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Comment on Part 6 CASE Report Air Distribution, Section 3 (Modulating DPAS)

Additional submitted attachment is included below.

TO: California Energy Commission, Building Energy Efficiency Standards Division

RE: Comment on 2028 Title 24, Part 6 Draft CASE Report: HVAC Air Distribution, Section 3 (Modulating DOAS)

DOCKET: 25-BSTD-03

FROM: Charlie Stephens, Systems Consultant, Sisters, OR, May 14th, 2026

I am a systems engineer with more than 10 years of experience designing and specifying high performance commercial HVAC systems based on DOAS systems in the Pacific Northwest and nationally, including California. I am submitting these comments to oppose several elements of the 2028 Modulating DOAS measure and to raise concern about the broader implications of this proposal for how "DOAS" is understood and defined in code.

The core concern: these proposals misrepresent what DOAS is

The purpose of a Dedicated Outside Air System is to provide outside air that is dedicated to the ventilation function of an HVAC system. It delivers 100 percent outdoor air, is controlled based on occupancy, and is zoned based on occupancy patterns. When fully optimized, it can manage latent loads using energy recovery (an ERV-based system) and/or using a DX coil sized to the residual latent load in the ventilation air flow. It should be designed to supply near-neutral air to its ventilation zone so the decoupled conditioning equipment serves only the residual load. The thermal zone fan coil or VRF unit, controlled via a thermostat, handles sensible conditioning and can cycle fully off when there is no load. That is the efficiency mechanism. The ventilation zoning and thermal zoning are not always the same.That is why DOAS can enable a much more efficient HVAC system than one that mixes ventilation and space conditioning air. That is what DOAS designers design for.

The 2028 proposals pull in the opposite direction on all three fronts. Submeasure A adds per-zone modulating controls that mirror VAV terminal box requirements. Submeasure C routes ventilation into the fan coil return air path, re-coupling the systems DOAS is designed to decouple. Submeasure D mandates 55 degree F supply air, putting the DOAS unit in the role of a primary sensible cooling device. Together, these proposals describe a low-flow recirculating mixed air system with outdoor air, not a Dedicated Outdoor Air System.

In 2015, while working for the Northwest Energy Efficiency Alliance (NEEA), I designed and ran a pilot program for existing commercial buildings that converted existing building HVAC systems (typically RTU-based, including VAV systems) to a fully optimized DOAS-based system. Ultimately NEEA funded 15 pilot projects that mostly consisted of office occupancies, but also included some restaurants. HVAC energy savings ranged from 50 to 80 percent, demand savings ranged from 20 to 40 percent, and heating/cooling system capacities were typically reduced by 20 to 40 percent. Conversion system installed costs were typically no more than those for a VAV system and often cost less. Paybacks ranged from 6 months to 5 years. Note that these projects were for existing building retrofits, not new construction, where installed costs would be much lower, but relative system costs would be similar.

It's important to note that energy modeling grossly underestimated the energy and demand savings delivered by the fully optimized conversion systems, especially when code miniumum systems were the base case. This was due to over-estimating the efficiency of the code minimum systems while underestimating the efficiency of the conversion systems.

The DOAS code proposals at issue amount to grafting a DOAS system onto an inherently inefficient VAV system, or assuming that a DOAS system should function like a VAV system.These proposals do not reflect how DOAS-based systems should work in practice.

The report characterizes designer practice without evidence

The CASE report states that designers 'typically' specify DOAS without modulating controls, that most designers interpret DCV and occupied standby as not applying to DOAS, and that the constant volume approach is favored because it is 'cheaper and simpler.' No citation is provided for any of these claims. No survey, no compliance form analysis, no enforcement record.

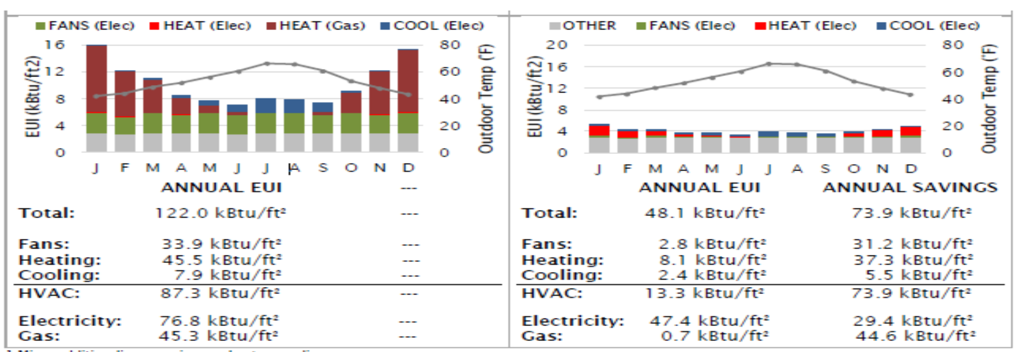
These characterizations do not match my experience. All of the DOAS systems I specify use a high efficiency HRV or ERV (depending on the climate), with recovery efficiencies above 75 percent, latent transfer above 60 percent at fully occupied design air flow rates, and fan turndown ratios of 4:1 or 5:1. Zoning is based on occupancy patterns and controls are specified accordingly – DCV-based when occupancy varies substantially during the course of daily building operations, and daily schedule-based for other zones. Systems are controlled for “off” whenever possible, or minimum flow rates otherwise, depending on space types.

Between 2020 and 2024, installed commercial HVAC system costs doubled, while the cost of system ducting tripled. For this reason, and to simplify zoning for control purposes, we specify multiple H/ERV units, each sized based on maximum space occupancies and controlled based on space types. The market offers air flow capacities from 400 cfm to more than 8,000 cfm, installed outdoors or indoors, so it’s easy to match unit specs to project requirements.

The CASE report’s designer practice claims do not at all reflect the practices we’re using all over the country today.

Submeasure A: Per-Zone Air Valves

The mandatory requirement for pressure-independent air valves with airflow monitoring stations at every zone is a significant hardware mandate. At full occupancy and typically two-thirds of full rated flow, the H/ERV technologies we’re using have cooling Seasonal COPs between 5.5 (hot humid climate) and 10 (marine climate) and heating Seasonal COPs between 8 (hot humid climate) and 12 (marine climate), tested and rated using CSA SPE18-2024. With these equipment efficiencies, managing air flow rates at the ventilation sub-zone level will deliver trivial energy savings and in no way would be cost-effective. Energy savings models must use a workaround because the compliance software cannot simulate the proposed system directly. Fan power baselines and assumptions do not reflect the HRV-DOAS systems that dominate California new construction in dry climates. Field research at California DOAS sites also found per-zone DCV on DOAS was not cost-effective. Below are the results from one of my pilot projects – note the change in fan power, which the models did not predict.



Washington State Energy Code Section C403.2.1 achieves the same ventilation control objective through a ventilation isolation area requirement: a maximum of 25,000 square feet per floor with an exception for fan systems at or below 5,000 cfm. Buildings that use multiple smaller DOAS units, each serving a separate building area, comply without per-zone air valve hardware. This approach has been in Washington State code since 2018 with no reported implementation problems. California should adopt a comparable approach rather than a per-zone hardware mandate.

Submeasure C: FCU Return Air Inlet Delivery

When a FCU fan cycles off, ventilation air delivered to the return air inlet of that fan coil has no reliable path to the occupied zone. The zone has to keep its fan running to distribute ventilation air, which defeats the primary energy benefit of decoupled DOAS design. This option should not be added as a prescriptive compliance pathway. The current approach of direct-to-zone or discharge delivery should be retained.

This provision will entirely defeat the core design principle of a DOAS-based system – complete separation of the ventilation air, controlled based on occupancy, and the heating/cooling system, controlled on thermostat setpoints. It also assumes that ventilation zoning and heating/cooling zoning are the same, which in my experience is an exception to general practice.

Submeasure D: 55 Degrees F Supply Air Temperature

As in all of my projects, DOAS units in California are sized for ventilation air flows, not primary cooling air flows. A major efficiency benefit comes from letting zone heat pumps handle sensible loads at elevated suction temperatures and high part-load COP. Delivering 55 degree F supply air from the DOAS unit moves cooling from the thermal zone equipment to the DOAS DX coil, requires mechanical cooling across a much wider range of California ambient conditions, and creates a heating penalty in zones not calling for cooling.

The proposed limit is drawn from ASHRAE research conducted for humid climate applications and is not supported by California field data. Research on California DOAS installations recommends neutral supply air delivery in the 65 to 70 degree F range for systems with active mechanical conditioning. The current 60 degree F limit reflects sound California practice and should be retained. The proposed 75 degree F lower bound in heating mode would require mechanical heating during conditions where passive heat recovery delivers neutral air without any energy input, and should not be implemented.

Request

I request that the CEC require the CASE Team to:

1. Withdraw Submeasure C and Submeasure D.
2. Replace Submeasure A with a ventilation isolation area requirement modeled on WSEC C403.2.1, and conduct a comparative cost-effectiveness analysis before any mandatory requirement is adopted.
3. Revise Submeasure B to retain the area-dependent occupancy sensor trigger condition.
4. Formally address, in its response to comments, the PG&E-funded California field research on DOAS controls cost-effectiveness that was not cited in the draft.

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