Jason Glass
Director, Kentucky Department of Agriculture
Chair, NCWM Specification & Tolerances Committee

Dear Director Glass,

This letter is given in response to the letter from the California Agricultural Commissioners and Sealers Association. The concerns raised by this letter all have proposals that should be considered unlike the initial letter. These proposals take advantage of latest technologies that would make product evaluations during Type Approval and field review much simpler and without hampering or undermining the integrity of the code. As a dedicated participant for the past 6-7 years the spirit of the intended categories are clarified as follows.

- "Major" are those which are unresolved and considered high priority to resolve for the code to go forward. There is no proposal against any clause that would "undermine or cause harm to the HB44 code". This comment appears to taint the intention agreed to between regulators and industry which is to prioritize the most important issues first.
- "Moderate" are those which have less impact but are still important.
- "Minor" are lowest priority and are indeed editorial or congruency issues that are taken as the lowest priority for resolution.

Regarding the level of participation from regulators verses industry; There was historically a senior pattern approval (type approval) expert who brought many excellent ideas that were attempted to be capitalized on but those could not be agreed upon. The remaining participants are from various counties of California typically involved in field inspections. No other states in the US appear to be represented in any way during these "Working Group" sessions. Industry has for many years on this topic, provided a global regulatory view of all disciplines of regulatory approvals i.e., type approval, meter sealing and field verification and understands these disciplines very well. Industry representatives were invited into the discussion of the development of a new HB44 through CDFA, NEMA and NIST. This was a collective gesture of "good will" with the objective of producing the best possible HB 44 code for sub-metering.

Both socket meters (IS) and electronic meters (ES) have been around for many years and the associated concept of using an instrument transformer/sensor outside or inside the meter is not new. Now there are a wider variety of current sensors at lower and safer secondary outputs that are also much more accurate than the traditional 5A and other higher current secondaries previously mentioned. Utilities and non-utilities use all of these technologies today. The new code is intended to address many opportunities for new and useful technologies, aimed at making all aspects of any evaluation easier. Some of these methods are listed here.

- Reducing marking requirements on the outside of the meter which can easily be read by smart devices.
- Measurements can be reviewed over a host of interface protocols that can be viewed by PC or smart phones locally and remotely making review of installations or Type approvals easier.
- Extending current sensing to locations on other floors from where the meter is and still be able to evaluate accuracy using the interface protocols mentioned previously.
- Multiple instrument/sensor values being used on the same device.

Although these meters may use new technology, they as stated in the afore referenced letter, perform the same function.

Please find attached reasonable proposals for all the issues as they were stated, with accompanying rationale identifying why the proposal should be adopted. Special attention should be paid to specific comments made about “Pulse Output only” devices which industry has accepted and have proven alternate technology solutions for. This was a significant change and was one of the most contentious issues in the “major” priorities of clauses to be resolved. Industry also offered meters for review by the regulatory groups both physically and over the public network, to share more details about the technology. These offers are still available and can make resolution during the Tentative Code” phase much easier to resolve.

The list of items with rationale and what was agreed to between participating regulators and industry is also contained here. In many of these, industry agreed with the regulatory participants. Industry is still confident that there are no open issues significant enough to warrant the draft being downgraded back to development status.

We sincerely hope that the review of the proposals herein, address concerns listed in the afore mentioned letter as initially shared as long as two months ago to the entire “Working Group”, will be enough to sustain “Voting” status such that procedure development can begin. This next phase will allow for any remaining open issues to be resolved with proper technical support. These details are offered as a supporting document and also be posted on the NCWM website.

Kind regards,

Henry Alton
Product Verification & Type Approvals Manager
METERGY, TRIACTA Power Solutions Division
NEMA 5ESM Technical Committee Vice Chair and
Standards Working Group Chair
NIST SG, Watthour Meters Participant

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Item	**Clause**	**Proposer**	**Comment (rationale)**	**Proposed change**
			Major Items of concern from California regulators	
1	S.1.3.2. Test Output		Regulators not ready to rely on anything other than pulse output for modern meters. The idea, in theory, is acceptable. More time is needed to prove this method before it is put into a code, even a draft code. Also need to add rotating disc to language. a. T.2 No-Load Test – Language referring to "NUEMS without a pulse output" should be omitted until such a method can be accepted. b. T.3. NUEMS Starting Load Test - Same as T.2.	
		NEMA	**Industry agrees** with this request after some manufacturers who had issues with mandating a pulse output got together with field regulators in the state of California to arrive at least one solution involving the use of the meter display as a method to output pulses that could be used to accuracy test a meter.	1) a means for viewing accumulated values, and 2) a pulse output (visible and/or infrared pulse) or an electrical pulse output in the form of a closure (relay or electronic such as an open drain field effect transistor (FET)) which provides a pulse at an interval of Kt Watt-Hours per pulse. The value of Kt shall be such that the NUEMS's accuracy can be tested in 5 minutes or less for any specified test condition. **Use OTH-16.1 7/7/2023 statement**
2	Table S.3.2.3.a		Table S.3.2.3.a True Ratio – If "True Ratio" is not marked on the meter body, how does an inspector know the sensors are appropriate for the meter? Does the other marked information lead to this? If so, this should be explained in the tables or code.	

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		NEMA	The meter programming and the COA provide this information regarding the input compatibility. The existing type approval process also mandates knowing the specific manufacturer of the component, but the sensor manufacturer is not required to be on the meter nameplate and therefore the COA is needed for full verification. *The manufacturer is on the CTs.* Manufacturers prefer that the code continues to allow a unitless ratio and mandate a true ratio only if input marking does not specifically match the secondary output of the sensor being used. This will avoid this regulation from causing meter software changes to an electricity meter where unitless ratios are already used and would cause the resubmission if changed to every regulatory body to confirm that the meter is still in compliance with those rules. *The unitless Ratio and the True Ratio are both on the CT in some cases.*	**10. NUEMS Current Input (Input Inom or Imax).** The nominal current or voltage input for the current channel of the NUEMS electronics. The output of the current sensor must match the input configuration of the meter. This shall be a Unitless Ratio or a True Ratio. **12. True Ratio** True Ratio. Shall be used if the sensor secondary rating is a different secondary output rating than the NUEMS Current input rating marked on the meter. The True Ratio shall appear in primary amperes or volts to secondary amperes or volts shall be physically marked on a meter unless it is contained in either electronic or printed documentation. This is to be expressed as xxxA:yyyA; or xxxA:yyyV; or xxxV:yyyV or a unit-less ratio. The number of digits is the number needed to express the values.
3	Table S.3.2.3.a Electronic Display		If implemented as written, what security protocol needs to be in place? Is that something we can generically give regulatory structure to? There is concern that this is currently too broad of an allowance and needs some guard rails.	
		NEMA	The display as defined in the latest accepted code as per Ballot 2 Oct10/22and as part of the *HB44 General Code Table S.1.11.* Categories of Device and Methods of Sealing is part of metrology and therefore must be evaluated for and approved for Category 2 – not remotely programmable or Category 3 Remotely programmable. See Table S.2.3 of the latest version of Code.	**Latest 7/7/2023 HB44 Draft Code** *The Category dialog has been taken from the General Code and placed directly into the latest 7/7/2023 Draft.*

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4	Table S.3.2.3.a. 7-11		Regulators feel strongly that abbreviations need to be standardized, or, at the very least, limited to a defined set of options. It is understood that this is not the current practice in the industry, but these devices will be regulated by inspectors who will not have experience, much less expertise, in the area of electricity metering nomenclature. These items are not required to be physically marked to make it easier to comply with new requirements. a. S.3.4. Abbreviations and Symbols – Tied to comment for Table S.3.2.3. 7-11. The accepted abbreviations can be placed in this section.	
		NEMA	At the very least, all of the usable and accepted abbreviations should be placed into S3.4 if they are not already there or in Appendix D Definitions. The word NUEMS should not be associated specifically with any of S3.4 although NUEMS could be in Appendix D stand alone.	Latest 7/7/2023 HB44 Draft Code
5	Table S.3.3.a. Polarity (11)		If applicable, polarity must be physically marked. This marking seems to have been overlooked. How can an arrow on a screen give you any info about which way to install an external sensor?	
		NEMA	**Industry agrees** and here are some typical markings that are commonly given for Current Sensors. An arrow shows which way current flows through the bushing. There are color coded wires for the secondary. Primary a) An arrow on the actual CT with a statement that says it is pointing to the source or the load b) Placing H1 on the Primary facing side of the current sensor. H2 will be the unmarked other side or specifically marked H2. Secondary side wires c) Color coded to identify X1 and X2 d) Positive and negative signs on the case where the leads are. e) Color codes of the wires identified with documentation that is provided with the current sensors. UL2808 Safety already requires documentation to be included.	Latest 7/7/2023 HB44 Draft Code and as per the rationale given here

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6	TableS.3.3.a. Note ‡		Table S.3.3.a. Note ‡ - Regulators are not comfortable having metrologically significant elements not be traceable by unique ID. Need a physically marked SN, no exceptions. We understand space is extremely limited. We need to discuss how to accomplish the marking requirements on sensors.	
		NEMA	If there is a means of the meter to read a unique ID from the current sensor itself and it is evaluated during the Type approval process, it should be permitted. The current draft code addresses traceability.	Latest 7/7/2023 HB44 Draft Code. Accept the need to physically marked Sensors.
7	Table S.3.3.a		As was done with Table S.3.2.3.a., we need to remove the "Separate Document" column.	
		NEMA	As stated for Item 5 above for example, the allowance of a separate document should continue to be permitted. It is permitted for Safety which is also a regulatory requirement. *Industry is considering removing the separate document column for serial numbers. Agree*	**Latest 7/7/2023 HB44 Draft Code**
8	Appendix A - Definitions		Bi-Directional, Internal Sensors, External Sensors, Non-Integral, Self-Limiting Device, and Voltage Sensor.	
		NEMA	Definitions are offered for the terms identified. a.The SM31000 standards choose to use "interchangeable" instead of "external" because we felt interchangeability was more the concern than whether the sensor was internal or external. One additional offering for a bidirectional meter is given.	**Bidirectional** – ~~A bidirectional or net NEUMS measures energy flow in both directions in two separate registers on the same device. One for delivered and one for received. both in and out of the meter, commonly referred to as delivered and received energy. Bidirectional NEUMS must provide separate primary indicating elements and test outputs for both directions of energy flow.~~ Bidirectional - A NUEMS equipped to register the accumulation of energy in both directions (i.e., for delivered and received energy): A bidirectional NUEMS shall fall into at least one of the following categories: a. Single register or net meter that displays the difference between the delivered and received energy or b. Separate register(s) for delivered or received.

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				Internal Sensors – Any voltage or current sensors located inside of the NEUMS itself ~~or inside the sealed enclosure containing the NUEMS.~~ **External Sensors** – Any voltage or current sensors not located inside of the NEUMS itself ~~and not inside the sealed enclosure containing the NUEMS.~~ **Non-Integral** – Used to describe external sensors that can be disconnected from the meter ~~without breaking the meter sealing.~~ **Self-Limiting Current Transformer** – Any current transformer with an output that is limited to safe voltages, such that an external shorting block is not required when servicing the current transformer. Primary current to secondary current transformers can build a large secondary open circuit voltage. **Voltage Sensor** – A sensor used in conjunction with a NEUMS to sense the line voltage. Typically, a voltage sensor will scale down the line voltage to a lower value for safety or to make the voltage compatible with the input circuitry of the NEUMS.
			Moderate Items	
9			General comment – There are references to body of NUEMS, NUEMS electronics, and meter. These can all, at times, seemingly refer to the same thing. A single term should be agreed upon and used throughout the document.	
		NEMA	An offering is made here to rename the NUEMS an Electricity Meter which is a much more standard term. This should be placed in Appendix D with the other definitions.	

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10	S.3.2.1. Device Identification and Marking Requirements of Meter with External Sensors		This section seems out of place. It goes from ES markings to IS markings and back to ES markings.	
		NEMA	Since these all seem to be related to Identification Requirements of the meter in some way there is no need to move this. *Leaving this the same is mainly in the interest of saving time on additional code modifications.*	Latest 7/7/2023 HB44 Draft Code
11	S.3.2.3.(a)		Should this be in the table instead of floating by itself?	
		NEMA	**Agree.** It belongs to the other definitions and was accidently separated from the rest. The service types can be defined in a pictorial table that comes from Safety. An earlier version identifies this as follows; *(h) (MM) Number of meter stator(s) or (EM) Range of element(s); (optional) Electrical service type. E.g. 120/208V or 120/240V"* Other later versions may further identify the intention. This only referenced voltages other than stator *(the stationary part of a rotary system). Ref. 1st Draft Apr2014. Restore the code this original statement as (a).*	(g) (MM) Number of meter stator(s) or (EM) Range of element(s); (optional) Electrical service type. E.g. 120/208V or 120/240V"
12	Table S.3.2.3.b. 2. & 4		For the sake of clarity, can we reword the final section to read, "…the associated NUEMS is not required to be physically marked per General Code paragraph G-S.1. Identification (b)(1)." The concern is this being misinterpreted to think the marking can be entirely omitted.	

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		NEMA	**Industry agrees.** The suggested rewording should be used for clarity. It does not change the meaning of the clause in any way.	2. Manufacturer's Model Prefix. For an External Sensor (ES) NUEMS having its NTEP number clearly identified, conspicuously and indelibly marked on the meter, where the NTEP certificate contains the complete marking details (including a description of the location and purpose of specific markings~~),~~ ~~the associated NUEMS is not required to meet General Code paragraph G-S.1. Identification (b)(1)~~. the associated NUEMS is not required to be physically marked per General Code paragraph G-S.1. Identification (b)(1) 4. Serial Number Prefix. For an External Sensor (ES) NUEMS having its NTEP number clearly identified, conspicuously and indelibly marked on the meter, where the NTEP certificate contains the complete marking details (including a description of the location and purpose of specific markings), ~~the associated NUEMS is not required to meet General Code paragraph G-S.1. Identification (c)(1)~~. the associated NUEMS is not required to be physically marked per General Code paragraph G-S.1. Identification (c)(1)
13	Table S.3.2.3.b. 6 (Wrong Reference Should be S.3.3.6 a and S.3.3.6 b)		This mentions having separate type approval. We're not there yet and this should be removed. It can read as note 5 for now. a. Table S.3.3.a Note † - This mentions having separate type approval. We're not there yet and this should be removed. b. Table S.3.3.b. 6. - This mentions having separate type approval. We're not there yet and this should be removed. It can read as note 5 for now.	
		NEMA	This reference does not appear to contain the content described. Requires discussion.	Latest 7/7/2023 HB44 Draft Code
14	Table S.3.2.3.b. 7		Can this be reworded to more clearly identify what is meant by the marking?	

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		NEMA	The definition expressed here appears to be clear. There could be other acceptable forms of the terminology used that are not mentioned here and need some kind of covering statement.	**NUEMS Voltage Input Rating (Vnom)**. The nominal voltage input(s) for the voltage channel of the NUEMS electronics (e.g., 120VAC, 600VAC, 120-480VAC, etc.). Multiple forms of the term such as "Rated Voltage," "~~Max~~ Min/Max Voltage," and "Reference Voltage" and other forms with the same meaning are permitted. Other acceptable terms arrived at during the Type Approval process shall be stated in the COA. This appears to be in the 7/7/2023 OTH-16.1 Crosswalk. Accept.
15	Table S.3.2.3.b. 10		Voltage is also mentioned in the description. Should "Voltage" be added to the title of the section?	
		NEMA	Since this is specifically the current input part of the meter's energy measurement circuitry "voltage" should not appear in the title for that term. Regarding any debates about specifics for markings, the term NUEMS should not be part of any title of the 1-14 descriptions given.	10. ~~**NUEMS**~~ **Current Input (Input Inom or Imax).** The nominal current or voltage input for the current channel of the NUEMS electronics. The output of the current sensor must match the input configuration of the meter. This is in the 7/7/2023 OTH-16.1 Crosswalk. Accept
16	S.3.3. Device Identification and Marking Requirement – External Sensors		Section refers to marking being on a "permanent identification label". Should we eliminate the reference to a label to avoid limiting devices due to the choice of marking methodology?	
16		NEMA	Agree.	**Device Identification and Marking Requirements – External Sensors**. – In addition to all the marking requirements of Section 1.10 General Code, paragraph G-S.1. Identification, each external sensor that is non-integral with the meter shall have the following conspicuously, legibly, and indelibly marked ~~on a permanent identification label~~ as shown in Table S.3.3.a. Device Identification and Marking Requirements - External Sensors and in Table S.3.3.b. Descriptors for Table S.3.3.a. Device Identification and Marking Requirements - External Sensors. This is in the 7/7/2023 OTH-16.1 Crosswalk. Accept

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Item	**Clause**	**Proposer**	**Comment (rationale)**	**Proposed change**
17	N.3. Minimum Test Duration		Change to state, "Full load test shall consist of a minimum of 10 watthour test constants, light load test shall consist of a minimum of 1 watthour test constant."	
			This is potentially acceptable. The rationale for this change needs to be expressed by the commenter. What affect will this have on the maximum test time limit? *The NEMA perspective is that the code is already changed and there is no further effort required.*	Latest 7/7/2023 HB44 Draft Code
18	N.5. Test of a NUEMS (a)		Would prefer this to be moved to the UR with some additional language. "Each NUEMS submitted for testing shall have all necessary components assembled, connected, and configured as intended for use. Components may include, but are not limited to, meter, sensor(s), indicator(s), etc."	
			Moving the statement to a UR seems acceptable. The NUEMS should not be required to be fully assembled as this is cumbersome for units if there is significant cabling between current Sensors, voltage transformer interconnects or other details. All necessary components required should be available for testing. The clause should therefore maintain the wording used as per Oct10/22 Ballot 2 Code	~~N.5. Test of a NUEMS.~~ ~~(a) Each NUEMS submitted for test shall have the necessary components required to test such as meter, sensor(s), indicators(s), system software, etc. Testing may be performed in the field.~~ UR2.4.2a – NUEMS Test Features. – All NUEMS shall be provided with test features to facilitate common tests methods used in the electrical submetering industry. UR.2.4.2.b Each NUEMS submitted for test shall have the necessary components required to test such as meter, sensor(s), indicators(s), system software, etc. Testing may be performed in the field. This is in the 7/7/2023 OTH-16.1 Crosswalk. Accept
			Minor Items	
19	A.4. Type Evaluation		The acronym (NRTL) is noted but never actually used anywhere in the draft code. This seems extraneous and could be deleted.	

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Item	**Clause**	**Proposer**	**Comment (rationale)**	**Proposed change**
		NEMA	The term NRTL (Nationally Recognized Test Lab) for Safety Certification is where safety evaluations for electricity meters are performed. It should be acceptable to identify it here stand alone in this case and if necessary, provide it as a definition in Appendix D.	Latest 7/7/2023 HB44 Draft Code This is in the 7/7/2023 OTH-16.1 Crosswalk. Accept
20	S.3.2.2. Device Identification and Marking Requirements, Internal Sensor (IS) NUEMS. (b)		Writing out "Watthour test constant" twice seems redundant. It could read, "Watthour test constant (Kh, Kt)	

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		NEMA	Agree. There were references made to Ke and there also references elsewhere in regulatory regimes to wh/i. These should be added to Appendix D for clarity. They all appear to be derived in a similar fashion. Additional Definitions Kh – Kt For a solid-state meter (Kh or Kt): The number of watthours represented by one increment (pulse period) of serial data. Example: Kh or Kt = 1.8 watthours/pulse. (ref. Metering Handbook) Constant, KYZ Output (Ke)—Pulse constant for the KYZ outputs of a solid-state meter, programmable in unit-hours per pulse. Constant, Mass Memory (Km)—The value, in unit quantities, of one increment (pulse period) of stored serial data. Example: Km = 2.500 watthours/pulse. KYZ Output—A three-wire pulse output from a metering device to drive external control or recording equipment. Each pulse or transition represents a predetermined. increment of energy or other quantity. Average power can be determined with a known pulse count over a specified period and a given energy pulse value.	Simple recommendation from regulators is fine. Implemented as recommended by them.
21	S.3.2.2. Device Identification and Marking Requirements, Internal Sensor (IS) NUEMS. (c)		The term Kr may need to be deleted. Also, the section that reads, “preceded by ‘multiply by’ or ‘mult by’ or ‘Kr’” may be too prescriptive and unnecessary.	
21		NEMA	Rationale for this change should be provided by the commenter Discuss	The term Kr may need to be deleted. Also, the section that reads, “preceded by ‘multiply by’ this multiplier.

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22	S.3.2.3.b. 13.		Bi-Directional – This note refers to the use of a "Separate Document". This option was eliminated from Table S.3.2.3.a., thus this note should be changed to explain what Bi-Directional means.	
		NEMA	Please see the responses of Item 8.	The meaning has been provided via the latest 7/7/2023 HB44 Draft Code
22A	T.2. No-Load Test	NEMA	This is added as it accompanies at least the Kh, Kt meter constant associated with S.1.3.2	The NUEMS shall not emit more than one Kt or Kh pulse. Also see Note N.1
				This is in the 7/7/2023 OTH-16.1 Crosswalk. Accept
23	N.5. Test of a NUEMS (e)		Editorial note, it reads "test of a for a 0.5…" Delete "of a".	
		NEMA	Agree	(e) The test load applied for a light load test of ~~a for a~~ 0.5 power factor lagging ~~setting~~ shall be conducted at 3% to 6 % of either the Current Class (CL) or the Sensor Primary Current Rating. This test shall be conducted during type evaluation and may be conducted during in-service (field) or laboratory testing as deemed necessary.
24	UR.1.1. Customer Indicating Element, Accessibility		delete "such as". Also part c) should have the word "through" deleted.	
		NEMA	Agree	UR.1.1. Customer Indicating Element, Accessibility. – For systems in which the primary indicating element is not reasonably accessible to the customer, ~~such as~~ one of the following shall be provided. This is in the 7/7/2023 OTH-16.1 Crosswalk. Accept
25	UR.1.2. Submeter Required		This may need to apply in situations that are not strictly submeters. Perhaps reword title to "NUEMS Required".	

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		NEMA	Agree	NUEMS ~~Submeter~~ Required. – When a tenant is not directly served by the serving utility, and charges for electric energy are not included in the fixed periodic rent charges, a dedicated NUEMS that measures only the energy used at the discretion of the tenant shall be used.
26	UR.1.3.1. Service Applications		Equation refers to Current Class, but ES meters do not have a Current Class. Do we want to add the term "Sensor Primary Current Rating"? Alternatively, we could add a note.	
		NEMA	If ES is referring to External Sensor meters, they will have a Current Class associated with the sensor that is connected to them at the time. No note is needed.	Latest 7/7/2023 HB44 Draft Code. His has been changed in the formula for the Industry edited version.
27	UR1.3.2. Maximum Quantity-Value Division		The term maximum might not be the best. May cause a device to be rejected because of capability as opposed to actual setting. We could change "Maximum" to "Programmed" or "Configured".	
		NEMA	Agreed with a slight change. It is a programmed value but is a maximum also.	UR.1.3.2. Programmed Maximum Quantity-Value Division. - The maximum quantity-value division shall not exceed the minimum increment to be used in billing. This is in the 7/7/2023 OTH-16.1 Crosswalk. Accept
28	UR.1.4. Current Sensor		Would it be appropriate to add voltage sensor to this section and change the title to just "Sensor"?	
		NEMA	Whether it is a current sensor with a secondary voltage or a current sensor with a secondary current, it is still the current sensor part of the NUEMS.	This has been updated in this industry version 7/7/2023 OTH-16.1 Crosswalk. Accept
29	UR.2.2. Load Range		Personal preference (Andrew K) to have "if necessary" start the second sentence instead of end the sentence.	

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		NEMA	This seems acceptable.	UR.2.2. Load Range. – A device shall be installed so that the current and voltage will not exceed the maximum continuous ratings of the NUEMS. If necessary, a means to limit current and/or voltage shall be incorporated in the installation ~~if necessary~~.
30	UR.2.4.5. Dedicated Tenant NUEMS Service		Could we add "including but not limited to…" with the intent of expanding the possible use cases.	
		NEMA	The current statement is clear and concise. If something new is added it would be a revision to the current code.	Latest 7/7/2023 HB44 Draft Code