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Related/Referenced Documents

N/A

Version History

Version	Date	Revision Comments
01	Sep. 20, 2022	Initial Release
02	Oct. 10, 2022	Catalog ID changed from 032-83596 to 032-83460.
03	Jul. 17, 2024	Format corrections, TOC added, Section 4 modified, and sections order rearranged.
04	Feb. 06, 2025	General format modifications, TOC updated, Sections 3, 5, 8, and 9 modified. New Item added (032-86890).

Item Version History

Warehouse Catalog #	Asset Suite #	Version	Date
032-83460	83460	4	02/06/2025
032-86890	86890	1	02/06/2025

1. Introduction

This is a general specification that covers the minimum requirements for voltage regulators to be used in the distribution system in Puerto Rico. Further information will be provided by LUMA Energy at the time of order placement and will provide information on site specific conditions, quantity, and other requirements. This document includes the general electrical and mechanical characteristics of the equipment/material.

2. Special Requirements

2.1. Samples shall be furnished as requested by LUMA Energy. Vendors that have supplied this equipment/material to LUMA on previous orders, will not have to furnish samples at bid opening. The equipment/material will be received at the LUMA's general warehouse (011) at Palo Seco, Puerto Rico. Shipping will include transportation and unloading at the indicated warehouse.

2.2. The manufacturer of the equipment/material shall be completely and solely responsible for the performance of such equipment/material as well as the complete integrated unit.

3. Literature

3.1. Descriptive and technical literature must be supplied by the vendor at time of bidding. This literature must include, but is not limited to details of material, drawings, documented testing, and instructions for use and installation. **The literature must be an official document from and certified by the manufacturer.** Failure to submit documents on time and duly certified by the manufacturer will cause bidder disqualification.

3.2. If required by LUMA, final drawings and documentation shall be submitted by the vendor before the manufacturing and shipping process for approval.

4. Compatible with

For compatible manufacturer and model see Table 1 on Section 12. These models are examples of the equipment/material described in this document and do not represent a preference. LUMA will evaluate equally any model not listed here during any acquisition event.

5. Markings

5.1. Containers or pallets shall be marked outside with LUMA Energy purchase order and item number.

5.2. Individual package(s) shall be clearly marked with manufacturer name and item information (part number, serial number, quantity, etc.).

5.3. Packaging labels and tags shall be waterproof.

6. Packaging

6.1. All equipment/material shall be packaged and marked in such a way as to facilitate handling and protection from damage and that the receiving warehouse can readily identify it and send it, in one complete unit, to a field location without opening crates or boxes to sort items and/or parts.

6.2. A list of all parts included in the container and/or package must be provided at the time of delivery so that the receiving personnel can verify that everything requested is present, avoiding any delay in the receiving process.

6.3. All equipment/materials, elements, parts, and hardware crates shall be shipped on flatbed trailers and stored in such a way so that they can be unloaded by finger lifts. Deliveries in containers or closed platforms where finger lifts cannot be used will not be accepted.

6.4. A warning label shall be placed on the equipment for special handling and storage requirements.

7. Number Per Package (Logistics)

Standard package: One (1) unit with parts and hardware per box or as requested by LUMA Energy.

8. Acceptance Criteria

8.1. Test required: Certified by external qualified laboratories.

8.2. Product shall be manufactured in accordance with the latest issue below (section 8.3). When conflicts occur between purchaser's specifications and the latest issue below, the purchaser's specification shall prevail.

8.3. Latest applicable codes, standards, and other regulations:

a. IEEE C37.90.1: For surge withstand capability (SWC) tests for relays and relay systems associated with electric power apparatus.

b. IEEE C57.12.00: For general requirements for liquid-immersed distribution, power, and regulating transformers.

c. IEEE C57.12.28: Pad-Mounted equipment enclosure integrity.

d. IEEE C57.12.29: Pad-Mounted equipment enclosure integrity for coastal environments.

e. IEEE C57.12.30: Pole-Mounted equipment enclosure integrity for coastal environments.

f. IEEE C57.12.31: Pole-Mounted equipment enclosure integrity.

g. IEEE C57.12.90: Test code for liquid-immersed distribution, power, and regulating transformers and IEEE guide for short-circuit testing of distribution and power transformers.

h. IEEE C57.15/IEC 60076-21: Requirements, terminology, and test code for step-type voltage regulators.

i. IEEE C57.131/IEC 60214-1: Applies to on-load tap-changers of both resistor and reactor types, de-energized tap-changers, and their motor-drive mechanisms.

j. IEC 60068-2: Methods for environmental testing of electronic equipment and products to assess their ability to perform under various environmental conditions and situations.

k. EN 50081-2: Provides emission requirements for electrical and electronic apparatus intended for industrial environments.

l. EN 61000-4: A collection of standards for electromagnetic compatibility (EMC) testing and measurement.

8.4. If any other standards different from the ones indicated in this document are used, the supplier must provide information showing compatibility with the required ones.

8.5. The routine and design test shall be in accordance with the latest ANSI/IEEE C57.15 and IEC 60076-21 Standards. The routine test samples performed on the units shall be submitted at the bid opening. The design test samples will be submitted only when the supplier requires approval of the equipment. The bidder shall submit a written certification stating that all tests shall be performed according to the latest codes, standards, and regulations to provide a product of quality. A certified report of the tests performed, per section 9 and 10 of ANSI C57.15, with results, shall be provided for each regulator.

9. Description

9.1. The voltage regulator (named VR hereafter) is used to keep voltage levels within configured limits to improve power quality in the distribution system.

9.2. The VR shall be single-phase, 60 Hz, 65°C average winding rise, and oil immerse type.

9.3. Shall be constructed and tested as per ANSI C57.15.

9.4. The VR must be designed to automatically regulate the line voltages in the distribution system with bi-directional capabilities.

9.5. The VR must be suitable to be operated at more than one system voltage as indicated on Section 9.18.b.

9.6. The VR shall provide a control accuracy of ± 1% (ANSI Class 1) for reverse power regulation.

9.7. Painting

a. The tank and the cover shall be protected against environmental conditions and corrosion by means of an adequate process of painting. The paint shall be suitable for tropical climate conditions as per ANSI C57.12.28, ANSI C57.12.29, C57.12.30, and ANSI C57.12.31, when applicable.

b. The tank and the cover shall be painted light gray, with one primer coat paint and a powder coating process, according to ANSI #70.

c. The paint shall have a great retention of brightness and color in surfaces like aluminum and ferrous and non-ferrous materials. It shall be resistant, during long term, to ultraviolet rays, humidity, corrosion due to acids, salts, organic solvents, gases, and others. It shall comply with federal regulations on temperature and environment.

d. Technical and descriptive literature shall be supplied at the bid opening. This literature shall include, but shall not be limited to, the process, type of painting and description, material safety data sheet, etc.

9.8. Nameplate

a. Two nameplates shall be furnished with each VR as per ANSI C57.15. The nameplates shall have no sharp edges and shall be located so it can be easily visible. The information on the nameplates shall be engraved or stamped. Any of the two processes shall ensure legibility for the life of the transformer.

b. The nameplates shall be made of stainless steel or aluminum.

c. The nameplates shall indicate the winding material, date of manufacture, total weight, serial number, no-PCB compliance, diagrams, among all the other information as per ANSI C57.15.

9.9. Welding

a. Welds to be made shall be in accordance with the material that will be welded and as per American Welding Society (AWS) 1.1 or latest revision.

b. All welds at the exterior of the tank shall be continuous. It shall include the welding, ON ALL SIDES, of lifting lugs, locking system, grounding provisions, etc., to prevent accumulation of humidity.

9.10. Core and Windings

a. The core shall be made of grain-oriented steel with a low reluctance lap joint. Other materials shall be evaluated by LUMA.

b. The windings shall be made of copper or aluminum. This information shall be indicated in the nameplates as mentioned above in Section 9.8.c.

9.11. Transformer Losses and Bidding Procedure

a. The bidder shall submit the no load losses at 20°C, load losses at 85°C full load and load losses at 55°C at 50% of load. **If not submitted, the bid will be declared incomplete**.

b. All losses information will be used to evaluate the life cycle cost (LCC) of each bidder according to the following formula,

LCC = (UC) + ($8.95) * NLL + ($4.73) * LL, where

UC = unit cost ($)

NLL = No load losses (W) at 20°C

LL = Load losses (W) at 85°C full load

9.12. Control

a. The VR and control system should be suitable for three or four wire overhead and underground systems connected Wye (phase to neutral), Open-Delta (phase to phase), or Delta (phase to phase) with various of the following typical rated operating voltages:

Line to Line (kV)	Line to Neutral (kV)
13.20	7.62
8.32	4.80
7.20	4.16
4.16	2.40

b. The automatic regulation range shall be ± 10%, in thirty-two (32) steps according to ANSI C57.15.

c. Shall have an accuracy of ± 1%.

d. It must be compatible with SCADA and the automation distribution systems.

e. A multi conductor neoprene 600V, -50°C to 105°C cable, with disconnect plugs at each end, shall be provided to stablish the connection between the internal circuitry of the VR and the control.

f. The control shall be compatible with the Eaton CL-7 model or latest version, having the following minimum features:

1. Single-Phase Usage
2. Spanish Language
3. Tap Changer Capacitor Location - External
4. 50 µF Tap Changer Capacitor
5. 12-pin Cable Conductors
6. 10ft. (3m) VR1 Cable

7. Port 1 Communications Card - None
8. Port 1 Protocol DNP, IEC 60870-5, 2179, MODBUS Serial & MODBUS TCP/IP
9. Port 2 Communications Card - None
10. Port 2 Protocol DNP, IEC 60870-5, 2179, MODBUS Serial & MODBUS TCP/IP
11. Reverse Power Flow Capabilities Included
12. Control Box Material - Stainless Steel
13. Control Box Size - Standard Box
14. Control Box Rating - NEMA 3R
15. VR Cable Entry - Bottom

9.13. Control Panel Cabinet

a. The VR must have a stainless-steel 304 or 316, NEMA 3R cabinet for the control panel, compatible with Eaton model CL-7 or latest version.

b. The control cabinet shall be tampered resistant.

c. It shall have a weather-tight door with locking provision. The door shall be hinged and have latching provisions that do not require tools for opening.

d. A ground connector shall be installed on the lower right side of the control cabinet for a conductor range of # 6 AWG to 250 MCM.

9.14. Insulating Oil

a. The VR shall be furnished with its tank filled with oil with a polychlorinated biphenyl (PCB) concentration of less than 1 PPM (NO-PCB). Less than 2 PPM could be accepted in case that less than 1 PPM is not present. The nameplate shall indicate this compliance. A label indicating NO-PCB shall be affixed to the transformer in a visible place. The label shall have the same duration as the transformer under normal operating conditions.

b. The oil must be Type II in compliance with ANSI/ASTM D3487. “Envirotemp” FR3 type fluid is also accepted.

c. A certificate stating the compliance with the concentration of less than 1 PPM of PCB shall be submitted by the supplier to LUMA. Same thing applies if the concentration of less than 2 PPM is accepted.

d. The Safety Data Sheet (SDS) of the oil shall be submitted by the supplier to LUMA.

9.15. Labels

a. The labels shall be made as per section 9.16 below.

b. The labels shall have a margin of approximately 1/2" (1.27 cm) on each side.

c. Each number and letter shall have a width between 0.75" and 1" (1.9 and 2.5 cm). The height shall be 2" (5.1 cm).

d. The VR shall get to LUMA with the following labels affixed to it:

1. NO-PCB:

   This label shall be placed in a visible place. Dimensions as per Section 9.15.e.

2. kVA Rating:

   This label shall be placed in a visible place. Dimensions as per Section 9.15.e.

3. STAINLESS STEEL:

   This label shall be placed directly under the kVA rating label. Dimensions as per Section 9.15.e.

4. Warehouse Item Number & Manufacturer's Identification Suffix:

   A label/stencil of the warehouse item number and manufacturer's identification suffix, in 1" (2.5 cm), black lettering, shall be required on the tank below the control.

e. The following table summarizes the approximate dimensions of the required labels:

LABEL DESCRIPTION	WIDTH (IN.)		HEIGHT (IN.)	
	MIN.	MAX.	MIN.	MAX.
NO-PCB	INDUSTRY STANDARD			
kVA RATING	7	8	3	4
STAINLESS STEEL	12	13	3	

9.16. Thermal Transfer Polyester Label Characteristics

a. Substrate specifications

1. Material: Polyester

2. Shall resist heat, UV rays, oil, abrasion, acids, chemicals, solvent, moisture and humidity, cold, and tearing.

3. Temperature range: 0°C to 50°C (32°F to 122°F)

b. Adhesive specifications

1. The adhesive type shall be acrylic.

2. Shall be compatible with dirt, high-energy and low-energy plastics, painted metal, polyethylene, metals and untreated metals, and irregular surfaces.

c. Color: The numbers and letters will be black over a white base to assure legibility from about 35' (10.7 m). If there is any discrepancy about the color between this statement and the required by the industry standards, the industry standards shall prevail.

d. The label shall last a minimum of 20 years when installed on the transformer under normal operating conditions.

9.17. kVA Rating

a. The VR shall be designed in accordance with this specification and shall have one of the following kVA ratings:

kVA RATINGS	
125	**167**

b. The kVA ratings are continuous and shall be based on 65°C average winding temperature rise or 80°C hot spot conductor temperature rise.

9.18. Electrical Characteristics

Voltage Rating (KV)	Capacity (kVA)	BIL (kV)	Current Rating (A)	Short Circuit (kA) at 2 sec
5.00 / 8.66Y	125	75	250	6.25
7.62 / 13.20Y	167	95	219	5.48

a. For the short circuit requirement, the VR shall be designed to withstand 25 times the rated current for at least two (2) seconds.

b. The VR shall be able to operate in the voltages indicated in the following table and such voltages shall be shown in the nameplates:

Nominal Voltage (kV)	Standard Voltages (kV)							
5.00	5.00	4.80	4.06	2.40	-	-	-	-
7.62	8.00	7.97	7.62	7.20	6.93	4.80	4.16	2.40

c. The VR shall have add-amp capability for additional current-carrying capacity at reduced regulation. The limit switches have scales graduated in percent regulation, and are adjustable to specific values of 5, 6-1/4, 7-1/2, 8-3/4, and 10% regulation to alter the regulation range. See the table below for details.

Nominal Voltage (kV)	Rated kVA	Load Current Ratings (Amps) Regulation Rate				
		±10%	±8.75%	±7.5%	±6.25%	±5%
5.00	125	250	275	300	336	400
7.62	167	219/232	241/255	263/278	296/313	350/370

9.19. Tank

a. The VR tank must be conventional, distribution type, for outdoor use, cylindrical shape, and appropriate to be installed on poles, platforms, pad mounted, and substation configurations.

b. All VR's must be capable of being secured to elevating structures.

c. Shall be suitable for high corrosive environments. The material shall be stainless steel 304 as well as the hardware. LUMA will evaluate other materials for approval in case stainless steel is not offered.

d. Shall be sealed type and constructed as per ANSI C57.15 as indicated above in Section 9.3.

e. The tank shall have brackets for pole type installation with a separation of 23.25" (59.1 cm) or 35.25" (89.5 cm), depending on the tank height, as per ANSI C57.15.

f. For 167 kVA and above, the VR shall be provided with a substation base, as part of the tank, suitable for securing them to an elevating structure and for pad mounting installation.

g. Grounding provisions: VR with pole-mounting hanger brackets shall be provided with two stainless steel 1/2" –13 UNC welded ground bosses located diagonally opposite from each other. VR with substation base mounts shall have two stainless steel ground pads located diagonally opposite from each other. Each pad shall have two stainless steel 1/2"-13 UNC ground provisions. All grounding provisions are to be located near the base of the regulator.

h. The tank shall have three (3) arrester mounting provisions (bosses), one per bushing. Each provision shall be composed by, at least, two (2) 1/2"-13 tapped holes. The first one located 2.5" to 3" below the top of the tank. The second one shall be located 2.5" to 3", center to center, below the first one.

9.20. Bushings

a. Shall be insulated at a level not less than the winding terminal to which they are connected, unless otherwise specified.

b. The creepage distance shall be not less than 18" (45.72 cm).

c. The insulation shall be porcelain. Other material such as polymer will be evaluated for approval by LUMA if it follows the ANSI C57.15 requirements.

d. The color of the bushings shall be light gray no. 70, Munsell Notation 5 BG 7.0/ 0.4.

e. The terminals provided shall be clamp-type connectors, tin-plated, for aluminum and copper conductors with a size range from, at least, #6 AWG to 800 MCM, depending on the current rating.

f. Wildlife protection shall be included.

9.21. Pressure Relief Valve

a. The valve shall have a pull ring for manually reducing pressure to atmospheric level using a standard hook stick and shall be capable of withstanding a static pull force of 25 lbf (112 N) for 1 min without permanent deformation as per ANSI C57.15.

b. The relief valve shall allow the pressure inside the tank to be released but not allow air to enter when the unit is cool or lightly loaded.

c. The venting pressure shall occur at 5 psig (34.5 kPa) ± 2 psig (13 kPa) and the resealing pressure shall occur at 1 psig (6.9 kPa) minimum as per ANSI C57.15.

d. The valve shall be located on the tank above the 110°C top oil level.

9.22. Tap Changer

a. On-load tap-changer equipment consisting of a liquid-immersed arcing tap switch, a tap selector, and an arcing switch, or a tap selector with vacuum switch or other current interrupting facility, and motor mechanism.

b. Shall be thirty-two (32) steps, sixteen (16) above nominal voltage and sixteen (16) below nominal voltage as per ANSI C57.15, of approximately 5/8% each.

c. A position indicator for the on-load tap-changer shall be provided with maximum and minimum indicating hands, and provision for resetting. Shall be polymer constructed for corrosion resistance, mounted above the oil level, and slanted downward at a 45° angle for ease of reading when the regulator is mounted above ground level.

9.23. Required Accessories and Features:

a. All 304 stainless steel unit, including the hardware.

b. Add-Amp capability for additional current-carrying capacity at reduced regulation.

c. Liquid Tight Flexible Armored cable (10 to 50 ft, factory installed)

d. Quick disconnect control cable with liquid tight connectors.

e. Wildlife protection

f. Dual rated 55º/65ºC rise temperature.

g. Drain valve and oil sampling device.

h. Enviro-temp FR3 fluid

i. Ground boss with tank grounding provisions furnished as specified in ANSI C57.15.

j. MOV type external series arrester (3 kV for VR rated below 22 kV) with mounting brackets.

k. Shunt arrester mounting bosses as per Section 9.19.g.

l. Shunt arresters (6 kV for the 5 kV VR and 10 kV for the 7.62 kV VR) with mounting brackets.

m. Position indicator for the on-load tap-changer as per Section 9.22.c.

n. Oil level gauge

o. Oil sight gauge

p. Oil thermometer

q. Pressure relief device

r. Pressure and vacuum gauge.

s. Pole mounting brackets (below 167 kVA)

t. Substation base (167 kVA and above).

u. Rapid pressure rises delay

v. Sealed tank construction

w. Shielded cable with liquid tight connectors.

x. Insulating oil as described in Section 9.14.

9.24. The voltage regulator warranty period of 12 months begins when the order is received in LUMA Energy's warehouse (011).

10. Inspection

10.1. Upon inspection of incoming equipment/material, the purchaser reserves the right to refuse product shipments and to determine the acceptability or rejection of the product received. The supplier shall be liable for all costs incurred for a product that is rejected.

10.2. The acceptance of any equipment/material shall in no way relieve the vendor from his responsibility to meet all the requirements of this specification, and it would not prevent subsequent rejection if such equipment/materials were found later to be defective.

10.3. The supplier shall issue a credit and remove major non-conforming regulators from the purchaser's facilities at no cost to the purchaser within 10 days of receipt of a written request.

10.4. Results from each regulatory inspection will be compiled into a Quality History of each supplier and will be used in evaluating the supplier's ability to supply a quality product for future purchases.

11. Proposal Information

11.1. Submitted proposals must include:

a. Technical information, drawings, and tests.

b. Table of Compliance completed by the bidder with reference (see Appendix 1).

12. Table 1: Warehouse and Asset Suite Identification Number

Warehouse Catalog #	Asset Suite #	Voltage Rating (kV)	Rated Capacity (kVA)	Compatible Manufacturer & Model
032-83460	83460	5 / 8.66Y	125	Eaton (Series VR-32 with CL-7 or latest control)
032-86890	86890	7.62 / 13.2Y	167	Eaton (Series VR-32 with CL-7 or latest control)

— End of Specification —

Appendix

Appendix 1: Table of Compliance

Line	Description	Pass/Fail (P / F)	Comments
1	Compliance with the document 4350.018.		
2	Industry Standards: IEEE C37.90.1, IEEE C57 (12.00, 12.28, 12.29, 12.30, 12.31 & 12.90), IEEE C57.15/IEC 60076-21, IEEE C57.131/IEC 60214-1, IEC 60068-2, EN (50081-2 & 61000-4).		
3	Technical info., drawings, and tests provided.		
4	VR losses provided.		
6	1Ø, 60Hz, 65°C avg winding rise, and oil immersed.		
7	Constructed and tested as per ANSI C57.15.		
4	Suitable for more than one system voltage as per Section 9.18.b.		
8	Control accuracy of ± 1% (ANSI Class 1) for reverse power regulation.		
9	Entire unit and hardware in SS 304.		
10	Paint: Light gray and in compliance with all Section 9.7.		
11	Two nameplates (SS or AL) in compliance with all Section 9.8.		
12	CU or AL Windings		
13	Grain-oriented steel core.		
14	No PCB oil as per Section 9.14.		
15	Labels as per Sections 9.15 and 9.16.		
16	Capacity: 125 and 167 kVA		
17	Voltage: 5.00 / 8.66Y kV and 7.62 / 13.20Y kV		
18	75 kVBIL (5kV VR) and 95 kVBIL (7.62kV VR)		
19	Current Rating with Add-Amp capabilities as per Section 9.18.c.		
20	Short Circuit at 2 Sec: 6.25 kA (5kV VR) and 5.48 kA (7.62kV VR)		
21	Sealed Type Tank		
22	Brackets for Pole Type at 23.25” separation or 35.25” depending on the tank height as per Section 9.19.e.		
23	Substation Base (167kVA VR) as per Section 9.19.f.		
24	Grounding as per Section 9.19.g.		
25	Mounting provision for arresters as per Section 9.19.h.		
26	Bushings as per Section 9.20 (wildlife included).		
27	Pressure relief valve as per Section 9.21.		
28	Tap changer as per Section 9.22.		
29	Required accessories and features as per Section 9.23.		
30	Control Unit as per Section 9.12.		
31	Control Box as per Section 9.13.		

NOTE: This table is only a checklist for reference. The compliance must be with the complete document. Filling out the table with “PASS” won’t be accepted as a compliance without the technical information required to certify it.

4350.018 Voltage Regulator (2-6-25)

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