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Response to 45-Day Language

Additional submitted attachment is included below.

Compressors

Codes and Standards Enhancement (CASE) Initiative
For PY 2018: Title 20 Standards Development

Response to 45-Day Language for
Compressors
18-AAER-05

December 31, 2018

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1. Purpose

The Codes and Standards Enhancement (CASE) initiative presents recommendations to support California Energy Commission's (Energy Commission) efforts to update California's Appliance Efficiency Regulations (Title 20) to include new requirements or to upgrade existing requirements for various technologies. Three California Investor-Owned Utilities (IOUs) – Pacific Gas and Electric Company (PG&E), San Diego Gas and Electric (SDG&E), and Southern California Edison (SCE) – sponsored this effort (herein referred to as the Statewide CASE Team). The program goal is to prepare and submit proposals that will result in cost-effective enhancements to improve the energy and water efficiency of various products sold in California. This document is a part of the effort to develop technical and cost-effectiveness information for potential appliance standards. This CASE Document covers the Statewide CASE Team's response to the Energy Commission's 45-Day Language for certain categories of commercial and industrial air compressors.

2. Comments on 45-Day Language

2.1 Energy Conservation Standard Levels for Rotary Lubricated Air Compressors

The Statewide CASE Team supports the Energy Commission moving forward with energy conservation standards for commercial and industrial air compressors ("compressors"). If adopted, these standards will become the first energy efficiency standards ever enacted anywhere in the United States (U.S.) for compressors. The standards will contribute to California's various energy efficiency goals, including those set by AB 32 (2006) and SB 350 (2015). The Energy Commission chose to align its scope and standard levels with the incomplete U.S. Department of Energy (DOE) compressors rulemaking (U.S. DOE 2016a). It must be noted that the Energy Commission would not achieve the maximum possible cost-effective energy savings by adopting U.S. DOE's trial standard level (TSL) 2 with this standard. The Statewide CASE Team recommended the higher efficiency TSL 3 in its proposal, docketed March 26, 2018, and it stands by that recommendation today (CA IOUs 2018).

According to the Statewide CASE Team's analysis, which was adapted from U.S. DOE analysis, TSL 3 California would save 27 Gigawatt hours (GWh) in the first year and 538 GWh after full stock turnover 13 years after enforcement begins. In contrast, the Statewide CASE Team's analysis shows that TSL 2 would only save 15 GWh in the first year and 315 GWh after full stock turnover; 42 percent less than TSL 3. Note that in the Energy Commission's Initial Statement of Reasons, it estimates 25 GWh of first-year savings and 322 GWh after full stock turnover (CEC 2018b). This larger Energy Commission estimate for TSL 2 suggests that the savings for TSL 3 could be even larger than the Statewide CASE Team estimate as well.

Regarding cost-effectiveness, both TSL 2 and TSL 3 are cost-effective for California users of air compressors. The Statewide CASE Team's analysis indicates a benefit-to-cost (B/C) ratio of 6.5 at TSL 2 and 5.5 at TSL 3 and shows that the net present value (NPV) after stock turnover is $264 million at TSL 2 and a NPV after stock turnover of $477 million at TSL 3 (CA IOUs 2018).

Regarding greenhouse gas emissions, at TSL 2 the Statewide CASE Team analysis shows that the Compressors Standards would result in a reduction of 51,834 metric tons of carbon dioxide equivalent (MTCO2e) after stock turnover. However, at TSL 3, the analysis shows 88,341

MTCO2e of emissions reductions, resulting in a 70 percent increase in emissions reductions over TSL 2 (CA IOUs 2018).

In summary, setting an energy conservation standard at TSL 3 would result in 223 GWh more energy savings after stock turnover, 36,507 MTCO2e additional GHG reductions, and would still be cost-effective for California. Furthermore, these estimates are likely conservative relative to what the Energy Commission would calculate given the differences between the Statewide CASE Team's analysis and the Energy Commission's analysis at TSL 2.

2.2 Energy Conservation Standards Effective Date

In its Proposed Express Terms, the Energy Commission states January 1, 2022 as the compliance date for Compressor Standards (CEC 2018a). In contrast, the Statewide CASE Team recommends a one-year period between standards adoption and compliance, which would mean an effective date in early 2020, depending on when the Energy Commission officially adopts the standard (CA IOUs 2018). The Statewide CASE Team notes that the Energy Commission is only statutorily required to provide a one-year gap between standard adoption and compliance (Public Resources Code 2018). The Energy Commission has already made accommodations to manufacturers in its Proposed Express Terms. First, the Energy Commission has allowed the use of Alternative Efficiency Determination Methods (AEDMs) similar to what U.S. DOE allows for many of its regulated appliances. This results in a significant reduction in test burden for manufacturers. Second, the Energy Commission is allowing older test results to meet its test procedure requirements if manufacturers can prove that the test results meet the new test procedure's level of stringency. These two elements of the compressors rule result in a reduced need for an extended period between standard adoption and compliance. For this reason, the Statewide CASE Team recommends that the Energy Commission require compressor standards enforcement one year after adoption.

2.3 Compressor Annual Operating Hours

In their comments on U.S. DOE's compressors notice of proposed rulemaking (NOPR), Sullivan-Palatek, Atlas Copco, Jenny Products, Ingersoll Rand, Sullair, and Compressed Air Systems commented that U.S. DOE had used an overestimate for the distribution of compressor annual operating hours (AOH) (U.S. DOE 2016a). The Compressed Air and Gas Institute (CAGI) provided a table in its comments with a proposed AOH distribution (CAGI 2016). U.S. DOE responded to this comment in its Final Rule (IV.E.2. Annual Hours of Operation) by noting that the AOH profile proposed by CAGI skewed higher than what U.S. DOE had analyzed. Further, Atlas Copco commented with a proposed AOH by capacity distribution that differed from what U.S. DOE used in its NOPR (Atlas Copco 2016). U.S. DOE responded by adjusting its AOH by capacity in the energy-use analysis in its Final Rule (U.S. DOE 2016a). U.S. DOE provided additional details in Section 7.2.3.4 of the Final Rule technical support document, where it is explicitly stated that Atlas Copco's feedback to the NOPR was incorporated into the Final Rule analysis (U.S. DOE 2016c). The Energy Commission used U.S. DOE's Final Rule analysis as the basis of its analysis. Table 1 shows the comparison of annual energy usage between U.S. DOE's NOPR analysis and its Final Rule analysis for the dominant equipment class of compressors, namely rotary, fixed-speed, lubricated, air-cooled compressors. The energy use is a direct result of the AOH. Note that energy use declines at all efficiency levels shown from the NOPR to the Final Rule analysis; this is because the AOH estimate decreased for all compressor equipment classes from the NOPR to the Final Rule. Table 2 shows the corresponding increase in average service lifetime as a

result of the decrease in annual operating hours for rotary, fixed-speed, lubricated, air-cooled compressors. This arises from the fact that if the equipment is operated less frequently in a given year, its overall lifetime should increase, which is shown in Table 2.

Table 1: Average Annual Energy Use at Select Efficiency Levels for Rotary, Fixed-Speed, Lubricated, Air-Cooled Compressors in Kilowatt Hours per Year (kWh/yr)

Efficiency Level	NOPR	Final Rule
Base	147,820	124,243
EL 2	146,114	119,954
EL 3	143,516	116,415

Source: U.S. DOE 2016b, U.S. DOE 2016c.

Table 2: Change in Average Service Lifetime Estimate from NOPR to Final Rule for Rotary, Fixed-Speed, Lubricated, Air-Cooled Compressors

	NOPR	Final Rule
Average Service Lifetime (years)	11.8	12.9

Source: U.S. DOE 2016b, U.S. DOE 2016c.

The purpose of displaying this data is to reinforce the fact that U.S. DOE has comprehensively incorporated all information and data presented to it during its NOPR and public comment period into the Final Rule analysis. Raising issues that have already been addressed by U.S. DOE is unnecessary and does not contribute productively to the Energy Commission's rulemaking process.

2.4 Test-and-list for Additional Categories of Compressors

In its March 2018 proposal, the Statewide CASE Team recommended that the Energy Commission set testing and reporting (test-and-list) requirements for categories of compressors not covered by the energy conservation standards (CA IOUs 2018). Specifically, the Statewide CASE Team proposed test-and-list for reciprocating compressors between one and 500 horsepower (hp), rotary non-lubricated compressors between one and 500 hp, rotary lubricated compressors between one and ten hp, and rotary lubricated compressors between 200 and 500 hp. These requirements would provide valuable information to many stakeholders. First, users of these types of compressors would be more knowledgeable about the efficiency of the products on the market. Second, energy efficiency program administrators would be able to develop incentive offerings around the highest efficiency compressors in these categories. Third, regulators such as the Energy Commission would be able to gather the efficiency and capacity ratings of these categories of compressors for use in future energy conservation standard rulemakings. However, in its Proposed Express Terms, the Energy Commission did not include test-and-list requirements for any categories of compressors (CEC 2018a). The Statewide CASE Team urges the Energy Commission to reconsider its decision.

The Statewide CASE Team notes that the Energy Commission currently requires test-and-list for other products. Specifically, test-and-list is in effect for evaporative coolers, whole-house fans, residential exhaust fans, ceiling fans, and heat pump water-heating packages (CCR 2018).

The Statewide CASE Team notes that rotary compressors in our proposed test-and-list scope are already covered by the voluntary CAGI compressor rating program. These existing ratings may be able to be used in a potential test-and-list requirement from the Energy Commission. This could reduce test burden for the manufacturers participating in the CAGI rating program because the

testing has already been completed. Just like with rotary compressors within the scope of the energy conservation standards, manufacturers would need to prove the older test results align with the new U.S. DOE test procedure requirements (see Section 2.6). Using the older test data would eliminate the need for retesting and reduce test burden on manufacturers.

For the reasons cited above, the Statewide CASE Team urges the Energy Commission to reconsider its decision to omit test-and-list requirements for the categories of compressors listed above.

2.5 Basic Models and AEDM Rules

In its test procedure Final Rule, U.S. DOE defined a compressor basic model as including "all units of a class of compressors manufactured by one manufacturer, having the same primary energy source, and having essentially identical electrical, physical, and functional (or pneumatic) characteristics that affect energy consumption and energy efficiency" (U.S. DOE 2017a). The existence of the basic model concept allows manufacturers to group similar equipment to minimize testing burden, assuming all representations are identical and based on the least efficient unit. Manufacturers benefit from the reduced testing burden but also assume risk, as it becomes more likely that an individual compressor model could be found to be non-compliant (U.S. DOE 2017a).

In addition to allowing basic models, U.S. DOE allowed AEDMs in its test procedure Final Rule. The AEDM is an optional compliance pathway for manufacturers in addition to the physical lab-based testing to achieve compliance. An AEDM is a software program that mathematically models compressor energy performance. In order to use an AEDM, the manufacturer must validate the model against lab data for two basic models. Once the AEDM is validated, the software may be used for a large number of additional basic models (U.S. DOE 2017a).

The Energy Commission has adopted both U.S. DOE's basic model and AEDM definitions as ways to ease test burden for manufacturers (CEC 2018a). The Statewide CASE Team agrees with the Energy Commission's decision to align with the U.S. DOE test procedure and allow manufacturers to use basic models and AEDMs to meet compliance requirements. These options reduce test burden but are crafted in a way that do not diminish consumer confidence in the efficiency ratings.

2.6 Existing Compressor Test Results

In its test procedure Final Rule, U.S. DOE was prepared to allow compressor manufacturers to use older test data showing capacity and isentropic efficiency, rather than data tested after its test procedure was finalized (U.S. DOE 2017a). However, the burden of proof was on the manufacturer to show that its tests were conducted to the U.S. DOE test procedure's level of rigor. The U.S. DOE test procedure is based on ISO 1217:2009(E) as amended through Amendment 1:2016 (hereafter referred to as "ISO 1217"), which is significantly less prescriptive than the U.S. DOE test procedure regarding test tolerances and how to calculate isentropic efficiency. If the manufacturer can prove that its older test results did meet the U.S DOE test procedure and showed that isentropic efficiency was calculated correctly, then the older data could be used for compliance purposes. Although the burden of proof is on the manufacturer, the Energy Commission must also be able to enforce its allowance that older test data be used for compliance.

The Statewide CASE Team notes that the U.S. DOE test procedure was originally scheduled to come into enforcement on July 3, 2017 (U.S. DOE 2017a) but was delayed until December 31, 2017 (U.S. DOE 2017b). Despite the delay, the test procedure has been in effect since December 31, 2017, and manufacturers should already be retesting their product lines to U.S. DOE's test procedure.

The Statewide CASE Team has conducted an in-depth review comparing the U.S. DOE test procedure with ISO 1217 and has concluded that the U.S. DOE test procedure is substantially based on ISO 1217, with a few key distinctions. ISO 1217 can be thought of as the basis for how to set up the tests and collect the measurement data, but U.S. DOE overlaid details such as requirements around tighter tolerances, the required and optional equipment present during test, part-load equation, ratings, and method to determine maximum full-flow operating pressure.

Several of U.S. DOE's modifications were based on CAGI recommendations or the CAGI Performance Verification Program. If compressors were tested to that program, some of these requirements would likely be met.

Two requirements in the new U.S. DOE test procedure stand out in comparison to ISO 1217. First, manufacturers would need to show that their old data was tested to U.S. DOE's tighter tolerances. Second, they would need to show that they measured the maximum full-flow operating pressure in accordance with U.S. DOE's very specific step-by-step instructions (CFR 2017). The Statewide CASE Team agrees with the Energy Commission's decision to allow manufacturers to use older test data for Title 20 compliance, so long as it meets the U.S. DOE test procedure requirements.

3. References

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