



17 North Second Street
12th Floor
Harrisburg, PA 17101-1601
717-731-1970 Main
717-731-1985 Main Fax
www.postschell.com

Devin Ryan

dryan@postschell.com
717-612-6052 Direct
717-731-1981 Direct Fax
File #: 175564

May 24, 2019

VIA ELECTRONIC FILING

Rosemary Chiavetta, Secretary
Pennsylvania Public Utility Commission
Commonwealth Keystone Building
400 North Street, 2nd Floor North
P.O. Box 3265
Harrisburg, PA 17105-3265

**Re: Petition of PPL Electric Utilities Corporation for Approval of Tariff Modifications and Waivers of Regulations Necessary to Implement its Distributed Energy Resources Management Plan
Docket No. P-2019-**

Dear Secretary Chiavetta:

Enclosed for filing is the Petition of PPL Electric Utilities Corporation for Approval of Tariff Modifications and Waivers of Regulations Necessary to Implement its Distributed Energy Resources Management Plan in the above-referenced proceeding. Copies will be provided as indicated on the Certificate of Service.

Respectfully submitted,

Devin Ryan

DTR/jl
Enclosures

cc: Certificate of Service

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing has been served upon the following persons, in the manner indicated, in accordance with the requirements of 52 Pa. Code § 1.54 (relating to service by a participant).

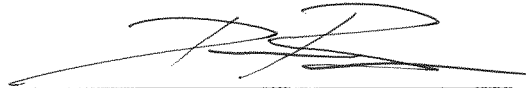
VIA E-MAIL & FIRST CLASS MAIL

Richard A. Kanaskie Esquire
Director and Chief Prosecutor
Pennsylvania Public Utility Commission
Bureau of Investigation & Enforcement
Commonwealth Keystone Building
400 North Street, 2nd Floor West
PO Box 3265
Harrisburg, PA 17105-3265

Tanya J. McCloskey Esquire
Senior Assistant Consumer Advocate
Office of Consumer Advocate
555 Walnut Street
Forum Place, 5th Floor
Harrisburg, PA 17101-1923

John R. Evans
Small Business Advocate
Office of Small Business Advocate
300 North Second Street, Suite 202
Harrisburg, PA 17101

Date: May 24, 2019



Devin Ryan

**BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION**

Petition of PPL Electric Utilities Corporation :
for Approval of Tariff Modifications and :
Waivers of Regulations Necessary to : Docket No. P-2019 _____
Implement its Distributed Energy Resources :
Management Plan :

**PETITION OF PPL ELECTRIC UTILITIES CORPORATION FOR
APPROVAL OF TARIFF MODIFICATIONS AND WAIVERS OF REGULATIONS
NECESSARY TO IMPLEMENT ITS DISTRIBUTED ENERGY RESOURCES
MANAGEMENT PLAN**

Kimberly A. Klock (ID # 89716)
Michael J. Shafer (ID # 205681)
PPL Services Corporation
Two North Ninth Street
Allentown, PA 18101
Phone: 610-774-5696
Fax: 610-774-4102
E-mail: kklock@pplweb.com
E-mail: mjshafer@pplweb.com

David B. MacGregor (ID # 28804)
Devin T. Ryan (ID # 316602)
Post & Schell, P.C.
17 North Second Street
12th Floor
Harrisburg, PA 17101-1601
Phone: 717-731-1970
Fax: 717-731-1985
E-mail: dmacgregor@postschell.com
E-mail: dryan@postschell.com

Date: May 24, 2019

Counsel for PPL Electric Utilities Corporation

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Pursuant to 52 Pa. Code §§ 5.41, 5.43, 53.3, 53.31, and 75.13(k), PPL Electric Utilities Corporation (“PPL Electric” or the “Company”) hereby petitions the Pennsylvania Public Utility Commission (“Commission”) for approval of tariff modifications and, to the extent required, associated waivers of certain Commission regulations that are needed to implement PPL Electric’s Distributed Energy Resources Management Plan as set forth in this Petition (“DER Management Plan” or the “Plan”), which will govern the interconnection and operation of new Distributed Energy Resources (“DERs”) deployed in the Company’s service territory.

As explained herein, the electric transmission and distribution systems in Pennsylvania and the United States are currently undergoing significant changes. In particular, the increasing deployment and use of DERs, such as solar panels and batteries, are upending the traditional electric grid¹ model of large scale generation located at significant distances from customers. By allowing customers to both consume and produce electricity at what were traditionally points of delivery, DERs force the electric distribution system to perform in a way for which it was not originally designed and, as a result, place an increasing stress on the grid. However, even as the deployment of DERs in Pennsylvania continues to increase, the Company still must provide reasonable, safe, and reliable electric service to all of its customers, including those who have not installed DERs. This can be particularly difficult because electricity cannot be readily stored. As a result, PPL Electric and all electric utilities must simultaneously balance distribution system demand and supply.

The instant Petition is an affirmative step by the Company to address these changing dynamics within the electric utility industry and to better integrate and manage the increased deployment of DERs in its service territory. Through the instant Petition, PPL Electric seeks to

¹ The terms “grid,” “electric grid,” or “power grid,” as used in this Petition, mean an interconnected network for delivering electricity from producers to consumers. The network includes both the transmission system and distribution system.

proactively implement the 2018 revisions to the Institute of Electrical and Electronics Engineers (“IEEE”)² Standard 1547, “Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces” (“IEEE Standard 1547” or “IEEE 1547-2018”) and the related, forthcoming revisions to Underwriters Laboratories (“UL”)³ Standard 1741, “Inverters, Converters and Controllers for use in Independent Power Systems” (“UL Standard 1741”). Specifically, under the Company’s proposal, customers applying to interconnect new DERs with PPL Electric’s distribution system will be required to: (1) use Company-approved smart inverters that are compliant with IEEE 1547-2018 and forthcoming UL Standard 1741⁴; and (2) install devices that enable PPL Electric to monitor and proactively manage DERs.

As explained in Section V.E., *infra*, PPL Electric’s proposal is designed to produce substantial electric service, safety, and reliability benefits for PPL Electric and its customers while also facilitating the increased deployment of DERs throughout the Company’s service territory, as is consistent with Pennsylvania’s environmental objectives. Indeed, among other things, the proposal will enable PPL Electric to: (1) improve system efficiency, power quality, and reliability; (2) operate more safely; (3) increase the number of DERs that can be interconnected with the constrained portions of the Company’s distribution system; and (4)

² IEEE is a global non-profit association working toward the development, implementation and maintenance of technology-centered products and services. IEEE primarily innovates new electronic products and services, designs the standards that govern them, and imparts, publishes, and promotes industry knowledge through publications, conferences, and partnering with academic institutes.

³ UL is a company that “helps companies demonstrate safety, confirm compliance, enhance sustainability, manage transparency, deliver quality and performance, strengthen security, protect brand reputation, build workplace excellence, and advance societal wellbeing. Some of the services offered by UL include: inspection, advisory services, education and training, testing, auditing and analytics, certification software solutions, and marketing claim verification.” *What We Do*, UL, <https://www.ul.com/aboutul/what-we-do/>.

⁴ As described in Section VI.B., *infra*, in the absence of the revisions to UL Standard 1741 being finalized, PPL Electric may adopt screening requirements that are different and stricter than what is ultimately adopted by UL.

reduce capital investments by the Company where DER installations have traditionally required capital-intensive system enhancements or upgrades.

In sum, the instant Petition is intended to support and enable Pennsylvania's vision of renewable growth to address climate and sustainability objectives. The Company's Petition will facilitate the greatest penetration of DERs at the least cost while maintaining service reliability and safety. By acting today, the Company's proposal permits new DER installations to perform consistent with the updated standards and provide enhanced grid support functions.⁵ Moreover, the proposal will limit the number of legacy DERs that do not have and may never have those required capabilities.

For these reasons, and as explained in more detail below, PPL Electric respectfully requests that the Commission approve the proposed revisions to PPL Electric's tariff, grant the proposed waivers of certain Commission regulations to the extent required, and grant any other Commission approvals and waivers that are needed to implement the Company's DER Management Plan.

I. INTRODUCTION

1. PPL Electric is a corporation organized and existing under the laws of the Commonwealth of Pennsylvania. PPL Electric is a wholly-owned direct subsidiary of PPL Corporation.

2. PPL Electric furnishes electric distribution, transmission and default supply services to approximately 1.4 million customers throughout its certificated service territory,

⁵ The term "grid support functions," as used in this Petition, means features, settings, and operating modes of inverters that can provide benefits to the distribution and transmission system while minimizing the adverse impacts of DER. Grid support functions include, but are not limited to, the following: voltage and frequency ride-through, reactive power support, ramp rates, and anti-islanding detection.

which includes all or portions of 29 counties and encompasses approximately 10,000 square miles in eastern and central Pennsylvania.

3. PPL Electric is a “public utility,” an “electric distribution company” and a “default service provider” as defined in Sections 102 and 2803 of the Public Utility Code, 66 Pa. C.S. §§ 102, 2803.

4. The complete name and address of PPL Electric is as follows:

PPL Electric Utilities Corporation
Two North Ninth Street
Allentown, PA 18101

5. The attorneys for PPL Electric are:

Kimberly A. Klock (ID # 89716)
Michael J. Shafer (ID # 205681)
PPL Services Corporation
Two North Ninth Street
Allentown, PA 18101
Phone: 610-774-5696
Fax: 610-774-4102
E-mail: kklock@pplweb.com
E-mail: mjshafer@pplweb.com

David B. MacGregor (ID # 28804)
Devin T. Ryan (ID # 316602)
Post & Schell, P.C.
17 North Second Street
12th Floor
Harrisburg, PA 17101-1601
Phone: 717-731-1970
Fax: 717-731-1985
E-mail: dmacgregor@postschell.com
E-mail: dryan@postschell.com

PPL Electric’s attorneys are authorized to receive all notices and communications regarding this Petition.

II. LEGAL STANDARDS

6. Section 5.41 of the Commission’s regulations states, in part, that “[p]etitions for relief under the act or other statute that the Commission administers, must be in writing, state clearly and concisely the interest of the petitioner in the subject matter, the facts and law relied upon, and the relief sought.” 52 Pa. Code § 5.41(a).

7. Similarly, Section 5.43 of the Commission’s regulations provides that a petition for waiver of a regulation “must set forth clearly and concisely the interest of the petitioner in the subject matter, the specific . . . waiver . . . requested, and cite by appropriate reference the statutory provision or other authority involved.” 52 Pa. Code § 5.43(a). Such petition also “must set forth the purpose of, and the facts claimed to constitute the grounds requiring the . . . waiver.”

Id.

8. Copies of any petition under Sections 5.41 and 5.43 must be served on the statutory parties and “on all persons directly affected and on other parties whom petitioner believes will be affected by the petition,” as well as further directed by the Commission. 52 Pa. Code §§ 5.41(b)-(c), 5.43(b)-(c).

9. “Unless the Commission otherwise orders, a public utility . . . may not change an existing and duly established tariff, except after notice of 60 days to the public.” 52 Pa. Code § 53.31.

10. Electric distribution companies (“EDCs”) are required to “file a tariff with the Commission that provides for net metering consistent with” Chapter 75 of the Commission’s regulations. 52 Pa. Code § 75.13(c).

11. In addition, an EDC and default service provider (“DSP”) “may not require additional equipment or insurance or impose any other requirement” on a net metering customer-generator “unless the additional equipment, insurance or other requirement is specifically authorized under this chapter or by order of the Commission.” 52 Pa. Code § 75.13(k).

III. BACKGROUND

12. In Pennsylvania, customer-owned DERs are governed by the Alternative Energy Portfolio Standards (“AEPS”) Act of 2004, 73 P.S. §§ 1648.1-1648.8, which became effective in

February 2005, and has since been revised by Act 35 of 2007 (effective July 2007) and Act 129 of 2008 (effective November 2008). The AEPS Act enables customer-generators to interconnect their generating facilities with the distribution systems of EDCs, like PPL Electric. *See* 73 P.S. § 1648.5.

13. The AEPS Act directed the Commission to “develop the technical and net metering interconnection rules for customer-generators to operate renewable onsite generators in parallel with the electric utility grid.” *See id.* Pursuant to this directive, the Commission promulgated regulations that govern the interconnection and net metering of customer-generators’ facilities. *See* 52 Pa. Code, Ch. 75.

14. Since the Commission’s AEPS Act regulations became effective on December 16, 2006, the Company has connected over 8,000 customer-owned and third party-owned DERs to its electric distribution system. Of these, approximately 7,900 are solar photovoltaic (“PV”) facilities, with the remaining systems primarily consisting of combined heat and power, wind, and biomass.

15. On average, PPL Electric receives between 1,000 and 1,500 DER interconnection applications per year, with the overwhelming majority of applications for solar PV systems.

16. Based upon historic interconnection of renewables throughout Pennsylvania,⁶ the Company expects DER interconnection applications to rise as DER technologies become increasingly affordable and efficient.

17. Moreover, DER development has been and continues to be encouraged by financial incentives, legislative changes, and most recently, Pennsylvania Governor Tom Wolf’s executive order to establish statewide goals to reduce carbon emissions.

⁶ See page 29 of the Commission’s PA AEPS Annual report (available at http://www.puc.state.pa.us/Electric/pdf/AEPS/AEPS_Ann_Rpt_2017.pdf), which shows an increase in total Tier I and Solar PV from 2011 through 2017.

18. For example, financial incentives from the private sector, state and federal grant programs, and the Federal Investment Tax Credits (“ITC”) directly support the development of solar generation. While many state and federal grant programs have ended over the past few years, the ITC is still in effect and utilized by many solar developers and customers. Financial incentives make solar assets less costly and reduce the payback, or break-even period, directly supporting a customer’s ability to install solar assets at their homes and businesses.

19. Further, in July of 2018, the Pennsylvania Department of Environmental Protection (“DEP”) released its draft Pennsylvania’s Solar Future Plan (“PSFP”) for public review and comment.⁷ The PSFP considers various opportunities for Pennsylvania residents and businesses to capitalize on the technical and economic potential of solar electric generation from distributed generation systems and utility-scale solar PV farms. One key proposal of the PSFP is to “[a]ccelerate use of smart inverters to managed [sic] over-voltage concerns on low voltage distribution lines and avoid unnecessarily adding costs on small solar distributed generation projects.”⁸ Additionally, the PSFP modeled various scenarios that investigated the viability of increasing the state’s solar obligation from 0.5% in 2021 to 10% by 2030 – amounting to an estimated 11 gigawatts of new solar generation.⁹

20. Additionally, in October of 2017, Governor Wolf signed Act 40¹⁰ into law, which effectively closed Pennsylvania’s borders to solar renewable energy credits (“SRECs”) generated from solar facilities outside of the Commonwealth. This is expected to support the development of solar facilities within the Commonwealth because EDCs and electric generation suppliers

⁷ Solar Future Plan, Pennsylvania Department of Environmental Protection (July 7, 2018), *available at* <http://files.dep.state.pa.us/Energy/Office%20of%20Energy%20and%20Technology/OETDPortalFiles/Pollution%20prevention%20and%20Energy%20assistance/SolarFuture/Pennsylvania%27s%20Solar%20Future%20Plan.pdf>.

⁸ PSFP at 97.

⁹ PSFP at xvi.

¹⁰ Act 40 of 2017, H.B. 118, 2017 Pa. Laws 40; *see also Implementation of Act 40 of 2017*, Docket No. M-2017-2631527 (Order entered May 3, 2018), *reconsideration granted in part and denied in part*, Docket No. M-2017-2631527, 2018 Pa. PUC LEXIS 276 (Order entered Aug. 2, 2018).

(“EGSs”) must now fulfill their AEPS Act solar obligations from the generation of solar energy within the Commonwealth.

21. Moreover, the passage of Act 58 of 2018 in Pennsylvania,¹¹ which added Section 1330 of the Public Utility Code,¹² provides utilities the opportunity to utilize alternative rate mechanisms to support the integration of DERs with the distribution system through decoupling mechanisms, demand management, and non-wires alternatives. Relatedly, the Commission’s recent Proposed Policy Statement Order on alternative ratemaking methodologies¹³ also highlights the potential benefits of decoupling and demand management, which in turn could accelerate DER expansion.

22. In addition, on January 8, 2019, Governor Tom Wolf issued an Executive Order, “Commonwealth Leadership in Addressing Climate Change and Promoting Energy Conservation and Sustainable Governance,”¹⁴ which establishes carbon emission reduction targets relating to Commonwealth buildings and operations. One objective of the Order is to procure renewable energy to offset at least 40% of the Commonwealth’s annual electricity usage.

23. The projected increased installation of DER also is supported by the Commission’s “*Electric Power Outlook for Pennsylvania 2017-2022*,”¹⁵ which states on page 3 that “a total of 37 GW (nameplate) of solar additions are projected by 2022. Of these, 20 GW (nameplate) are distributed” The report also states on page 4 that “more robust planning approaches are needed to ensure adequate essential reliability services.” This was emphasized

¹¹ Act 58 of 2018, H.B. 1782, 2018 Pa. Laws 58; *see also Implementation of Act 58 of 2018 Alternative Ratemaking for Utilities*, Docket No. M-2018-3003269 (Order entered Apr. 25, 2019) (setting forth the Commission’s interpretation and implementation of Act 58 of 2018).

¹² *See* 66 Pa. C.S. § 1330.

¹³ *See Fixed Utility Distribution Rates Policy Statement*, Docket No. M-2015-2518883 (Order entered May 23, 2018).

¹⁴ <https://www.governor.pa.gov/executive-order-2019-01-commonwealth-leadership-in-addressing-climate-change-and-promoting-energy-conservation-and-sustainable-governance/>

¹⁵ Pennsylvania Public Utility Commission, “*Electric Power Outlook for Pennsylvania 2017-2022*” (August 2018), *available at* http://www.puc.state.pa.us/General/publications_reports/pdf/EPO_2018.pdf

by the report's summary of North American Electric Reliability Corporation's ("NERC") 2017 assessment,¹⁶ which found that system operators and planners need to gather data about "aggregate technical specifications of DERs connected to local distribution grids to ensure accurate system planning models, coordinated system protection, and real-time situation awareness," especially with expected growth in DERs.

24. PPL Electric has been proactively preparing for increasing DER interconnections. The Company is actively engaged in assessing and understanding the impact of DER development through its Keystone Solar Future Project ("KSFP") and received a grant of over \$3 million for this program from the U.S. Department of Energy's ("DOE") Office of Energy Efficiency and Renewable Energy through its Sunshot Initiative in August 2017. The objective of the project is to gain greater insights into operational and technical impacts on the distribution system as increasing amounts of customer-owned and third party-owned solar generation are integrated into the existing distribution system. As a part of the KSFP, the Company developed and implemented a Distributed Generation ("DG") Portal, a web-based tool for rapid review of customer-owned DG applications. Further, PPL Electric is developing a Distribution Energy Resource Management System ("DERMS") to gather DER data, provide DER system forecast capabilities, and potentially provide DER management capabilities. The KSFP is an example of the Company's proactive approach to understanding and preparing for the opportunities and challenges presented by increased DER installations, so that PPL Electric can smoothly integrate DERs into its distribution system while maintaining system reliability.

25. In light of these financial incentives, legislative changes, and Company efforts, PPL Electric expects an increase in DER interconnection applications in the future based upon

¹⁶ NERC 2017 Long-Term Reliability Assessment (Dec. 2017), *available at* https://www.nerc.com/pa/rapa/ra/reliability%20assessments%20dl/nerc_ltra_12132017_final.pdf

historic trends of renewable interconnections throughout Pennsylvania,¹⁷ projected incentives to encourage installations to reduce carbon emissions, and the increasing affordability and efficiency of DER technology. As explained previously, there are several activities – some promulgated by the market, some by government entities, and others by PPL Electric itself – to enhance and prepare for the future development of DERs within Pennsylvania. Efforts such as these demonstrate opportunities to increase DER installations within the Commonwealth. This increased solar generation and other types of DER on distribution systems will require careful and thoughtful planning by all EDCs. Through the instant Petition, PPL Electric seeks to proactively update its own processes and practices to integrate, monitor, and manage DERs on its distribution system.

IV. HISTORY OF IEEE STANDARD 1547 AND UL STANDARD 1741

26. IEEE Standard 1547 is formally identified as “IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces.” This standard outlines technical requirements concerning the interconnection and interoperability performance of DERs, including operation and testing, safety, maintenance, and security requirements. The standard also specifies that a DER must be equipped with additional grid support functions.

27. In April 2018, IEEE Standard 1547 was revised to transform how DERs interact with and function on the electrical distribution system by standardizing inverter capability requirements, incorporating improved communication interface standards, expanding grid support functions, and improving anti-islanding protections.

¹⁷ See page 29, Chart 15 of the Commission’s PA AEPS Annual report (available at http://www.puc.state.pa.us/Electric/pdf/AEPS/AEPS_Ann_Rpt_2017.pdf).

28. The previous version of IEEE Standard 1547 (adopted in 2003) was limited to electrical requirements. However, IEEE 1547-2018 includes both electrical as well as interoperability and communication requirements.

29. DERs interconnecting with the distribution system in the coming years are expected to be inverter-based, specifically equipped with “smart inverters” that comply with IEEE 1547-2018 and provide grid support functionality relating to voltage, frequency, communication, and controls. When widely used and adopted, IEEE 1547-2018 will enable a higher saturation of DERs on the distribution system, while maintaining grid safety and reliability and providing new benefits for the grid and customers.

30. Of specific importance to PPL Electric and DER customers is the new requirement for DER inverters to be “smart,” *i.e.*, capable of providing grid support functionality and communications using revised specifications. IEEE 1547-2018 states that DERs must provide the local electric distribution utility with a standardized local interface for the monitoring and management of the DER. Section 10.2 of IEEE 1547-2018 specifies that DERs “shall use a unified information model, and non-proprietary protocol encodings based on international standards or open industry specifications as described in 10.7.” Section 10.7 then specifies that the DER must offer either an Ethernet or a Serial (RS-485) interface that uses one of three standardized protocols: (1) SunSpec Modbus; (2) DNP3 (IEEE 1815); or (3) SEP2 (IEEE 2030.5). The more sophisticated and standardized communications specified by IEEE 1547-2018 will enable DERs to convey performance data, so the Company will have increased situational awareness and can more quickly diagnose and address any operational or maintenance issues.

31. By implementing IEEE 1547-2018, a significant and longstanding impediment to the development of replicable and scalable DER management has been resolved—inverter protocol standardization. Now, inverter manufacturers will have standardized information models detailing read/write protocols. This will enable electric utilities to use standardized system programming to interface with DERs instead of creating custom programs for each inverter type.

32. In addition to the IEEE 1547-2018 standard, which governs the technical requirements for DERs, UL Standard 1741 also applies to DERs and governs the physical testing procedures that manufacturers must perform to certify that a DER inverter meets IEEE 1547-2018. Based upon the recent update of IEEE Standard 1547 in 2018, UL Standard 1741 is currently under revision, with an expected release in 2019.

33. Once the updated UL Standard 1741 is published, DER equipment manufacturers will be obligated to comply with the new UL Standard 1741 and IEEE Standard 1547. Typically, manufacturers are provided time to change their production operations and processes before they must manufacture their products to meet the new standards. Most recently, California¹⁸ provided manufacturers one year to update their products to the new standards imposed through California Senate Bill 1, “Guidelines for California’s Solar Electric Incentive Programs.” As such, all DER inverter and communication devices are expected to be certified in 2020 under IEEE 1547-2018, using the new UL Standard 1741.

34. At the time of this Petition, adoption of IEEE 1547-2018 by all inverter and communication device manufacturers is pending the finalization of updates to UL Standard 1741. PPL Electric believes an expedited process to incorporate IEEE 1547-2018 is warranted

¹⁸ Guidelines for California Solar Electric Incentive Program, Senate Bill 1, December 2018. <https://www.energy.ca.gov/2018publications/CEC-300-2018-009/CEC-300-2018-009-CMF.pdf>.

and is requesting approval to proactively implement IEEE 1547-2018 to begin achieving the benefits of the new inverter technology. Doing so reduces the time to implement IEEE 1547-2018 once the revised UL Standard 1741 standard becomes effective. Although the finalization of updates to UL Standard 1741 is still pending, there are currently-available inverters that meet IEEE 1547-2018.

35. Proactive implementation also permits new DERs to utilize the smart inverters and communication devices and take advantage of the functionality features provided by those devices. Overall, consistent adherence to the updated standards will maintain or increase the stability, reliability, and efficiency of the distribution system over time as DER penetration levels increase. It also will improve distribution system management capabilities, streamline the interconnection process for new DERs by reducing the protocols the Company will need to manage and maintain, provide increased DER interconnection potential, and could reduce utility investments supporting DER interconnection.

V. DETAILS OF THE COMPANY'S DER MANAGEMENT PLAN

36. PPL Electric is proposing to require all new customer-owned and third party-owned DERs that connect to the PPL Electric distribution system to comply with IEEE 1547-2018. Specifically, after approval of this Petition, all new customer-owned and third party-owned DER system installations must be equipped with smart inverters, DER management devices, and local communication interfaces and protocols that meet IEEE 1547-2018.¹⁹ No new

¹⁹ IEEE 1547-2018 Section 10.2 specifies that the DER “shall use a unified information model, and non-proprietary protocol encodings based on international standards or open industry specifications as described in 10.7”. Section 10.7 specifies that the DER shall have a “local communication interface” that supports “at least one of the protocols specified in Table 41” and that “the protocol to be used may be specified by the” local electric distribution utility. The protocols specified in Table 41 include: SEP2 over Ethernet, DNP3 over Ethernet, SunSpec Modbus over Ethernet, and SunSpec Modbus over Serial RS-485. The PPL Electric system is presently compatible with all of these protocols with the exception of SEP2 over Ethernet.

DER system will be approved for interconnection unless both a Company-approved smart inverter and a DER management device are included in the DER system interconnection application.

37. PPL Electric's DER Management Plan will enable the Company to better integrate, monitor, and manage DER resources throughout PPL Electric's service territory. Indeed, as explained in Section V.E., *infra*, the Company's proposal will facilitate DER adoption and provide a wide range of benefits, while also supporting the statewide goal to reduce carbon pollution with renewable energy.

38. The following sections outline the required equipment, technical standards, and benefits of implementing the changes for PPL Electric and its customers.

A. SMART INVERTERS

39. Inverters are devices that convert the direct current ("DC") power produced by solar panels into the alternating current ("AC") power transported on the electric distribution system for use in homes and businesses.

40. Smart inverters²⁰ provide additional functionality to standard inverters. For example, smart inverters are equipped with many grid support functions, including: (1) fixed power factor, volt/VAR, volt/watt, and reactive power; (2) frequency/watt; (3) low and high voltage and frequency ride through; and (4) power curtailment and remote ON/OFF capability. This functionality allows the DERs that utilize smart inverters to operate in "sync" with the distribution system, thereby reducing power quality issues and maximizing potential DER output

²⁰ As used in this Petition, "smart inverter" means an "inverter that performs functions that, when activated, can autonomously contribute to grid support during excursions from normal operating voltage and frequency system conditions by providing: dynamic reactive/real power support, voltage and frequency ride-through, ramp rate controls, communication systems with ability to accept external commands and other functions." PG&E Rule 21 Interconnection Tariff, *available at* <http://www.cpuc.ca.gov/General.aspx?id=5071>.

and operability. Smart inverters are also used in battery (energy storage) systems, electric vehicle chargers, and any other technologies that use DC power.

B. DER MANAGEMENT DEVICES

41. A DER management device is the communication medium between the DER inverters and the EDC.

42. Under the DER Management Plan, DER management devices must be installed and connected to the local communication interface of the DER system, so that the Company can monitor and manage the DERs and take advantage of the DERs' grid support functions.

43. Currently, PPL Electric envisions two types of DER management devices being used in conjunction with IEEE 1547-2018: (1) mesh network radios; or (2) cellular modems.

44. Mesh network radios are the proposed default communication device to be utilized for customer-owned and third party-owned DERs. Mesh network radios have the capability to connect wirelessly to the Company's new Radio Frequency ("RF") mesh network. By enacting a standard whereby DERs utilize mesh network radios, the Company will be able to seamlessly integrate DERs through its established RF mesh network. Given the robust nature of the RF mesh network already in place, this is the preferred communication device of PPL Electric.

45. Cellular modems will be used only in instances when a mesh network radio is not feasible. The Company has experience using cellular modems in its operations, as they are used by PPL Electric to communicate with equipment throughout its system, such as reclosers, sectionalizers, capacitor banks, and other forms of distribution automation equipment.

46. Because both RF mesh and cellular modem communication devices are operational on PPL Electric's system today, the Company is experienced with managing cybersecurity concerns associated with these communication devices. Robust practices and

protocols are used to manage and mitigate cyber threats. These practices and protocols are equal to or exceed industry standards and will be enhanced as necessary to address evolving threats.

C. DER SYSTEM MONITORING AND MANAGEMENT

47. As highlighted above, the primary changes to both IEEE Standard 1547 and the pending UL Standard 1741 focus on the necessity of smart inverters' grid support functionality and communication with EDCs' systems.

48. As the deployment of DERs continues to increase, it will become critically important for the Company to monitor and manage the DERs interconnected with its electric distribution system. Solar and other intermittent resources can negatively affect the voltage on the electric distribution system, resulting in delayed interconnection or distribution system reinforcements before additional DERs can be installed. Given PPL Electric's current inability to directly communicate and manage customer DERs to leverage grid support functionality, the amount of intermittent generation that can be interconnected must be limited to maintain system stability and reliability. Therefore, PPL Electric also is requesting the ability to monitor and manage DERs through the DER management devices by engaging their smart inverter grid support capabilities.²¹

D. CUSTOMER COMMUNICATION

49. The implementation of new equipment and DER management protocols and standards requires clear communication with any prospective customer-generators.

50. Customers who are pursuing or are interested in learning more about installing DERs on the PPL Electric distribution system will be able to find detailed information and instructions about the interconnection process on PPL Electric's external website, which will be

²¹ As mentioned previously, PPL Electric also has developed a DERMS through the PPL Electric KSFP that is focused on utilizing grid support functionality to better monitor and manage DER integration with the PPL Electric power grid.

updated to appropriately reflect the changes to its DER standards. For example, the Frequently Asked Questions section on the website will be updated to include additional information regarding customer impacts and equipment requirements for the DER management device. Further, the Renewable Energy Connection portal will be updated to include a section on the DER management device and steps required before receiving approval from PPL Electric to interconnect with the distribution system.

51. In addition, the Company's Rules for Electric Metering and Service Installation ("REMSI") tariff pages will include the requirements for interconnecting DERs, required equipment specifications, and installation instructions for the DER management device.

52. PPL Electric's customer service department also will be equipped with documentation allowing them to address customers' questions regarding the smart inverters and DER management devices.

E. BENEFITS OF THE DER MANAGEMENT PLAN

53. PPL Electric's DER Management Plan is designed to provide several substantial benefits to customers, the Company, and the Commonwealth by improving the safety, quality, efficiency, stability, and reliability of the Company's operations and service while facilitating the increased deployment of DERs through the Company's service territory.

54. First, by enabling PPL Electric to monitor and manage the DERs, the amount of DERs that can be safely and reliably interconnected with the Company's electric distribution system can be significantly increased, as demonstrated in various industry research studies.²² Indeed, power factor management can increase the hosting capacity of the Company's electric

²² See Seuss, J., *et al.*, "Improving Distribution Network PV Hosting Capacity via Smart Inverter Reactive Power Support" (July 2015), available at <https://energy.sandia.gov/download/33230/>; Ding, F., *et al.*, "Technologies to Increase PV Hosting Capacity in Distribution Feeders" (July 2016), available at <https://www.nrel.gov/docs/fy16osti/65995.pdf>.

distribution system, meaning that PPL Electric can accommodate the interconnection of more DERs without the need for system upgrades. Therefore, the Company's proposal is consistent with the several governmental and private initiatives encouraging the widespread deployment of DERs throughout Pennsylvania. *See* Section III, *supra*.

55. Second, allowing PPL Electric to monitor and manage DERs provides several safety benefits. When there is a disturbance or an outage on the system, PPL Electric will be able to better determine the output of impacted DERs and enable the Company's system operators to safely perform system restoration without violating any equipment constraints. Moreover, if necessary, PPL Electric could remotely curtail the DERs in the vicinity of the Company's employees who may be working nearby and keep the distribution lines de-energized during maintenance and repair work.

56. Additionally, depending on the characteristics of the circuit, a delay or failure to trip off could lead to unintentional islanding of the DER. This unintentional islanding occurs when the generation from the DERs is strong enough to supply the load when isolated from the distribution system. Such a situation presents a significant safety risk to both the public and PPL Electric's employees and contractors. If crews are dispatched to repair equipment and see a visible break in the Company's protective equipment, they cannot assume the downstream line is de-energized. If the unintentional island has formed, the lines will be energized downstream of this device, which can be a safety hazard to line workers and the public. If there are downed conductors, the DER can backfeed into this low impedance fault and can cause fires or electrical hazards to the public. Also, when unintentional islanding occurs, there is no way for the utility to maintain power quality, which can lead to customers' equipment being damaged.

57. Currently, PPL Electric has no way of detecting if an unintentional island forms or de-energizing DERs to remove the island. However, the Company's Plan would enable PPL Electric to locate and disconnect DERs in these unintentional islanding scenarios.

58. Third, by utilizing the grid support functionality, PPL Electric can improve system efficiency. Indeed, enabling localized power generation improves system efficiency by reducing line losses. This is because power would be generated locally instead of being generated at utility-scale generation facilities and transported across transmission and distribution lines to end-use customers.

59. Fourth, the Company's proposal can improve power quality at customer sites and on distribution circuits by leveraging DER voltage support functions, potentially avoiding the need to deploy traditional voltage regulation infrastructure. Specifically, power factor, Volt/VAR, Volt/Watt, ramp rates,²³ and reactive power functions allow DERs to maintain appropriate voltage levels on the distribution system. As a result, the Company will be able to reduce DER interconnection system upgrade costs and reduce the need to deploy equipment, such as capacitor banks or voltage regulators, to manage voltage irregularities. Similarly, frequency/watt functionality allows a DER to maintain appropriate grid frequency, thereby improving the stability of the distribution system and the DER's ability to maintain a connection with the distribution system.

60. Fifth, the DER Management Plan will improve system stability and reliability. Smart inverters with IEEE 1547-2018 capabilities provide DERs with the ability to "ride through" low and high voltage and frequency events. As a result, DERs will be more likely to

²³ Inverters can change the rate at which the generation output ramps up to full capacity when the solar irradiance becomes present. The default setting for this parameter is 100%, which means when clouds give way to sunshine, the inverter ramps from almost no output to the full amount allowed by the solar resource. Given the intermittent nature of solar irradiance, inverters ramping up quickly can lead to power quality issues in high penetration scenarios, such as flicker or spikes in voltage.

remain online and operating properly during abnormal voltage and frequency disturbances occurring on the distribution or transmission system, thereby maintaining reliable service. Inverters without a setting for this functionality traditionally “trip off” DERs when a system disturbance occurs. In higher solar PV penetration scenarios, large numbers of inverters going offline due to a deviation from normal distribution system operating parameters can exacerbate the stress on existing infrastructure and negatively affect service reliability. Ensuring that DERs remain online during short-term system interruptions can mitigate system imbalances between load and generation resources and can reduce the likelihood of more significant disturbances to the system.²⁴ Additionally, if a substantial number of DERs trip offline simultaneously, they could destabilize the bulk electric system and increase the likelihood of a cascading outage. With ride-through capabilities, however, DERs can help support the bulk electric system rather than exacerbating the problem.

61. Further, allowing PPL Electric to monitor and manage DERs eliminates the issue of “load masking”²⁵ because it provides real time visibility into individual and aggregate DER generation output. With the ability to have real-time visibility to DER generation and an understanding of masked load, PPL Electric can more effectively design and operate the system. For example, when there is a disturbance on the system, PPL Electric will be able to accurately determine the actual electric demand on a circuit without the contribution from DERs and act accordingly. This allows the Company’s system operators to safely perform system restoration without violating any equipment ratings or constraints such as current or voltage limits.

²⁴ The importance of this functionality is highlighted by a recent initiative between the Department of Energy’s Argonne National Laboratory and PJM’s Distributed Energy Resource Ride-Through Task Force. These groups have entered into agreement to study the ride-through and trip guidelines per IEEE 1547-2018 and adjust the rules to better manage rooftop solar energy resources. *See* <http://insidelines.pjm.com/pjm-and-argonne-national-lab-working-to-fine-tune-guidelines-for-solar/>.

²⁵ As used in this Petition, “load masking” means the difference between the amount of electricity flowing through PPL Electric’s distribution lines and the totality of electric demand from its customers as some of the demand is being served by electricity generated by local DERs.

62. Finally, apart from the general system benefits, the DER Management Plan will provide benefits to individual DER customers. For example, currently, when inverters trip offline due to grid disturbances, they remain offline for as long as five minutes after power is restored. As a result, the customer-generators' output and credits are reduced over the life-cycle of the system. However, inverters that comply with IEEE 1547-2018 can remain online during certain grid disturbances by utilizing fault ride through and momentary cessation functionalities.

63. Thus, as shown above, the DER Management Plan is designed to produce several substantial benefits for customers, the Company, and the Commonwealth.

VI. THE COMPANY'S PROPOSED TARIFF MODIFICATIONS AND WAIVERS OF REGULATIONS ARE REASONABLE AND IN THE PUBLIC INTEREST AND SHOULD BE APPROVED

64. PPL Electric respectfully requests approval of waivers of certain Commission regulations to the extent required as well as tariff modifications relating to the Company's net metering and interconnection requirements, as set forth in the *pro forma* tariff supplement attached hereto as **Appendix A** to become effective on one day's notice of a Commission order approving such tariff modifications.

65. As noted previously, these waivers and tariff modifications are necessary to implement the DER Management Plan.

66. Given the substantial benefits of the DER Management Plan,²⁶ the proposed waivers and tariff modifications are in the public interest and should be approved.

²⁶ See Section V.E., *supra*.

A. PROPOSED TARIFF MODIFICATIONS

67. Attached as **Appendix A** to this Petition is the Company’s *pro forma* tariff supplement establishing the new PPL Electric “Rule 12 – Distributed Energy Resources Interconnection Service” (“DERIS”).

68. The DERIS provides customer application details and technical DER equipment standards under the DER Management Plan. Specifically, these tariff pages provide details about the device requirements, including smart inverters, DER management devices, and DER monitoring and management.²⁷

B. PROPOSED WAIVERS OF REGULATIONS

69. PPL Electric also requests, to the extent required, waivers of all or portions of several Commission regulations because such waivers may be necessary to implement the Company’s proposal.

70. Specifically, the Company requests waivers of all or portions of the following regulations: 52 Pa. Code §§ 75.13(c), 75.13(k), 75.22, 75.34, 75.35, 75.37, 75.38, 75.39, and 75.40.

71. Section 75.13(c) provides, in pertinent part that “[a]n EDC shall file a tariff with the Commission that provides for net metering consistent with this chapter.” 52 Pa. Code § 75.13(c). As part of this Petition, the Company proposes to implement tariff modifications that could be construed as not being consistent with Chapter 75. Therefore, a waiver of Section 75.13(c) may be needed to implement the DER Management Plan.

72. Section 75.13(k) states, in pertinent part, that “[t]he EDC and DSP may not require additional equipment or insurance or impose any other requirement unless the additional

²⁷ The hyperlinks in the *pro forma* tariff supplement are not live yet, and the actual URLs may change during the course of the proceeding.

equipment, insurance or other requirement is specifically authorized under this chapter or by order of the Commission.” 52 Pa. Code § 75.13(k). Here, the Company will require new customer-generators to install additional equipment (*i.e.*, the DER management device) and impose additional requirements (*e.g.*, that the customer-generator allow PPL Electric to monitor and manage the DER and that the DER utilize a standardized, non-proprietary communications protocol specified by the utility) that are not specifically authorized under Chapter 75 or a Commission order. Therefore, PPL Electric is requesting a waiver of Section 75.13(k), which is necessary to implement the DER Management Plan.

73. Section 75.22 of the Commission’s regulations defines several terms that are used in Subchapter C of Chapter 75 of the Commission’s regulations. Among those terms is “Certified,” which is defined as:

A designation that the interconnection equipment to be used by a customer-generator complies with the following standards, as applicable:

(i) IEEE Standard 1547, “Standard for Interconnecting Distributed Resources with Electric Power Systems,” as amended and supplemented.

(ii) UL Standard 1741, “Inverters, Converters and Controllers for use in Independent Power Systems” (January 2001), as amended and supplemented.”

74. Section 75.34 of the Commission’s regulations sets forth when the Levels 1, 2, and 4 interconnection review procedures shall be used, which for Levels 1 and 2 includes when “[t]he customer interconnection equipment [t] proposed for the small generator facility is certified.” 52 Pa. Code § 75.34(1)(ii), (2)(iii).

75. Section 75.35 of the Commission’s regulations provides that “[t]he technical standards to be used in evaluating all interconnection requests under Level 1, Level 2, Level 3

and Level 4 reviews, unless otherwise provided for in these procedures, are IEEE 1547 and UL 1741, as they may be amended and modified.” 52 Pa. Code § 75.35.

76. Section 75.37 of the Commission’s regulations sets forth the Level 1 interconnection review procedures. The regulation prescribes that “[a]n EDC may not impose additional requirements for Level 1 reviews not specifically authorized under this subchapter.” 52 Pa. Code § 75.37(a). Moreover, “[f]or interconnection of a proposed small generator facility to the load side of spot network protectors,” the regulation requires that “[t]he customer interconnection equipment proposed for the small generator facility . . . be certified.” 52 Pa. Code § 75.37(b)(2).

77. Section 75.38 of the Commission’s regulations provides the Level 2 interconnection review procedures. The regulation states that “[a]n EDC may not impose additional requirements for Level 2 reviews not specifically authorized under this subchapter.” 52 Pa. Code § 75.38(a). Additionally, “[f]or interconnection of a proposed small generator facility to the load side of spot network protectors,” the regulation requires that “[t]he customer interconnection equipment proposed for the small generator facility . . . be certified.” 52 Pa. Code § 75.38(b)(2).

78. Section 75.39 of the Commission’s regulations outlines the Level 3 interconnection review procedures, which can apply to small generator facilities that are less than 5 MW, “not certified,” and “noninverter based.” 52 Pa. Code § 75.39(a)(1)-(3).

79. Section 75.40 of the Commission’s regulations sets forth the Level 4 interconnection review procedures. Subsection (c) specifies the procedures for reviewing an interconnection request from a customer who wants the generating facility “interconnected to the load side of an area network.” 52 Pa. Code § 75.40(c). Such procedures are to be used

“notwithstanding any conflicting requirements in IEEE Standard 1547.” 52 Pa. Code § 75.40(c). Subsections (c)(1)(ii) and (c)(5)(ii) require the proposed small generator facility to use “a certified inverter-based equipment package for interconnection.” 52 Pa. Code § 75.40(c)(1)(ii), (c)(5)(ii). Subsection (d) also sets forth the review procedures and criteria for a requested “interconnection to circuits that are not networked.” 52 Pa. Code § 75.40(d).

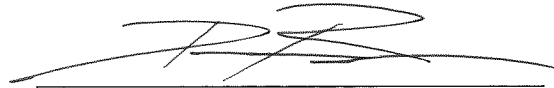
80. Waivers of all or portions of Sections 75.13(c), 75.13(k), 75.22, 75.34, 75.35, 75.37, 75.38, 75.39, and 75.40 may be needed to implement the DER Management Plan because PPL Electric will require DERs to meet IEEE 1547-2018, which is dependent upon forthcoming updates to UL Standard 1741. Indeed, although the relevant revisions to IEEE Standard 1547 have been made, UL Standard 1741 is still under revision. Until UL Standard 1741’s revisions are published, there is no standardized testing for manufacturers to certify that their inverters meet IEEE 1547-2018. In the absence of the revised UL Standard 1741, the Company may institute screening requirements for a DER system to be qualified for interconnection that are different than the current standards. Therefore, to the extent that the new UL Standard 1741 is not published by the time the Commission approves this Petition, PPL Electric respectfully requests a waiver of the Commission’s requirement that “certified” comply with the 2001 version of UL Standard 1741.

81. Finally, the Company respectfully requests that the Commission grant any additional waivers of the Commission’s regulations it deems are necessary to implement the DER Management Plan.

VII. CONCLUSION

WHEREFORE, PPL Electric Utilities Corporation respectfully requests that the Pennsylvania Public Utility Commission approve the Company's proposed tariff modifications, grant the requested waivers of certain regulations to the extent required, and grant any other approvals or waivers that are necessary to implement PPL Electric's Distributed Energy Resources Management Plan.

Respectfully submitted,



Kimberly A. Klock (ID # 89716)
Michael J. Shafer (ID # 205681)
PPL Services Corporation
Two North Ninth Street
Allentown, PA 18101
Phone: 610-774-5696
Fax: 610-774-4102
E-mail: kklock@pplweb.com
E-mail: mjshafer@pplweb.com

David B. MacGregor (ID # 28804)
Devin T. Ryan (ID # 316602)
Post & Schell, P.C.
17 North Second Street
12th Floor
Harrisburg, PA 17101-1601
Phone: 717-731-1970
Fax: 717-731-1985
E-mail: dmacgregor@postschell.com
E-mail: dryan@postschell.com

Date: May 24, 2019

Counsel for PPL Electric Utilities Corporation

Appendix A

***Pro Forma* Tariff Supplement**

Distributed Energy Resources Interconnection Service (“DERIS”)

PPL Electric Utilities Corporation

RULES FOR ELECTRIC SERVICE

RULE 12 - DISTRIBUTED ENERGY RESOURCE (DER) INTERCONNECTION SERVICE

A. PURPOSE

The Distributed Energy Resource Interconnection Service (DERIS) shall be applied to all new DER interconnections to the distribution system to enable the Company to monitor and manage the flow of electric energy from DER resources to the distribution system. DER resources shall include inverter-based alternative energy sources and systems, as defined in the Alternative Energy Portfolio Standards Act of 2004 (73 P.S. §§ 1648.1 – 1648.8), and storage resources (batteries).

B. APPLICATION

- (1) This Rule shall apply to all DER resources interconnected to the distribution system on or after XXXX (date the application is approved).
- (2) It shall apply to all customers who receive Basic Utility Supply Service under Rate Schedules RS, GS-1, GS-3, and LP-4.

C. DEVICE REQUIREMENTS

- (1) Renewable Energy Connection – The online portal allows customers to apply to interconnect the DER Management and Communication devices with the distribution system. Refer to the REMSI Renewable Energy Connection under PPL Electric's Electric Rates and Rules for additional information. <https://www.pplelectric.com/utility/about-us/electric-rates-and-rules.aspx>
- (2) Smart Inverters – All inverters connected to the distribution system must comply to the UL 1741 safety certification and be capable of utilizing smart functions for grid support. In addition, these systems must have communication capabilities for monitoring and managing the DER in accordance with IEEE Standard 1547-2018 and UL Standard 1741 as amended and supplemented unless otherwise approved by the Pennsylvania Public Utility Commission. A list of approved smart inverters is provided in the REMSI link under PPL Electric's Electric Rates and Rules: <https://www.pplelectric.com/utility/about-us/electric-rates-and-rules.aspx>

(C) Indicates Change

Issued::

Effective: April XX, 2019

PPL Electric Utilities Corporation

(Continued)

DISTRIBUTED ENERGY RESOURCE (DER) INTERCONNECTION SERVICE (Continued)

C. DEVICE REQUIREMENTS (Continued)

- (3) DER Management Device - All DER resources whether Customer-Owned or Third Party-Owned that are applying to interconnect with PPL Electric's distribution system must install smart inverters as defined in Rule 12C(2). Additionally, a DER Management Device will be directed by the Company and must be installed and connected to the data port of the smart inverter. The communication medias with the DER Management Device may use either: (1) Meter Network radios connected wirelessly to PPL Electric's RF mesh network or (2) Cellular Modem. Cellular modems will be permitted only in instances when a mesh network radio is not feasible, as determined at the sole discretion of the Company. These devices shall be installed and maintained in accordance with Company's "Rules for Electric Meter and Service Installations (REMSI)". Refer to the REMSI DER Management Device section for additional information.
- (4) DER Monitoring and Management – By installation of an approved DER system in accordance with device requirements under Rule 12C(2) and Rule 12C(3), customer and owner agree to allow PPL Electric to monitor and manage the DER system in accordance with Company policy and the PA PUC's approval at Docket No. P-2019-XXXXXX.

(C) Indicates Change

Issued::

Effective: April XX, 2019

VERIFICATION

I, SALIM SALET, being the Director-Operations at PPL Electric Utilities Corporation, hereby state that the facts above set forth are true and correct to the best of my knowledge, information and belief and that I expect PPL Electric Utilities Corporation to be able to prove the same at a hearing held in this matter. I understand that the statements herein are made subject to the penalties of 18 Pa.C.S. § 4904 relating to unsworn falsification to authorities.

Date: 5/23/2019


Salim Salet