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Comments on Proposed Section 1201(d)6, Modulating DOAS

Additional submitted attachment is included below.

Comments on Proposed Section 120.1(d)6, Modulating DOAS

Docket: 25-BSTD-03, 2028 Energy Code Pre-Rulemaking

Subject: Proposed Section 120.1(d)6, Modulating DOAS

Reference: 2028 Title 24, Part 6 Final CASE Report, Air Distribution (Statewide CASE Team), Modulating DOAS Submeasure a

Submitted by: Neil Bulger, PE, LEED AP, Principal, A2 Efficiency, Inc.

Date: July 17, 2026

This comment cites the requirement as Section 120.1(d)6, per Appendix F.2 of the CASE Report. Section 3.1.2.1 discusses it as Section 401.2.1.2.6, which is titled differently in the report's code language sections.

Summary

A2 Efficiency supports the intent of the Modulating DOAS measure. This comment identifies two respects in which the supporting record does not establish an adequate basis for adopting the requirement as mandatory:

1. The mandatory designation for occupied standby ventilation control was established in the 2019 code cycle at an incremental cost of $100 per room, on the stated premise that the capability to modulate ventilation was already present for reasons unrelated to ventilation control. That premise does not describe a dedicated outdoor air system. The present proposal makes mandatory the purchase of that capability at 15 to 35 times the basis on which the designation was established.
2. The incremental cost analysis holds the ratio of base case ventilation outlets to measure case space conditioning zones at unity. The CASE Report itself states that current DOAS practice does not always meet that condition, and the parametric matrix is structured such that this ratio cannot be varied.

Alternative code language is offered at the end of this comment. It is offered in the alternative and does not qualify Findings 1 and 2, which stand independently of whether the alternative is adopted.

Basis for this comment

A2 Efficiency participated in stakeholder engagement for this measure and is listed in Table 65 of the CASE Report. The DOAS field assessment work cited in the report as Bulger (2022) and Bulger (2024) is ours, including the finding that 8 of 15 surveyed DOAS units had variable speed drives while only 3 were operated as variable air volume.

Finding 1. The mandatory designation for occupied standby was established on a cost basis this measure does not share

Occupied standby ventilation control was adopted through the 2019 Title 24, Part 6 CASE Report 2019-NR-ASHRAE90.1-F, Section 8. Section 8.4.3 of that report states that incremental first cost was determined from contractor quotes averaging $100 per room, across a 5,500 square foot prototype with seven rooms, for a resulting incremental cost of $0.13 per square foot. That figure covers an occupancy sensor and added controls for the building monitoring system. It contains no allowance for airflow modulation hardware.

The rationale is stated directly at page 104: the cost is low because the zone already has an occupancy sensor and the ability to modulate the ventilation. Page 105 confirms the premise, noting that in multi-zone ventilation systems the outside air damper must reduce outside air flow rates when a zone enters occupied standby. The damper was treated as a precondition of the measure, not a cost of it. Section 8.2.2 accordingly characterized the measure as a minor change to an existing requirement, with no constructability or inspection challenges.

That premise holds for mixed-air multiple-zone VAV, where the space conditioning zone and the ventilation zone are the same terminal unit and the damper exists for thermal reasons regardless of ventilation control. It does not hold for DOAS, whose defining characteristic is that ventilation is decoupled from sensible conditioning. In a DOAS, no thermal requirement provides a zone-level modulating damper.

The present proposal makes mandatory the purchase of that hardware. Table 38 gives a measure case cost of $1,922 per zone integrated and $3,912 per zone non-integrated, against a base case of $400, for incremental costs of $1,522 and $3,512 per zone. At the report's office zone size of 825 square feet, those are $1.84 and $4.26 per square foot. The 2019 prototype averaged 786 square feet per room, so the comparison is close to direct. The incremental cost is 15 to 35 times the basis on which the mandatory designation was established.

That multiple may be understated. Appendix F.2 requires "modulating pressure independent air valves," while Section 3.1.2.1 and Table 38 refer to and price modulating pressure independent dampers. A pressure independent venturi air valve and a pressure independent damper differ materially in cost. If air valves are intended, the incremental cost in Table 38 is understated and the multiple above is larger. If dampers are intended, Appendix F.2 should say so.

Cost effectiveness and designation are distinct questions. A mandatory requirement offers no compliance alternative, which is appropriate for a low-cost measure of general applicability, and that is what Section 8.2.2 certified in 2019. A requirement costing $1,522 to $3,512 per zone, whose applicability turns on system architecture, does not share that character. Section 8.2.2's constructability finding does not transfer, because in 2019 no hardware was being added.

Finding 2. The cost model holds the base-to-measure zone count ratio at unity

Section 3.1.2.1 states that some DOAS designs provide one outlet for several thermal zones, and identifies correcting that condition as the purpose of the measure. Section 120.1(d)6A requires modulating outside air at each space conditioning zone. Space conditioning zone boundaries are set by thermal criteria, principally exposure, orientation, and internal load, which ventilation requirements do not follow.

Table 38 compares base case and measure case at a single zone count, implying a one to one correspondence between base case ventilation outlets and measure case space conditioning zones. For the buildings Section 3.1.2.1 describes, that correspondence does not hold, and the counts of dampers, controls, and airflow measuring stations increase by the aggregation ratio.

Because those costs scale directly with the number of space conditioning zones, incremental first cost scales approximately in proportion to this ratio. A ratio of 1.5 would increase incremental first cost by roughly 50 percent, and a ratio of 2.0 by roughly 100 percent. Section 3.1.2.1 describes the aggregated condition as one outlet serving several thermal zones. The report does not state the incremental cost at any ratio other than unity.

Table 32 does not vary this ratio, and varying zone size cannot detect it, because zone size scales base case and measure case together and preserves the correspondence by construction. The stated sensitivity of $2,000 per zone varies cost per zone, not the ratio between the two counts. The record demonstrates cost effectiveness at a ratio of unity and is silent above it. The non-integrated office case, which requires occupied standby occupancy of 65 percent and DCV occupancy of 70 percent at the survey average zone size, was not run at any other zone size.

Request

Both findings go to the adequacy of the record supporting a mandatory designation rather than to the merit of the measure. A2 Efficiency asks that the Commission not adopt Section 120.1(d)6 as a mandatory requirement unless the supporting analysis reaches the configurations to which the requirement would apply.

Alternative language, offered in the alternative

The following is offered to assist staff and does not qualify Findings 1 and 2. If the alternative is not adopted, the findings above are unaffected and remain outstanding.

This alternative preserves the demand control ventilation savings the CASE Report identifies as sufficient on their own, while confining the mandatory purchase of modulating hardware to the zones that generate those savings.

Proposed language

Additions in bold, deletions in strikethrough, relative to Appendix F.2 of the CASE Report.

> **6. Modulating DOAS.** DOAS systems ~~in buildings~~ with design outdoor airflow rates > 3,000 cfm shall meet all of the following:
>
> **A.** Include modulating pressure independent air valves or other means of independently modulating outside air at ~~each space conditioning zone~~ **each space for which demand ventilation controls are required by Section 120.1(d)3. A single air valve or other means of modulating outside air is permitted to serve more than one such space, provided the controlled outdoor airflow is not reduced below the airflow at which every space served receives no less than the minimum outdoor air rate required by Section 120.1(c)3.**

> **B.** Disable ventilation to unoccupied space conditioning zones **served by an air valve or other means of independently modulating outside air** while maintaining measured outside air ventilation rates to occupied zones per 120.1(d)5
>
> **C.** Include demand ventilation controls for high density spaces per 120.1(d)4
>
> **D.** Modulate DOAS supply fan speed in accordance with 140.4(c)2

Conforming change to Section 120.1(d)5:

> **Exception 2 to Section 120.1(d)5: Reduction of ventilation air is not required for space conditioning zones served by a DOAS that are not served by an air valve or other means of independently modulating outside air. All other requirements of Section 120.1(d)5B continue to apply.**

Basis

The threshold attaches to the system rather than the building. As proposed, the requirement reaches any DOAS in a building whose design outdoor airflow rate exceeds 3,000 cfm, including a DOAS whose own design outdoor airflow is well below that figure, because other systems in the same building bring the building total above it. The supporting analysis is developed per system and per zone. Cost item 7 in Table 38 assigns $6,000 per DOAS air handler for the duct static pressure sensor and fan speed controls, which the report allocates across the 13 zones of the office prototype at $462 per zone. A DOAS serving two or three zones carries that same air handler cost across far fewer zones, and no run in Table 32 addresses a system of that size. Attaching the threshold to the DOAS system confines the requirement to systems the analysis represents.

The trigger already exists and is already enforced. Section 120.1(d)3 defines the affected spaces by design occupant density at or above 25 people per 1,000 square feet. That threshold is documented on the ventilation compliance forms and is verifiable by a plans examiner. No new definition and no new design judgment is introduced.

It completes a mandatory requirement rather than weakening one. Demand control ventilation is mandatory at design outdoor airflow above 3,000 cfm under Section 120.1(d)3, and in a DOAS it cannot be delivered without zone-level modulation. Item A as revised requires the hardware that the existing mandatory function requires, and no more.

The permitted aggregation is bounded by the trigger itself. Spaces meeting the 120.1(d)3 density threshold share the characteristic that the design outdoor air rate is occupancy driven while the minimum rate is area driven. The ratio between them is therefore similar across the spaces a common air valve would serve, and proportional turndown does not strand any of them. The proviso in item A sets the floor explicitly so that this holds regardless of the grouping a designer selects.

The zone count basis becomes determinate. Spaces subject to 120.1(d)3 are discrete rooms, principally conference rooms, lecture halls, auditoria, and breakrooms, which are ordinarily coincident with a single space conditioning zone. The one to one correspondence assumed in Table 38 is representative for this population, which it is not for the building as a whole.

Applicability scales with building type without a carve-out. In offices, spaces meeting the density threshold constitute roughly 20 percent of floor area, per the assumptions stated at page 91. In K-12 and post-secondary buildings, classrooms and lecture halls meet the threshold, so the revised requirement reaches most of the conditioned area and the effect approaches that of the proposed language. No prototype is favored by exception.

The savings the record relies on are preserved in full. Page 91 states that for the default office case the measure is cost effective with all spaces occupied 100 percent of the time the HVAC system is scheduled to operate, that is, that the demand control ventilation savings alone are sufficient without taking any credit for the occupied standby savings. Every air valve generating those savings remains mandatory under this alternative.

It is consistent with the basis on which occupied standby was adopted. Under this alternative, occupied standby remains mandatory and remains at the cost basis established in 2019 wherever an air valve is present for demand control ventilation. What is not required is the purchase of an air valve for the sole purpose of enabling occupied standby.

What this forfeits

Occupied standby ventilation reduction at low density spaces that are not served by an air valve. In the office assumptions at page 91 those spaces constitute roughly 70 percent of floor area. This is a real reduction in modeled savings relative to the proposed language and is not characterized here as immaterial.

Two points bear on that trade. First, the marginal cost effectiveness of air valves installed solely to enable occupied standby at low density spaces is not separately demonstrated in the record. In every published run the demand control ventilation savings are sufficient without occupied standby credit, so the two are not separable as presented. Second, relative to what is presently constructed rather than to the proposal, this alternative increases occupied standby coverage substantially. The field assessment cited in the report as Bulger (2022) found that 8 of 15 surveyed DOAS units had variable speed drives while only 3 were operated as variable air volume. Occupied standby in DOAS is at present largely unrealized, and requiring modulation at demand control ventilation zones would establish it where none exists today.

If occupied standby ventilation reduction at low density spaces is to be adopted as a mandatory requirement, the appropriate basis is an analysis demonstrating that it is cost effective on its own terms, which a subsequent cycle would be well positioned to provide.

Respectfully submitted,

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