BSR/ASHRAE Addendum b
to ANSI/ASHRAE Standard 90.4-2022

Second Public Review Draft

Proposed Addendum b to Standard 90.4-2022, *Energy Standard for Data Centers*

Second Public Review (July, 2025)
(Draft Shows Proposed Changes to Current Standard)

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Foreword

The second publication public review draft fixes clerical errors in the definitions and normative text which were originally omitted during the first publication public review. Changes to the requirements are for clarification and a comprehensive review of the 90.4-2022 standard. Definitions and sections were no changes were made were omitted from the ISC, however the first publication public review draft is available for comparison. This ISC also makes changes to Section 6.6.2.1 which was previously updated by Published Addendum g to 90.4-2022.

The UPS Segment of the ELC calculation requires knowing three different load numbers. While those numbers have always been described in the Informative Appendix examples, they have not been clearly delineated in definitions, leading to confusion in the use of undefined terms. This Addendum b adds a definition for "UPS redundant capacity" to clarify the fact that UPS efficiency must be based on the total available capacity of the UPS, including its redundant capacity, even though that additional capacity is not intended to be used under normal operating conditions.

Terminology throughout Section 8 "Electrical", as well as in the Informative Appendices, has also been updated to correspond with the revised definitions terminology.

[Note to Reviewers: This addendum makes proposed changes to the current standard. These changes are indicated in the text by underlining (for additions) and strikethrough (for deletions) except where the reviewer instructions specifically describe some other means of showing the changes. Highlighted changes shown where the previous public review draft made a previous change. Only these changes to the current standard are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed changes.]

Addendum b to 90.4-2022, PPR 2 ISC

Modify the following definitions to Section 3.

data center ITE design power: the combined power in *kilowatts* of all the *ITE* loads for which the *ITE system* was designed. The *data center ITE design power* ~~power shall~~ does not include any additional loads. See *UPS operational design load*.~~, such as *cabinet fans* or other devices that are not inherent parts of the *ITE*., even if the loads are part of the *UPS operational design load*.~~

design electrical loss component (design ELC): the *design electrical loss component* for the *data center* or *data center addition* ~~shall be~~ is the combined *losses* (or the *losses* calculated from *efficiencies*) of two segments of the electrical chain: *UPS segment* and *ITE distribution segment*. ~~The *design ELC* shall be calculated using the highest *loss* (lowest efficiency) parts of each segment of the power chain in order to demonstrate a minimum level of electrically efficient design. The *design ELC* does not, and is not intended to, integrate all electrical *losses* in the facility.~~

incoming electrical service ~~segment~~: the *incoming electrical service ~~segment~~* ~~shall include~~ includes all elements of the electrical *power chain* ~~power chain~~ prior to the *UPS segment*, beginning with the load side of the *incoming electrical service point* supplying the *building*, continuing through all other intervening *transformers*, wiring, and switchgear, and ending at the *manufacturer*-provided input *terminals* of the *UPS* or its equivalent location in the *power chain* ~~circuit~~.

redundancy (redundant): deliberate duplication of components, *equipment*, controls, or *systems* and their interconnections to enable continued operation ~~at needed functional capacities~~ during the failure ~~and after the *loss*~~ of ~~the~~ primary components, *equipment*, controls, or *systems* due to failure, maintenance, servicing, or other modification activities.

N: base number of capacity components needed to provide design *system* functional capacity.

N+1, N+2, etc.: single *system redundancy* having one or more additional capacity components.

2N, 2N+1 or 2(N+1), etc.: dual *system redundancy* having one or more additional capacity components.

incoming electrical service point (service point): the point of connection between the ~~facilities of the~~ serving utility wiring and the premises wiring, also known as the point of demarcation between where the serving utility wiring ends and the premises wiring begins, as defined by the *National Electrical Code*® (NFPA 70).

Informative Note: Any power generation source, e.g. microgrids, can be considered the serving utility to the data center.

~~***service point:*** the point of connection between the facilities of the serving utility and the premises wiring. The *service point* can be described as the point of demarcation between where the serving utility ends and the premises continuation begins. The serving utility generally specifies the location of the *service point* based on the conditions of *service*.~~

terminal: a device by which *energy* from a *system* is finally delivered (e.g., UPS, transformers, receptacles ~~registers, diffusers, lighting fixtures, faucets~~) terminating prior to the interface with the *ITE* or *ITE enclosure*. For devices used for other purposes or in other *systems*, the definition of *terminal* in ANSI/ASHRAE/IES Standard 90.1 applies (see Annex 1).

UPS economy mode: a mode of *UPS* operation in which power is ~~normally~~ fed to the load without going through power conversions ~~within the *UPS* for the purpose of reducing~~ in order to reduce *loss* during normal operation. ~~so as to save *energy*. Circuitry is incorporated to rapidly switch the load to the rectifier/battery/inverter in the event of a power failure or voltage drop below a preset threshold. Economy mode is normally a configurable option that can be used or overridden at user discretion.~~

UPS operational design load: the load in *kilowatts* at which the *UPS* is intended to operate by design that includes ~~. This will be~~ the *data center ITE design power* plus any other loads, such as *cabinet* door fans or refrigerant pumps, that will be connected to the *UPS*. The *UPS operational design load* is typically less than the *UPS rated capacity*.

UPS rated capacity: the maximum load in *kilowatts* or *kilovolt-amperes* at which an individual *UPS* is designed and specified by the *manufacturer* to operate on a continuous basis under specified ~~environmental~~ conditions. *UPS rated capacity* does not include the capacity of any *redundant UPS* components or *systems*.

UPS redundant capacity: the *UPS rated capacity* plus the capacities of *redundant* online modules. For non-*redundant UPS systems*, this will be the same as the *UPS rated capacity*.

UPS segment: ~~the *UPS segment* of the *design ELC* shall include the *manufacturer* provided *UPS system*~~ segment from the input *terminals* to the output *terminals* of the *manufacturer*-provided *UPS system,* including all *transformers*, switchgear, rectifiers, inverters, rotary propulsion units, and wiring ~~provided by the *manufacturer*~~ between those two points. ~~Transformers and switchgear provided by the *UPS manufacturer* but housed in different *cabinets* from the actual *UPS* capacity components shall be considered parts of the *UPS segment* along with associated wiring. *Transformers* and switchgear functioning as parts of the *UPS* but installed separately and not provided by the *UPS manufacturer* (such as custom-configured bypass) shall not be considered part of the *UPS segment*. All such associated components shall be included with the *incoming electrical service segment* and/or the *ITE distribution segment* in accordance with their specific design logic.~~

Core and shell buildout: site work, walls, floor slabs and roof structure including utilities necessary to obtain a Certificate of Occupancy. Infrastructure such as raised access floors, communications ducts, header piping or primary switchboards

may be installed, but no power or *HVAC systems* specific to *data center* usage are included.

Full buildout: design for the complete *data center* facility based on total *UPS Operational Design Load* and as permitted and constructed in-full as a single project.

Scaled buildout: design is for the complete facility (as if for a *full buildout*), based on total *UPS Operational Design Load* where the *ITE cabinets* and associated power and *HVAC systems* are initially installed for only a portion of the facility, with the remainder of the facility left to be built-out as future phases. Each intended phase is delineated on design documents.

Modular buildout: design, permitting, and construction are "Per Module", based on the *UPS Operational Design Load* for each module. Each Module is delineated by demising walls.

Modify the language in Section 4.2.1.3 and the Exceptions to 4.2.1.3 as follows:

4.2.1.3 Alterations to Existing Buildings. *Alterations* of existing *data center spaces* shall comply with the provisions of Sections 5, 7, 9, and 10 and with either Sections 6 and 8 or Section 11, provided such compliance will not result in the increase of *energy* consumption of the *building*.

Component or *system* replacements or modifications that result in changes in either capacity or type of technology require compliance with the applicable sections and versions of this standard in accordance with Chart 1 (see Informative Appendix C).

Alterations of other *spaces* shall comply with ANSI/ASHRAE/IES Standard 90.1, Section 4.2.1.3.

Exceptions to 4.2.1.3:

1. ITE adds, moves, and changes ~~*ITE adds, moves and changes*~~ are excluded.

Informative Note: ITE adds, moves, and changes are the normal and somewhat perpetual additions, moves, and changes to ITE.

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Add new Section 4.2.1.4 as follows:

4.2.1.4 Applicable Editions of Standard for Various Forms of Design and Buildout

4.2.1.4.1 Core and shell buildouts. Design and construction of *core and shell buildouts* shall be in accordance with the most recent applicable version of Standard 90.1. Compliance with Standard 90.4 is required when *data center* power and *HVAC systems equipment* are designed and permitted for installation in the *space* and shall be in accordance with the applicable form of design and buildout in Section 4.2.1.4.2 - 4.2.1.4.4.

4.2.1.4.2 Full buildout. Design and construction of *full buildouts* shall comply with the most recent applicable version of this Standard.

4.2.1.4.3 Scaled buildout. Design and construction of *scaled buildouts* shall comply in accordance with the most recent applicable version of this standard at the time of design and permitting, with the following requirements:

a) Permitting shall be based on the *full buildout* design.

b) Facility remains in compliance with the Standard if all stages of the buildout adhere to the original design and permit.

c) Initial stage of the *scaled buildout*, and each subsequent stage, shall comply with the latest applicable version of this Standard at the time each stage is designed and permitted.

d) If deviations from the original power or *HVAC systems* designs occur in any stage of the remaining buildout, they shall be considered *additions*, require new permitting, and comply with the latest applicable version of this Standard.

Exception to 4.2.1.4.3: If power or *HVAC system* deviations are newer models of the originally specified *equipment* and meet or exceed the energy efficiencies of those systems, they are considered compliant with the original design. (See Exception 2 to Section 6.1.1.3.1 and 8.1.1.3.1, respectively.)

4.2.1.4.4 Modular buildout: *Modular buildout* and each subsequent *modular buildout* shall comply with the latest applicable version of this Standard at the time each module is designed and permitted.

Informative Note: More information on buildout types are found in Informative Appendix C.

Modify the language in Section 6.6.2.1as follows:
Note to reviewer: highlighted language was added by Published Addendum g to Standard 90.4-2022.

6.6.2.1 Drawings. *Construction documents* shall require ~~that~~, within 90 days after the date of *system* acceptance, *record drawings* of the actual installation be provided to the *building* owner or the designated representative of the *building* owner. *Record drawings* shall include, as a minimum, the location and performance data on each piece of *equipment*; general configuration of the duct and pipe *distribution system*, including sizes; and the ~~*terminal*~~ air or water design flow rates. Plans shall show the location of *equipment* to be installed and locations for all deferred *equipment*. Plans shall ~~D~~describe the amount ~~amounts~~ of mechanical & electrical *equipment* assumed (in each part-load MLC calculation) to be installed and operating during the 25%, 50%, 75% and 100% *ITE* power level in the associated MLC compliance calculation.

Modify the language in Section 8.4.1 as follows:

8.4.1 **Electrical Distribution Systems for Mechanical Loads.** The electrical *distribution systems* serving…

8.4.1.2 Minimum Efficiency or Maximum Loss. The *design ELC* calculations shall use the minimum operating *efficiency* or maximum operating *loss* of each segment of the *power chain* ~~component~~ unless a specific mode of operation (with higher *efficiency* or lower *loss*) is designated on the approved design documents.

Informative Note: The *design ELC* does not, and is not intended to, integrate all electrical *losses* in the facility.

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8.4.1.4 Incoming Electrical Service ~~Segment~~. The *incoming electrical service* ~~*segment*~~ is not part of the *design ELC* ~~ELC~~ calculation. However, all ~~components~~ *transformers* in the incoming *power chain* ~~power chain~~ shall meet or exceed published U.S. DOE minimum *efficiencies* for *transformers* or the equivalent international standards, and shall comply with all related applicable codes. ~~U.S. National Electrical Code® (NFPA 70) maximum losses for service conductors or the equivalent international electrical codes.~~

~~**Exception to 8.4.1.4:** Emergency or stand-by power *systems* are not considered a part of the *incoming electrical service segment*, with the exception of individual elements such as associated transfer switches, transformers, or other devices that are also included between the *design ELC demarcation* and the *UPS*. Diesel rotary *UPS* (DRUPS) *systems* shall be calculated as part of the *UPS segment* with the engine element decoupled.~~

8.4.1.5 UPS Segment Efficiency.

Efficiency and resulting *loss* through the *UPS segment* shall be calculated at both full and partial loads as follows:

a. *UPS* configuration *losses* shall be based on the *manufacturer*'s stated *efficiencies* at 100%, 75%, 50%, and 25% of the *operational design load* at *efficiencies* based on the *UPS redundant capacity* ~~*UPS operational design load*~~.

b. For *2N*, *2N+1*, *2(N+1)* or other dual-feed *UPS* configurations where *UPS systems* are identical, only one of the *systems* shall be used in the calculation. Where *UPS systems* are not identical, both *systems* shall be calculated, and the *system* with the lowest *efficiency* shall be used to compute the *UPS segment* of the *design ELC*.

c. Where a *UPS* has more than one mode of operation (e.g., normal and *UPS economy modes*), the mode used in these calculations shall be the same as the mode used as the Basis of Design and so designated on the approved *construction documents*.

d. Where nonrated *UPS systems* are used, the *efficiencies* and *losses* shall be as published or provided in writing by the *manufacturer*.

e. Diesel rotary *UPS* (DRUPS) *systems* shall be calculated as part of the *UPS segment* with the engine element decoupled.

8.4.1.6 ITE Distribution Segment Efficiency. Where significant numbers of power paths exist between the *UPS* and the many *equipment cabinets*, the *ITE distribution segment efficiency* shall be that with the lowest path *efficiency*. This shall be the longest path with the largest numbers of *loss* producing components, such as *transformers*, switchgear, and/or panelboards. Calculations are required to determine the path with the greatest *loss* or lowest *efficiency*, which shall be used in developing the total *design ELC*.

Informative Note: The *ITE distribution segment* does not include the actual *ITE*, its power cords, or any accessory part of the *ITE*. In cases where power is to be permanently installed or hardwired into self-contained, *manufacturer* configured *cabinets*, the calculation path terminates at the power input *terminals* provided by the *manufacturer* within that *equipment*. The *ITE distribution segment* used to calculate the *design ELC* is the highest *loss* (lowest *efficiency*) path. This is normally the longest path that also contains devices producing a *loss* (e.g. *transformers*).