, and concludes with communication equipment at DR protective relaying and equipment. BARC will interface to IC's communication equipment to carry transfer trip into IC's owned protective equipment.
- There exist conditions where existing relaying is sufficient to protect Transmission and Distribution systems but cannot be configured to produce a transfer trip signal (e.g. electromechanical relays, fuses, etc.). IC shall also bear the full cost to upgrade any BARC or Affected System relaying necessary to produce transfer trip signal.
- BARC shall own communication equipment at signal origination point to a point of demarcation, typically a junction box immediately outside of impacted substation(s) Delivery Point(s) (Participant Facility). The interconnection between point of demarcation and BARC or Affected System equipment shall be fiber optic cable so as to limit potentially harmful potential difference concerns.
- Transfer Trip shall be configured in a positive control orientation where loss of communication channel shall initiate a trip command to BARC-owned DR protective equipment to isolate the DR from BARC's Transmission and Distribution Facilities. BARC owned protective equipment will not reconnect the DR to BARC's Transmission and Distribution system until the communication channel has been reestablished and held for a period five (5) continuous minutes.
- Transfer trip shall be capable of full operation from signal origination to trip execution (contacts open) in less than 120 milliseconds.

Electric System Equipment

Protection: The IC is responsible for rating equipment capable of protecting BARC and Affected System(s) facilities. The IC must be capable of interrupting available fault current at the PCC. All possible contributors of fault current shall be accounted for when rating equipment. For example, a generator installation with dual source feeds from BARC would require the fault current contributions from both BARC sources and the generator contribution to be aggregated to determine the total available fault current.

BARC will provide available fault current to the IC. The IC shall be responsible for all calculations and sizing of the DR equipment. (Note: the IC shall notify BARC if changes to equipment have or will occur. The IC is responsible for any and all costs associated with necessary upgrades to accommodate these changes.)

Where relays and control equipment are required to meet protective needs, relays must directly communicate to protective equipment without the use of intermediate relays or repeating communication devices. (Transfer Trip is inherently excluded from this requirement.)

A failure of any single relay or relaying component shall not render the protection scheme inoperable. DR shall employ redundant relays operating in a primary and back-up scenario.

Utility grade relays meeting IEEE standard C37 are required for all paralleling DR interconnections. Relays shall coordinate with practices of BARC and Affected System(s). BARC utilizes single phase trip, single phase lockout, single phase trip, three phase lockout, three phase trip, three phase lockout, and three phase trip, single phase lockout protection scenarios that engage automatic reclosing. In order to prevent DR connection to a de-energized circuit, BARC requires DR disconnect for a period of time during reclose operations prior to reconnect. The recommended disconnection time is five (5) consecutive minutes with presence of satisfactory voltage.

Relays and protective equipment shall have a battery power source that shall be capable of operating for an eight (8) hour duration after loss of charging source.

BARC or Affected System(s) may require a breaker failure scheme be implemented.

BARC requires different protective schemes for different interconnection conditions. It is impractical to define and describe all protective schemes in this document. Instead, an approach will be outlined. Actual interconnection protection schemes to be installed are at the sole discretion of BARC utilizing good utility practice and consideration for any and all Affected System(s).

- Distribution: BARC requires installation of its own protection system in addition to the IC's at the PCC. A circuit recloser or circuit breaker, associated instrument transformers, and relaying are common, but interconnection specifics may dictate other solutions.
- Transmission: Shall be considered on a case-by-case basis with consideration for future operating configuration, needs, and intent.

Construction: BARC facilities shall be constructed to the most current revision of ANSI/IEEE C.2 or those required by the Rural Utilities Service, whichever is more stringent. BARC reserves the right to design and install facilities it deems necessary to adequately protect its Transmission and Distribution System.

- Equipment: All equipment installed shall be capable of handling the load and short circuit availability of the DR site.
- Overvoltage – Surge Conditions: Infrastructure and facilities must be adequately arrested for overvoltage conditions consistent with BARC Transmission and Distribution standards.
- Insulation: Insulators for all energized equipment shall meet Basic Insulation Levels per the NESC, Table 110-1.
- Shielding: Above ground facilities shall be adequately shielded from lightning using masts or shield wires.
- Grounding: the DR shall be adequately grounded to meet ANSI/IEEE C2 (NESC), OSHA, and ANSI-IEEE-80 (where applicable).
 - All aspects of DR installation shall be effectively grounded. This includes but is not limited to: equipment, equipment housing, fences, buildings, metal poles, communication equipment, and metal enclosures.
 - The facilities must be designed to accommodate total available fault current as described in Section titled "Protection.
 - If the IC facilities are adjacent to BARC facilities, grounding grids of BARC and the DR shall be connected. Ground grid shall use exothermic welds, or swage (compression) subgrade and mechanical connections above grade.
 - If the DR are fenced, ground grid shall extend five (5) feet outside of fence for public safety.

Metrology: BARC requires revenue grade metering installed between the DR and BARC facilities in addition to the IC owned, operated, and maintained metering for Market Participation settlement. This BARC owned, operated, and maintained metering shall be located as near the PCC as possible with appropriate compensation.

IC owned, operated, and maintained metering shall be accessible and provide electronic load files through an MV-90 system to Old Dominion Electric Cooperative for Wholesale Power Bill reconciliation. Old Dominion Electric Cooperative metering and data standards will be provided to the IC. All metering costs due to the IC design shall be paid at full cost by the IC.

- IC owned metering may be installed at primary voltage or secondary voltage. If installed at secondary voltage, loss compensation for Generator Step-Up transformer and any significant length of line to Point of Common Coupling shall be applied to metering.
- Instrument transformers used in metering shall conform to IEEE C57.13 and must be rated to record power (kW, kVA, kVAR) flow in either direction at full load, full capacity, in fifteen (15) minute intervals, and minimum loads all at a revenue grade accuracy of $\pm 0.2\%$ accuracy per ANSI C12.
- Meters used shall be four quadrant meters capable of storing a minimum of 45 days of historical data.
- Instrument transformers in the configuration of three (3) potential transformers and three (3) current transformers shall be used. Instrument transformers shall meet ANSI C57 and shall not be overloaded. Current Transformer secondary circuits shall be dedicated to metering and shall carry no other burden.
- BARC reserves the right to request meter testing by IC for any and all parts of metering equipment including but not limited to components discussed here.
- IC shall install, operate, and maintain communication systems to allow MV-90 meter reads by BARC, ODEC, and/or other Affected Systems as necessary.

Transformation: BARC has specific requirements associated with both Generator Step-Up transformers and BARC-owned power transformers.

Generator Step-Up (“GSU”) transformers must be provided, installed, owned, and maintained by IC. GSU transformer shall align with appropriate winding configuration for the BARC-owned line for DR interconnection. Please request Transmission or Distribution line configuration at PCC from BARC prior to purchasing GSU. Please consult with BARC staff prior to purchasing GSU. The nameplate rating of the GSU transformer shall not be exceeded by the aggregate of the nameplate of the generation it serves. The GSU transformer shall not employ a grounding scheme that causes over-voltages on BARC-owned Transmission and Distribution facilities during ground faults.

BARC-owned power transformers were designed, purchased, installed, operated, and maintained to serve a greater Transmission and Distribution system than just those facilities required by DR. BARC, therefore, reserves a load operating margin to account for electric system planning and transformer manufacturer unknowns, uncertainties, and design constraints on all power transformers it operates. This load operating margin limits the reverse power

though the power transformer to be no more than ONAN rating of the power transformer plus the minimum operating load in the last year up to 10% of the top rating.

For single-phase generators interconnected to a center tap neutral of a 240-volt service on BARC-owned distribution transformers, imbalance between phases shall not exceed 20%.

3.03 BARC Operational Requirements

The IC facilities shall not cause negative impact to BARC facilities. Locations and layouts shall be chosen so as to not impede access or hinder restoration efforts. (i.e. thought and consideration for bucket trucks, cranes, or other equipment necessary to make repairs or upgrades.)

The IC facilities shall be designed to promote positive electrical synchronization with BARC facilities. Programmatic intelligence shall be used to automate frequency, voltage, and current synchronization between generation output and BARC's supply. This intelligence shall create safety measures, checks, and limits to counteract human error. (e.g. solid state relaying shall recognize out-of-synch conditions and disable manual closing of interconnection tie breakers.)

BARC recognizes the need for facility maintenance based on good operating protocols. The IC must accept that there will be periods of necessary maintenance and pre-arranged down-time of generating facilities. Maintenance activities may require IC facilities to be fed from an alternate source for a duration sometimes extending many months. The IC must cease power export and generating activities during this time unless alternate feed was considered in BARC's and Affected System's studies as well as the PJM WMPA. These down-times shall be coordinated and minimized to the best of both parties' ability. BARC requests at least thirty (30) days notification of planned maintenance activities. This is to prepare for needs of the requesting member as well as to combine any BARC maintenance needs to the down-time to further reduce future impacts to the member.

BARC reserves the right, at any time and without any notice, to disconnect the IC's DR from the BARC distribution or transmission grid if BARC deems, in its sole discretion, that safety or equipment are in jeopardy.

Operating Requirements

The IC is permitted to operate its generation in a long-term parallel format, short-term parallel format, or isolation format provided that the interconnection is synchronized and protected as described earlier in this document and consistent with the SGIA. Parallel formats include import or export of power from the IC generating facilities.

Operating Electrical Format:

Long Term Parallel Operation (time paralleled > 60 seconds)

Examples:

Net metering (solar, hydro, wind)
Peak Shaving (TBD rate structure, or other savings provider)
Net Export (Power production for market sale)

Description:

For facilities intended to operate a distributed resource in parallel with the Utility system for greater than 60 seconds, a closed transition (***make before break***) may occur provided the interconnecting facilities meet requirements set forth earlier in this document.

Short Term Parallel (time paralleled < 60 seconds)

Examples:

Facility Maintenance
Operational Needs

Description:

For facilities intended to operate a distributed resource as an emergency back-up only, an Open Transition (***break before make***) transition is required. *This provides that no paralleling occurs* between the Utility and the IC systems. This can be accomplished by any type of properly rated switching device that inhibits both switches in the closed position simultaneously.

Operating Modes:

Load Curtailment Mode

Configuration:

Short Term Parallel

Function:

For facilities intended to perform maintenance or otherwise need to isolate from Utility. Often this mode is used to allow Utility to perform maintenance on serving facilities without interruption to facility.

Emergency Standby Mode

Configuration:

Break before Make, and/or Blackstart

Function:

For facilities to handle unintended loss of Utility supply. This allows facility generators to isolate from Utility at PCC (*Point of Common Coupling*) upon loss of Utility, start generators and run indefinitely and independently of Utility.

Basic Operation:

Upon loss of utility, the PCC shall open and isolate Facility from Utility. To return to utility, generator shall synchronize across the PCC, parallel with utility, and softly transfer load to Utility.

Power Export/Net Metering Mode

Configuration:

Long Term Parallel

Function:

For facilities intending normal operation in a parallel configuration where power flow can be bi-directional and in varying quantities.

Basic Operation:

Facility shall maintain parallel operation per IEEE-1547 requirements allowing power flow per Interconnection Agreement.

Appendix A -- Applications for Interconnection

Net Metering Interconnection Notification

This Application for Interconnection form is a state-approved document and is not provided here. Please reference the Cooperative Website www.BARCElectric.com for latest NMIN form.

Level 1, Level 2, and Level 3 Small Generating Interconnection

The Application for Small Generator Interconnection is a state- approved document and is not provided here. Please reference the Virginia Law Administrative Code website for the latest form: <https://law.lis.virginia.gov/admincode/title20/agency5/chapter314/section170/>