DEPARTMENT OF ENERGY

10 CFR Parts 429 and 431

[EERE–2020–BT–TP–0032]

RIN 1904–AC54

Energy Conservation Program: Test Procedure for Commercial and Industrial Pumps

AGENCY: Office of Energy Efficiency and Renewable Energy, Department of Energy.

ACTION: Notice of proposed rulemaking and announcement of public webinar.

SUMMARY: The U.S. Department of Energy (''DOE'') proposes to amend the test procedure for commercial and industrial pumps (''pumps'') to harmonize with updated industry standards, to expand the scope of clean water pumps covered by this test procedure, and to revise calculation methods for pumps sold with motors and controls to better represent field energy use. DOE is seeking comment from interested parties on the proposal and announcing a public meeting to collect comments and data on its proposal.

DATES: DOE will accept comments, data, and information regarding this proposal no later than June 10, 2022. See section V, ''Public Participation,'' for details. DOE will hold a webinar on April 26, 2022, from 1:00 p.m. to 4:00 p.m. See section V, ''Public Participation,'' for webinar registration information, participant instructions, and information about the capabilities available to webinar participants. If no participants register for the webinar, it will be cancelled.

ADDRESSES: Interested persons are encouraged to submit comments using the Federal eRulemaking Portal at *www.regulations.gov,* under docket number EERE–2020–BT–TP–0032. Follow the instructions for submitting comments. Alternatively, interested persons may submit comments by email to *pumps2020tp0032@ee.doe.gov.* Include docket number EERE–2020–BT–TP–0032 in the subject line of the message. No telefacsimiles (''faxes'') will be accepted. For detailed instructions on submitting comments and additional information on this process, see section V of this document.

Although DOE has routinely accepted public comment submissions through a variety of mechanisms, including postal mail and hand delivery/courier, the Department has found it necessary to make temporary modifications to the comment submission process in light of the ongoing COVID–19 pandemic. DOE is currently suspending receipt of public comments via postal mail and hand delivery/courier. If a commenter finds that this change poses an undue hardship, please contact Appliance Standards Program staff at (202) 586–1445 to discuss the need for alternative arrangements. Once the COVID–19 pandemic health emergency is resolved, DOE anticipates resuming all of its regular options for public comment submission, including postal mail and hand delivery/courier.

Docket: The docket, which includes **Federal Register** notices, public meeting attendee lists and transcripts (if a public meeting is held), comments, and other supporting documents/materials, is available for review at *www.regulations.gov.* All documents in the docket are listed in the *www.regulations.gov* index. However, some documents listed in the index, such as those containing information that is exempt from public disclosure, may not be publicly-available.

The docket web page can be found at *www.regulations.gov/docket/EERE-2020-BT-TP-0032.* The docket web page contains instructions on how to access all documents, including public comments, in the docket. See section V for information on how to submit comments through *www.regulations.gov.*

FOR FURTHER INFORMATION CONTACT:

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For further information on how to submit a comment, review other public comments and the docket, or participate in the webinar, contact the Appliance and Equipment Standards Program staff at (202) 287–1445 or by email: *ApplianceStandardsQuestions@ee.doe.gov.*

SUPPLEMENTARY INFORMATION: DOE proposes to update a previously approved standard by incorporating by reference the following industry standard into part 431: HI 40.6–2021, ''Methods for Rotodynamic Pump Efficiency Testing.''

Copies of HI 40.6–2021 can be obtained from the Hydraulic Institute at 6 Campus Drive, First Floor North, Parsippany, NJ, 07054–4406, or by going to *www.pumps.org.*

DOE proposes to maintain previously approved standards incorporated by reference into part 431, except for the following, which DOE proposes to remove from part 431:

ANSI/HI 1.1–1.2–2014, ''American National Standard for Rotodynamic Centrifugal Pumps for Nomenclature and Definitions.''

ANSI/HI 2.1–2.2–2014, ''American National Standard for Rotodynamic Vertical Pumps of Radial, Mixed, and Axial Flow types for Nomenclature and Definitions.''

For a further discussion of these standards, see section IV.M of this document.

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I. Authority and Background

Commercial and industrial pumps (collectively, ''pumps'') are included in the list of ''covered equipment'' for which DOE is authorized to establish and amend energy conservation standards and test procedures. (42 U.S.C. 6311)(1)(A)) DOE's energy test procedures for pumps are currently prescribed at title 10 of the Code of Federal Regulations (''CFR''), § 431.464, and 10 CFR part 431 subpart Y appendix A (''appendix A''). The following sections discuss DOE's authority to establish test procedures for pumps and relevant background information regarding DOE's consideration of test procedures for this equipment.

A. Authority

The Energy Policy and Conservation Act, as amended (''EPCA''),[1] authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. (42 U.S.C. 6291–6317) Title III, Part C of EPCA, added by Public Law 95–619, Title IV, section 441(a), established the Energy Conservation Program for Certain Industrial Equipment, which sets forth a variety of provisions designed to improve energy efficiency. This equipment includes pumps, the subject of this document. (42 U.S.C. 6311(1)(A))

The energy conservation program under EPCA consists essentially of four parts: (1) Testing, (2) labeling, (3) Federal energy conservation standards, and (4) certification and enforcement procedures. EPCA include definitions (42 U.S.C. 6311), test procedures (42 U.S.C. 6314), labeling provisions (42 U.S.C. 6315), energy conservation standards (42 U.S.C. 6313), and the authority to require information and reports from manufacturers (42 U.S.C. 6316).

The Federal testing requirements consist of test procedures that manufacturers of covered equipment must use as the basis for: (1) Certifying to DOE that their equipment complies with the applicable energy conservation standards adopted pursuant to EPCA (42 U.S.C. 6316(a); 42 U.S.C. 6295(s)), and (2) making other representations about the efficiency of that equipment (42 U.S.C. 6314(d)). Similarly, DOE must use these test procedures to determine whether the equipment complies with relevant standards promulgated under EPCA. (42 U.S.C. 6316(a); 42 U.S.C. 6295(s))

Federal energy efficiency requirements for covered equipment established under EPCA generally supersede State laws and regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6316(a) and 42 U.S.C. 6316(b); 42 U.S.C. 6297) DOE may, however, grant waivers of Federal preemption for particular State laws or regulations, in accordance with the procedures and other provisions of EPCA. (42 U.S.C. 6316(a))

Under 42 U.S.C. 6314, EPCA sets forth the criteria and procedures DOE must follow when prescribing or amending test procedures for covered equipment. EPCA requires that any test procedures prescribed or amended under this section must be reasonably designed to produce test results which reflect energy efficiency, energy use or estimated annual operating cost of a given type of covered equipment during a representative average use cycle and requires that test procedures not be unduly burdensome to conduct. (42 U.S.C. 6314(a)(2))

EPCA also requires that, at least once every 7 years, DOE evaluate test procedures for each type of covered equipment, including pumps, to determine whether amended test procedures would more accurately or fully comply with the requirements for the test procedures to not be unduly burdensome to conduct and be reasonably designed to produce test results that reflect energy efficiency, energy use, and estimated operating costs during a representative average use cycle.[2] (42 U.S.C. 6314(a)(1))

In addition, if the Secretary determines that a test procedure amendment is warranted, the Secretary must publish proposed test procedures in the **Federal Register**, and afford interested persons an opportunity (of not less than 45 days' duration) to present oral and written data, views, and arguments on the proposed test procedures. (42 U.S.C. 6314(b)) If DOE determines that test procedure revisions are not appropriate, DOE must publish its determination not to amend the test procedures. (42 U.S.C. 6314(a)(1)(A)(ii)) DOE is publishing this Notice of Proposed Rulemaking (NOPR) in satisfaction of the 7-year review requirement specified in EPCA.

B. Background

DOE's established its test procedure for pumps in a final rule published on January 25, 2016. 81 FR 4086 (''January

[1] All references to EPCA in this document refer to the statute as amended through the Energy Act of 2020, Public Law 116–260 (Dec. 27, 2020), which reflect the last statutory amendments that impact Parts A and A–1 of EPCA.

[2] EPCA also requires after DOE first prescribes a test procedure for regulated industrial equipment, to conduct an evaluation of that test procedure not later than three years after the prescribing of that test procedure—and from time to time thereafter. *See* 42 U.S.C. 6314(c). DOE considers this rulemaking to be in satisfaction of this initial evaluation requirement.

2016 Final Rule'').[3] The January 2016 Final Rule established definitions for the terms ''pump,''[4] ''driver,''[5] and ''controls,''[6] and identified several categories and configurations of pumps. The pumps test procedure currently incorporates by reference the Hydraulic Institute (''HI'') Standard 40.6–2014, ''Methods for Rotodynamic Pump Efficiency Testing'' (''HI 40.6–2014''), along with several modifications to that testing method related to measuring the hydraulic power, shaft power, and electric input power of pumps, inclusive of electric motors and any continuous or non-continuous controls.[7]

On September 28, 2020, DOE published an early assessment review request for information (''RFI'') to determine whether to proceed with a rulemaking to amend the test procedure for commercial and industrial pumps. 85 FR 60734 (''September 2020 Early Assessment RFI''). Following review of the comments received in response to the September 2020 Early Assessment RFI, on April 16, 2021, DOE published an RFI in which it sought data and information pertinent to whether amended test procedures would (1) more accurately or fully comply with the requirement that the test procedure produces results that measure energy use during a representative average use cycle for the equipment without being unduly burdensome to conduct, or (2) reduce testing burden. 86 FR 20075 (''April 2021 RFI''). In response to requests from stakeholders,[8] on May 5, 2021, DOE published an extension of the comment period for an additional 30 days. (86 FR 23875) DOE received comments in response to the April 2021 RFI from the interested parties listed in Table I.1.[9] A parenthetical reference at the end of a comment quotation or paraphrase provides the location of the item in the public record.[10]

Table I.1 List of Commenters with Written Submissions in Response to the April 2021 RFI

Organization(s)	Reference in this NOPR	Organization Type
Appliance Standards Awareness Project, Natural Resources Defense Council	ASAP and NRDC	Efficiency Organization
Pacific Gas and Electric Company, Southern California Gas Company, Southern California Edison, and San Diego Gas and Electric Company (collectively, the California Investor-Owned Utilities)	CA IOUs	Utility Association
Grundfos Americas Corporation	Grundfos	Manufacturer
Hydraulic Institute	HI	Industry Association
Northwest Energy Efficiency Alliance and Northwest Power and Conservation Council	NEEA	Efficiency Organization
Summit Pump, Inc	Summit	Manufacturer

In their comments, Summit asserted that the industry as a whole has become more aware of DOE's energy standards for pumps since January 2020 when the pumps standards went into effect. (Summit, No. 16 at p. 7) Grundfos suggested that DOE consider eliminating multiple open notices that affect a given industry to ensure proper stakeholder engagement. (Grundfos, No. 17 at p. 1)

As noted, EPCA requires DOE to periodically review the test procedures of covered equipment, including pumps, to determine whether amended test procedures would more accurately or fully comply with the requirements for the test procedures to not be unduly burdensome to conduct and be reasonably designed to produce test results that reflect energy efficiency, energy use, and estimated operating costs during a representative average use cycle. (42 U.S.C. 6314(a)(1)) In order to provide stakeholders opportunities to engage as part of DOE's decision making, DOE provided opportunity for stakeholder comment to the September 2020 Early Assessment RFI and the April 2021 RFI. This NOPR provides further opportunity for comment on

[3] On March 23, 2016, DOE published a correction to the January 2016 Final Rule to correct the placement of the product-specific enforcement provisions related to pumps under 10 CFR 429.134(i). 81 FR 15426.

[4] A ''pump'' means equipment designed to move liquids (which may include entrained gases, free solids, and totally dissolved solids) by physical or mechanical action and includes a bare pump and, if included by the manufacturer at the time of sale, mechanical equipment, driver, and controls.

[5] A ''driver'' provides mechanical input to drive a bare pump directly or through the use of mechanical equipment. Electric motors, internal combustion engines, and gas/steam turbines are examples of drivers. (10 CFR 431.462)

[6] A ''control'' is used to operate a driver. (10 CFR 431.462)

[7] A ''continuous control'' is a control that adjusts the speed of the pump driver continuously over the driver operating speed range in response to incremental changes in the required pump flow, head, or power output. A ''non-continuous control'' is a control that adjusts the speed of a driver to one of a discrete number of non-continuous preset operating speeds, and does not respond to incremental reductions in the required pump flow, head, or power output. 10 CFR 431.462.

[8] Price Pump, EERE–2020–BT–TP–0032, No. 10 at p. 1; Hydraulic Institute EERE–2020–BT–TP–0032, No. 11 at p. 1; Grundfos, EERE–2020–BT–TP–0032, No. 12, at p. 1; Xylem, EERE–2020–BT–TP–0032, No. 13 at p. 1.

[9] In addition to the comments listed in Table I.1, DOE also received one comment from an individual, which was unrelated to the test procedures for pumps.

[10] The parenthetical reference provides a reference for information located in the docket of DOE's rulemaking to develop test procedures for pumps (Docket No. EERE–2020–BT–TP–0032, which is maintained at *www.regulations.gov/#!docketDetail;D=EERE-2020-BT-TP-0032*). The references are arranged as follows: (Commenter name, comment docket ID number, page of that document).

proposed amendments to the test procedure for pumps, which are discussed in the following sections. DOE acknowledges that it has multiple open notices that may inordinately impact a given industry at any time. However, DOE notes that the purpose of the rulemaking process is to engage stakeholders. While notices have specific comment dates by which comments are due, stakeholders may submit material to the rulemaking docket at any time during the course of the rulemaking by contacting the DOE program manager.

II. Synopsis of the Notice of Proposed Rulemaking

In this NOPR, DOE is proposing to:

(1) Expand the scope of the test procedure to include additional clean water pumps, specifically:

(a) Between-bearing (''BB'') pumps;

(b) radially-split, multi-stage, horizontal,

(c) in-line diffuser casing (''RSHIL'') pumps;

(d) radially-split, multi-stage, horizontal, end-suction diffuser casing (''RSHES'') pumps;

(e) small vertical in-line (''SVIL'') pumps;

(f) vertical turbine (''VT'') pumps;

(g) pumps sold with 6-pole induction motors or motors with design speeds between 960 rpm and 1,440 rpm;

(h) submersible turbine (''ST'') pumps with bowl diameters larger than 6 inches; and

(i) end-suction pumps not covered by the current test procedure;

(2) Clarify the applicability of the design temperature range scope limitation and modify the range parameters;

(3) Add and modify certain definitions in 10 CFR 431.462 to accommodate the expansion of scope and clarify existing definitions;

(4) Incorporate by reference HI 40.6–2021 into 10 CFR 431.463 and make minor revisions to the test procedure to address provisions in the current DOE test procedure that have been added to HI 40.6–2021;

(5) Remove the incorporations by reference of ANSI/HI 1.1–1.2–2014 and ANSI/HI 2.1–2.2–2014;

(6) Add specifications for stages for testing for expanded scope multi-stage pumps;

(7) Clarify test provisions for pumps with BEP at run-out;

(8) Clarify test provisions for calibration of measurement equipment;

(9) Update part-load loss factor equation coefficients in the calculation method for pumps sold with induction motors and controls;

(10) Provide a calculation method for pumps sold with inverter-only motors;

(11) Update the test procedure for submersible pumps to address proposed DOE coverage of submersible motors;

(12) Update the test procedure to address SVIL pumps;

(13) Add provisions for testing and rating pumps sold with a 6-pole induction motor or with design speeds between 960 rpm and 1,440 rpm; and

(14) Allow use of Alternative Efficiency Determination Methods (''AEDMs'').

DOE's proposed actions are summarized in Table II.1 compared to the current test procedure as well as the reason for the proposed change.

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Table II.1 Summary of Changes in Proposed Test Procedure Relative to Current Test Procedure

Current DOE Test Procedure	Proposed Test Procedure	Reason for Proposed Change
Does not include in the scope of the test procedure BB, RSHIL, RSHES, SVIL, or VT pumps; pumps distributed in commerce with nominal speeds of 1,200 rpm; ST pumps with bowl diameter greater than 6 inches; or all end-suction pumps	Includes in the scope of the test procedure BB, RSHIL, RSHES, SVIL, and VT pumps; pumps distributed in commerce with nominal speeds of 1,200 rpm; ST pumps with bowl diameter greater than 6 inches; and all end-suction pumps	Improved representativeness
Includes a scope limitation of a design temperature range from 14 to 248 °F.	Specifies a scope limitation of a pump whose design temperature range falls wholly or partially into the range from 15 to 250 °F.	Improved clarity and enforceability
Includes definitions for pump categories within the current scope of the test procedure.	Includes definitions for additional pump categories and clarifications to the definitions for some existing pump categories.	Required for proposed scope expansion; improved enforceability
Incorporates by reference HI 40.6-2014 for determining the constant load pump energy index (“PEI_{CL}”) and the variable load pump energy index (“PEI_{VL}”) value of pumps	Incorporates by reference HI 40.6-2021 for determining the PEI_{CL} and the PEI_{VL} value of pumps	Updates to applicable industry test standard
Provides example pump categories for certain pump definitions by referencing ANSI/HI 1.1-1.2-2014 and ANSI/HI 2.1-2.2-2014	Removes example pump categories from all relevant definitions.	Simplification of the test procedure
References ANSI/HI 2.1-2.2-2014 to define “intermediate bowl” within the definition for bowl diameter.	Incorporates a definition for “intermediate bowl” in the definition for bowl diameter, removing the reference to ANSI/HI 2.1-2.2-2014	Simplification of the test procedure
Does not include test provisions for multistage pumps other than RSV and ST	Includes specifications for stages for testing for BB, RSHIL, RSHES, and VT pumps	Required for proposed scope expansion
Includes provisions for pumps with BEP at run-out.	Clarifies provisions for pumps with BEP at run-out.	Improved repeatability and reproducibility
References a section of HI 40.6-2014 related to calibration of measurement equipment.	Clarifies the applicable test provisions in HI 40.6-2021 for calibration of measurement equipment.	Improved repeatability and reproducibility
Includes a calculation method for pumps sold with induction motors and controls.	Includes revised part-load loss factor equation coefficients for motors 50 hp and above.	Improved representativeness
Does not provide a calculation method for pumps sold with inverter-only motors	Provides a calculation method for pumps sold with inverter-only motors	Reduced burden

Current DOE Test Procedure	Proposed Test Procedure	Reason for Proposed Change
Includes test provisions specific to submersible pumps based on default motor efficiency.	Includes test provisions specific to submersible pumps based on DOE's proposed coverage of submersible motors.	Responsive to DOE proposals in related rulemaking
Does not include test provisions specific to SVILs.	Includes test provisions specific to SVILs.	Required for proposed scope expansion
Does not include provisions for testing pumps distributed in commerce with 6-pole motors or motors with design speeds between 960 rpm and 1,440 rpm.	Includes provisions for testing pumps sold with 6-pole motors or motors with design speeds between 960 rpm and 1,440 rpm	Improved representativeness
Does not allow use of AEDMs.	Allows use of AEDMs.	Reduced burden

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DOE has tentatively determined that the proposed amendments described in section III of this NOPR would not alter the measured efficiency of commercial and industrial pumps that are currently included in the scope of DOE's energy conservation standards for pumps. Therefore, DOE does not expect that retesting or recertification would be necessary for currently certified pumps as a result of DOE's adoption of the proposed amendments to the test procedures, if made final. Additionally, DOE has tentatively determined that the proposed amendments, if made final, would not increase the cost of testing for these pumps. As such, for pumps currently within the scope of DOE's energy conservation standards, any representations regarding the energy consumption of a pump or the cost of energy consumed by a pump would have to be made in accordance with the amended test procedure beginning 180 days after publication of the final rule. (42 U.S.C. 6314(d))

For pumps that are not currently within the scope of the test procedure and are not currently required to certify pump energy use, DOE is proposing that the test requirements proposed in appendix A, if adopted, would take place on the compliance date of amended energy conservation standards for pumps that DOE may ultimately decide to adopt as part of a separate rulemaking assessing the technological feasibility and economic justification for such standards. In other words, for pumps that DOE is proposing to include in the scope of the proposed test procedure, manufacturers would need to use the results of testing under appendix A to determine compliance with any new energy conservation standards that DOE may establish for these pumps.

Discussion of DOE's proposed actions are addressed in detail in section III of this NOPR.

III. Discussion

In the following sections, DOE proposes certain amendments to its test procedures for pumps. For each proposed amendment, DOE provides relevant background information, explains why the amendment merits consideration, discusses relevant public comments, and proposes a potential approach.

A. Scope of Applicability

The current DOE test procedure for pumps applies to five categories of "clean water pumps" with specific defined characteristics, and excludes certain defined categories [11] of pumps. 10 CFR 431.464(a)(1).

DOE defines "clean water pump" as a pump that is designed for use in pumping water with a maximum non-absorbent free solid content of 0.016 pounds per cubic foot, and with a maximum dissolved solid content of 3.1 pounds per cubic foot, provided that the total gas content of the water does not exceed the saturation volume, and disregarding any additives necessary to prevent the water from freezing at a minimum of 14 °F. 10 CFR 431.462.

The five categories of clean water pumps to which the current test procedure applies are: End-suction close-coupled ("ESCC"); end-suction frame mounted/own bearings ("ESFM"); in-line ("IL"); radially-split, multi-stage, vertical, in-line diffuser casing ("RSV"); and submersible turbine ("ST"). 10 CFR 431.464(a)(1)(i). The defined characteristics specify limits on flow rate, maximum head, design temperature range, motor type, bowl diameter, and speed.[12] 10 CFR 431.464(a)(1)(ii). In the context of the energy conservation standards, pumps are further delineated into equipment classes based on nominal speed of rotation and operating mode (*i.e.,* constant load or variable load). 10 CFR 431.465.

In the April 2021 RFI, DOE requested comment on the percentage of pump models that fall within the scope of DOE's current test procedure. 86 FR 20075, 20079. Additionally, DOE also sought information regarding how manufacturers communicated performance in catalogs and other related literature for out-of-scope pumps. *Id.* DOE also requested shipment and market performance data for SVIL pumps, pumps operating with motors at speeds different than 1,800 rpm or 3,600 rpm, submersible turbine pumps with a bowl diameter greater than 6 inches, and other pumps that are currently excluded from scope based on the pump characteristics provided at 10 CFR 431.464(a)(1)(ii). *Id.*

In response, Grundfos generally recommended that an expansion to the

[11] The excluded categories of pumps are fire pumps; self-priming pumps; prime-assist pumps; magnet driven pumps; pumps designed to be used in a nuclear facility subject to 10 CFR part 50, "Domestic Licensing of Production and Utilization Facilities"; and pumps meeting the design and construction requirements set forth in Military Specifications: MIL–P–17639F, "Pumps, Centrifugal, Miscellaneous Service, Naval Shipboard Use" (as amended); MIL–P–17881D, "Pumps, Centrifugal, Boiler Feed, (Multi-Stage)" (as amended); MIL–P–17840C, "Pumps, Centrifugal, Close-Coupled, Navy Standard (For Surface Ship Application)" (as amended); MIL–P–18682D, "Pump, Centrifugal, Main Condenser Circulating, Naval Shipboard" (as amended); and MIL–P–18472G, "Pumps, Centrifugal, Condensate, Feed Booster, Waste Heat Boiler, And Distilling Plant" (as amended). 10 CFR 431.464(a)(1)(iii).

[12] More specifically, these characteristics include: (A) flow rate of 25 gpm or greater at BEP and full impeller diameter; (B) maximum head of 459 feet at BEP and full impeller diameter and the number of stages required for testing; (C) design temperature range from 14 to 248 °F; (D) designed to operate with either (1) a 2- or 4-pole induction motor, or (2) a non-induction motor with a speed of rotation operating range that includes speeds of rotation between 2,880 and 4,320 revolutions per minute (rpm) and/or 1,440 and 2,160 rpm, and in either case, the driver and impeller must rotate at the same speed; (E) For ST pumps, a 6-inch or smaller bowl diameter; and (F) For ESCC and ESFM pumps, a specific speed less than or equal to 5,000 when calculated using U.S. customary units. 10 CFR 431.464(a)(1)(ii).

pumps test procedure scope should be addressed through a negotiated rulemaking process. (Grundfos, No. 17 at p. 3) Similarly, HI commented that manufacturers and other stakeholders should be involved in creating new pump categories. (HI, No. 20 at p. 3) HI also stated that significant changes to the test procedure and scope may lead to market confusion and result in additional testing burden (HI, No. 20 at p. 1) DOE notes that it published a notice on October 29, 2021 announcing a meeting of the Appliance Standards and Rulemaking Federal Advisory Committee (''ASRAC'') held on December 14, 2021 to discuss and prioritize topic areas for which ASRAC can assist the Appliance and Equipment Standards Program. 86 FR 60020. At this meeting, pumps themselves were not suggested as a category for negotiation, but extended equipment systems (*i.e.,* motor, drive, and driven load) inclusive of the pump were discussed for possible negotiation.

Summit responded that eight percent of their models are within scope of the DOE test procedure and that pump performance information is published in catalogs, pump curves, and brochures. (Summit, No. 16 at p. 3) Additionally, Summit stated that all in-scope pumps are labeled as meeting the DOE standard. *Id.* Grundfos stated that it has 27 basic models that it does not certify based on the scope limitations in the DOE test procedure. (Grundfos, No. 17 at p. 2) HI estimated that approximately 14 percent of manufacturer basic models would not be included in the scope of the current DOE standards because they are SVILs or because of the limitations included in 10 CFR 431.464(a)(1)(ii). (HI, No. 20 at p. 3) HI also stated that for products not within scope, manufacturers generally do not make representations of the pump energy index (''PEI'') value. (HI, No. 20 at p. 3) NEEA stated that it found that 16 percent of pumps reported by distributors (which are typically heating, ventilation, and air conditioning (''HVAC'') and domestic water equipment companies) are not included in DOE's current test procedure scope. (NEEA, No. 21 at p. 3) NEEA asserted that nearly all of the pumps sold by these distributors pump clean water and therefore should be in scope. *Id.*

Although stakeholders did not respond to DOE's request for data on pumps operating with motors at speeds other than 1,800 rotations per minute (''rpm'') or 3,600 rpm in the April 2021 RFI, DOE did receive comments on this issue in response to the August 9, 2021 pumps energy conservation standards early assessment review RFI (''August 2021 ECS RFI'', Docket EERE–2021–BT–STD–0018, No. 1). 86 FR 43430. Specifically, the CA IOUs stated that for one pump distributor, 27 percent of its commercial pump sales were either pumps with motors running at 1,200 rpm or double suction pumps [13] (both of which are not included in the scope of DOE's current test procedure). (CA IOUs, Docket EERE–2021–BT–STD–0018, No. 10 at p. 3)

DOE considered expanding scope to the following pump categories: Chemical process and wastewater pumps, small vertical inline pumps, certain additional clean water pumps (between-bearing, vertical suction, radially-split, multi-stage horizontal, line shaft and cantilever pumps), and pumps sold with motors that operate at 1,200 rpm. The following sections provide additional information and responses to stakeholder comments specific to the pumps that DOE considered for inclusion in the test procedure scope.

DOE notes that it is proposing changes to the current test procedure applicable to currently regulated pumps. Any representations regarding the energy consumption of these pumps or the cost of energy consumed by these pumps would have to be made in accordance with the amended test procedure beginning 180 days after publication of the final rule. (42 U.S.C. 6314(d)) The proposed changes to the test procedure would also apply to those pumps that DOE is proposing to include in its scope; however, for these pumps, the revised test procedure would be required in conjunction with the compliance date of any future amended energy conservation standards that DOE may set.

1. Pumps Not Designed for Clean Water Applications

The scope of the current DOE test procedure, as described previously, excludes both chemical process and wastewater pumps. *See* 10 CFR 431.464(a)(1)(i). Chemical process pumps are designed to pump fluids other than water, and wastewater pumps are designed for water with a higher level of free solids than clean water pumps.

In response to the April 2021 RFI, NEEA stated that there is functional overlap between pumps that are within the scope of the current DOE test procedure and those pumps that are excluded because they are certified under ASME/ANSI B73. (NEEA, No. 21 at p. 6) NEEA also stated that distributors report that a ''significant portion'' of ASME/ANSI B73 pumps are installed in clean water applications and that without this certification designation these pumps would be included in the scope for the DOE test procedure. *Id.* Summit stated that if DOE were to include ASME/ANSI B73 pumps within scope of the DOE test procedure, 80 percent of their pumps would be covered rather than the eight percent currently covered. (Summit, No. 16 at p. 4) ASAP and NRDC recommended that DOE consider how the DOE test procedure could facilitate greater market adoption of wastewater pumps with variable-speed drives, similar to what has been done for clean water pumps. (ASAP and NRDC, No. 18 at p. 2)

DOE also received comments pertaining to non-clean water pumps in the August 2021 ECS RFI. HI stated that the current definition of clean water pumps and the exclusion of non-clean water pumps from the test procedure scope aligns with regulations in both Canada and the EU. (HI, Docket EERE–2021–BT–STD–0018, No. 8 at p. 2) HI asserted that maintaining harmonization between the United States, Canada and the EU is important to minimize burden for manufacturers that distribute their pumps outside of the U.S. *Id.* HI stated that a large number of additional pump categories would need to be added to the DOE test procedure in order to appropriately characterize non-clean water pumps. *Id.* HI explained that there is not a clear distinction between a pump being designed for clean water or for wastewater or chemicals. Instead, HI explained that pump designs constitute a range of operation based on a liquid's chemical compatibility and containment requirements, in addition to the concentration, and hardness of the solids being pumped. *Id.* HI stated that it was not aware of any established definitions that characterize non-clean water pumps into unique groupings, and that any definitions would need to define each pump group and include distinct design features that affect their efficiency. *Id.* HI stated that DOE would need to establish many definitions and classes for non-clean water pumps to accurately develop standards. *Id.* HI also commented that the specificity necessary to group pumps with similar design options and loss characteristics would leave little data in each category to develop C-values, making it difficult to develop energy conservation standards. *Id.* Finally, HI stated that

[13] A double-suction pump is one whose impeller is designed to draw flow from both sides, as opposed to a single-suction pump whose impeller only draws flow from one side.

ASME/American Petroleum Institute, solids handling, slurry, positive displacement, and magnet driven pumps could not be tested with the HI 40.6 standard. (HI, Docket EERE–2021–BT–STD–0018, No. 8 at p. 4)

Also in response to the August 2021 ECS RFI, Grundfos recommended against expanding the DOE scope beyond clean water pumps, asserting that uses for pumping other fluids are too varied. (Grundfos, Docket EERE–2021–BT–STD–0018, No. 9 at p. 2)

DOE acknowledges that certain non-clean water pumps may be used in clean water applications; however, DOE expects the number of non-clean water pumps used in the clean water applications to be relatively small. DOE notes that the scope of HI 40.6–2014, which is currently incorporated by reference into the DOE test procedure, includes clean water pumps only. The scope of the HI 40.6 standard changed in the 2016 version to state that the standard covers pumps that are included in DOE's energy conservation standards and therefore does not provide requirements for testing pumps designed for non-clean water applications. The scope of HI 40.6–2021 is identical to that of HI 40.6–2016. To test non-clean water pumps, DOE would need to reference or develop an alternate test procedure. While this test procedure might enable comparison between non-clean water pumps, it is unlikely that a clean water and non-clean water test procedure would provide comparable results.

Additionally, DOE notes that non-clean water pumps, specifically wastewater pumps, must meet specific performance requirements to ensure the health of the U.S. population. DOE would need to carefully evaluate how the performance of non-clean water pumps could be impacted by energy conservation standards and ensure that public health and safety would not be negatively affected. As such, additional investigation is needed to understand the market, energy savings potential, test procedure implications, and performance requirements of non-clean water pumps (*i.e.,* chemical process and wastewater). DOE notes that because ''C-value'' is specified in the energy conservation standard (*see* 10 CFR 431.465(b)(4)) and C-value is required for determining PEI_{CL} and PEI_{VL}, there would be limited use of the test procedure without corresponding standards. Therefore, DOE has determined that it will continue to limit the applicability of this test procedure to clean water pumps at this time.

2. Small Vertical Inline Pumps

As discussed, the scope of the current DOE test procedure is limited to five categories of pumps designed for clean water applications. 10 CFR 431.464(a)(1)(i). One of these categories is in-line (IL) pumps, which are limited to shaft input power greater than or equal to 1 hp and less than or equal to 200 hp at BEP and full impeller diameter, and in which liquid is discharged in a plane perpendicular to the impeller shaft. 10 CFR 431.462. In 2016, a Circulator Pump Working Group [14] recommended a test procedure and energy conservation standard for circulator pumps, which DOE is addressing in a separate rulemaking, and also made recommendations for SVIL pumps. SVIL pumps have characteristics identical to those for in-line pumps but SVIL pumps have shaft input power of less than 1 hp. The Circulator Pump Working Group recommended that (1) SVIL pumps be evaluated using the PEI_{CL} or PEI_{VL} metric, and (2) SVIL pumps should be tested using the DOE pump test procedure, with any needed modifications determined by DOE. (Docket No. EERE–2016–BT–STD–0004, No. 58 Recommendation #1B at pp. 1–2)

In response to the April 2021 RFI, NEEA, Grundfos, ASAP and NRDC, the CA IOUs, and HI recommended that DOE address SVIL pumps in the commercial and industrial pumps test procedure and energy conservation standards rulemakings, rather than in a rulemaking for circulator pumps (NEEA, No. 21 at p.7; Grundfos, No. 17 at p. 3; ASAP and NRDC, No. 18 at p. 2; CA IOUs No. 19 at p. 11; HI, No. 20 at p. 3) NEEA stated that there is confusion in the market as to whether SVIL pumps are subject to the DOE test procedure and energy conservation standards, and that SVIL pumps may be in the same family as, or have overlapping pump curves with, larger pumps that are currently subject to the test procedure and standards. (NEEA, No. 21 at p. 6) NEEA also stated that there is a trend in the HVAC industry to move away from distributing large central pumps to distributing smaller pumps, and that therefore unregulated SVIL pumps compete with larger regulated pumps. *Id.*

DOE also received comments relative to SVIL pumps in the August 2021 ECS RFI. The CA IOUs stated that in discussions with distributors, one recommended adding fractional SVIL pumps to the scope of regulated equipment. (CA IOUs, Docket EERE–2021–BT–STD–0018, No. 10 at p. 5) According to the CA IOUs, this distributor stated that the lack of coverage currently causes confusion since some pumps within a given product line are covered and some are not. *Id* . For example, 7 percent of Taco's SVIL pump sales are fractional horsepower (''hp'') and are therefore uncovered.[15] *Id.* The CA IOUs also reported that SVIL pump use in hydronic HVAC systems is increasing and asserted that this means that SVIL pumps are competing with larger regulated pumps. *Id.*

Finally, DOE received comments relative to SVIL pumps in the May 7, 2021 Circulator Pumps Test Procedure and Energy Conservation Standard RFI (''May 2021 Circulator Pumps RFI''). 86 FR 24516, 24521. The CA IOUs supported NEEA's comments on SVIL pumps from the April 2021 RFI. (CA IOUs, Docket EERE–2016–BT–STD–0004, No. 116 at p. 6) The CA IOUs supported the incorporation and development of SVIL pump standards based on the PEI metric. *Id.*

In the April 2021 RFI, DOE also requested shipment and market performance data for SVIL pumps. 86 FR 20075, 20079. In response, Grundfos and HI recommended that DOE conduct manufacturer interviews to obtain specific market performance data. (Grundfos, No. 17 at p. 3; HI, No. 20 at p. 4)

Issue 1: Consistent with the Circulator Pump Working Group recommendation and based on the concerns expressed in the comments summarized above regarding SVILs being a part of the same model family as IL pumps and serving as an unregulated alternative to pumps currently subject to DOE test procedures and energy conservation standards, DOE proposes to include SVIL pumps within the test procedure's scope. DOE has tentatively determined that SVIL pumps can be tested using the current DOE pumps test procedure with certain additional modifications. The proposed test procedure and metric for SVIL pumps are discussed in sections III.G

[14] On February 3, 2016, DOE published its intention to establish a working group under the Appliance Standards and Rulemaking Federal Advisory Committee (''ASRAC'') to negotiate a test procedure and energy conservation standards for circulator pumps. 81 FR 5658. Throughout this document this working group shall be referred to as ''the Circulator Pumps working Group''.

[15] The use of the term SVIL here implies such pumps can be over 1 horsepower. The current DOE definition of in-line (''IL'') pumps, and the proposed definition of SVIL in section I.B.6 clarify that IL pumps under one horsepower are SVIL pumps. DOE assumes that the comment may have intended that 7 percent of IL pumps are SVIL pumps.

and III.D of this NOPR. Moreover, DOE expects that including SVIL pumps within the scope of the pumps test procedure would reduce confusion over which inline pumps are and are not regulated. DOE requests comment on its proposal to expand the scope of the test procedure to cover SVIL pumps.

3. Other Clean Water Pump Categories

In the April 2021 RFI, DOE requested comment on whether the five pump categories currently included in DOE's regulations sufficiently represent the market and technology available for clean water pumps; whether these categories are sufficiently defined in order to ensure that the categories are mutually exclusive; or whether any of these categories or descriptions should be amended. 86 FR 20075, 20078.

In response to DOE's request for comment in the April 2021 RFI, Grundfos and HI supported the current pump equipment categories, and Grundfos stated that these pump categories represent the current market. (Grundfos, No. 17 at p. 1; HI, No. 20 at p. 2) NEEA and ASAP and NRDC recommended that DOE expand the scope of the pumps test procedure to cover additional pumps used in clean water applications. (ASAP and NRDC, No. 18 at p. 1; NEEA, No. 21 at p. 2) NEEA identified four categories of pumps that it stated may have overlapping uses and therefore may compete with pumps that are currently within scope of DOE regulations; specifically: Single and two stage axially-split pumps, end-suction multi-stage pumps, vertical turbine pumps, and American Society of Mechanical Engineers (''ASME'')/ANSI B73 certified pumps,[16] (NEEA, No. 21 at p. 2) NEEA stated that having similar pumps that compete in the market but that do not use PEI as a performance metric is confusing for distributors and end users. (NEEA, No. 21 at p. 3) NEEA reiterated its points about pump scope expansion in its comments to the August 2021 ECS RFI. (NEEA, Docket EERE–2021–BT–STD–0018, No. 11 at p. 2)

Similarly, ASAP and NRDC recommended adding double suction pumps, multi-stage end-suction pumps, vertical turbine pumps, and pumps tested at a nominal speed of 1,200 rpm. (ASAP and NRDC, No. 18 at p. 2) ASAP and NRDC stated that this would ensure consistent pump efficiency information is available for purchasers. (ASAP and NRDC, No. 18 at p. 1) ASAP and NRDC additionally commented that some unregulated pumps can be used in the same applications as some regulated pumps. *Id.* ASAP and NRDC contended that including additional pump categories in the test procedure scope would provide a more level playing field for manufacturers. *Id.* In response to the August 2021 ECS RFI, ASAP and NRDC reiterated the points they made in response to the April 2021 RFI. (ASAP and NRDC, Docket EERE–2021–BT–STD–0018, No. 7 at pp. 1–2)

In response to the August 2021 ECS RFI, the CA IOUs supported NEEA's recommendation to expand the scope of the pumps test procedure to the four categories listed above. (CA IOUs, Docket EERE–2021–BT–STD–0018, No. 10 at p. 2) Grundfos stated that DOE should limit its focus of scope expansion to radially-split multi-stage horizontal pumps; and that positive displacement, axial/mixed flow, double suction, multi-stage axially-split, multi-stage radial split vertical immersible, non-submersible vertical turbine, and VS4/VS5 pumps[17] should remain excluded from the DOE scope. (Grundfos, Docket EERE–2021–BT–STD–0018, No. 9 at pp. 1–2) HI commented that DOE should not expand the scope of its regulation to either non-clean water pumps or to clean water pumps that may serve diverse markets and applications and therefore may have multiple design variants within each pump type. (HI, Docket EERE–2021–BT–STD–0018, No. 8 at p. 1). Additionally, HI stated that significant changes to the scope would cause market confusion since current standards and labeling requirements for pumps went into effect only recently in early 2020. *Id.*

The following sections discuss DOE's consideration of additional categories of clean water pumps within the scope of the test procedure, including the specific categories suggested by commenters.

a. Between-Bearing Pumps

Section 1.2.9.2 of ANSI–HI 14.1–14.2–2019 describes between-bearing (''BB'') pumps as pumps that are one- or two-stage, axially-split, mounted to a baseplate, driven by a motor via a flexible coupling, and with bearings on both ends of the rotating assembly.

In the April 2021 RFI, DOE requested comment on whether pumps that meet the description of BB pumps might fall within the current test procedure scope and if BB pumps could be tested with the current DOE test procedure. 86 FR 20075, 20079. In response, ASAP and NRDC and NEEA recommended evaluating double suction pumps for inclusion in the test standards, and stated that most of these pumps are BB1 pumps,[18] many are used in chilled clean water applications, and these pumps are often below 200 hp. (ASAP and NRDC, No. 18 at p. 1; NEEA, No. 21 at p. 2) In addition, DOE understands that NEEA's recommendation that DOE cover single and two-stage axially-split pumps to also refer to BB1 pumps. The CA IOUs also seemed to offer support for NEEA's comments. (CA IOUs, No. 19 at pp. 10–11)

Summit and Grundfos recommended a new category of double suction pumps/between-bearing pumps if DOE decides to expand its scope beyond clean water pumps. (Summit, No. 16 at p. 2; Grundfos, No. 17 at p. 4) Additionally, Grundfos specifically stated that BB1 pumps have different inlet/outlet configurations and losses when compared to IL pumps that are currently within the scope of the DOE test procedure. (Grundfos, No. 17 at p. 4) Summit stated that although they supply BB pumps, none are used in clean water applications, and that testing these pumps would be burdensome. (Summit, No. 16 at p. 3) Grundfos and HI commented that some BB1 pumps are designed for clean water applications and may be rated under 200 hp. (Grundfos, No. 17 at p. 3–4; HI, No. 20 at p. 4) Grundfos agreed that BB1 pumps can be tested according to the current DOE test procedure. (Grundfos, No. 17 at p. 4) While HI also agreed that BB1 pumps can be tested according to the DOE test procedure, they stated that BB1 pumps do not share the same physical and functional characteristics affecting energy consumption of any pump category currently defined by DOE. (HI, No. 20 at p. 4)

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[16] Pumps certified under the ASME B73 designation include: B73.1 (''Specification for Horizontal End-suction Centrifugal Pumps for Chemical Process''), B73.2 (''Specification for Vertical In-Line Centrifugal Pumps for Chemical Process''), B73.3 (''Specification for Sealless Horizontal End-suction Centrifugal Pumps for Chemical Process''), and B73.5 (''Thermoplastic/thermoset Polymer Material Horizontal End-suction Centrifugal Pumps Chemical Process''). All B73 pumps are designed for use as chemical process pumps, which have specific design requirements related to reliability and performance such as maximum shaft deflections, bearing frame lubrication, sealing requirements, and vibration limits.

[17] VS4 and VS5 are pump categories defined in HI 14.1–14.2–2019 that both refer to vertically separate discharge pumps. VS4 pumps are line shaft pumps and VS5 pumps are cantilever pumps.

[18] BB1 pumps are a pump class defined by HI 14.1–14.2–2019 that are 1 and 2 stage, axially-split pumps with the impeller(s) mounted between bearings at either end. BB1 pumps are a specific sub-category of BB pumps.

DOE also received comments on the August 2021 ECS RFI relevant to BB pumps. The CA IOUs stated that in discussions with distributors, two distributors suggested that split case and double suction pumps should be included in the scope of the pumps rulemaking. (CA IOUs, Docket EERE–2021–BT–STD–0018, No. 10 at p. 3) It is DOE's understanding that the recommendations to include split case and double suction pumps refer to BB pumps, since these two characteristics synonymous with between-bearing pumps.

Based on a review of the market, BB pumps tend to generally be larger than the pumps currently subject to the DOE test procedure. Many BB pumps exceed the head and horsepower limits in the current DOE test procedure. Additionally, BB pumps are not typically designed for clean water applications. Despite these generalities, DOE has identified certain clean water BB pumps under 200 hp and 459 feet of head that could be viewed as potentially interchangeable with those pumps that fall within the scope of the current DOE test procedure.

In order to address the potential for pumps that provide unregulated alternatives to the pumps currently subject to the DOE test procedure, DOE proposes to include BB pumps within the scope of the DOE test procedure. However, DOE does not propose to expand beyond clean water pumps and does not propose to expand the head or horsepower limitations currently listed in 10 CFR 431.464(1)(ii). Additional investigation is needed to understand the market, energy savings potential, test procedure implications, and performance requirements of non-clean water pumps. DOE has determined that it will continue to limit the applicability of this test procedure to clean water pumps at this time. An expansion of the head and horsepower restrictions has the potential to increase test burden by requiring larger laboratory equipment to test pumps according to the DOE test procedure. Through its literature review DOE has found few BB pumps that exceed the head and horsepower limits and are designed for clean water, leading DOE to tentatively determine that the burden of expanding head and horsepower restrictions outweigh the benefits of expanded scope.

Based on stakeholder comments, literature reviews, and reviews of pump schematics, DOE has tentatively determined that BB pumps can be tested using the methodology in HI 40.6–2021; therefore, DOE is not proposing any modifications specific to testing BB pumps in this test procedure NOPR.

Specific proposals for a definition of BB pumps are detailed in section III.B.5 of this document.

Issue 2: DOE requests comment on its proposal to expand the current test procedure's scope to include BB pumps. Additionally, DOE requests comment on the repeatability and representativeness of testing BB pumps using the current DOE test procedure. DOE also requests comment on any additional burdens associated with testing BB pumps that are different from those burdens associated with pumps currently covered by the DOE test procedure.

b. Vertical Turbine Pumps

Section 1.3.3.1.2 of HI 14.1–14.2–2019 defines VS1 and VS2 pumps as vertically suspended, wet pit pumps with a single casing and discharge through the suspension column. VS1 pumps use a diffuser, while VS2 use a volute.[19] VS1 and VS2 pumps are generally known as vertical turbine pumps. These pumps are generally not designed for clean water applications, and often exceed head and horsepower limits laid out in the current test procedure.

In response to the April 2021 RFI, DOE received comments from ASAP and NRDC and NEEA recommending the inclusion of vertical turbine pumps in the scope of the current DOE test procedure. (ASAP and NRDC, No. 18 at pp. 1–2; NEEA, No. 21 at p. 2) NEEA stated that these pumps present a compliance loophole in DOE's pump regulations and create market confusion. (NEEA, No. 21 at pp. 2–3) The CA IOUs encouraged DOE to evaluate vertical turbine pumps for inclusion in the test procedure. (CA IOUs, No. 19 at p. 11)

Based on a review of literature, DOE has tentatively determined that ST pumps and vertical turbine pumps have similar end uses. Additionally, DOE has tentatively determined that ST and vertical turbine pumps have similar bowl and impeller assemblies, and that vertical turbine pumps may even share an identical assembly with an ST pump produced by the same manufacturer. To address the potential of pumps that provide unregulated alternatives to the pumps currently subject to the DOE test procedure, DOE proposes to include vertical turbine pumps within the scope of the DOE test procedure. However, as discussed previously, DOE does not propose to expand beyond clean water pumps and does not propose to expand the head or horsepower limitations currently listed in 10 CFR 431.464(1)(ii). An expansion of the head and horsepower restrictions has the potential to increase test burden by requiring larger laboratory equipment to test pumps according to the DOE test procedure. Through its literature review, DOE has found few vertical turbine pumps that exceed the head and horsepower limits and are designed for clean water. Therefore, DOE has tentatively determined that the burden of expanding head and horsepower restrictions outweigh the benefits of expanded scope.

Based on literature reviews and reviews of pump schematics, DOE has tentatively determined that vertical turbine pumps can be tested using the methodology in HI 40.6–2021; therefore, DOE is not proposing any modifications specific to testing vertical turbine pumps in this test procedure NOPR.

Specific proposals for a definition of VT pumps are detailed in section III.B.6 of this document.

Issue 3: DOE requests comment on its proposal to expand the current test procedure's scope to include VT pumps. Additionally, DOE requests comment on the repeatability and representativeness of testing VT pumps using the current DOE test procedure. DOE also requests comment on any additional burdens associated with testing VT pumps that differ from those burdens associated with pumps currently covered by the DOE test procedure.

c. Radially-Split Multi-Stage Horizontal Pumps

The current scope of the DOE test procedure includes radially-split, multi-stage, vertical, in-line casing diffuser (RSV) pumps, but does not include radially-split horizontal pumps, which are also multistage pumps used primarily in heating, cooling, and pressure boosting applications. In response to the April 2021 RFI, NEEA and ASAP and NRDC recommended that multi-stage end-suction pumps (specifically OH1j, OH7j, and OH13j)[20] should be included in the scope of the pumps test procedure. (NEEA, No. 21 at p. 2; ASAP and NRDC, No. 18 at p. 1) The CA IOUs supported NEEA's comment and recommended that DOE evaluate multi-stage end-suction pumps

[19] Both diffusers and volutes diffuse velocity energy into pressure as the flow exits a pump's impeller. A volute is a one or two scroll shaped diffusing passageway, while a diffuser is characterized by many radially-symmetric diffusing passageways.

[20] OH1J, OH7J, and OH13J are HI 14.1–14.2–2019 pump class definitions that refer to the multi-stage versions of OH1, OH7, and OH13 end-suction pumps. OH pumps are generally classified as overhung meaning the impeller shaft is only supported by bearings on one side of the impeller. OH1 pumps are horizontal, flexibly coupled, and have a centerline mount. OH7 pumps are horizontal and close coupled. OH13 pumps are horizontal and rigidly/short coupled.

for inclusion in the pumps test procedure. (CA IOUs, No. 19 at p. 10–11) NEEA additionally stated that multi-stage end-suction pumps are often in direct competition with RSV pumps in pressure boosting applications. (NEEA, No. 21 at p. 3) NEEA also provided a list of applications for multi-stage end-suction pumps to demonstrate the similarities between these pumps and those that are included in the scope of the current test procedure. (NEEA, No. 21 at p. 4)

DOE also received comments in response to the August 2021 ECS RFI relevant to multi-stage end-suction pumps. The CA IOUs stated that many distributors sell water booster pumps, which are often multi-stage end-suction pumps. (CA IOUs, Docket EERE–2021–BT–STD–0018, No. 10 at p. 3) Grundfos recommended that DOE focus its scope expansions on radially-split multi-stage horizontal pumps. (Grundfos, Docket EERE–2021–BT–STD–0018, No. 9 at p. 2) Grundfos also suggested that, like RSV pumps, RSH pumps should be limited to in-line flow, and that DOE should consider new categories for multi-stage products that do not have in-line connections. *Id.*

DOE has surveyed materials and product literature available online and has tentatively determined that the multi-stage end-suction pumps discussed by NEEA, ASAP and NRDC, and the CA IOUs would be classified as radially-split, multi-stage, horizontal, (''RSH'') end-suction pumps. DOE's literature survey also tentatively concluded that RSV and RSH pumps were marketed for similar applications, and that RSH could therefore serve as an unregulated loophole to RSV pumps. In addition, through reviews of product literature and HI 14.1–14.2–2019 pump schematics, DOE has tentatively determined that RSH pumps can be tested using the current DOE test procedure. Based on DOE's research, DOE proposes to include RSH pumps with both in-line and end-suction flow configurations in its test procedure scope. Specific proposals for definitions or RSH pump categories are detailed in section III.B.7 of this document.

Issue 4: DOE requests comment on its proposal to expand scope to include RSH pumps. Additionally, DOE requests comment on the repeatability and representativeness of testing RSH pumps using the current DOE test procedure. DOE also requests comment on any additional burdens associated with testing RSH pumps which are different from those burdens associated with pumps currently covered by the DOE test procedure.

d. End-suction Pumps Similar to ESFM and ESCC Pumps

DOE defines a ''close-coupled pump'' as a pump having a motor shaft that also acts as the impeller shaft, and defines a ''mechanically-coupled pump'' as a pump that has its own impeller shaft and bearings separate from the motor shaft. 10 CFR 431.462. As discussed in the April 2021 RFI, DOE is aware that certain pumps may have their own shaft, but with no bearings to support that shaft. 86 FR 20075, 20078. Additionally, while the close-coupled pump definition describes a pump in which the motor shaft also serves as the pump shaft, the definition does not provide detail on how the motor and pump shaft may be connected. DOE has observed that some manufacturers describe close-coupled pumps as using an adapter to mount the impeller directly to the motor shaft. The coupling type is the only differentiator between ESCC pumps, which are ''close-coupled pumps,'' and ESFM pumps, which are ''mechanically-coupled pumps.'' In the January 2016 Final Rule, DOE noted that it intended for ESFM and ESCC pumps to be mutually exclusive in order to ensure that pumps that are close-coupled to the motor and have a single impeller and motor shaft would be part of the ESCC equipment category, while all other end-suction pumps that are mechanically-coupled to the motor and for which the bare pump and motor have separate shafts would be part of the ESFM equipment category. 81 FR 4086, 4096. Despite this intention DOE is aware that these definitions may have left some end-suction pumps out of scope.

In the April 2021 RFI, DOE requested comment on whether there are pumps being sold in commerce that may not meet the ''close-coupled'' or ''mechanically-coupled'' definitions but would otherwise meet the definition for an ''end-suction'' pump. 86 FR 20075, 20078.

HI stated that there are currently pumps that have impellers not directly connected to the motor shaft, with all pump loads supported by the motor bearings, which do not meet either the definition of close-coupled or mechanically-coupled pumps. (HI, No. 20 at p. 3)

Based on HI's response and DOE's review of ESCC and ESFM pumps, DOE has tentatively determined that there is a group of end-suction pumps that do not currently fall into either the ESFM or ESCC definition, but which may be competitors to the currently regulated pumps. Therefore, DOE proposes to include all end-suction pumps within the coverage of this test procedure by modifying the definitions of ESFM and ESCC pumps. The details of this proposal are outlined in section III.B.8 of this document. DOE has tentatively determined that no test procedure revisions would be needed to accommodate these additional end-suction pumps.

Issue 5: DOE requests comment on its tentative determination that there are certain ends suction pumps excluded from the current test procedure due to the ESFM and ESCC definitions. DOE also requests comment on the number of pump models that may fall into this category and whether they are currently being tested according to the DOE test procedure.

e. Line Shaft and Cantilever Pumps

ANSI/HI 14.1–14.2–2019 includes design criteria for different pump configurations, and section 14.1.3.3.1.3 describes vertically separate discharge sump pumps, a category of pump that includes line shaft (''VS4'') pumps and cantilever (''VS5'') pumps. Both VS4 and VS5 pumps are vertically-suspended pumps with a single casing and with a discharge column that is separate from the shaft column. The pump equipment categories defined by DOE do not explicitly reference VS4 or VS5 pumps, and some pumps may be covered by both the DOE definition of an ESFM pump and the HI definition of a VS4 or VS5 pump. 86 FR 20075, 20079.

In the April 2021 RFI, DOE requested comment on whether the test procedure should be amended to explicitly address line shaft and cantilever pumps as described in the ANSI/HI 14.1–14.2–2019. 86 FR 20075, 20079. In response, Grundfos stated that line shaft pumps and cantilever pumps have designs similar to ESFM and ESCC pumps and that some are sold for clean water applications. (Grundfos, No. 17 at p. 3) Grundfos also commented that if DOE were to include line shaft and cantilever pumps within its scope, DOE should create a new equipment class since these pumps have different losses, and DOE would need to define a standard sump depth for testing since these products have a wide variance in sump depth. *Id.* HI stated that VS4 and VS5 are not clean water pumps and therefore there is no need to address their potential test procedures. (HI, No. 20 at p. 4)

Consistent with the comments from HI, DOE's literature survey indicates all cantilever pumps are primarily designed for non-clean water applications including liquids and slurries containing large solids. Therefore, DOE has tentatively determined that it will not expand the scope of its test procedure to include line shaft or cantilever pumps at this time. This proposed approach is consistent with DOE's tentative decision not to expand the current test procedure's scope to pumps designed for non-clean water applications. DOE agrees that a standard sump depth must be defined for testing of these products but a representative sump depth could be determined for the purpose of this test procedure. DOE has not, however, assessed what a representative depth would be as it is not proposing a test procedure for line shaft and cantilever pumps.

4. Scope Limitations

Within the categories of clean water pumps included in the current DOE test procedure and proposed for inclusion in this notice, DOE also considered potential expansion to scope limitations related to bowl diameter, nominal speed, horsepower, and design temperature range.

a. Submersible Turbine Pumps With Bowl Diameter Greater Than 6 Inches

As discussed previously, the scope of the current DOE test procedure includes submersible turbine pumps with a bowl diameter of 6 inches or smaller. 10 CFR 431.464(a)(1)(i)(E) and (a)(1)(ii)(E). In response to the September 2020 Early Assessment RFI, NEEA listed submersible turbine (ST) pumps with a bowl diameter greater than 6 inches as an example of pumps that DOE should consider including as part of an expanded scope. (NEEA, No. 7 at p. 8) NEEA's reasoning was that pumps within a regulated family may not be rated because they have a bowl diameter greater than 6 inches.[21] (NEEA, No. 7 at p. 8) In the April 2021 RFI, DOE requested shipment data for submersible turbine pumps with a bowl diameter greater than 6 inches. 86 FR 20075, 20079. DOE received no shipment information on submersible turbine pumps with bowl diameters greater than 6 inches.

However, in response to the April 2021 RFI, HI stated that submersible turbine pumps with a flow rate less than 25 gpm at BEP are used in residential well applications and should remain out of scope since they have limited operating time. (HI, No. 20 at p. 3) DOE is not considering expanding scope to pumps with a flow rate less than 25 gpm at this time, due to the limitations leading to the current scope provision. However, DOE understands that flow rate typically increases with bowl diameter, so it is DOE's understanding that HI's comment is unrelated to a potential scope expansion to pumps with a bowl diameter greater than 6 inches.

As discussed in section III.A.3.b, DOE is proposing to include vertical turbine pumps within the scope of the DOE test procedure. These pumps are similar in design to ST pumps and commenters have indicated that the two pump categories can be used in overlapping applications. Stakeholder comments about the addition of vertical turbine pumps did not indicate a suggested bowl diameter limitation. As such DOE is not proposing one. To maintain consistency across pump categories, and in response to NEEA's early assessment RFI comments, DOE is proposing to remove the 6-inch bowl diameter limitations for ST pumps.

Issue 6: DOE requests comment on its proposal to remove the 6-inch maximum bowl diameter restriction from ST pumps, including whether there are any testing limitations for larger bowl diameters.

b. Pumps Designed To Be Operated at 1,200 RPM

As discussed, DOE limits the scope of pumps under the current test procedure to those designed to operate with a 2- or 4-pole induction motor, or a non-induction motor with an operating range that includes speeds of rotation between 2,880 and 4,320 rpm and/or 1,440 and 2,160 rpm. 10 CFR 431.464(a)(1)(ii). In either case, the driver and impeller must rotate at the same speed. 10 CFR 431.464(a)(1)(ii)(D). The current DOE test procedure does not include pumps designed to operate with 6-pole induction motors or with non-induction motors that have a speed of rotation operating range exclusively outside the ranges defined.

In response to the April 2021 RFI, ASAP and NRDC recommended evaluating pumps sold with 6-pole, 1,200 rpm motors and pumps designed to be operated at 1,200 rpm. (ASAP and NRDC, No. 18 at pp. 1–2) Summit stated that if DOE were to expand the nominal motor speeds included in its test procedure, 1,200 rpm would be the best nominal speed to add. (Summit, No. 16 at p. 5)

In addition, DOE received comments in response to the August 2021 ECS RFI pertaining to this topic. The CA IOUs stated that it contacted several distributors, two of whom recommended adding pumps designed to operate at 1,200 rpm. (CA IOUs, Docket EERE–2021–BT–STD–0018, No. 10 at p. 3) The CA IOUs added that one of these distributors stated that 1,200 rpm pumps have a longer life than higher rpm pumps, while the other stated that not including them within the test procedure's scope is confusing to customers. *Id.*

Based on a review of pump performance curves available online, DOE has tentatively determined that unregulated pumps tested with a nominal speed of 1,200 rpm are part of the same pump families as those pumps that currently fall within the scope of the DOE test procedure.[22] To ensure equitable treatment among these pumps, DOE is proposing to extend the scope of this test procedure to cover pumps designed to operate with 6-pole induction motors, and pumps designed to operate with non-induction motors with an operating range that includes speeds of rotation between 960 rpm and 1,440 rpm.[23] DOE proposes test provisions to accommodate these pumps in sections III.E.1 and III.H of this document.

Issue 7: DOE requests comment on its proposal to expand the scope of the test procedure to include pumps designed to operate with a 6-pole induction motor, and pumps designed to operate with non-induction motors with an operating range that includes speeds of rotation between 960 rpm and 1,440.

c. Pump Horsepower and Design Speed

As discussed, the current DOE test procedure's scope is limited to covered pump categories with a 2- or 4-pole induction motor; or a non-induction motor with an operating range that includes speeds of rotation between 2,880 and 4,320 rpm and/or between 1,440 and 2,160 rpm, and for which the driver and impeller rotate at the same speed. 10 CFR 431.464(a)(1)(ii)(D). In addition, DOE's definitions for the five pump categories are limited to pumps with shaft input power greater than or equal to 1 hp and less than or equal to 200 hp at BEP and full impeller diameter. 10 CFR 431.462.

DOE received comments on the August 2021 ECS RFI from the CA IOUs, who stated that in discussions with distributors one stated that some pumps sold with electronically commutated motors (''ECMs'') and intended to run at higher speeds, such as 4,320 rpm, must be normalized to rate at 3,600 rpm and this adjustment causes the power of the

[21] ST pumps with a bowl diameter greater than 6 inches are currently excluded from the scope of the DOE test procedure.

[22] See *https://www.regulations.gov/document/EERE-2020-BT-TP-0032-0024.* (Docket No. EERE–2020–BT–TP–0032–0024.)

[23] 960 and 1440 rpm are ± 20 percent of 1,200 rpm. The acceptable non-induction motor ranges for 1800 and 3600 rpm pumps are also ± 20 percent of the nominal value.

motor to fall below 1 hp. (CA IOUs, Docket EERE–2021–BT–STD–0018, No. 10 at p. 4) The CA IOUs asserted that this limits purchasers from comparing PEI_{VL} values across product lines. *Id.* The CA IOUs argued that this exclusion of ECM pump products from the DOE test procedure is caused by adjusting operation to the BEP operating point and does not consider the real-world use of this product, which is expected to provide similar head and flow as many IL pumps that are within the scope of the current DOE test procedure. (CA IOUs, Docket EERE–2021–BT–STD–0018, No. 10 at p. 7) The CA IOUs commented that ECM pumps would be considered a highly efficient pump, and the aforementioned test issue limits consumer comparison of these pumps with non-ECM pumps, which in turn creates a market distortion that will slow the adoption of more efficient technologies and makes it difficult for PEI pump rebate programs to include this product subset. *Id.* The CA IOUs recommended that DOE revise the inclusion and exclusion criteria for these products to be based on the driver horsepower of the full operating window of the unit. *Id.* The CA IOUs also stated that this issue might be addressed if SVIL pumps are included in the pumps test procedure. (CA IOUs, Docket EERE–2021–BT–STD–0018, No. 10 at p. 6)

As stated previously, the definitions of the pump categories within the scope of the test procedure reference horsepower limitations based on shaft input power at BEP and full impeller diameter. 10 CFR 431.462. DOE defines ''BEP'' as the pump hydraulic power operating point (consisting of both flow and head conditions) that results in maximum efficiency and defines ''full impeller diameter'' as the maximum impeller diameter with which a given pump basic model is distributed in commerce. 10 CFR 431.462. DOE's test procedure for pumps at appendix A to subpart Y of part 431 also includes test provisions for determining both BEP and pump input power (also known as shaft input power), as well as provisions for normalizing all measured data to the specified nominal speed of rotation. As such, while the definitions themselves do not specify that shaft input power is determined at nominal speed, DOE understands the CA IOUs concern that the pump definitions could be read to exclude pumps with shaft input power greater than or equal to 1 HP at BEP at their design speed, but less than 1 HP when tested and corrected to nominal speed. In addition, DOE understands that the value of maximum efficiency varies little with speed, and is often assumed to be constant, and as such the definition of BEP alone would not be sufficient to assume that it must be determined at a certain speed different from that in the test procedure. For these reasons, DOE believes there could be value in clarifying the current scope limitations regarding horsepower that are embedded in the pump category definitions.

However, DOE also notes that, as previously discussed, it is proposing to expand the current test procedure's scope to include SVIL pumps, which the CA IOUs noted might address this issue. Specifically, the proposed inclusion of SVIL pumps would be for fractional horsepower pumps, so even when corrected to nominal speed, the pumps in question would be included in scope. DOE understands that use of high frequency (circa 4,000 rpm) ECMs is likely more prevalent on SVILs than on other pumps in this horsepower range, particularly as a result of their applications and competition with the circulator market. This means that including SVILs in this proposed test procedure would include most, if not all, pumps where motor power decreases below 1 hp when rated at BEP. For these reasons, DOE is not proposing to change the specified horsepower limitations within the pump category definitions at this time.

Issue 8: DOE requests comment on its tentative determination that incorporating SVILs into the test procedure will largely eliminate the issue of higher speed 1 hp pumps falling out of scope when they rate at a nominal speed of 3600 rpm.

d. Horsepower and Number of Stages for Testing

In response to the April 2021 RFI, Grundfos urged DOE to clarify how to handle certification of equipment where some equipment is regulated while others are not and provided the example of an RSV basic model sold with a 1 horsepower (''hp'') motor tested at 3 stages. Grundfos continued that if a similar pump is 2-stage and uses a 0.75 hp motor, it's partially out of scope. Grundfos recommended that equipment that straddles the scope of the test procedure should be considered to be out of scope. (Grundfos, No. 17 at p. 10–11)

DOE understands that the same model of RSV pump may be sold with two stages, three stages, or some other number of stages. DOE's RSV pump definition includes those pumps that have a shaft input power greater than or equal to 1 hp and less than or equal to 200 hp at BEP and full impeller diameter and at the number of stages required for testing. 10 CFR 431.462. DOE's testing provisions for RSV in section C.2 of appendix A to subpart Y of part 431 specify that the number of stages required for testing is three—or, if the basic model is only available with fewer than three stages, to test the basic model with the maximum number of stages with which it is distributed in commerce in the United States. Therefore, the RSV pump model sold with 2 or 3 stages would be included in the scope of the test procedure (and standards) if it has a shaft input power greater than or equal to 1 hp when tested at 3 stages, and the resulting PEI would apply to all stages with which the pump model is sold. For this reason, DOE is not making any changes to the scope of the test procedure.

e. Design Temperature Range

The current scope for the pumps test procedure is limited to pumps with a design temperature range between and including 14 to 248 °F. This range was derived from the original negotiation term sheet for pumps, which recommended limiting the scope to pumps with a design range from –10 °C to 120 °C. (Docket EERE–2013–BT–NOC–0039–0092). For the purposes of its regulations, DOE translated this range to Fahrenheit. DOE has received inquires as to whether a pump marketed for temperatures up to 250 °F is outside of the current test procedure's scope. DOE has reviewed marketing materials for a number of pumps and found that common upper limits of temperature are 212, 225, 248, 250, and 300 °F. Some marketing materials state that standard seals may have one high temperature limit while optional seals provide a higher limit (typically 250 or 300 °F). DOE understands the original intent of the scope limitation was to exclude pumps designed exclusively for low or high temperatures from the test procedure. However, if a manufacturer is offering a pump model across all temperature ranges in order to minimize SKUs, rather than offering separate low temperature and high temperature models, DOE considers that such a pump model should be subject to the regulations. Only pumps designed and marketed for temperatures exclusively outside the range of DOE's scope would be excluded from the test procedure and energy conservation standards. DOE has also recognized that rounding to a temperature limit of 250 °F when translating from °C to °F would be preferable to using the exact value of 248 °F since manufacturers commonly use rounded temperature values in their marketing materials. Similarly, DOE proposes rounding the lower temperature limit from 14 °F to 15 °F.

To clarify the scope of the pumps test procedure and to improve the enforceability of the regulation, DOE is proposing to change the wording and the values, such that the scope would include pumps with a design temperature inclusive of any part of the range from 15 to 250 °F.

Issue 9: DOE seeks comment on its proposal to clarify the scope of the pumps test procedure with respect to design temperature. Specifically, DOE requests comment on whether 15 °F and 250 °F are more appropriate than 14 °F and 248 °F, or whether other minor adjustments could be made to the range to assist with clarity and enforceability.

B. Definitions

1. Removing Certain References to Volute

Pumps generally have one of two common discharge types, either a volute or a diffuser. A volute is made up of one or two scroll-shaped channels, whereas a diffuser has 3 or more passages that diffuse the liquid that is being pumped. The current definitions for end-suction and in-line pumps use the term ''volute,'' when in practice either volutes or diffusers may be used for these categories of pumps. For example, DOE's current definition for end-suction pump includes the following: ''The liquid is discharged through a volute in a plane perpendicular to the shaft,'' while the definition for ESCC pump, which is an end suction pump, specifically references OH7 pumps. 10 CFR 431.462. However, Table 14.1.3.7 of HI 14.1–14.2–2019 specifies a diffuser as the standard casing for OH7 pumps. Similarly, DOE's current definition for IL pump includes the following: ''in which liquid is discharged through a volute in a plane perpendicular to the shaft,'' and specifically references OH4 and OH5 pumps as examples of end-suction pumps. *Id.* In contrast, Table 14.1.3.7 of HI 14.1–14.2–2019 specifies a diffuser as the standard casing for OH4 and OH5 pumps. DOE notes that HI 1.1–1.2–2014 did not make these casing distinctions.

DOE interprets the term ''volute'' in its definitions for ''end-suction pump'' and ''in-line pump'' to mean the part of the pump casing through which liquid is discharged generally, rather than to reference a specific type of discharge. To avoid this unintentional inconsistency between DOE's terminology and the terminology used by the updated industry standard, DOE proposes to amend the definitions of in-line pump and end-suction pump to remove the distinction that liquid is discharged ''*through a volute* in a plane perpendicular to the shaft'' [emphasis added] by specifying instead that liquid is discharged ''in a plane perpendicular to the shaft.''

Issue 10: DOE requests comment on the proposed changes to the definitions for ''in-line pump'' and ''end-suction pump'' to remove the distinction that liquid is discharged ''through a volute''.

2. HI Pump Class References

The current DOE definitions for ESCC pump, ESFM pump, IL pump, RSV pump, and ST pump all include references to ANSI/HI 2.1–2.2–2014 pump configurations as examples of pumps that would meet the given definition. DOE has tentatively determined that it will be beneficial if the definitions are self-contained, and that these examples may have been causing confusion as to which pumps the definitions applied to. Therefore, DOE proposes to remove references to specific pump configurations as defined in ANSI/HI 1.1–1.2–2014 and ANSI/HI 2.1–2.2–2014 in the definitions for ESCC, ESFM, IL, RSV, and ST pumps.

Issue 11: DOE requests comment on the proposed changes to the definitions for ESCC, ESFM, IL, RSV, and ST pumps to remove references to ANSI/HI 1.1–1.2–2014 pump classes. Specifically, DOE requests comment on the ability of the modified definitions to clearly communicate the intended pump categories to industry stake holders.

3. Bowl Diameter

The current DOE definition for ''bowl diameter'' references the definition of ''intermediate bowl'' in ANSI/HI 2.1–2.2–2014. This is the sole remaining reference to ANSI/HI 2.1–2.2–2014 in the test procedure if the proposed changes to eliminate the HI pump class references are adopted. DOE has tentatively determined it would be more helpful for readers if the bowl diameter definition was self-contained, particularly since HI 2.1–2.2–2014 would not be referenced elsewhere. To disassociate the definition of ''bowl diameter'' from ANSI/HI 2.1–2.2–2014, DOE is proposing to define ''bowl diameter'' as referring to ''the maximum dimension of an imaginary straight line passing through, and in the plane of, the circular shape of the intermediate bowl of the bare pump that is perpendicular to the pump shaft and that intersects the outermost circular shape of the intermediate bowl of the bare pump at both of its ends.'' With respect to ''intermediate bowl,'' DOE proposes to define this term as ''the enclosure within which the impeller rotates and which serves as a guide for the flow from one impeller to the next.''

The proposed definitions would be added to 10 CFR 431.462.

Issue 12: DOE requests comment on the proposed change to the definition of bowl diameter to include a more specific definition of intermediate bowl instead of referring to the term as defined in ANSI/HI 1.1–1.2–2014.

4. Small Vertical Inline Pumps

As discussed in section III.A.2, DOE is proposing to expand the scope of the test procedure to include SVIL pumps, which are identical to IL pumps except for having a shaft input power less 1 hp. The Circulator Pump Working Group recommended the following definition for SVIL pumps:

''Small vertical in-line pump means a single stage, single-axis flow, dry rotor, rotodynamic pump that: (1) Has a shaft input power less than 1 hp at best efficiency point at full impeller diameter, (2) is distributed in commerce with a motor that does not have to be in a horizontal position to function as designed, and (3) discharges the pumped liquid through a volute in a plane perpendicular to the shaft.'' (Docket No. EERE–2016–BT–STD–0004, No. 58 Recommendations #3C at p. 3)

In the May 2021 Circulator Pumps RFI, DOE requested comment on the suitability of the above definition. 86 FR 24516, 24522. In response, HI and NEEA supported the circulator pumps working group definition of SVILs. (HI, Docket EERE–2016–BT–STD–0004, No. 112 at p. 4; NEEA, Docket EERE–2016–BT–STD–0004, No. 115 at p. 4)

The recommended definition would distinguish SVIL pumps from DOE's current IL pump definition [24] in that SVIL pumps have a reduced shaft power input range (IL pump is constrained to greater than or equal to 1 hp and less than or equal to 200 hp; SVIL must be less than 1 hp) and a different maximum pump power output limitation (IL pump has a limit of 5 hp at BEP; SVIL pumps have no hp limitation). The change to

[24] An ''in-line (IL) pump'' means a pump that is either a twin-head pump or a single-stage, single-axis flow, dry rotor, rotodynamic pump that has a shaft input power greater than or equal to 1 hp and less than or equal to 200 hp at BEP and full impeller diameter, in which liquid is discharged through a volute in a plane perpendicular to the shaft. Such pumps do not include pumps that are mechanically-coupled or close-coupled, have a pump power output that is less than or equal to 5 hp at BEP at full impeller diameter, and are distributed in commerce with a horizontal motor. Examples of in-line pumps include, but are not limited to, pumps within the specified horsepower range that comply with ANSI/HI nomenclature OH3, OH4, or OH5, as described in ANSI/HI 1.1–1.2–2014. 10 CFR 431.462.

shaft input power is the primary distinction between IL and SVIL pumps. DOE has tentatively determined this distinction is necessary to adequately separate the two categories. The pump power output is a consequence of the shaft power limitations. DOE has tentatively determined that SVIL pumps do not require a 5 hp pump power output limitation as their shaft input power is already capped below 1 hp.

Another difference is that the IL definition includes a group of three parameters to exclude circulator pumps—namely that they are either mechanically-coupled or close-coupled, have a pump power output that is less than or equal to 5 hp at BEP at full impeller diameter, and are distributed in commerce with a horizontal motor. In contrast, the recommended SVIL definition is meant to exclude circulator pumps through clause (2)—*i.e.,* ''related to distribution in commerce with a motor that does not have to be in a horizontal position to function as designed.'' On December 20, 2021, DOE published a notice of proposed rulemaking to establish a test procedure for circulator pumps (''Circulator Pumps TP NOPR''). 86 FR 72096. In the NOPR, DOE proposed to define a circulator pump as consisting of a wet rotor circulator pump; dry rotor, two-piece circulator pump; or dry rotor, three-piece circulator pumps. The NOPR also included proposed definitions for these subcategories of circulator pumps. *Id.* at 86 FR 72139. For clarity, DOE proposes that for the SVIL definition, rather than including the recommendation in clause (2), to instead exclude circulator pumps. Should a test procedure not be finalized for circulator pumps, DOE could instead finalize an SVIL definition using clause (2). For consistency, DOE also proposes to revise the IL pump definition to explicitly include circulator pumps instead of including the clauses meant to implicitly exclude them. Should a test procedure not be finalized for circulator pumps, DOE would retain the existing relevant clauses of the IL definition.

DOE notes that clause (3) of the recommended SVIL definition (''discharges the pumped liquid through a volute in a plane perpendicular to the shaft'') refers to a volute. For the reasons discussed in section III.B.1 of this document, DOE proposes excluding this reference from the proposed SVIL definition.

The recommended SVIL pump definition, through clause (2), also requires that these pumps be distributed into commerce with a motor, meaning SVIL pumps cannot be sold as a bare pump. Based on a literature search, DOE has tentatively determined that all SVIL pumps are sold with a motor. However, by proposing to replace clause (2) with an exclusion for circulator pumps, this requirement would be eliminated.

Although not addressed in the recommendation from the Working Group, the defined term ''twin-head pump'' (10 CFR 431.462) would be applicable to SVIL pumps. Specifically, in the January 2016 Final Rule, DOE adopted a test procedure for ''twin-head pumps'', where a twin-head pump is defined as a: ''dry rotor, single-axis flow, rotodynamic pump that contains two impeller assemblies, which both share a common casing, inlet, and discharge, and each of which (1) Contains an impeller, impeller shaft (or motor shaft in the case of close-coupled pumps), shaft seal or packing, driver (if present), and mechanical equipment (if present); (2) Has a shaft input power that is greater than or equal to 1 hp and less than or equal to 200 hp at best efficiency point (BEP) and full impeller diameter; (3) Has the same primary energy source (if sold with a driver) and the same electrical, physical, and functional characteristics that affect energy consumption or energy efficiency; (4) Is mounted in its own volute; and (5) Discharges liquid through its volute and the common discharge in a plane perpendicular to the impeller shaft.'' 81 FR 4086, 4095–4096 and 4115–4116 (Jan. 25, 2016).

Since SVIL pumps are similar to IL pumps but operate at a smaller horsepower, and also are available in twin-head configurations DOE proposes to define a new term—''small vertical twin-head pump''—and to extend the twin-head pump test procedure adopted in the January 2016 Final Rule to small vertical twin-head pumps. Accordingly, the proposed definition would read as: ''small vertical twin-head pump'' as a dry rotor, single-axis flow, rotodynamic pump that contains two equivalent impeller assemblies, each of which:

(1) Contains an impeller, impeller shaft (or motor shaft in the case of close-coupled pumps), shaft seal or packing, driver (if present), and mechanical equipment (if present); and

(2) Has a shaft input power that is less than or equal to 1 hp at BEP and full impeller diameter; and

(3) Has the same primary energy source (if sold with a driver) and the same electrical, physical, and functional characteristics that affect energy consumption or energy efficiency; and

(4) Is mounted in its own volute; and

(5) Discharges liquid through its volute and the common discharge in a plane perpendicular to the impeller shaft.

To summarize, DOE is proposing to define SVIL pumps based on the recommended definition from the Circulator Pump Working Group with modifications to include SVILs that are small vertical twin-head pumps; to exclude pumps that are circulator pumps; and to remove the current reference to a volute. Specifically, DOE is proposing to define a ''small vertical in-line pump'' as a small vertical twin-head pump or a single stage, single-axis flow, dry rotor, rotodynamic pump that: (1) Has a shaft input power less than 1 hp at best efficiency point at full impeller diameter, (2) in which liquid is discharged in a plane perpendicular to the shaft; and (3) is not a circulator pump.

Issue 13: DOE also proposes to revise the IL definition to explicitly exclude circulator pumps. DOE requests comment on its proposed definitions for ''small vertical in-line pumps'' and ''small vertical twin-head pump.''

Issue 14: DOE requests comment on the percentage of SVIL pumps, if any, that are not sold with a motor, and whether the definition of SVIL pump should be limited to those sold with a motor.

Issue 15: DOE requests comment on its proposed revision to the IL pump definition to explicitly exclude circulator pumps.

5. Between-Bearing Pumps

As discussed in section III.A.3.a, DOE is proposing to add between-bearing pumps to the scope of this test procedure and is therefore proposing a definition for this pump category.

ANSI/HI 14.1–14.2–2019 defines between-bearing pump as a rotodynamic pump with the impeller(s) mounted on a shaft between-bearings on either end. In addition, all between-bearing pumps described in ANSI/HI 14.1–14–2–2019 are mechanically-coupled and dry rotor. Through a literature review, DOE has tentatively determined that the between-bearing pumps that are most similar to the pumps currently regulated by DOE have axially-split casings and 1 or 2 stages. Accordingly, using ANSI/HI 14.1–14.2–2019 as the basis for its approach, DOE is proposing to use the defined terms ''dry rotor pump'', rotodynamic pump'', and ''mechanically-coupled pump'' to define a between-bearing pump,—*i.e.,* ''an axially-split, mechanically-coupled, one- or two-stage, dry rotor, rotodynamic pump with bearings on both ends of the rotating assembly that has a shaft input power greater than or equal to 1 hp and less than or equal to 200 hp at BEP and full impeller diameter and at the number of stages required for testing.''

Issue 16: DOE requests comment on its proposed definition for between-bearing pumps, specifically if it is sufficient to identify the intended scope.

In addition to proposing a definition for between-bearing pump, DOE is also proposing to define the associated term ''axially-split pump.'' The term ''axially-split'' refers to a design of pump casing that can be separated, for maintenance and assembly, in a plane parallel to the impeller shaft. DOE proposes to define an ''axially-split pump'' based on ANSI/HI 14.1–14.2–2019 as ''a pump with a casing that can be separated or split in a plane that is parallel to and which contains the axis of the impeller shaft.''

Issue 17: DOE request comment on the proposed definition for axially-split pump.

6. Vertical Turbine Pump

As discussed in section III.A.3.b, DOE is proposing to add vertical turbine pumps to the scope of its test procedure and is therefore proposing a definition for this pump category. ANSI/HI 14.2–14.2 –2019 defines vertical turbine pumps as ''single-casing, non-submersible, pumps with impellers mounted in a vertically suspended shaft, that discharge liquid through the column.'' Based on this definition and existing DOE defined terms and proposed defined terms, DOE is proposing to define the term ''vertical turbine pump'' as a vertically-suspended, single-stage or multi-stage, dry rotor, rotodynamic pump:

(1) That has a shaft input power greater than or equal to 1 hp and less than or equal to 200 hp at BEP and full impeller diameter and at the number of stages required for testing;

(2) For which no external part of such a pump is designed to be submerged in the pumped liquid;

(3) That has a single pressure containing boundary (*i.e.,* is single casing), which may consist of but is not limited to bowls, columns, and discharge heads; and

(4) That discharges liquid through the same casing in which the impeller shaft is contained.

Issue 18: DOE requests comment on the proposed definition for vertical turbine pump.

7. Radially-Split, Multi-Stage Horizontal Pumps

DOE currently defines a RSV pump as a vertically-suspended, multi-stage, single axis flow, dry rotor, rotodynamic pump:

(1) That has a shaft input power greater than or equal to 1 hp and less than or equal to 200 hp at BEP and full impeller diameter and at the number of stages required for testing; and

(2) In which liquid is discharged in a place perpendicular to the impeller shaft; and

(3) For which each stage (or bowl) consists of an impeller and diffuser;

(4) For which no external part of such a pump is designed to be submerged in the pumped liquid; and

(5) Examples include, but are not limited to, pumps complying with ANSI/HI nomenclature VS8, as described in ANSI/HI 2.1–2.2–2014.

As discussed in section III.A.3.c, DOE is proposing to include within the scope of the DOE test procedure RSH pumps with both end-suction and in-line flow configurations. RSH pumps are nearly identical to RSV pumps except for the mounting orientation and flow configurations. In their comments to the August 2021 ECS RFI, Grundfos recommended that DOE consider new categories for products similar to RSV and RSH with connections that are not in line. (Grundfos, Docket EERE–2021–BT–STD–0018, No. 9 at p. 2) As discussed in section III.A.3.c, RSH pumps may have different flow configurations that are expected to impact pump efficiency; therefore, DOE is proposing three definitions for RSH pumps based on the existing DOE definition for pumps: One for an overarching category of RSH pumps, which does not characterize flow; one for in-line RHS pumps; and one for end-suction RSH pumps. The three definitions would be modified to read as follows:

Radially-split, multi-stage, horizontal, diffuser casing (RSH) pump means a horizontal, multi-stage, dry rotor, rotodynamic pump:

(1) That has a shaft input power greater than or equal to 1 hp and less than or equal to 200 hp at BEP and full impeller diameter and at the number of stages required for testing; and

(2) In which liquid is discharged in a plane perpendicular to the impeller shaft; and

(3) For which each stage (or bowl) consists of an impeller and diffuser; and

(4) For which no external part of such a pump is designed to be submerged in the pumped liquid.

Radially-split, multi-stage, horizontal, in-line diffuser casing (''RSHIL'') pump means a single-axis flow RSH pump in which the liquid enters the pump in a plane perpendicular to the impeller shaft.

Radially-split, multi-stage, horizontal, end-suction diffuser casing (''RSHES'') pump means a RSH pump in which the liquid enters the bare pump in a direction parallel to the impeller shaft and on the side opposite of the bare pump's driver-end.

Issue 19: DOE requests comment on the proposed definitions for RSH, RSHIL, and RSHES pumps—particularly whether they are sufficient to identify the intended scope of such pumps as discussed in section III.A.3.c of this document.

8. Close-Coupled and Mechanically-Coupled Pumps

As discussed in section III.A.3.d, DOE defines a close-coupled pump as a pump having a motor shaft that also acts as the impeller shaft, and defines a mechanically-coupled pump as a pump that has its own impeller shaft and bearings separate from the motor shaft. DOE has tentatively determined that these definitions leave a gap in the end-suction pump category and is proposing to modify the definitions to eliminate that gap.

In the April 2021 RFI, DOE requested comment on the definitions of ''close-coupled pump'' and ''mechanically-coupled pump'' and whether the terms should be revised. 86 FR 20075, 20078.

Summit stated that it has no concerns with the current definitions for ESCC and ESFM and that they are definitive enough. (Summit, No. 16 at p. 3) Summit's comments also addressed energy conservation standards topics, which DOE will address in the pumps standards rulemaking. HI suggested the following change to the definitions: (1) A close-coupled pump, for the purposes of this regulation, is defined as a pump in which the driver's bearings absorb the pump axial load; and (2) A mechanically-coupled pump, for the purposes of this regulation, is defined as a pump in which bearings external to the driver absorb the pump axial load. (HI, No. 20 at p. 3) Grundfos agreed with HI's recommendation to modify the definitions for close-coupled pump and mechanically-coupled pump and emphasized that products that do not have bearings and have an impeller that is not on the motor shaft should be covered by these definitions. (Grundfos, No. 17 at p. 2) Grundfos additionally stated that the definitions for these products should utilize how the axial loads are handled as a differentiating factor for these terms. *Id.* Grundfos added that DOE's definitions are not necessarily aligned with standard industry definitions, and therefore recommended that DOE preface its definitions with the phrase, ''For the purposes of this regulation, [product] pump means . . .''. *Id.*

DOE acknowledges that a definition that addresses how the axial load is absorbed may better differentiate close-coupled and mechanically-coupled pumps. DOE notes that regardless of whether its definitions align with industry definitions, the text in the CFR takes precedence over definitions in industry standards that may be incorporated by reference. *See* 10 CFR 431.462. Based on responses received from stakeholders and DOE's review of ESCC and ESFM pumps, DOE has tentatively determined that there is a group of end-suction pumps that do not currently fall within the ESFM or ESCC definitions. To address this issue, DOE proposes revising its definitions for ''close-coupled pump'' and ''mechanically-coupled pump'' as follows:

A close-coupled pump means a pump in which the driver's bearings absorb the pump's axial load.

A mechanically-coupled pump means a pump in which bearings external to the driver absorb the pump's axial load.

In DOE's view, these revised definitions should capture all end-suction pumps whose axial loads are supported with bearings. This change should encompass the previously uncovered end-suction pumps and clarify the definitions sufficiently to avoid future confusion.

Issue 20: DOE requests comment on the proposed definitional changes to ESFM and ESCC pumps in defining both categories based on the location of the bearings which bear the axial load of the pump. Specifically, DOE seeks comment on whether these proposed changes will capture the end-suction pumps identified by stakeholders as not currently meeting the ESCC or ESFM definitions.

9. Tangential Discharge

The definition for IL pump applies to pumps for which the liquid is discharged from the pump in a plane (*i.e.,* direction) perpendicular to the impeller shaft, and for which the entering and exiting flows are along the same axis (*i.e.,* single-axis flow). *See* 10 CFR 431.462. The definition for end-suction pump applies to pumps for which the liquid enters the pump in a direction parallel to the impeller shaft and exits the pump in a plane perpendicular to the shaft. *Id.* DOE also currently defines the term ''single axis flow pump'' as ''a pump in which the liquid inlet of the bare pump is on the same axis as the liquid discharge of the bare pump.'' *Id.* As discussed in the April 2021 RFI, the ''single axis flow pump'' definition does not explicitly state whether the axis is defined by the suction opening to the volute or the suction opening at the perimeter of the pump. 86 FR 20075, 20078. Close-coupled pumps can be designed with a perpendicular discharge volute which is also tangential (*i.e.,* a design in which the suction and discharge openings do not share a common axis). *See* 10 CFR 431.462 (defining ''single axis flow pump'').

In the April 2021 RFI, DOE requested comment on how manufacturers are currently categorizing close-coupled pumps with tangential discharge volutes relative to the five pump categories defined at 10 CFR 431.464 and whether DOE should provide additional detail in the definitions for single-axis flow pump and/or end-suction pump regarding tangential discharge volute configurations. 86 FR 20075, 20078. Summit, Grundfos, and HI all commented that the existing definitions of end-suction pump and IL pump are sufficient. (Summit, No. 16 at p. 3; Grundfos, No. 17, at p. 2; HI, No. 20 at p. 3) Summit additionally stated that it assumes end-suction was relative to suction and parallel to the shaft, and that tangential discharge pumps are included in end-suction type pumps (Summit, No. 16 at p. 3) DOE interpreted this to mean Summit interprets end-suction as suction parallel to the impeller shaft. HI and Grundfos stated that tangential discharge is not a concern for IL pumps and RSV pumps because of the requirement for single axis flow included in the definitions for IL pump and RSV pump. (HI, No. 20 at p. 3; Grundfos, No. 17 at p. 2) HI and Grundfos additionally stated that tangential discharge is not a design characteristic for ST pumps, since this would imply a pump discharge perpendicular to the pump shaft, and that tangential discharge is already covered in both the ESCC pump and ESFM pump definitions. *Id.* Grundfos recommended that DOE specify whether tangential discharge is the location of the discharge outlet or the discharge exit from the volute. *Id.*

After further reviewing the definitions for single axis flow pump, ESCC pump, ESFM pump, IL pump, and RSV pump, and taking into account stakeholder comments, DOE has tentatively determined that the current definitions are sufficient and is not proposing to revise the definitions for end-suction pump or in-line pump at this time.

10. Pump

DOE currently defines a ''pump'' as ''equipment designed to move liquids (which may include entrained gases, free solids, and totally dissolved solids) by physical or mechanical action and includes a bare pump and, if included by the manufacturer at the time of sale, mechanical equipment, driver, and controls.'' 10 CFR 431.462. DOE currently defines ''bare pump'' as ''a pump excluding mechanical equipment, driver, and controls.'' *Id.* As discussed in the April 2021 RFI, some manufacturers distribute kits of unassembled components that customers (including end users or distributors) may purchase and assemble into finished equipment that meets the definition of a pump or a bare pump. 86 FR 20075, 20078 DOE requested comment on the definitions of ''pump'' and its components and whether any of the terms should be amended, and if so, how the terms should be amended. *Id.* In particular, DOE requested comment on whether the terms are sufficient to identify which equipment is subject to the test procedure and whether any test procedure amendments are required to ensure that all such equipment can be appropriately tested in accordance with the test procedure. *Id.*

In response to the April 2021 RFI, Grundfos and HI supported the definition of a pump as written. (Grundfos, No. 17 at p. 1; HI, No. 20 at p. 2) Summit commented that the pump definition could better describe what pump parts are subject to regulation. (Summit, No. 16 at p. 2) Specifically, Summit stated that it interpreted the definition such that if the parts in a kit alone will only be used to make a pump, with no other kits or parts needed, such a kit would be considered a pump. *Id.* Summit stated that determining the end use of a pump kit can be extremely burdensome. *Id.* Summit additionally commented that if a pump does not meet the PEI standard, Summit will no longer distribute its impeller/casing kit; however, Summit does not consider these spare parts to be covered by the DOE regulation. *Id.*

DOE acknowledges that determining the end use of a pump kit, or a pump part can be burdensome. DOE currently interprets the term ''bare pump'' to include any kit that contains all the parts necessary for an operating pump, barring mechanical equipment, driver, and controls. Replacement parts are not the subject of this regulation.

C. Updates to Industry Standards

The current DOE test procedure for pumps incorporates the following industry test standards: HI 40.6–2014, ANSI/HI 1.1–1.2–2014, and ANSI/HI 2.1–2.2–2014. 10 CFR 431.463. The following sections describe updates to these industry standards and discuss what industry standards DOE is proposing to incorporate by reference in the NOPR and the relevant provisions of those industry standards that DOE is proposing to reference.

1. ANSI/HI 40.6

As discussed in the April 2021 RFI, the DOE test procedure for pumps generally incorporates HI 40.6–2014. 86 FR 20075, 20080. Since publication of the January 2016 Final Rule, the Hydraulics Institute updated HI 40.6–2014 with the publication of HI Standard 40.6–2016, ''Methods for Rotodynamic Pump Efficiency Testing'' (''HI 40.6–2016''). The definitions and procedures in HI 40.6–2016 align with the DOE test procedure for pumps published in the January 2016 Final Rule. HI published another updated version of HI 40.6 in 2021, ''Methods for Rotodynamic Pump Efficiency Testing'' (''HI 40.6–2021''). HI 40.6–2021 includes the following modifications as compared to HI 40.6–2014 (relevant sections of HI 40.6–2021 are included in parentheses after a summary of the modification):

(1) Clarified that the industy testing standard covers efficiency testing of rotodynamic pumps that are subject to DOE's energy conservation standards. (Section 40.6.1 ''Scope'')

(2) Updated the calculation of bare pump efficiency to match the current DOE test procedure requirements for plotting test data to determine the best efficiency point (''BEP'') rate of flow. (Section 40.6.6.3 ''Performance curve'')

(3) Updated the description and requirements of the pressure tap configuration for measurement sections at inlet and outlet of the pump. (Section A.3.1.3 ''Pressure taps'')

(4) Added an informative appendix for determining, applying, and calculating measurement instrument uncertainty. (Appendix H ''Determination, application, and calculation of instrument (systematic) uncertainty (informative)'')

(5) References ANSI/HI 14.1–14.2 ''Rotodynamic Pumps for Nomenclature and Definitions'' (''ANSI/HI 14.1–14.2'') which supersedes ANSI/HI 1.1–1.2–2014 and ANSI/HI 2.1–2.2–2014. (Section 40.6.4.1 ''Vertically suspended pumps''; Section 40.6.4.3 ''All other pump types'')

(6) Includes a new appendix (Appendix E) for the testing of circulator pumps. (Appendix E ''Testing Circulator Pumps'')

DOE noted in the April 2021 RFI that comments in response to the September 2020 Early Assessment RFI suggested that DOE adopt HI 40.6–2021 instead of HI 40.6–2016, with commenters stating that the 2021 version includes clarifying edits, is no more burdensome to conduct, and includes a section for testing circulator pumps. 86 FR 20075, 20080. In the April 2021 RFI, DOE again requested comment on whether it should adopt HI 40.6–2016 or HI 40.6–2021. *Id.* Grundfos, the CA IOUs, HI, and NEEA all supported the adoption of HI 40.6–2021, stating that the 2021 version does not change the measured test values as compared to HI 40.6–2014 as referenced by the DOE test procedure, and that testing according to the 2021 version would not be more burdensome to conduct. (Grundfos, No. 17 at p. 4; CA IOUs, No. 19 at p. 11; HI, No. 20 at p. 2; NEEA, No. 21 at p. 2)

DOE has tentatively determined that with respect to the provisions of HI 40.6–2014, the corresponding provisions of HI 40.6–2021 are substantively the same and adopting such provisions would not change the current test procedure. As such, in order to reference the most current industry test procedure, DOE is proposing to incorporate by reference HI 40.6–2021 in place of HI 40.6–2014.

While DOE proposes to incorporate by reference HI 40.6–2021 as the basis for its proposed test procedure, DOE has tentatively determined that certain sections of the industry testing standard are not applicable to the DOE test procedure. Specifically, Section 40.6.1, Scope, provides the scope specific to the test methods outlined in HI 40.6; Section 40.6.5.3 provides provisions regarding the generation of a test report; appendix ''B'' provides informative guidance on test report formatting; appendix ''E'' provides normative test procedures for circulator pumps; and appendix ''G'' compares HI 40.6 and DOE's nomenclature. None of these sections are required for testing and rating pumps in accordance with DOE's proposed procedure. As such, DOE is not proposing to adopt Section 40.6.1, Section 40.6.5.3, appendix B, appendix E, and appendix G.

Additionally, certain provisions of HI 40.6–2021 are consistent with the additional provisions established by DOE in appendix A. As such, DOE is proposing to maintain those provisions through reference to HI 40.6–2021, specifically:

(1) Section I.D.1 of appendix A, which addresses damping devices, would be amended to reference the corresponding provisions in HI 40.6.3.2.2;

(2) Section I.D.2 of appendix A, which addresses stabilization, would be amended to reference the corresponding provisions in HI 40.6.5.5.1;

(3) Section I.D.3 of appendix A, which addresses calculations and rounding, would be amended to reference the corresponding provisions in HI 40.6.6.1.1;

(4) Sections III.D.1, IV.D.1, V.D.1, VI.D.1, and VII.D.1 of appendix A, which outline testing the BEP of different pump configurations, would be amended to reference the corresponding provisions in HI 40.6.5.5.1.

2. ANSI/HI 1.1–1.2–2014 and ANSI/HI 2.1–2.2–2014

Subpart Y to part 431 currently incorporates by reference ANSI/HI 1.1–1.2–2014 and ANSI/HI 2.1–2.2–2014. DOE references ANSI/HI 1.1–1.2–2014 and ANSI/HI 2.1–2.2–2014 in defining certain terms in 10 CFR 431.462. In 2019, ANSI/HI 1.1–1.2–2014 and ANSI/HI 2.1–2.2–2014 were updated and combined into ANSI/HI 14.1–14.2–2019, ''American National Standard for Rotodynamic Pumps for Nomenclature and Definitions'' (''ANSI/HI 14.1–14.2–2019''). The notable additions to ANSI/HI 14.1–14.2 which were absent in ANSI/HI 1.1–1.2–2014 and ANSI/HI 2.1–2.2–2014 are outlined below:

(1) ANSI/HI 14.1–14.2–2019 includes additonal figures and tables to represent information included in ANSI/HI 1.1–1.2–2014 and ANSI/HI 2.1–2.2–2014;

(2) ANSI/HI 14.1–14.2–2019 adds new pump definitions and pump classifications;

(3) ANSI/HI 14.1–14.2–2019 includes configuration definitions for vertical in-line, vertical end-suction, vertical self-priming, seal-less, magnetic drive, canned motor, and multi-stage pumps;

(4) ANSI/HI 14.1–14.2–2019 adds new definitions for discharge casing, volute,concentric casing, modified concentric casing, vaned diffuser/collector, bowl, and stage casing; and [25]

(5) ANSI/HI 14.1–14.2–2019 includes a new ''preferred operating region'' section to define a guideline for reccomended operating flow rates.

In the April 2021 RFI, DOE requested comment on incorporating ANSI/HI 14.1–14.2–2019 by reference into the DOE test procedure. 86 FR 20075, 20080–20081. Grundfos and HI encouraged DOE to incorporate ANSI/HI 14.1–14.2–2019 (Grundfos, No. 17 at p. 4; HI, No. 20 at p. 2). However, stakeholders did not address whether adoption of ANSI/HI 14.1–14.2–2019 would substantively change currently defined terms and equipment classes.

As stated previously, in general the current DOE test procedure incorporates pump designations from ANSI/HI 1.1–1.2–2014 and ANSI/HI 2.1–2.2–2014 as examples for the definitions of end-suction close-coupled (ESCC); end-

[25] A volute may also be referred to as a ''housing'' or ''casing.''

suction frame mounted/own bearings (ESFM); in-line (IL); radially-split, multi-stage, vertical, in-line diffuser casing (RSV); and submersible turbine (ST) pump categories under the DOE test procedure. 10 CFR 431.462. DOE notes that generally, the references to ANSI/HI 1.1–1.2–2014 and ANSI/HI 2.1–2.2–2014 are in the context of providing non-limiting examples. DOE is concerned that continued inclusion of HI pump designations as examples of specific pump categories may cause confusion in the market or be misunderstood to limit the scope of the relevant definitions. To avoid any such misreading, DOE is proposing to remove the references to ANSI/HI 1.1–1.2–2014 and ANSI/HI 2.1–2.2–2014 as examples of certain pump category definitions. Additional detail on the proposed changes to the definitions is discussed in section III.B.2 of this document.

Additionally, DOE's current test procedure definition of ''bowl diameter'' relies on the ''intermediate bowl'' definition in ANSI/HI 2.1–2.2–2014. DOE is proposing to modify its definition for ''bowl diameter'' and add a DOE definition for ''intermediate bowl'' to remove the current reference to ANSI/HI 2.1–2.2–2014. These proposed changes will create a more self-contained definition. These proposed changes are discussed in section III.B.3 of this document.

D. Metric

The current energy efficiency standards for pumps are based on the PEI metric. 10 CFR 431.465. The PEI metric is a ratio of the pump energy rating (''PER'') of the tested pump to the PER of a minimally-compliant pump (''PER_{STD}''). *See* section II of appendix A. The current test procedure defines the metric PEI_{CL}, the pump energy index for a constant load, as applicable to pumps rated as bare pumps or sold with motors; and the metric PEI_{VL}, the pump energy index for a variable load, as applicable to pumps sold with motors and continuous controls or noncontinuous controls. Appendix A, section II.A. A ''continuous control'' is a control that adjusts the speed of the pump driver continuously over the driver's operating speed range in response to incremental changes in the required pump flow, head, or power output. 10 CFR 431.462. A ''non-continuous control'' is a control that adjusts the speed of a driver to one of a discrete number of non-continuous preset operating speeds and does not respond to incremental reductions in the required pump flow, head, or power output. *Id.*

The PEI metric is a ratio of the pump energy rating (''PER'') of the tested pump to the PER of a minimally-compliant pump (''PER_{STD}''). *See* appendix A. The pump energy rating for constant load pumps (''PER_{CL}'') is calculated as the average of driver power input at 75 percent, 100 percent, and 110 percent of flow at the BEP, where the flows are achieved by varying the operating head to follow the pump performance curve. *See* appendix A, section II.A.1 and subsequently referenced sections. The pump energy rating for variable load pumps (''PER_{VL}'') is calculated as the average of driver power input at 25%, 50%, 75%, 100% of flow at BEP, where the flows are achieved by speed reduction to follow a specified system curve. *See* appendix A, section II.A.2 and subsequently referenced sections. BEP is defined as the pump hydraulic power operating point (consisting of both flow and head conditions) that results in the maximum efficiency. 10 CFR 431.462.

In response to the April 2021 RFI, NEEA stated that DOE's current pump test procedure generally provides a good representation of pump energy consumption and that the current pump metrics are good indicators of relative efficiency. (NEEA, No. 21 at p. 2)

This section discusses the proposed regulatory metric for SVIL pumps and additional clean water pumps that DOE is proposing to incorporate into its test procedure scope. In the May 2021 Circulator Pumps RFI, DOE discussed that the Circulator Pump Working Group recommended evaluating SVIL pumps using the PEI_{CL} or PEI_{VL} metrics, similar to commercial and industrial pumps, and using the commercial and industrial pump test procedure to measure performance, with any additional modifications necessary as determined by DOE. 86 FR 24516, 24527.

In their comments to the May 2021 Circulator Pumps RFI, the CA IOUs reiterated their support for SVILs to be rated using the PEI_{CL} or PEI_{VL} metric, consistent with the Circulator Pump Working Group term sheet. (CA IOUs, EERE–2016–BT–STD–0004, at No. 10 p. 6)

DOE reviewed the PEI_{CL} and PEI_{VL} metrics and has tentatively determined that, in general, use of PER_{CL} and PER_{VL} and indexing the results against PER_{STD} would be a reasonable and consistent way to evaluate SVIL performance. This tentative determination is based largely on the similarities between SVILs and in-line pumps, which are evaluated using the PER_{CL} and PER_{VL} metrics. As such, DOE is proposing that the rating metric for SVIL pumps would be PEI_{CL} for constant load pumps and PEI_{VL} for variable load pumps, equivalent to the metric already in use for currently covered commercial and industrial pumps.

For the additional clean water pump categories that DOE is proposing to include within the scope of the test procedure (*i.e.,* vertical turbine pumps, between-bearing pumps, and radially-split, multi-stage horizontal pumps), DOE has tentatively determined that its proposed test procedure would measure energy efficiency during a representative average use cycle and not be unduly burdensome to conduct. This determination is based on the similarities between the pump categories that are addressed in the current test procedure and those that DOE is proposing to add. Therefore, DOE tentatively determines that PEI_{CL} and PEI_{VL} are appropriate metrics for use these pumps. DOE tentatively determines that using PEI_{CL} and PEI_{VL} for the additional pump categories would ensure a consistent rating approach in the market. Thus, DOE proposes that the PEI_{CL} and PEI_{VL} metric would be used for rating the performance of small vertical in-line pumps, vertical turbine pumps, between-bearing pumps, and radially-split multi-stage horizontal pumps.

E. Proposed Amendments to Test Method

As discussed in section III.C.1, DOE is proposing to utilize HI 40.6–2021 in its test procedure for pumps with certain exceptions. HI 40.6–2021 specifies calculating pump power input,[26] driver power input (for testing-based methods),[27] pump power output,[28] pump efficiency,[29] bowl efficiency,[30] overall efficiency,[31] and other relevant values at

[26] The term ''pump power input'' in HI 40.6–2021 is defined as ''the power transmitted to the pump by its driver'' and is synonymous with the term ''pump shaft input power,'' as used in this document.

[27] The term ''driver power input'' in HI 40.6–2014 is defined as ''the power absorbed by the pump driver'' and is synonymous with the term ''pump input power to the driver,'' as used in this document.

[28] The term ''pump power output'' in HI–40.6 is defined as ''the mechanical power transferred to the liquid as it passes through the pump, also known as pump hydraulic power.'' It is used synonymously with ''pump hydraulic power'' in this document.

[29] The term ''pump efficiency'' is defined in HI 40.6–2014 as a ratio of pump power output to pump power input.

[30] The term ''bowl efficiency'' is defined in HI 40.6–2014 as a ratio of pump power output to bowl assembly power input and is applicable only to VTS and RSV pumps.

[31] The term ''overall efficiency'' is defined in HI 40.6–2014 as a ratio of pump power output to driver power input and describes the combined efficiency of a pump and driver.

the specified load points necessary to determine PEI_{CL} and PEI_{VL}. HI 40.6–2021 also contains specifications regarding test methodology, standard rating conditions, equipment specifications, uncertainty calculations, and tolerances.

Sections II through VII of the DOE test procedure specify methods for determining PEI_{CL} and PEI_{VL} for pumps based on whether they are distributed into commerce with a motor and or with controls and are summarized below:

- *Section II:* Calculation of PEICL or PEIVL for all pumps based on the pump energy rating for a minimally-compliant reference pump (PERCL or PERVL, respectively);
- *Section III:* Test procedure for bare pumps;
- *Section IV:* Testing-based approach for pumps sold with motors;
- *Section V:* Calculation-based approach for pumps sold with motors;
- *Section VI:* Testing-based approach for pumps sold with motors and controls; and
- *Section VII:* Calculation-based approach for pumps sold with motors and controls.

See appendix A, sections I.A.2 through I.A.6.

In response to the April 2021 RFI, NEEA recommended against any modifications to the test procedure that would minimally improve its representation of efficiency but that would require manufacturers to retest and rerate. (NEEA, No. 21 at p. 2) Similarly, HI recommended making only clarifications to the test procedure, except for the addition of a calculation method for power drive system losses for inverter-only motors. (HI, No. 20 at p. 1) The following sections discuss proposed amendments to the test procedure.

1. Nominal Speed

The scope of the current test procedure is limited to pumps designed to operate with either a 2- or 4-pole induction motor or a non-induction motor with a speed of rotation operating range between 2,880 and 4,320 rpm and/or 1,440 and 2,160 rpm. 10 CFR 431.464(a)(1)(ii). Section I.C.1 of appendix A specifies the selection of nominal speed of rotation of either 1,800 or 3,600 rpm depending on the number of poles of the motor or the operating range of non-induction motors.

As discussed in section III.A.4.b, DOE is proposing to include in the scope of the test procedure pumps that operate between 960 and 1,440 rpm or are designed to operate with 6-pole motors. DOE proposes that these pumps would be tested with a nominal speed of 1,200 rpm. DOE is also proposing updates to the calculation and rounding sections of the test procedure to address this additional nominal speed.

Issue 21: DOE requests comment on its proposal that pumps designed to operate between 960 and 1,440 rpm or with 6-pole motors be assigned a nominal speed of 1,200 rpm.

In the April 2021 RFI, DOE requested comment on whether the nominal motor speeds of 1,800 rpm and 3,600 rpm used in the current DOE test procedure appropriately represent the operation and energy use of pumps that are capable of higher speeds. 86 FR 20075, 20083. If these motor speeds are not representative, DOE requested comment on whether a testing-based or calculation-based approach would provide more representative energy use values and the expected cost burden of each. *Id.* Additionally, DOE requested test data at speeds other than the nominal speeds specified in the current test procedure in order to determine if a calculation-based method is appropriate. *Id.*

HI commented that the test procedure has a gap in regard to pumps sold with higher speed motors but asserted that the comment period did not allow enough time to fully develop a recommendation to modify the test procedure. (HI, No. 20 at p. 7). HI stated that they would continue to work on a recommendation and requested that DOE involve stakeholders in the solution.[32] *Id.* Grundfos supported the work of HI in creating a recommendation for how to handle this equipment. (Grundfos, No. 17 at p. 7) Given that many of the motors in this category would be included in the inverter-only motor category for which a new calculation method is being proposed, and that DOE has not identified any data indicating what nominal speed would be more representative of higher design speeds, DOE has tentatively decided not to propose a higher nominal speed for testing.

2. Testing of Multi-Stage Pumps

The current DOE test procedure specifies that RSV pumps shall be tested with three stages and that ST pumps shall be tested with nine stages. If the unit under test is only available with fewer than the required number of stages, the pump is tested with the maximum number of stages with which the unit is distributed in commerce in the United States. If the unit under test is only available with greater than the number of required stages, the pump is tested with the lowest number of stages with which the unit is distributed in commerce in the United States. If the unit under test is available with both fewer and greater than the required number of stages, but not the required number of stages, the pump is tested with the number of stages closest to the required number of stages. If both the next lower and next higher number of stages are equivalently close to the required number of stages, the pump is tested with the next higher number of stages. *See* appendix A, section I.C.2.

RSH and VT pumps are sold with a varying number of stages, in which the same pump may have options for multiple different stages for multiple applications. To reduce testing burden and mirror the practice established for RSV pumps, DOE proposes that RSH pumps be tested with three stages. To reduce testing burden and mirror the practice established for ST pumps, DOE proposes testing VT pumps with nine stages. If units of the basic model of pump being tested are not distributed in commerce with the number of stages prescribed for testing, the existing instructions for selection of the correct number of stages to use during testing would be followed.

As defined in section IIIB.5, BB pumps can have either one or two stages. For BB basic models that are distributed into commerce with both one and two stages, DOE proposes that the pump would be tested at two stages. This proposed approach would maintain consistency with DOE's current test procedure requiring that multi-stage pumps be tested with more than one stage.

Issue 22: DOE requests comment on the proposed number of stages for testing RSH, VT, and BB pumps.

3. Best Fit Curve

In the current DOE test procedure, BEP flow rate is determined as the flow rate at which maximum pump efficiency is achieved on the pump efficiency curve, as determined in accordance with Section 40.6.6.3 of HI 40.6–2014. Appendix A, Sections III.D.2, IV.D.2, V.D.2, VI.D.2, and VII.D.2. Section 40.6.6.3 of HI 40.6–2014 provides instruction for determining the best fit curve for pump flow rate versus efficiency. Specifically, the best fit curve may be either (1) up to a 6th order polynomial, or (2) a spline function with a single slow reversal in the region of the BEP rate of flow. HI 40.6.6.3.

In response to the April 2021 RFI, Summit recommended better defining

[32] DOE notes that HI's supplemental comments responding to the April 2021 RFI did not provide input on this issue. (HI, No. 22)

''best fit curve'' to the speed corrected data, possibly specifying a degree of polynomial required. (Summit, No. 16 at p. 2) Summit also recommended defining a minimum number of data points required per setpoint, or clarifying that a confidence interval—such as 95%—for each setpoint. (Summit, No. 16 at p. 2)

DOE tentatively concludes that the provisions in Section 40.6.6.3 of HI 40.6–2021 are sufficient for defining the best fit curve. When testing a pump, data relating to flow rate and efficiency can be fit using the allowed methods under HI 40.6–2021 in order to find the method with the best fit. DOE notes that, in general, ''best fit'' refers to a curve that best expresses the relationship between the data, and that can be determined through a least squares method. However, DOE does not fully understand Summit's request regarding the minimum number of data points required per setpoint. The test procedure requires taking a minimum of seven flow points and using a least squares regression to determine a linear relationship between pump power input or driver power input at measured flow points, which is then used to determine pump power input or driver power input at the specified load points. *See, e.g.,* appendix A, section III E.1.1. Because the specified load points are determined from the measured flow points, it is not essential for multiple data points to be taken per measured flow point. DOE notes that appendix A section VI.E.2.1 and section VI.E.2.2, which are relevant to the testing-based approach for pumps sold with motors and controls, provide tolerances and correction equations for the load points that must be measured at reduced speed. For these reasons, DOE is not proposing any changes in response to Summit's comment.

4. Load Profile

The current test procedure requires that constant load pump energy rating be determined using 75, 100 and 110 percent of BEP flow with each value multiplied by 0.33 and the results summed to determine PER_{CL}. Appendix A, sections III.E, IV.E, V.E. Similarly, for variable load pumps, energy ratings are determined at 25, 50, 75, and 100 percent of BEP flow with each point weighted by 0.25 and summed to obtain a value for PER_{VL}. Appendix A, sections VI.E, VII.E. In the April 2021 RFI, DOE sought additional comment on the load profile distribution for constant and variable load pumps and the effect of the distribution on PEI value. 86 FR 20075, 20083.

HI stated that the actual load profile of a pump in use is application specific and will vary widely for the applications covered by clean water pumps. HI stated that the current load profiles are sufficient for calculation of the PEI. (HI, No. 20 at p. 7) Grundfos supported keeping the existing load profiles and stated that given the large number of applications in which regulated pumps are used, the current profiles are sufficient to evaluate general pump performance. (Grundfos, No. 17 at p. 7) NEEA stated that they had no additional comment beyond their response to the September 2020 Early Assessment RFI, which DOE summarized in the April 2021 RFI. (NEEA, No. 21 at p. 11)

The existing load profiles provide a consistent method for comparing the performance of different pumps, which, as noted by stakeholders, exhibit a range of load profiles across the wide range of installation environments. At this time, DOE does not have any indication that the current load profiles are not appropriately representative. Therefore, DOE is not proposing changes to the current test procedure's load profiles.

5. Pumps With BEP at Run-Out

To determine a pump's BEP, the DOE test procedure references testing provisions included in HI 40.6–2014 (excluding sections 40.6.5.3, section A.7 and appendix B) at the following seven flow points: 40, 60, 75, 90, 100, 110, and 120 percent of the expected BEP flow rate of the pump at the nominal speed of rotation. Appendix A, section III.D.1. All pumps have a maximum flow rate which is termed ''run out.'' For pumps where the BEP is expected to be within 20 percent of the maximum flow rate of the pump (BEP at run out), section I.D.4 of appendix A provides alternative flow points, with the maximum flow point equal to 100 percent of the expected maximum flow rate so that the pump may safely operate. As discussed in section III.C.1, Sections 40.6.5.5.1 and 40.6.6.3 of HI 40.6–2021 now include provisions related to pumps with BEP at run-out. Section 40.6.5.5.1 provides alternate test points based on the expected BEP rate of flow for pumps with a maximum allowable flow rate as specified by the manufacturer that is less than 120 percent of the BEP flow rate. Section 40.6.6.3 also provides alternate tested load points for the driver input power as a percentage of BEP flow rate for pumps that cannot be safely tested to flows greater than 120 percent of BEP. However, these provisions are based on flow points with respect to expected BEP flow rate rather than expected maximum flow rate.

In the January 2016 Final Rule, DOE responded to a comment from HI that in order to determine the location of BEP, testing must occur at rates of flow greater than 100 percent of expected BEP flow. 81 FR 4086, 4117. DOE stated that its proposal to use flow points only up to 100 percent was with respect to the expected maximum allowable flow rate rather than with respect to expected BEP. *Id.* DOE notes that the existing regulatory text contains an omission in which section I.D.4(1) of appendix A only refers to ''the expected'' while section I.D.4(2) refers to ''the expected maximum flow rate of the pump.'' DOE proposes to include ''expected maximum flow rate of the pump'' in both section I.D.4(1) and I.D.4(2) of appendix A and would not reference Sections 40.6.5.5.1 or 40.6.6.3 of HI 40.6–2021.

Issue 23: DOE requests comment on whether the alternate flow points for pumps with BEP at run-out should be determined with respect to expected maximum flow rate or expected BEP flow rate.

In addition, upon review and in response to previous stakeholder questions, DOE has tentatively determined that the current regulatory text would benefit from additional detail as to how the revised loading points should be applied in the determination of $PER_{STD.}$ DOE proposes to specify that the revised loading points would only be used in application of the α_i coefficient values when determining pump power input, and not when determining specific speed (''Ns'') or the minimally-compliant pump efficiency (''$\eta_{pump,STD}$''), which should always be based on 100% of BEP flow for standardization purposes.

DOE has also identified that the current provisions for pumps with BEP at run-out do not address how to perform motor sizing for bare pumps, which is based on the horsepower equivalent to, or the next highest horsepower greater than, the pump power input to the bare pump at 120 percent of the BEP flow rate of the tested pump. DOE proposes that for pumps with BEP at run-out, motor sizing would be based on 100 percent of the BEP flow rate of the tested pump, as there are no flow rates available higher than that level. However, DOE acknowledges that this proposed change could result in inequitable motor sizing as compared to pumps not subject to these provisions.

Issue 24: DOE requests comment on how manufacturers are currently performing motor sizing for bare pumps with BEP at run-out, and whether using 100 percent of the BEP flow rate is appropriate.

6. Calibration of Measurement Equipment

HI 40.6–2014 Appendix D, which the current DOE test procedure adopts, specifies the frequency of measurement equipment calibration. Table D.1 of HI 40.6–2014 provides that manufacturer's recommendations on calibration intervals should be followed if they differ from those in Table D.1. However, DOE notes that its test procedure does not explicitly reference Table D.1 of HI 40.6–2021.

In the dedicated-purpose pool pump test procedures included in appendix B and appendix C to 10 part 431 subpart Y (''appendix B'', ''appendix C''), DOE has, for clarity, included the calibration requirements contained in Appendix D of ANSI/HI 40.6–2014, with modification allowing for calibration periods up to 3 times longer than those specified in Table D.1 of ANSI/HI 40.6–2014 if justified by historical calibration data. *See* appendix B, section I.B.2 and appendix C, section I.B.2.

Similar to the approach DOE has followed with appendices B and C, DOE proposes to specifically reference the calibration requirements in Appendix D of HI 40.6–2021 in section I.B of appendix A to improve the overall clarity of its test procedure.

7. Calculations and Rounding

The DOE test procedure includes provisions for calculations and rounding in section I.D.3 of appendix A. Generally, all measured data must be normalized such that it represents performance at nominal speed of rotation in accordance with HI 40.6–2014, and all calculations must be carried out using raw measured values without rounding. *See* appendix A, section I.D.3. PER is rounded to three significant digits and PEI is rounded to the hundredths place. *Id.* Explicit rounding directions are not provided for other parameters. In the April 2021 RFI, DOE requested comment as to whether the test procedure should specify rounding requirements on parameters other than PER and PEI, and if so, what those rounding requirements should be. 86 FR 20075, 20079 and 20083.

HI stated that rounding is not a concern for parameters other than PER and PEI and that DOE does not need to specify rounding requirements for these parameters. (HI, No. 20 at p. 7) Grundfos commented that additional rounding requirements might result in unnecessary data manipulation and would increase manufacturer burden for data reporting. (Grundfos, No. 17 at p. 7)

With respect to the current rounding provisions for PER and PEI, Summit recommended rounding PER to 3 decimal places and rounding PEI to two decimal places. (Summit, No. 16 at p. 5). Summit also stated that the number of significant figures is dependent on measurement devices and measurement uncertainty. *Id.*

In response to Summit's suggestion for PER, DOE notes that three decimal places represent three significant figures for values less than 1. DOE has not identified any reason why three decimal places would be necessary for values greater than one and has tentatively determined that three significant figures is sufficient. DOE also notes that Summit's recommendation for two decimal places for PEI is consistent with the current test procedure's instruction to round to the hundredths place. For these reasons, DOE is not proposing any changes to its current rounding requirements, except for updates to reference the appropriate section of HI 40.6–2021, as discussed in section III.C.1 of this document.

8. Test Procedure Credits

In response to the April 2021 RFI, NEEA recommended that DOE add a credit for self-sensing ''smart'' pumps with continuous controls. NEEA stated that ''smart'' pump technologies use self-sensing technologies to measure power draw and speed to calculate load and then adjust speed to maximize performance and reduce energy consumption required to meet the load, and that the drive is programmed with the specific pump curve with which it is installed. NEEA stated that these features potentially reduce energy consumption by optimizing pump performance compared to traditional control strategies. NEEA commented that the potential performance improvements of such technology is not reflected in the test procedure. NEEA recommended that DOE investigate the potential for energy savings from such controls and develop minimally burdensome ways to incorporate them in the test procedure, such as the Controls Verification Procedure for Variable Refrigerant Flow (''VRF'') Systems or credit for occupancy systems given to certain beverage vending machines (''BVM''). (NEEA, No. 21 at p. 12)

According to DOE research, at this time the technology referenced by NEEA is proprietary, and DOE is unable to conduct sufficient testing on available proprietary technologies in applications to determine achievable energy savings. Furthermore, NEEA has not presented data demonstrating the viability of the asserted potential energy savings. For these reasons, DOE is not proposing a test procedure accommodation for pumps that incorporate self-sensing technologies at this time.

F. Calculation-Based and Testing-Based Options According to Pump Configuration (Table 1)

The DOE test procedure for pumps includes calculation-based and testing-based options that apply based on pump configuration (including style of motor and control) as distributed in commerce. *See* appendix A, Table 1. The calculation-based options rely on a bare pump test, whereas the testing-based options rely on a ''wire-to-water'' test. The calculation-based options may reduce test burden by allowing a manufacturer to test a sample of bare pumps and use that data to rate multiple pump configurations using calculation-based methods. On the other hand, wire-to-water testing may more accurately represent pump, motor, and control performance.

In order to further assess opportunity for reducing burden, DOE requested additional information on how manufacturers are implementing Table 1 of appendix A. Specifically, DOE sought comment on the extent to which pumps sold with multiple motor and control configurations are evaluated multiple times using physical testing-based methods (rather than a calculation-based approach); the extent to which pumps sold with single-phase motors are being rated as bare pumps (using a calculation-based approach); and the extent to which pumps sold with motors (other than inverter-only motors) are having their efficiency being evaluated using a calculation-based approach as opposed to a testing-based approach. 86 FR 20075, 20082. DOE also requested comment on whether any revisions to Table 1 of appendix A could be considered to maintain or improve the information derived from the test procedure while reducing burden with no impact on the PEI rating for currently regulated pumps. *Id.*

HI stated that testing burdens typically cause manufacturers to calculate losses based on the standard motor efficiency and that approximately 1 percent of pumps are wire-to-water tested according to section IV of the test procedure. HI stated that no products were reported with wire-to-water testing on induction motors with controls per section VI of the test procedure. (HI, No. 20 at p. 5) HI stated that a majority of pumps with single-phase motors use the bare pump PEI_{CL} value; however, there are a small number of these products that were wire-to-water tested. *Id.* Grundfos stated that it utilized calculated methods wherever it was allowed, given what Grundfos characterized as the overly burdensome testing required to qualify the most efficient products running inverter-only motors. Grundfos stated that it conducted no testing using Section IV or Section VI for any product using an induction motor and reported all single-phase equipment using Section III. (Grundfos, No. 17 at p. 5) Summit stated that it filed its certification reports using only Section III, as they saw only minimal PEI improvement with section V, and using section IV for ESCC pumps would be burdensome. (Summit, No. 16 at p. 5)

NEEA encouraged DOE to ensure the information derived from the test procedure is maintained when considering possible changes to Table 1 to reduce burden. Specifically, NEEA recommended against DOE removing options for wire-to-water testing as a way to reduce burden and asserted that wire-to-water testing may result in more accurate ratings. NEEA also recommended that DOE not require wire-to-water testing but keep the option to use calculation-based or wire-to-water testing approaches. (NEEA, No. 21 at p. 10–11)

HI recommended amending Table I to allow use of section IV for pumps + single-phase induction motor and to require section VI for pumps + single-phase induction motor + continuous or non-continuous controls. (HI, No. 20 at pp. 5–6). HI also recommended amending Table 1 to require section IV for pump + motor + controls other than continuous or non-continuous controls (*e.g.,* ON/OFF switches). (HI, No. 20 at pp. 5–6) Grundfos supported the edits to Table 1 as recommended by HI. (Grundfos, No. 17 at p. 5–6) Grundfos additionally stated that because single-phase motors are not completely regulated (currently only open drip-proof motors are regulated), using section III for pump + motors should remain, and section IV should be optional but not mandatory. Grundfos commented that section VI testing for single-phase product using a variable frequency drive (''VFD'') should be mandatory. (Grundfos, No. 17 at p. 9)

DOE has reviewed the ways in which manufacturers are utilizing the various options in Table 1 as well as the recommended edits to Table 1. In response to NEEA, DOE is not proposing to remove wire-to-water testing options from Table 1. In response to HI and Grundfos, DOE agrees that Table 1 would benefit from providing more explicit instruction, particularly by moving information out of footnotes and into the table itself. However, DOE does not agree with the specific changes requested. Specifically, commenters provided no reason that a ''pump + motor + controls,'' other than continuous or non-continuous controls, must use a test method rather than a calculation method, or why single-phase products using a VFD must use a test method rather than the bare pump calculation method. Neither of these constraints are currently included in appendix A Table 1. DOE maintains that the existing allowances to use a calculation method for these products are appropriate and consistent with stakeholders' general desire to use calculation methods where possible. In particular, controls other than continuous or non-continuous controls—such as ON/OFF switches—would not be expected to impact the results of the test method. As such, the calculation method should adequately represent performance. Similarly, the current procedure permits single-phase equipment to be tested using the bare pump method, which eliminates the possibility of penalizing this equipment for using these less efficient motors compared to pumps sold with polyphase motors. While manufacturers could choose to use a testing-based approach when evaluating pumps sold with single-phase induction motors that use continuous or non-continuous controls in order to get a better rating than a bare pump rating, this is not necessary. For these reasons, DOE is not proposing to remove the calculation-based option, but is proposing to clarify Table 1 by moving information out of footnotes and into the table itself.

NEEA encouraged DOE to consider developing a calculation-based testing approach that would apply to any new or future pump configurations not covered by the current Table 1. NEEA recommended that DOE consider a hybrid approach to testing and calculation, similar to the test method included in Appendix H of ANSI/AMCA Standard 214–21, ''Test Procedure for Calculating Fan Energy Index (FEI) for Commercial and Industrial Fans and Blowers'' (''AMCA 214''), which stipulates a one-time test of the motor at multiple load points, which can be used to determine the input power at the appropriate pump test procedure load points and then used to calculate a rating. With this method, each motor need only be tested once, and the results used for multiple pump configurations. (NEEA, No. 21 at p. 10)

The hybrid method as suggested by NEEA would require use of a test procedure that may be dependent on the type of motor. As such, DOE would be unable to implement such a method for unknown future pump configurations without specifying all possible test methods that might be appropriate for various motor types. Accordingly, DOE is declining to adopt this suggested approach. DOE addresses a similar request related to a specific motor type in section III.F.3 of this document.

Issue 25: DOE requests comment on whether manufacturers would use a hybrid mapping approach, and if so, whether manufacturers would conduct the motor tests or request the tests from their suppliers. In addition, DOE requests comment on what additional provisions would need to be added to Appendix H of AMCA 214 to make it applicable to pumps, such as speed and load corresponding to pump rating points.

In relation to Table 1, Grundfos asked DOE to clarify how manufacturers are expected to report pumps using single-phase motors. Grundfos commented that these are sold as a pump + motor but reported using section III data, and that it was unclear whether they should be reported as a bare pump. (Grundfos, No. 17 at p. 5)

Under the current scope, actual pump configuration should be certified for pumps sold with single-phase motors. These pumps should not be certified as a bare pump.

1. Calculation Method for Pumps Sold With Induction Motors and Controls

In the April 2021 RFI, DOE noted that while its test procedure for pumps incorporates by reference HI 40.6–2014, it also includes additional provisions related to measuring the hydraulic power, shaft power, and electric input power of pumps, inclusive of electric motors and any continuous or non-continuous controls. 86 FR 20075, 20081. DOE also noted the publication of the International Electrotechnical Commission (''IEC'') standard IEC 61800–9–2:2017 ''Adjustable speed electrical power drive systems—Part 9–2: Ecodesign for power drive systems, motor starters, power electronics and their driven applications—Energy efficiency indicators for power drive systems and motor starters,'' (''IEC 61800–9–2:2017''), which addresses test methods and reference losses for power drive systems, comparable to the approach in section VII of appendix A. *Id.* DOE noted that the majority of commenters responding to the

September 2020 Early Assessment RFI urged DOE to maintain the current test approach in section VII of appendix A and that substituting IEC 61800–9–2 would add burden without achieving additional energy savings. *Id.*

DOE also noted the publication of the American Movement and Control Association (''AMCA'') standard, AMCA 207–17 ''Fan System Efficiency and Fan System Input Power Calculation'' (''AMCA 207–17'') in the April 2021 RFI and requested comment on the applicability of the VFD/motor efficiencies in AMCA 207–17 to pumps, and whether DOE should consider replacing the calculations in section VII of appendix A with those in AMCA 207–17. 86 FR 20075, 20081. DOE additionally requested comment on whether adoption of the AMCA 207–17 approach would be representative for pumps, and whether such a change would impact PEI ratings, manufacturer testing burden, or manufacturer pump designs. *Id.* Finally, DOE requested comment on whether it should consider incorporating any aspect of ISO/ASME 14414 ''Pumps System Energy Assessment'' (''ISO ASME 14414'') into its test procedure for pumps, and if so, which aspects and why. *Id.*

As stated previously, the DOE test procedure for pumps includes calculation-based and testing-based options that apply based on pump configuration (including style of motor and control) as distributed in commerce. *See* appendix A, Table 1. The calculation-based options rely on a bare pump test, whereas the testing-based options rely on a wire-to-water test. Section VII of appendix A provides the calculation-based testing method for pumps sold with motors and continuous controls—specifically polyphase motors covered by DOE's electric motor energy conservation standards or submersible motors. Section VII includes four separate algorithms for determining part-load losses of the motor and continuous controls together. These algorithms account for part-load losses of the motor as well as additional losses that result from continuous control inefficiencies and from increased inefficiencies in the speed-controlled motor due to harmonic distortion as a function of motor horsepower.

HI stated that the current calculation methodology should remain consistent, but that HI would provide recommendations for updates to coefficients that would not increase testing burden on pump manufacturers. (HI, No. 20 at p. 4) HI additionally commented that ISO/ASME 14414 is a pump system assessment standard and is not applicable to individual bare pumps or pumps sold with motors and/or controls. (HI, No. 20 at p. 5) Grundfos stated that there is no need to modify or replace the Section VII calculation method. Grundfos supported the HI recommendation to use updated coefficients in section VII for induction equipment. (Grundfos, No. 17 at p. 4)

NEEA recommended that DOE continue using the current motor loss calculation approach, including the motor and drive loss equation and required test points for pump manufacturers. NEEA stated that the AMCA 207–17 approach would result in an average 3 to 6 percent reduction in calculated motor and drive losses, and also PEI_{VL}, in comparison to the current DOE pumps test procedure. NEEA also commented that, while the AMCA 207–17 approach could be considered more representative of typical losses in comparison to test data, AMCA 207–17 was developed specifically for fans. NEEA added that IEC 61800–9–2 results in a similar change in motor and drive losses and appears to be achieving wider adoption in the industry. NEEA suggested that if DOE were to consider updating the motor and drive losses in the test procedure, NEEA would support aligning with IEC 61800–9–2 (and the embedded standard IEC 60034–2, ''Rotating electrical machines—part 2–3: Specific test methods for determining losses and efficiency of converter-fed AC motors''). NEEA stated that updating the loss calculations to reference AMCA 207–2017 or IEC 61800–9–2 would require manufacturers to re-rate pumps for a difference in PEI_{VL} of only about 0.01. Instead, NEEA recommended that if DOE elects to pursue updates to the losses, DOE should do so by updating the coefficients or the calculations and make no changes to pump, motor, or drive testing. NEEA stated that it is important that the calculation-based approach result in conservative ratings so that manufacturers are not disincentivized from testing equipment, which provides a more accurate result, and are not able to overstate product performance based on the calculation-based approach. (NEEA, No. 21 at pp. 7–8)

The CA IOUs stated that cost of wire-to-water testing can result in the use of the calculation method for some efficient products, even though the calculated PEI would be reduced via this method, creating a market distortion in which efficient products are scored with PEIs worse than would be representative. The CA IOUs commented that this highlights the need for a calculation method to be as representative as possible, while requiring some conservativeness in the calculation methodology to prevent scores higher than wire-to-water testing of conventional products. The CA IOUs stated that the actual motor drive system performance is approximately 3 to 14 percent better in practice than estimated with the current methodology and encouraged DOE to make adjustments to the calculation method to improve the representativeness and align across industries. (CA IOUs, No. 19 at p. 2)

The CA IOUs expressed support for the use of AMCA 207–17, stating that it was designed for predictions based solely on variable-torque curves, which apply to pumps, that it provides accurate and somewhat conservative default losses, and that it has been directly or indirectly adopted by various industry consensus standards. The CA IOUs stated that the adoption of the AMCA 207–17 method would result in manufacturers reporting lower PEIs without actually improving the efficiency of the pump, but that they believe it is more important that DOE adopt a loss calculation method that is representative and can be used across all product lines that employ VFD power drive systems. The CA IOUs included a figure comparing the percent PER improvement with AMCA 207 losses compared to DOE losses, with PER improvements ranging between 6 and 14 percent. (CA IOUs, No. 19 at pp. 2–4)

The CA IOUs also commented that industry stakeholders highlighted IEC 61800–9–2 as a potential framework that could apply motor VFD losses in an industry and product independent manner, and stated that they provided a spreadsheet comparing this method, the AMCA 207 method, and the existing DOE methods.[33] The CA IOUs also stated that IEC 61800–9–2 provides high reference VFD losses that they expect to be dealt with in the International Energy Agency Round Robin of Converter Losses, Phase 2.[34] (CA IOUs, No. 19 at pp. 4–7).

In a subsequent submission, HI stated that the current coefficients for induction motors provide incremental losses well below the values in IEC 60034–31, and that the percent of incremental losses were up to 4 times more than what IEC provides (primarily above 50 hp). HI stated that it developed recommended coefficients using the delta between the IEC and current motor incremental losses, and that the

[33] The docketed spreadsheet only includes a comparison of the DOE method and the AMCA 207 method. (CA IOUs, No. 19, attachment).

[34] For information on the International Energy Agency Round Robin of Converter Losses, see: *www.iea-4e.org/emsa/news/global-round-robin-test-program-for-converter-losses/*.

modified coefficients provide more accurate, but still conservative, PEI values for induction products. HI also recommended a separate set of coefficients for the 50 to 100 hp range in order to provide more accurate losses. (HI, No. 22 at p. 3)

HI also provided a table showing the delta PEI as a function of horsepower with the proposed induction motor loss coefficients as well as a limited data set of Section VI wire-to-water testing results compared to the proposed Section VII induction motor loss calculations. For three tested pumps, the calculation method was equivalent to or more conservative than the wire-to-water test results. (HI, No. 22 at p. 4)

Since ISO/ASME 14414 is a pump system assessment standard and is not applicable to individual bare pumps or pumps sold with motors and/or controls, DOE has tentatively determined that this industry standard is not relevant to the DOE test procedure for pumps. DOE has reviewed the industry standards mentioned by NEEA, the CA IOUs, and HI, including AMCA 207–17, IEC 61800–9–2:2017, IEC 60034–2–3:2020 and IEC 60034–31:2021 (''Rotating Electrical Machines—Part 31: Selection of Energy-Efficient Motors Including Variable Speed Applications—Application Guidelines''). IEC 60034–2–3 is a method of test and does not provide information related to motor and control part-load losses, and as such DOE did not evaluate this method further. AMCA 207–17 is specific to fans and includes a more complicated model with more than three coefficients, resulting in efficiency rather than losses. IEC 60034–31:2021 is a technical specification document that gives technical and economical guidelines for the use of energy-efficient motors in constant speed and variable-speed operations in different applications. Annex A (informative) to this standard further provides typical efficiency values and losses of motors and controls. IEC 61800–9–2:2017 is an international standard and provides test methods and efficiency classification provisions for controls and for motors and controls. Annex A (normative) to this standard further provides losses for reference motors and controls used to develop the efficiency classifications.

DOE has also reviewed the coefficients provided by HI, which HI stated were designed to provide incremental motor losses similar to the values in IEC 60034–31 when comparing an induction motor operated without controls and with controls. (HI, No. 22 at p. 3) Based on a subsequent submission, DOE understands that the intent of HI's recommended coefficients is to better match the full-load losses that would result from starting with motor-only full-load losses and adding incremental harmonic losses of 15 percent for motors up to 90 kW and adding incremental harmonic losses of 25 percent for motors over 90 kW, as specified in section A.3 of IEC 60034–31, as well as adding an assumed VFD efficiency penalty [35] of 2 percent. (HI, No. 23 at p. 1)

Figures III–1 through III–3 [36] show example plots for a 1 hp, 10 hp, and 25 hp power drive system (*i.e.,* motor and controls), with the efficiency plotted as a function of motor load for the existing DOE loss model, HI's suggested loss model, AMCA 207, IEC 61800–9–2 (Annex A), and IEC 60034–31 (Annex A).[37] In addition, DOE has included AHRI Standard 1210, ''Standard for Performance Rating of Variable Frequency Drives,'' (''AHRI 1210'') certified data from 2016, 2020, and 2021 for specific power drive systems to provide a point of comparison, noting that this is a different test method and may not be directly comparable to the other standards. DOE has developed these plots for other horsepower drive systems, although the AHRI 1210 data do not go above 75 hp.[38]

DOE notes that on February 28, 2022, the National Electric Manufacturers Association (''NEMA'') released NEMA MG 1011–2022, ''Power Index Calculation Procedure—Standard Rating Methodology for Power Drive Systems and Complete Drive Modules.'' While this NEMA methodology does not addresses the default losses that are core to DOE's pumps test procedure method, and, accordingly, would not be considered within the context of the current rulemaking at hand, data based on MG 1011–2022's methodology could prove useful in supplementing already-collected data regarding part-load losses. To the extent that information and data using MG 1011–2022 are available, DOE invites interested parties to provide feedback and comment regarding their respective experience with this NEMA testing standard.[39]

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[35] Decrease in efficiency, in percentage points due to the addition of a VFD.

[36] Color versions of Figures 1–3 are available at Docket No. EERE–2020–BT–TP–0032–0025.

[37] In the IEC standards, the losses are a function of torque and speed, not load. Load equals torque times speed; as such there are multiple results at the same load depending on the torque/speed point, and the average of those results is plotted.

[38] Color versions of Figures III.1–III.3 are available at Docket No. EERE–2020–BT–TP–0032–0025.

[39] NEMA MG 1011–2022 defines a rating system for power drive systems that is similar to PEI, although it is exclusive of the driven load (*i.e.,* pump, fan, compressor). The direct measurement approach in the NEMA testing method relies on testing in accordance with Section 7.7.1 or 7.7.2 of IEC 61800–9–2; the testing standard also offers a calculation-based approach which includes default losses for a premium efficiency motor, but not default losses for a combined power drive system, as are needed for DOE's test procedure for pumps. However, DOE recognizes the possibility that industry use of this testing standard could encourage the collection of part-load performance data, including part-load losses, for power drive systems applied in pumping applications. These data could be used in the future to supplement the AHRI 1210-certified data displayed in Figures III.1–III.3 and help DOE better tailor potential energy conservation standards for the pumps addressed by the current test procedure rulemaking.

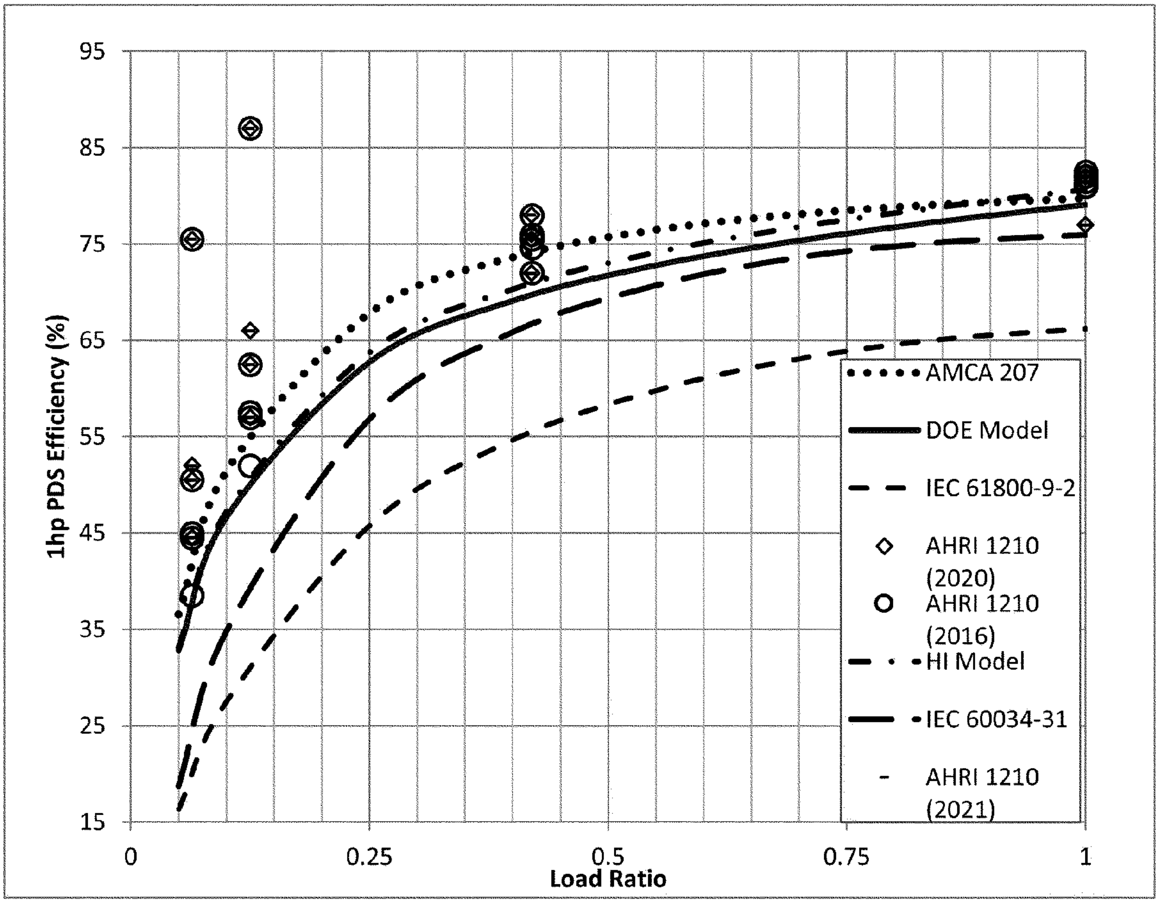

Figure III-1: Efficiency plotted as a function of load ratio for a 1 hp drive system. Comparison of DOE's loss model, HI's proposed loss model, AMCA 207 losses, IEC 61800-9-2 (Annex A), and IEC 60034-31 (Annex A), in addition to AHRI 1210 data from 2016, 2020, and 2021.

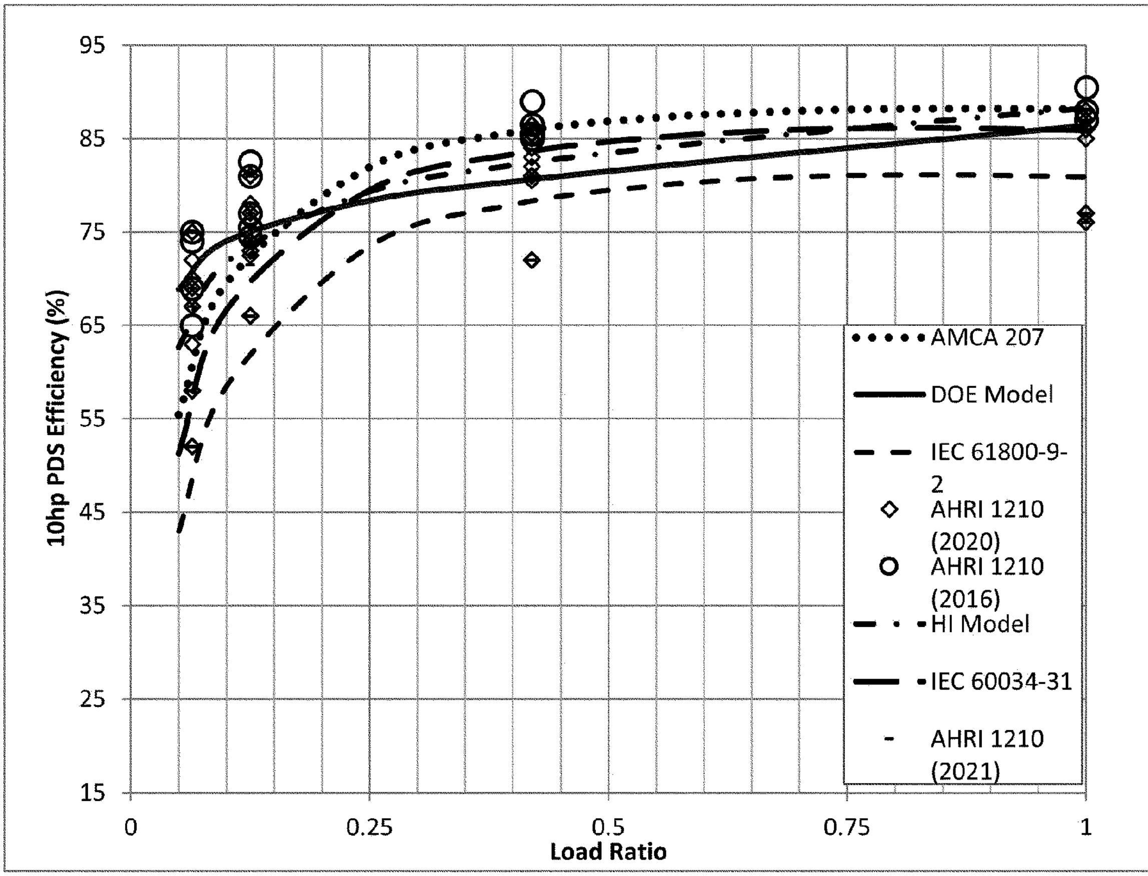

Figure III-2: Efficiency plotted as a function of load ratio for a 10 hp drive system. Comparison of DOE's loss model, HI's proposed loss model, AMCA 207 losses, IEC 61800-9-2 (Annex A), and IEC 60034-31 (Annex A), in addition to AHRI 1210 data from 2016, 2020, and 2021.

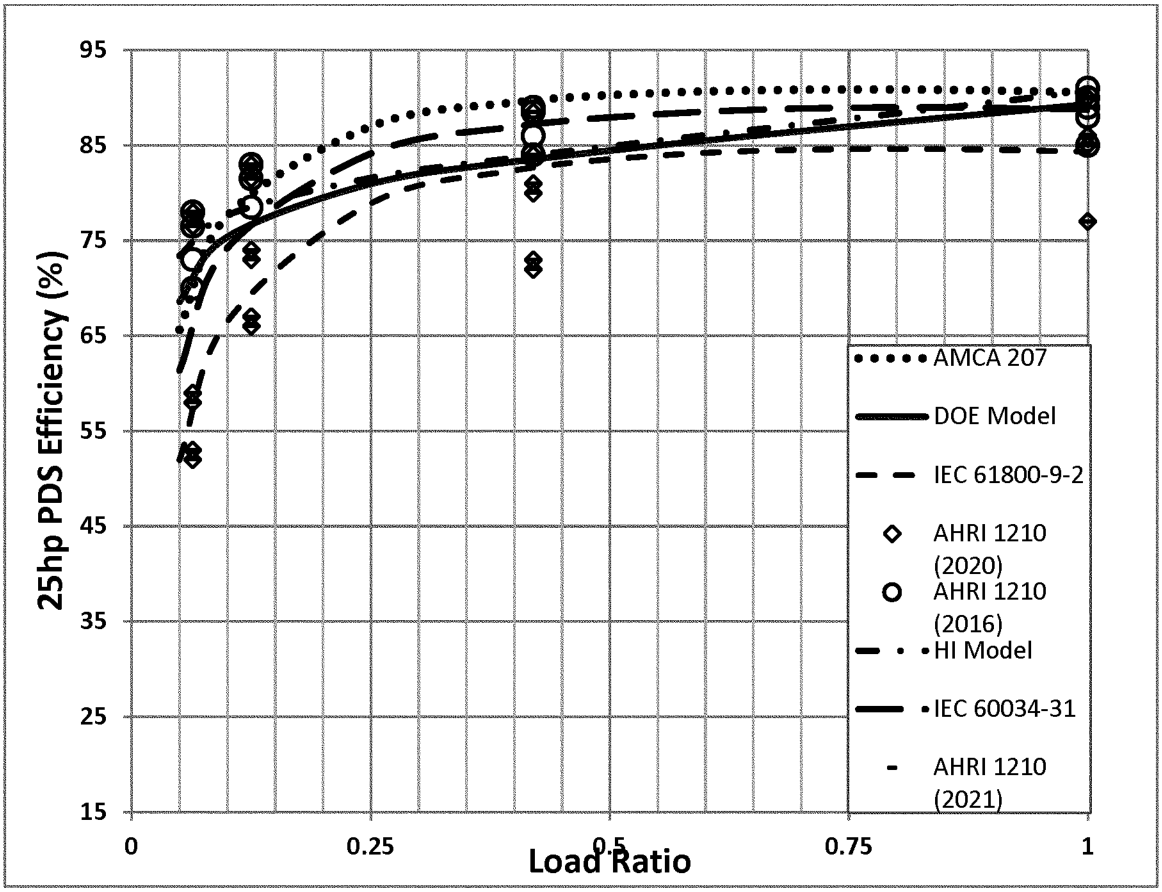

Figure III-3: Efficiency plotted as a function of load ratio for a 25 hp drive system. Comparison of DOE's loss model, HI's proposed loss model, AMCA 207 losses, IEC 61800-9-2 (Annex A), and IEC 60034-31 (Annex A), in addition to AHRI 1210 data from 2016, 2020 and 2021.

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DOE's current test procedure provides a calculation method for pumps sold with motors and controls in order to reduce testing burden compared to wire-to-water testing. However, DOE did not intend for the calculation method to be used for overrating pumps. None of the commenters provided justification for their statements that actual motor drive system performance is better than that assumed by the DOE coefficients. At 1 hp, the DOE model seems to appropriately capture motor drive system performance of the systems represented by the AHRI 1210 data (*i.e.,* none of the systems represented would likely be overrated using this model). However, while DOE based its model using results relying on AHRI 1210–2011 testing to establish the maximum values of the ratio of VFD and motor losses to the motor full-load losses,[40] current AHRI 1210 data for 10 hp to 50 hp motors show that the current DOE model may be overstating motor drive system performance across all loads. The curves for AMCA 207, IEC 60034–31, and HI's proposed coefficients result in better motor drive system performance compared to the DOE model at higher motor loads (with the exception of IEC 60034–31 at 1 hp). However, some curves result in worse motor drive system performance at lower motor loads compared to the DOE model since the DOE model tends to be flatter than the other curves, particularly in the 10–25 hp range. The relative efficiency difference between the DOE model and the suggested model with the highest efficiency (*i.e.,* the AMCA 207 curve) across the majority of the curve is 4 percent, averaged across all horsepower sizes and loads.

DOE notes that the motor load points do not necessarily correspond to the pump test points in appendix A; if motors were sized such that 100 percent BEP flow represented 100 percent motor load, the points would be relatively close. However, the current test procedure for bare pumps assumes that motor sizing is based on 120 percent BEP flow, which DOE understands to be more representative of typical use. Furthermore, a recent DOE motor study shows that only three percent of commercial sector motor system electricity consumption and six percent of industrial motor system electricity consumption operate below 40 percent load factor.[41] For these reasons, DOE expects that typical motor load points for pumps would tend to be higher than those tested according to AHRI 1210, and the higher load points represent a larger contribution to the average measured power under the test procedure. As such, DOE has tentatively determined that it is more important for the selected model to accurately capture performance at higher loads. Nevertheless, the best model that would be representative across all loads without overrating efficiency depends

[40] 80 FR 17586, 17621 (April 1, 2015)

[41] Prakash Rao et al., ''U.S. Industrial and Commercial Motor System Market Assessment Report Volume 1: Characteristics of the Installed Base,'' Prepared for the U.S. Department of Energy, January 12, 2021, *https://doi.org/10.2172/1760267.* (p. 173)

on the performance of the motor drive systems associated with the pumps being evaluated. DOE does not have these specific data.

DOE notes that AMCA 207 is specific to fans. IEC 60034–31 is based on ''typical'' values, which would be expected to overstate the performance of at least some motor drive systems. Section 7.7 of that testing standard states that Annex A may not be a good approximation of loads less than 50 percent, which DOE notes may be a significant portion of loads based on the pumps test procedure. Finally, HI's proposed induction coefficients are based on typical harmonic losses and typical VFD efficiency penalties. DOE believes that, at a minimum, the VFD efficiency penalty may be understated and it is also not clear if the typical harmonic losses associated with IE3 [42] motors are applicable to the U.S. market. Furthermore, HI's proposed inverter-only coefficients, discussed in section III.F.2, result in a lower PEI than a tested PEI in at least one instance (*i.e.* slightly overstate motor drive system performance), and given that those coefficients were based on HI's proposed induction coefficients and an assumed incremental efficiency improvement between induction and inverter-only motors, DOE expects that HI's proposed induction coefficients may also overstate motor drive system performance. As seen in Figure III–1, IEC 61800–9–2 represents coefficients least likely to overstate motor drive system performance; however, DOE understands that these coefficients are undergoing IEC review.

Based on its review of available coefficients and part-load loss data, DOE has tentatively determined that without further data indicating that its current coefficients overstate motor drive system losses for pumps, it will retain its current loss model for motors less than 50 hp. DOE's current coefficients correspond to about 30 percent added harmonic losses and a 3 percent VFD efficiency penalty. DOE would consider revising its coefficients below 50 hp in accordance with the method suggested by HI, or to harmonize with fans (AMCA 207) or with international standards (IEC 60034–31 or IEC 61800–9–2), given appropriate data specific to pumps. To ensure that the calculation method does not overrate pumps while balancing stakeholders' requests for representativeness, DOE is proposing to allow use of an AEDM, as discussed in section III.I.2 of this document.

Issue 26: DOE requests: (1) Data indicating whether AHRI 1210-certified data is applicable to pumps as well as any other applicable part-load loss data; (2) data indicating whether 15 percent and 25 percent incremental losses, which are specified as part of IE3 ratings that are not commonly used in the U.S., are applicable to the U.S. and do not overstate performance, and if not, what incremental losses would be appropriate to apply, and (3) data indicating an appropriate VFD efficiency penalty by hp.

Given HI's statement that losses are especially overstated in the 50 hp to 100 hp range, DOE has reviewed its existing coefficients and found that they result in a dip in full-load efficiency at 75 hp, which would not be expected. In addition, the AHRI 1210-certified data is limited to a maximum of 75 hp and does not exist at higher hp. Furthermore, DOE's current coefficients in the 50 hp to 100 hp range correspond to about 60 percent added harmonic losses and a 3 percent VFD penalty, and, based on previous discussion of typical losses, DOE has tentatively determined that these losses are too high.

In light of this situation, DOE proposes to update its coefficients for motors rated at 50 hp and above. DOE has determined that HI's approach is relatively reasonable, although the 2 percent VFD penalty may be too low. To adjust its coefficients for motors 50 hp and above, DOE started with the current DOE default losses for the motor-only at full-load and added 15 to 25 percent losses, as applicable, as well as a VFD efficiency penalty of 3 percent. DOE then adjusted the current DOE default losses for the motor and control at 100 percent to match the result of adding the incremental harmonic losses and VFD penalty and applied the same adjustment factor to all load points. Table III.1 includes DOE's proposal for the induction motor and control part-load loss coefficients.

Table III.1 Proposed Induction Motor and Control Part Load Loss Factor Equation Coefficients

Motor Horsepower (hp)	Coefficients for Induction Motor and Control part Load Loss Factor (z_i)		
	a	b	c
≤ 5	-0.4658	1.4965	0.5303
> 5 and ≤ 20	-1.3198	2.9551	0.1052
> 20 and ≤ 50	-1.5122	3.0777	0.1847
> 50 and ≤ 100	-0.6629	2.1452	0.1952
> 100	-0.7583	2.4538	0.2233

Issue 27: DOE requests comment on its proposed part-load loss factors for induction motors and controls greater than 50 hp.

2. Calculation Method for Pumps Sold With Inverter-Only Motors (With or Without Controls)

For pumps sold with motors or with motors and continuous or noncontinuous controls that are rated using the calculation-based approach, the nominal full-load motor efficiency used in determining the PER_{CL} or PER_{VL} will be the value that is certified to DOE as the nominal full-load motor efficiency in accordance with the standards and test procedures for electric motors at 10 CFR part 431, subpart B. Use of the certified motor efficiency is available only for motors that are subject to DOE's test procedure for electric motors and only pumps sold with motors subject to DOE's electric motor test procedure and energy conservation standards are able to utilize the calculation-based approach.

Inverter-only motors are currently not subject to DOE's electric motor energy conservation standards, and as such, based on Table 1 in appendix A, pumps with inverter-only motors currently require wire-to-water testing. DOE

[42] ''IE3'' is the IEC designation for premium efficiency motors. IE3, NEMA premium and Energy Independence and Security Act (''EISA'') 2007 standards for electric motors are often considered equivalent efficiency requirements, although the actual values differ depending on pole/hp/enclosure.

requested information and feedback on the categories of motors for which DOE should consider allowing the application of the calculation-based method in the April 2021 RFI. 86 FR 20075, 20082. Specifically, DOE requested information on the categories of inverter-only motors (*e.g.,* electronically commutated motors (''ECMs''), permanent magnet alternative current motors (''PMACs''), or other alternative current (''AC'') induction motors) for which DOE should consider allowing the application of the calculation-based method. *Id.* DOE also sought feedback on the general approach for including default values and equations to represent inverter-only motor performance. *Id.* DOE also requested data and information to support the development of default values for inverter-only motors (similar to the values developed for submersible motors in Table 2 of appendix A) as well as equations that would represent the part-load efficiency or losses of these motors (similar to the equations developed for certain motor and drive combinations in Table 4 of appendix A). *Id.* To the extent DOE should consider a different approach, DOE requested information on the methodology it should consider in addition to supporting data. *Id.* Finally, DOE requested information on the percentage of pumps sold with inverter-only motors without controls (which would be impacted by a change in rating from PEI_{CL} to PEI_{VL}). *Id.*

HI stated that all inverter-only (synchronous) motors should have a calculation method with similar methodology to ST pumps, but with updated full-load motor efficiencies and loss coefficients. (HI, No. 20 at p. 6) Grundfos supported the creation of a calculation method for inverter-only [43] equipment that covers IE4 and IE5 [44] motors and controls. (Grundfos, No. 17 at p. 4) Additionally, Grundfos supported HI's efforts to create a calculation-based method for inverter-only motors with part-load loss coefficients specifically designed for inverter-only products. Grundfos stated that the final proposal should include both IE4 and IE5 calculation-based methods to reduce testing burden. (Grundfos, No. 17 at p. 6)

NEEA commented that inverter-only motors are increasing in popularity because many inverter-only motors are represented as having higher efficiencies than induction motors, especially at reduced speeds, and that the variable-speed capabilities make them a compelling choice in variable load pumping applications. (NEEA, No. 21 at p. 8) NEEA also stated that while ECM motors are particularly common, there is no technical limitation to other inverter-only motor types such as permanent magnet and synchronous reluctance motors being used in clean water applications. (NEEA, No. 21 at p. 8)

NEEA stated that while they supported wire-to-water testing as the most accurate way to rate a pump and motor (and drive), the calculation method of test is a conservative but economical option, and the inability to rely on the calculation method may discourage manufacturers from selling or developing these more efficient pump systems. Therefore, NEEA recommended that DOE include a calculation test method for inverter-only motors. NEEA stated that motor efficiencies consistent with an IE4 efficiency level would be appropriate for pumps. (NEEA, No. 21 at p. 8–9)

The CA IOUs supported calculation approaches for inverter-only motor drive systems, provided that the calculation methodology can reliably generate representative, but slightly conservative motor drive system losses, in order to minimize potential market distortion. (CA IOUs, No. 19 at p. 7) Additionally, the CA IOUs commented that, unlike submersible motors, inverter-only motors are found in numerous industries, sectors, and applications, so the motor losses table must be aligned with other DOE and industry treatments of these motors. (CA IOUs, No. 19 at p. 8) The CA IOUs stated that ECM performance between products and manufacturers is likely similar enough to performance variance typical of conventional induction motors that a loss table could be developed with manufacturer-submitted data. The CA IOUs commented that typical ECM motors will be using surface permanent magnet architectures, while permanent magnet power drive systems will use internal permanent magnet architectures, and that while these differences may eventually result in diverging performance, at the moment a single losses table may be sufficient. The CA IOUs recommended that DOE verify this single losses table assumption. (CA IOUs, No. 19 at p. 8)

The CA IOUs recommended developing a conventional-efficiency branch and a high-efficiency branch of a calculation method, for example by referring to IEC 60034–30–2 and assigning conventional product losses to products with an IE4 motor-drive system rating and efficient product losses to products with an IE5 motor drive system rating. (CA IOUs, No. 19 at p. 8) For permanent magnet inverter-only motors with a non-integrated controller sold with a choice of controller, the CA IOUs cautioned against the use of a losses table due to variance in performance between drive units (as opposed to induction motors, which are relatively uninfluenced by choice of drive unit) and instead recommended this subset use a hybrid power drive system mapping procedure. The CA IOUs stated that this does not apply to ECM products that typically have the drive embedded. (CA IOUs, No. 19 at pp. 8–9) Ultimately, the CA IOUs recommended that DOE consider a hybrid testing approach similar to that detailed in appendix F of AMCA 214, in which a motor drive system is mapped at several test points, with interpolation allowed between test points, which could be applied to any pumps that would be connected to that power drive system. The CA IOUs estimated that this approach would reduce test time compared to a wire-to-water pump test. The CA IOUs suggested that manufacturers could choose to use the calculation method or the hybrid mapping test method. (CA IOUs, No. 19 at pp. 9–10)

In a subsequent submittal responding to the April 2021 RFI, HI stated that it developed coefficients and calculation modifications for inverter-only motors by establishing the incremental loss delta between power drive systems operating with induction motors and power drive systems operating with inverter-only motors.[45] HI commented that it used actual motor data from multiple manufacturers to calculate these coefficients. The coefficients developed by HI would require using either IE4 or IE5 minimum efficiencies (IEC 60034–30–2) in the Section VII calculation for the equipped motor efficiency in appendix A. As suggested by HI, IE3 efficiency would be used to calculate PER_{STD}. (HI, No. 22 at pp. 1–2) HI also provided limited comparisons of the recommended inverter-only calculation method to test data for IE5 products. In five out of six cases, the calculation method resulted in a PEI

[43] Grundfos referenced induction-only motors, which DOE understands to have been intended to be a reference to inverter-only motors.

[44] The International Electrotechnical Commission (''IEC'') standards IEC 60034–30 for variable-speed electric motors establishes an efficiency classification system for these motors. Efficiency classes are designated as IE1, IE2, IE3, IE4, and IE5. IE4 is an approximation of super premium efficiency motors and IE5 is the IEC designation for ultra-premium efficiency motors.

[45] HI provided the incremental loss delta values in a subsequent submission. (HI, No. 23 at p. 1)

equivalent to or higher than the test method.[46] (HI, No. 22 at p. 2)

After reviewing the comments, DOE understands stakeholder references to ''inverter-only motors'' to mean inverter-only electric motors that are synchronous electric motors. DOE's current definition of ''inverter-only motor'' at 10 CFR 431.12 also includes AC induction motors.[47]

In the December 17, 2021, Electric Motors TP NOPR (''Motors TP NOPR''), DOE describes a ''synchronous electric motor'' as an electric motor in which the average speed of the normal operation is exactly proportional to the frequency of power supply to which it is connected, regardless of load. 86 FR 71710, 71726. DOE proposed to include within the scope of its electric motors test procedure synchronous electric motors with specific characteristics, inclusive of synchronous electric motors that are inverter-only electric motors. 86 FR 71710, 71727.

As stated, only pumps sold with motors subject to DOE's electric motor test procedure and energy conservation standards can be used to conduct the calculation-based approach. The current electric motors test procedures and standards apply only to induction electric motors, and the ''induction motor'' criteria exclude synchronous electric motors from scope. 10 CFR 431.25(g)(1). In this NOPR, DOE proposes that, to the extent that DOE adopts a definition, test procedure, and energy conservation standard for synchronous electric motors that are inverter-only electric motors, DOE would reference such regulations in the pumps test procedure, allowing for the use of the calculation method by pumps sold with synchronous electric motors that are inverter-only electric motors.

In the Motors TP NOPR, DOE proposed to test inverter-only synchronous electric motors (inclusive of the inverter) that include an inverter in accordance with Section 7.7.2 of IEC 61800–9–2:2017, using the test provisions specified in section 7.7.3.5 and testing conditions specified in section 7.10. 86 FR 71710, 71742. DOE proposed to test inverter-only synchronous electric motors that do not include an inverter in the same manner and to specify that testing must be performed using an inverter as recommended in the manufacturer's catalogs or offered for sale with the electric motor. *Id.* In response to comments from HI, Grundfos, NEEA, and CA IOUs, rather than referencing IE4 and IE5 motor efficiencies in the proposed calculation method for pumps sold with inverter-only synchronous electric motors, DOE proposes to require use of the nameplate efficiency of the inverter-only synchronous electric motors tested in accordance with any relevant test procedure in subpart B to part 431 if available, or if none available, in accordance with the DOE test procedure, should it be finalized. DOE notes that this nameplate efficiency, as proposed, would be representative of the motor + inverter efficiency rather than just the motor efficiency.

As proposed in the Motors TP NOPR, manufacturers of synchronous electric motors would not be required to test according to the DOE test procedure, if finalized, until the compliance date of energy conservation standards. 86 FR 71710, 71716. Accordingly, should DOE finalize a test procedure for these motors, there may be a period of time in which motor manufacturers would not be required to publish efficiency information for these motors. However, since the proposed electric motors test procedure is an IEC test procedure, if DOE's proposal is finalized, the tested efficiency of the synchronous inverter-only electric motors + inverters would likely already be available.

Issue 28: DOE requests comment on whether inverter-only motors used by pump manufacturers are typically tested in accordance with IEC 61800–9–2:2017.

With respect to HI's proposal to use IE3 efficiency to calculate PER_{STD}, DOE maintains that the appropriate denominator for pumps sold with inverter-only synchronous electric motors is the same as for other pumps sold with motors (with or without controls)—*i.e.,* the efficiency standards for NEMA Design B motors in 10 CFR 431.25 is comparable to the PEI metric when comparing pumps across a common baseline. Consequently, DOE is not proposing a revision to the calculation of PER_{STD} for these pumps.

With respect to part-load losses, while DOE does not have data to evaluate the model quantitatively, DOE has plotted HI's suggested model and preliminarily finds the resulting trends in losses to be reasonable in relation to the expected loss differences between induction and synchronous electric motors. Specifically, the suggested model shows inverter-only motors to be more efficient at part-load when compared to DOE's loss model for induction motors. Further, HI's suggested model shows higher efficiency at full-load compared to DOE's loss model for induction motors—an expected outcome given that induction motor efficiency is set at a NEMA Premium level, whereas inverter-only efficiency is Super Premium.

DOE notes that the HI-provided comparison of wire-to-water test data with results from the calculation method using the recommended coefficients did result in one case in which the calculation method would result in a slightly lower PEI rating than the test method. In addition, HI's proposed coefficients were based on a delta between induction motors and inverter-only motors, and DOE is not proposing to adopt HI's proposed induction motor coefficients. Finally, HI's coefficients were developed to be applicable to motor-only efficiency, while DOE's proposed test procedure for inverter-only motors results in efficiency for the motor + inverter combined. Therefore, DOE proposes to make slight modifications to the inverter-only coefficients proposed by HI. Specifically, DOE started with the revised proposed DOE induction motor and control coefficients, then applied the deltas provided by HI (the difference in efficiency points between a synchronous motor + control versus induction motor + control at different load points and different hp ranges),[48] and then normalized to the motor + control losses (rather than the motor only losses). Table III.2 shows the proposed inverter-only motor and control part-load loss factor coefficients. These coefficients result in slightly higher losses than the HI model across all hp.

[46] While the final column of Table 2 shows that in all six cases, the calculation method resulted in a PEI equivalent to or higher than the tested PEI, in one case the actual delta calculated from columns three and five results in one case where the calculation method results in a lower PEI than the test method.

[47] DOE defines ''inverter-only electric motor'' in 10 CFR 431.12 as an electric motor that is capable of rated operation solely with an inverter, and is not intended for operation when directly connected to polyphase, sinusoidal line power.

[48] HI provided the delta values in a subsequent comment submission. (HI, No. 23 at p. 1)

Table III.2 Proposed Inverter-Only Motor and Control Part Load Loss Factor Equation Coefficients

Motor Horsepower (hp)	Coefficients for Induction Motor and Control part Load Loss Factor (z_i)		
	a	b	c
≤ 5	-0.0898	1.0251	0.0667
> 5 and ≤ 20	-0.1591	1.1683	-0.0085
> 20 and ≤ 50	-0.4071	1.4028	0.0055
> 50 and ≤ 100	-0.3341	1.3377	-0.0023
> 100	-0.0749	1.0864	-0.0096

Issue 29: DOE requests comment on its proposed inverter-only part-load loss coefficients. DOE specifically requests comment on the appropriateness of the delta used to derive these coefficients as well as any other available comparable motor data with which DOE could vet these coefficients.

In response to the suggestion by the CA IOUs that DOE investigate whether a single table of part-load loss factors would be suitable for both ECM and permanent magnet motors, as well as for both conventional-efficiency and high-efficiency motors, DOE has no efficiency data for ECM and permanent magnet motors with which to perform such an analysis at this time. DOE acknowledges that permanent magnet inverter-only motors sold without a controller may perform differently based on the inverter with which it is paired. However, DOE does not expect that the use of a hybrid mapping approach would provide the burden reduction intended by the use of the calculation method. While the hybrid mapping approach would be less burdensome than multiple wire-to-water tests, it would likely be significantly more burdensome than a calculation-based approach based on a bare pump test, as it would require physical tests of all motors with which the bare pump would be paired. Furthermore, DOE tentatively concludes that the calculation-based approach is sufficient to generate appropriately representative values for this equipment—and with the option to allow for a testing-based approach, or an AEDM as discussed in section III.I.2, a manufacturer is free to refine accuracy of the values for specific equipment.

Issue 30: DOE requests comment on the merits of using a hybrid mapping approach for inverter-only motors and whether it would reduce or increase manufacturer burden compared to the current proposals.

In the April 2021 RFI, DOE requested information on the percentage of pumps sold with inverter-only motors without controls (and thus would be impacted by a change in rating from PEI_{CL} to PEI_{VL}). 86 FR 20075, 20082.

HI stated that pumps sold with inverter-only motors without controls constitute a small percentage of the market, but that such pumps should be labeled with a PEI_{VL} since they cannot be operated without the inverter and are variable-speed capable. (HI, No. 20 at p. 7) Grundfos stated that products with inverter-only motors cannot operate without a controller and should not be required to have a PEI_{CL} on the nameplate if sold without a controller. Grundfos suggested that DOE allow a PEI_{VL} on any product sold with an inverter-only motor (whether PM or PM+ controller). Grundfos also stated that the PEI will be valid regardless of the controller used by the end user. (Grundfos, No. 17 at pp. 6–7)

DOE agrees with the positions presented by commenters and proposes that to the extent that the calculation-based method would be applicable to pumps sold with synchronous electric motors that are inverter-only electric motors, such provision would apply to pumps sold with inverter-only synchronous electric motors both with and without controls. DOE also proposes that pumps sold with inverter-only motors with or without controls would apply the testing-based approach in section VI of appendix A (for pumps sold with motors and controls) rather than in section IV of appendix A (for pumps sold with motors), given that section VI results in PEI_{VL}, and DOE assumes that such pumps, even if sold without an inverter, would be tested with an inverter.

Issue 31: DOE requests comment on its proposal to apply PEIVL to pumps sold with inverter-only synchronous motors without controls, including application of the testing method in section VI of appendix A and the calculation method in section VII of appendix A.

3. Pumps Sold With Submersible Motors

For pumps sold with submersible motors, the calculation of PER_{STD}, the test procedure for bare pumps, the calculation-based approach for pumps sold with motors, and the calculation-based approach for pumps sold with motors and controls all include reference to Table 2 of appendix A, which includes default nominal full-load submersible motor efficiency values. These motor efficiency values were developed to allow for pumps sold with submersible motors to be rated using calculation-based methods despite the fact that submersible motors are not included in DOE's current motor regulations. In the Motors TP NOPR, DOE proposed a test procedure for submersible motors based on Section 34.4 of NEMA MG1–2016 with its 2018 Supplements. 86 FR 71725, 71749–71750. DOE notes that it has not established energy conservation standards for submersible motors. Were DOE to establish a test procedure for submersible motors, such motors would not be required to be tested according to the DOE test procedure until such time that compliance with any energy conservation standards that DOE may establish is required.

DOE proposes that for the calculation-based approaches for submersible pumps sold with motors (with or without controls), for determination of PER_{CL} and PER_{VL}, the default efficiency values in Table 2 would be used until compliance with an energy conservation standard for submersible motors is required, should such a standard be established. At such time, calculation of the pump efficiency for submersible pumps would rely on the motor efficiency rating marked on the nameplate and tested in accordance with the relevant DOE test procedure. DOE further proposes that if DOE finalizes a test procedure for submersible pumps, prior to any required compliance with an energy conservation standard that DOE may establish for these pumps, a manufacturer may rely on the motor efficiency represented by the motor manufacturer, if such a representation were made, or the default values in Table 2.

DOE also proposes that when determining PER_{STD} using the calculation-based approach for bare pumps, before the compliance date of any future standards for submersible electric motors that publishes after January 1, 2021, the default efficiency values in Table 2 would be used. After the compliance date of any standards for submersible electric motors that publishes after January 1, 2021, any standards applicable to submersible motors in appendix B of part 431 would be used.

Issue 32: DOE requests comment on its proposal for the calculation-based approach for pumps sold with submersible pumps to require use of the rated motor efficiency marked on the nameplate that has been tested in accordance with the relevant DOE test procedure after such time as compliance is required with an energy conservation standard for submersible motors, should such a standard be established.

G. Test Procedure for SVIL Pumps

As discussed, DOE is proposing to expand the scope of the test procedure to include SVIL pumps. DOE reviewed the general pumps test procedure in appendix A to determine if any modifications were necessary to accommodate SVIL pumps. The current general pumps test procedure established in appendix A is based on the test methods contained in HI 40.6–2014, with certain modifications. As discussed in section III.C.1, DOE is proposing to update this reference to HI 40.6–2021, which DOE has tentatively determined also applies to SVIL pumps.

As discussed in section III.F, the general pumps test procedure also contains methods to determine the appropriate PEI using either calculation-based methods or testing-based methods. DOE has tentatively determined that these calculation- and testing-based methods are applicable to SVIL pumps just as they are applicable to IL pumps, based on the configuration in which the pump is being sold. Since SVIL pumps are sold as pumps with motors or pumps with motors and controls, the test methods established in the January 2016 Final Rule would apply to SVIL pumps. Additionally, the determination of pump performance in the general pumps test procedure, and as proposed to be updated in this proposed rule, would be appropriate for SVIL pumps.

The primary differences between SVIL and IL pumps affecting the application of DOE's general pumps test procedure are the size and certain characteristics of the motor with which the SVIL pumps are rated. Specifically, the general pumps test procedure establishes that the testing-based methods apply to all pump configurations, while the calculation-based methods apply only to (1) pumps sold without a motor or controls (*i.e.,* a bare pump), (2) pumps sold with motors that are subject to DOE's energy conservation standards for electric motors, as defined pursuant to 10 CFR 431.25(g), (with or without continuous controls), and (3) pumps sold with submersible motors (with or without continuous controls). This distinction exists because the calculation-based test methods presume motor efficiency and motor or motor and drive loss values based on the performance characteristics of motors that are subject to DOE's current electric motor energy conservation standards detailed in 10 CFR 431.25. These standards apply to electric motors, including partial electric motors, that satisfy the following criteria:

1. Are single-speed, induction motors;
2. Are rated for continuous duty (MG 1) operation or for duty type S1 (IEC);
3. Contain a squirrel-cage (MG 1) or cage (IEC) rotor;
4. Operate on polyphase alternating current 60-hertz sinusoidal line power;
5. Are rated 600 volts or less;
6. Have a 2-, 4-, 6-, or 8-pole configuration,
7. Are built in a three-digit or four-digit NEMA frame size (or IEC metric equivalent), including those designs between two consecutive NEMA frame sizes (or IEC metric equivalent), or an enclosed 56 NEMA frame size (or IEC metric equivalent),
8. Produce at least 1 hp (0.746 kW) but not greater than 500 hp (373 kW), and
9. Meet all of the performance requirements of one of the following motor types: A NEMA Design A, B, or C motor or an IEC Design N or H motor.

10 CFR 431.25(g)

DOE notes that SVIL pumps, which this NOPR proposes to define as pumps having shaft input power less than 1 hp, may be paired with motors that are less than 1 hp and, as such, are not subject to DOE's electric motor regulations specified at 10 CFR 431.25. However, some motors with less than 1 hp are subject to DOE's small electric motor regulations specified at 10 CFR 431.446.

The current general pumps test procedure established in the January 2016 Final Rule allows pumps sold with single-phase motors to apply the test procedure for bare pumps. 10 CFR 431.464 and appendix A. DOE specified this approach because the nominal full-load motor efficiency values and part-load motor loss curves developed in the January 2016 Final Rule that describe the minimally-compliant pump (*i.e.,* PER_{STD}) are based on the performance and minimum efficiency requirements for NEMA B polyphase induction motors. 81 FR 4086, 4104. In the January 2016 Final Rule, DOE noted, and interested parties agreed, that such an approach was equitable and appropriate, since the majority of pumps in the scope of that TP rulemaking are sold with polyphase induction motors and, to the extent that pumps within the scope of the proposed test procedure are distributed in commerce with single-phase motors, most of these pumps are offered for sale with either single-phase or polyphase induction motors of similar size, depending on the power requirements of customers. *Id.* However, SVIL pumps are much more commonly sold with single-phase induction motors, and DOE regulations at 10 CFR 431.446 include efficiency standards for single-phase capacitor-start capacitor-run (''CSCR'') and capacitor-start induction-run (''CSIR'') motors.

In the May 2021 Circulator Pumps RFI, DOE requested comment on the recommendation to test SVIL pumps with the test methods from the general pumps test procedure in conjunction with additional provisions to account for the differences in size and characteristics of SVIL pump motors. In particular, DOE requested comment on the potential extension of the nominal full-load motor efficiency values to reference DOE's small electric motor regulations, including certain single-phase motors, and the need for an exception for SVIL pumps so that those sold with single-phase motors do not have to be rated as bare pumps. DOE also requested comment on the prevalence of SVIL pumps sold with single-phase versus three-phase motors, and the prevalence of SVIL pumps sold with motors not covered by DOE's small electric motors and electric motors energy conservation standards for either single- or three-phase motors. 86 FR 24516, 24527.

HI stated that the small motor regulation does not cover the full scope of motors (*e.g.,* single-phase, totally enclosed, fan-cooled (''TEFC''), and permanent split capacitor (''PSC'')) used with SVILs and that efficiencies for non-covered motors would need to be addressed, similar to submersible motors in appendix A, to reduce test burden and number of basic models to report. (HI, Docket No. EERE–2016–BT–STD–0004–112, at pp. 5–6) HI stated that data reported by four manufacturers of SVIL pumps indicated that between 70% and 75% are single-phase products. (HI, Docket No. EERE–2016–BT–STD–0004–112 at p. 6) HI added that many of these are custom special purpose motors specific to each manufacturer and may not be covered under the current motor efficiency regulations. (HI, Docket No. EERE–2016–BT–STD–0004–0112, at p. 6)

Grundfos stated that the test method for general pumps is appropriate for SVIL pumps, but that SVIL pumps would require a new pump category and should be limited to variable load products only. Grundfos stated that incorporating the small [electric] motor rule is appropriate to facilitate calculations in section VII of appendix A but commented that this regulation does not cover TEFC products and that DOE must ensure TEFC motors can utilize the same calculation methods. (Grundfos, Docket No. EERE–2016–BT–STD–0004–0113 at p. 5) Grundfos stated that 70% of its SVIL pumps are sold as single-phase (in both constant- and variable-speed equipment) and 30% are sold with 3-phase motors. They added that nearly all SVIL pumps are sold with TEFC motors that are not covered by DOE's small [electric] motor regulation. (Grundfos, Docket No. EERE–2016–BT–STD–0004–0113 at p. 5) Grundfos suggested that SVILs may be removed from the market and replaced by equivalent circulator products but was not explicit as to reason for such a change. (Grundfos, Docket No. EERE–2016–BT–STD–0004–0113 at p. 5)

DOE motor regulations at 10 CFR 431.446 exclude TEFC and certain other motors considered non-general purpose motors. However, in the Motors TP NOPR, DOE proposed adding such motors to the scope of electric motors coverage under the term small non-small electric motor electric motors (''SNEMs''). Specifically, DOE has proposed to define SNEMs as agnostic to enclosure and topology, affirmatively stating that the proposed test procedure would apply to general-purpose, definite-purpose, and special-purpose motors. As proposed, SNEMs would include fractional horsepower motors as low as 0.25 hp. 86 FR 71710, 71721–71725. The Motors TP NOPR also proposed testing instructions specific to these motors. 86 FR 71710, 71739. DOE notes that it has not established energy conservation standards for SNEMs. Were DOE to establish a test procedure for SNEMs, such motors would not be required to test according to the DOE test procedure until such time as compliance with any energy conservation standards be required, should such standards be established. Under DOE's Motors TP NOPR, any definitions, test procedures, and standards finalized for SNEMs would be in found in subpart B of part 431.

DOE expects that the proposed definition and test procedure for SNEMs, as well as the proposed test procedure for inverter-only synchronous electric motors, as discussed in section III.F.2, would encompass the additional types of motors discussed by HI and Grundfos that are not currently covered by the standards at 10 CFR 431.446. Therefore, DOE proposes that where the calculation-based test methods refer to the ''represented nominal full-load motor efficiency (*i.e.,* nameplate/DOE-certified value),'' the nominal full-load motor efficiency for an SVIL pump would be determined in accordance with the applicable test procedure in 10 CFR 431.444 or in subpart B of part 431.

DOE is also proposing that for SVIL pumps, the determination of PER_{STD} would reference DOE's small electric motor regulations at 10 CFR 431.446 rather than the electric motor regulations at 10 CFR 431.25, and would be the minimum efficiency of the energy conservation standards for polyphase or single-phase (CSIR/CSCR) for the relevant number of poles and motor horsepower. As noted, the single-phase standards only apply to CSCR and CSIR but this proposal would apply the efficiency values found at 10 CFR 431.446 when determining an SVIL pump's PER_{STD}. DOE believes that these values represent an appropriate default for the SVIL market. However, DOE would also consider application of efficiency values found for specific SNEMs in subpart B of part 431, if the relevant proposed amendments contained in the Motors TP NOPR are finalized. While DOE's information does not indicate that SVIL pumps are sold as bare pumps, as discussed in section III.B.4, if stakeholders identify such models, DOE would include these same provisions in the calculation method for bare pumps.

Issue 33: DOE seeks comment on whether the efficiency standards found at 10 CFR 431.446 are appropriate for use in the determination of PERSTD for SVILs, whether certain motor topologies that would be classified as SNEM are more prevalent and significantly less efficient, and whether the minimum efficiency of the polyphase and CSCR/CSIR standards for the relevant number of poles and motor horsepower is appropriate or whether there should be differences depending on the phase of the motor with which the pump is sold.

DOE's market research indicates that the vast majority of SVILs are sold with motors with a nominal horsepower of 0.25 hp or greater. However, DOE has identified some models with horsepower closer to 0.125 hp. Such motors are not subject to the standards in 10 CFR 431.446 and are not proposed to be subject to any test procedure in the Motors TP NOPR. DOE proposes that for determination of PER_{STD} for SVILs sold with a motor nominal horsepower of less than 0.25 hp, the full-load efficiency values in Table III.3 would be used. DOE has scaled these values from the standards for 0.25 hp pumps (3.9 efficiency point decrease, comparable to the most common decrease from 0.33 to 0.25 hp) and taken the minimum value across polyphase and CSCR/CSIR motors. DOE also proposes that the nominal full-load motor efficiency for SVILs would be determined in accordance with the applicable test procedure in 10 CFR 431.444 or in subpart B of part 431, although such test procedure is not required for those motors. DOE may consider alternate methods of determining motor efficiency for motors less than 0.25 hp, or if there is no appropriate test procedure, DOE may consider requiring SVILs sold with such motors to use a testing-based approach.

Table III.3 Average Full Load Efficiency for SVILs Less than 0.25 hp

Motor Horsepower	Average Full-Load Efficiency		
	Open Motors (Number of Poles)		
	6	4	2
< 0.25	58.3	64.6	61.7

Issue 34: DOE seeks comment on: (1) How many models of SVILs are sold with motors with a nominal horsepower less than 0.25 hp, (2) whether such motors could be tested in accordance with the relevant test procedures in 10 CFR 431.446 or proposed in the Motors TP NOPR, and if not, how such motors are tested, and (3) whether the efficiency values in Table III.3 are appropriate for such motors, and if not, how those values should be determined.

DOE expects that the existing regulations for small electric motors at 10 CFR 431.446, as well as any finalized regulations for SNEMs and inverter-only synchronous electric motors, would account for the vast majority of motors sold with SVIL pumps. However, DOE proposes that any SVIL pumps that are distributed in commerce with motors that are not regulated by DOE's electric motor regulations at 10 CFR 431.25, DOE's small electric motor regulations at 10 CFR 431.466, or any electric motor regulations in subpart B to part 431 established after January 1, 2022, as applicable, would need to apply the testing-based methods currently specified in sections IV and VI of appendix A and as proposed to be modified in this proposed rule. Given that DOE is proposing for PER_{STD} to reference motor efficiencies relevant to SVIL pumps, DOE is proposing not to have an option for SVIL pumps sold with single-phase motors to be rated as bare pumps.

If regulations for SNEMs and inverter-only synchronous electric motors are not set, DOE may consider allowing an option for SVIL pumps sold with single-phase motors to be rated as bare pumps. In this case, DOE would reference the efficiency values in 10 CFR 431.446 to determine bare pump performance.

Issue 35: DOE seeks comment on its proposal to require testing of SVIL pumps distributed in commerce with motors not regulated by DOE's current electric motor regulations or any motor regulations finalized after January 1, 2022. DOE also seeks comment on whether it should allow such pumps to be rated as bare pumps only if any motor regulations finalized after January 1, 2022, do not include SNEMs and inverter-only synchronous electric motors.

As stated in section III.F.1, the general pumps test procedure includes calculation-based methods that specify part-load loss curves for pumps sold with motors, accounting for the part-load losses of the motor at each load point, as well as part-load loss curves for pumps sold with motors and continuous controls, which account for additional losses.

Both the motor and combined motor and drive loss curves were developed for the general pumps test procedure based on data from NEMA and from manufacturers of motors and drives, as well as data from DOE's own testing, for motors and drives from 1 to 250 hp gathered during the general pumps test procedure rulemaking. Since these losses were based on data for motors and drives from 1 to 250 hp, the nominal motor losses derived for the general pumps test procedure may not be appropriate for SVIL pumps, given the lower hp ratings of the motors used in these applications. In the May 2021 Circulator Pumps RFI, DOE requested comment on whether the equations used to establish the part-load motor and drive losses in the general pumps test procedure are appropriate for SVIL pumps under one hp—and if inappropriate, DOE requested data supporting the generation of alternative loss curves. 86 FR 24516, 24527.

HI stated that current loss coefficients would not be valid for smaller motors and that DOE should investigate since this data is not available in the public domain. As noted previously, HI added that many of these are custom special purpose motors specific to each manufacturer and may not be covered under the current motor efficiency regulations. (HI, Docket No. EERE–2016–BT–STD–0004–0112 at p. 6) Grundfos stated that it did not believe that current part-load loss calculations apply to fractional horsepower motors and that DOE must engage with motor manufacturers and NEMA to determine appropriate part-load loss calculations. (Grundfos, Docket No. EERE–2016–BT–STD–0004–0013 at p. 5)

DOE understands that part-load loss curves (*i.e.,* the variation in efficiency as a function of load) do not vary significantly between 1 hp motors and drives and motors and drives that are less than 1 hp. DOE did not receive any newer data in response to this RFI or any indication that the SVIL market has changed such that data collected in 2017 would no longer be applicable. As stated previously, DOE is not proposing to revise its part-load loss curves for motors and drives less than 5 hp. Therefore, DOE proposes to apply the existing motor and combined motor and drive part-load loss curves that are applicable to 1 hp motors and drives to the fractional horsepower motors and drives with which SVIL pumps may be sold. DOE notes that IEC standards do not include motors below ¾ kw (1 hp), and that many SVIL pumps may use integrated packages rather than separate motors and drives—and as noted by HI, may be specific to each manufacturer. Consequently, there may be more variation in losses across manufacturers or models compared to larger hp motors and drives. As discussed in section III.I.2, DOE is proposing to allow use of AEDMs for pumps. In cases where a manufacturer wishes to use an alternative to the part-load loss coefficient method, it may choose to perform wire-to-water testing of SVILs or employ an AEDM under DOE's proposal.

Issue 36: DOE seeks comment on whether the market for SVIL pumps has changed such that the data collected by DOE in 2017 would no longer be applicable, and whether the use of AEDM would address concerns related to part-load loss curves specific to low-horsepower motors.

H. Test Procedure for Other Expanded Scope Pumps

DOE reviewed the general pumps test procedure in appendix A, including the amendments proposed in this NOPR, to determine if any modifications were necessary to accommodate BB, RSH, and VT pumps, as well as pumps designed to operate with 6-pole induction motors and pumps designed to operate with non-induction motors with an operating range that includes speeds of rotation between 960 rpm and 1,440 rpm (''pumps tested with a nominal speed of 1,200 rpm''). Specifically, the general pumps test procedure established in appendix A is based on the test methods contained in HI 40.6–2014, with certain modifications. As discussed in section III.C.1, DOE is proposing to update this reference to HI 40.6–2021, which DOE has tentatively determined is also applicable to BB, RSH, and VT pumps, as well as to pumps tested with a nominal speed of 1,200 rpm.

As discussed in section III.F, the general pumps test procedure also contains methods to determine the appropriate PEI using either calculation-based methods and/or testing-based methods. DOE tentatively determined that these calculation- and testing-based methods are applicable to BB, RSH, and VT pumps, as well as pumps tested with a nominal speed of 1,200 rpm just as they apply to other general pumps, based on the configuration in which the pump is being sold. Since BB, RSH, and VT pumps, as well as pumps tested with a nominal speed of 1,200 rpm are sold as bare pumps, pumps with motors, or pumps with motors and controls, the test methods established in the January 2016 Final Rule would be applicable to BB, RSH, and VT pumps, as well as pumps tested with a nominal speed of 1,200 rpm pumps. Additionally, the determination of pump performance in the current general pumps test procedure, and as proposed to be updated in this document, would be applicable to BB, RSH, and VT pumps, as well as pumps tested with a nominal speed of 1,200 rpm.

DOE understands that the motors paired with BB, RSH, and VT pumps are typically similar to those paired with the existing scope of general pumps. As such, DOE tentatively determined that

Table 1 and the relevant test and calculation options are appropriate for these expanded scope pumps and that no modifications are needed.

Issue 37: DOE requests comment on whether the proposed test procedure is appropriate for BB, RSH, and VT pumps.

Issue 38: DOE seeks comment on whether BB, RSH, and VT pumps are typically sold with motors not subject to the energy conservation standards in 10 CFR 431.25 or synchronous inverter-only electric motors, and if so, what kind of motors they are sold with, and what calculation modifications would be needed to accommodate such motors.

For pumps tested at a nominal speed of 1,200 rpm, DOE tentatively determined that the existing test procedure references to 10 CFR 431.25 for the appropriate number of poles, and the part-load loss factors in Table 4, and as proposed in this document, would be appropriate. The current requirements at 10 CFR 431.25 and 10 CFR 431.446 include energy efficiency standards for 6-pole motors. In addition, part-load losses are a relative factor that is agnostic to pole configuration. As a result, DOE is not proposing to revise these references and factors. DOE notes that Table 2, the default efficiency values for submersible pumps, does not currently have values for 6-pole motors. DOE is proposing to expand Table 2 to include such values. The proposed values were developed at the same time as the existing values in Table 2 but were not included in the 2016 test procedure at that time because the original scope did not include pumps tested at a nominal speed of 1,200 rpm. DOE notes that, as discussed in section III.F.3, Table 2 may be replaced with energy conservation standard values for submersible motors, if such standards are developed and adopted.

Issue 39: DOE requests comment and data on the proposed default submersible motor efficiency values for 6-pole motors.

I. Sampling Plan, AEDMs, Enforcement Provisions, and Basic Model

1. Sampling Plan for Determining Represented Values

DOE currently provides sampling plans for all covered equipment that manufacturers must use when certifying their equipment as compliant with the relevant standards and when making written representations of energy consumption and efficiency. (*See generally* 10 CFR parts 429 and 431) DOE expects that SVIL pumps would have the same testing uncertainty and manufacturing variability as larger IL pumps, as they are similar in construction and design to IL pumps and would apply the same test procedure under DOE's proposal. Similarly, RSH pumps would have the same testing uncertainty and manufacturing variability as RSV pumps, as they are similar in construction and design to RSV pumps and would use the same test procedure under this proposal. DOE has tentatively determined that BB pumps would have the same testing uncertainty and manufacturing variability as large, currently covered, end-suction pumps, as they are reasonably similar in construction and design to BB pumps and would apply the same test procedure as end-section pumps. VT pumps would also likely have the same testing uncertainty and manufacturing variability as large, currently covered, ST pumps, as they are reasonably similar in construction and design to VT pumps and use the same test procedure as VT pumps. Additionally, DOE has tentatively determined that pumps tested at a nominal speed of 1,200 rpm would have the same testing uncertainty and manufacturing variability as pumps that are currently regulated and tested at nominal speeds of 1,800 and 3,600. Therefore, DOE proposes to adopt the same statistical sampling plans that are already in place for commercial industrial pumps and apply them to those pumps that DOE is proposing to include as part of its expanded test procedure scope (*i.e.,* SVIL, BB, RSH, VT, and 1,200 rpm pumps.).

Issue 40: DOE request comment on its tentative determinations that SVIL, BB, RSH, VT, and pumps tested at a nominal speed of 1,200 rpm have the same testing uncertainty and manufacturing variability as currently regulated pumps. DOE also requests comment on its proposal to adopt the same statistical sampling plans which are currently in place for commercial industrial pumps for SVIL, BB, RSH, VT, and pumps tested at a nominal speed of 1,200 rpm.

Under this proposal, for purposes of certification testing, determining whether a basic model complies with the applicable energy conservation standard would be based on testing conducted using the proposed DOE test procedure and sampling plan. The general sampling requirement currently applicable to all covered products and equipment provides that a sample of sufficient size must be randomly selected and tested to ensure compliance and that, unless otherwise specified, a minimum of two units must be tested to certify a basic model as compliant. 10 CFR 429.11 This minimum is implicit in the requirement to calculate a mean—an average—which requires at least two values.

DOE proposes to apply this minimum requirement to the pump categories addressed in this proposed expansion of the test procedure's scope. Manufacturers may need to test a sample of more than two units depending on the variability of their sample, as provided by the statistical sampling plan.

Additionally, DOE's certification requirements state that other performance parameters derived from the test procedure must be reported, but no sampling plan provisions are provided for such other parameters, which include: pump total head in feet at BEP and nominal speed, volume per unit time (*i.e.,* flow rate) in gallons per minute at BEP and nominal speed, and calculated driver power input at each load point (*i.e.,* corrected to nominal speed in horsepower). 10 CFR 429.59(b)(2). In the April 2021 RFI, DOE sought input on whether it should specify an approach for determining how to determine represented values for parameters other than PEI, and sought comment on using the mean of the value for each tested unit in the sample as the represented value. 86 FR 20075, 20083.

HI and Grundfos recommended that if the sample size is greater than one, the arithmetic mean should be used for reported parameters other than PEI (HI, No. 20 at p.7; Grundfos, No. 17 at p. 7).

Regarding representative values other than PEI and PER, DOE is proposing that if more than one unit is tested for a given sample, represented values (other than PEI and PER) would be determined using the arithmetic mean of the individual units. For example, if three units are tested for a given sample, and pump total head at BEP is measured at 99.1 ft, 96.2 ft, and 97.3 ft, the reported values for head would be the sum of the three values divided by three (*i.e.,* 97.5 ft). This proposal would apply to both the existing and proposed expanded scope of pumps that would be addressed by the general pumps test procedure.

Issue 41: DOE requests comment on the proposed statistical sampling procedures and certification requirements.

2. Alternative Efficiency Determination Methods

a. Background

Pursuant to the requirements of 10 CFR 429.70, DOE may permit use of an AEDM in cases where actual testing of regulated equipment may present considerable burdens to a manufacturer and use of that AEDM can reasonably predict the equipment's energy efficiency performance. Although specific requirements vary by product or equipment, use of an AEDM entails development of a mathematical model that estimates energy efficiency or energy consumption characteristics of the basic model, as would be measured by the applicable DOE test procedure. The AEDM must be based on engineering or statistical analysis, computer simulation or modeling, or other analytic evaluation of performance data. A manufacturer must validate an AEDM by demonstrating that its predicted efficiency performance of the evaluated equipment agrees with the performance as measured by actual testing in accordance with the applicable DOE test procedure. The validation procedure and requirements, including the statistical tolerance, number of basic models, and number of units tested vary by product.

Once developed, an AEDM may be used to certify the performance of untested basic models in lieu of physical testing. However, use of an AEDM for any basic model is always at the option of the manufacturer. One potential advantage of AEDM use is that it may free a manufacturer from the burden of physical testing—but this advantage must be weighed against the potential risk that an AEDM may not perfectly predict performance and could result in a finding that the equipment has an invalid rating and/or that the manufacturer has distributed a noncompliant basic model. The manufacturer, by using an AEDM, bears the responsibility and risk of the validity of the ratings, including cases where the manufacturer receives and relies on performance data for certain components from a component manufacturer.

Given stakeholder requests for the calculation methods to be more representative, and to balance the risk of allowing overrating through calculation methods, DOE proposes to accommodate the application of AEDMs to determine performance ratings for pumps. DOE expects that the use of AEDMs would allow manufacturers to rate equipment that performs better than the assumptions in DOE's calculation method with less burden than if physical testing were required for each basic model. Manufacturers could still choose to use the calculation method where they were satisfied that it resulted in appropriate representations of model performance. DOE proposes regulatory language that is consistent with most other commercial and industrial equipment that have AEDM provisions. The specific details are discussed in sections III.I.2.b through III.I.2.f of this document.

b. Basic Criteria Any AEDM Must Satisfy

A manufacturer may not use an AEDM to determine the values of metrics unless the following three criteria are met:

(1) The AEDM is derived from a mathematical model that estimates the energy efficiency or energy consumption characteristics of the basic model as measured by the applicable DOE test procedure;

(2) The AEDM is based on engineering or statistical analysis, computer simulation or modeling, or other analytic evaluation of performance data; and

(3) The manufacturer has validated the AEDM, in accordance with the applicable validation requirements for such equipment (discussed in section III.I.2.c of this document).

c. Validation

Validation is the process by which a manufacturer demonstrates that an AEDM meets DOE's requirements for use as a certification tool by physically testing a certain number and style of pump models and comparing the test results to the output of the AEDM. Before using an AEDM, a manufacturer must validate the AEDM's accuracy and reliability as follows:

A manufacturer must select a minimum number of basic models from each validation class to which the AEDM applies.[49] To validate an AEDM, the specified number of basic models from each validation class must be tested in accordance with the DOE test procedure and sampling plan in effect at the time those basic models used for validation are distributed in commerce. Testing may be conducted at a manufacturer's testing facility or a third-party testing facility. The resulting rating is directly compared to the result from the AEDM to determine the AEDM's validity. A manufacturer may develop multiple AEDMs per validation class, and each AEDM may span multiple validation classes; however, the minimum number of basic models must be validated per validation class for every AEDM that a manufacturer chooses to develop. An AEDM may be applied to any basic model within the applicable validation classes at the manufacturer's discretion. All documentation of testing, the AEDM results, and subsequent comparisons to the AEDM would be required to be maintained as part of both the test data underlying the certified rating and the AEDM validation package pursuant to 10 CFR 429.71.

DOE is proposing to include general pumps validation classes at 10 CFR 429.70(i) and to require that two basic models per validation class be tested using the relevant proposed test procedure. This number of basic models is consistent with the number for basic models required for most DOE-regulated equipment that utilize AEDMs. Additionally, DOE proposes that the AEDM-predicted result would be applied to the PEI metric and would be greater than or equal to 95 percent of the tested results for that same model. Additionally, the predicted PEI for each basic model calculated by applying the AEDM must meet or exceed the applicable federal energy conservation standard that applies.

DOE's proposed validation classes for general pumps are listed below:

- Constant Load End-suction Closed-Coupled Pumps and Constant Load End-suction Frame-Mounted Pumps
- Variable Load End-suction Closed-Coupled Pumps and Variable Load End-suction Frame-Mounted Pumps
- Constant Load Inline Pumps and Constant Load Small Volute Inline Pumps
- Variable Load Inline Pumps and Variable Load Small Volute Inline Pumps
- Constant Load Radially-Split Multi-Stage Vertical Pumps and Constant Load Radially-Split Multi-Stage Horizonal Pumps
- Variable Load Radially-Split Multi-Stage Vertical Pumps and Variable Load Radially-Split Multi-Stage Horizontal Pumps
- Constant Load Submersible Turbine Pumps and Constant Load Vertical Turbine Pumps
- Variable Load Submersible Turbine Pumps and Variable Load Vertical Turbine Pumps
- Constant Load Between-Bearing Pumps
- Variable Load Between-Bearing Pumps

d. Records Retention Requirements

Consistent with provisions for other commercial and industrial equipment, DOE also proposes requirements regarding retention of certain information related to validation and use of an AEDM to certify equipment. Specifically, any manufacturer using an AEDM to generate representative values must provide on request records showing: (1) The AEDM itself, and any

[49] "Validation classes" are groupings of products based on the equipment classes used for validating an AEDM.

mathematical modeling, engineering or statistical analysis, and/or computer simulation or modeling that forms the AEDM's basis; (2) regarding tested units that were used to validate the AEDM pursuant to section III.I.2.b, all relevant equipment information, complete test data, AEDM calculations, and statistical comparisons ; and (3) for each basic model to which the AEDM has been applied, all relevant equipment information and AEDM calculations.

e. Additional AEDM Requirements

Consistent with provisions for other commercial and industrial equipment, DOE proposes to require that, if requested by DOE, a manufacturer must perform at least one of the following activities: (1) Conduct a simulation before a DOE representative to predict the performance of particular basic models of the equipment to which the AEDM was applied; (2) provide analysis of previous simulations conducted by the manufacturer; or (3) conduct certification testing of basic model(s) selected by DOE.

In addition, DOE notes that when making representations of values other than PEI based on the output of an AEDM, all other representations regarding PER, pump efficiency, overall efficiency, flow, head, driver power input and pump power output would be required to be based on the same AEDM results used to generate the represented value of PEI.

f. AEDM Verification Testing

Consistent with provisions for certain other commercial and industrial equipment, DOE proposes including in 10 CFR 429.70 provisions related to AEDM verification testing for pumps, including: (1) Selection of units from retail if available, or otherwise from a manufacturer, (2) independent, third-party testing if available, or otherwise at a manufacturer's facility, (3) testing performed without manufacturer representatives on-site, (4) testing in accordance with the DOE test procedure, any active test procedures, any guidance issued by DOE, and lab communication with the manufacturer only if DOE organizes it, (5) notification of manufacturer if a model tests worse than its certified rating by an amount exceeding a 5 percent tolerance with opportunity for the manufacturer to respond, (6) potential finding of the rating for the model to be invalid, and (7) specifications regarding when a manufacturer's use of an AEDM may be restricted due to prior invalid represented values and how a manufacturer could regain the privilege of using an AEDM for rating.

DOE is also proposing conforming changes to 10 CFR 429.59 to allow use of AEDMs for general pumps in lieu of testing.

Issue 42: DOE requests feedback regarding all aspects of its proposal to permit use of an AEDM for general pumps, and any data or information comparing modeled performance with the results of physical testing. DOE specifically seeks comment on its proposed validation classes, and whether groupings should be considered where performance variation between two equipment classes or nominal speeds is well established. In addition, DOE requests comment on whether the calculation-based methods would still be necessary if manufacturers were permitted to use AEDMs in addition to physical testing.

3. Enforcement Provisions

Enforcement provisions govern the process DOE would follow when performing an assessment of basic model compliance with standards, as described under subpart C of part 429. Specifically, subpart C of part 429 describes the notification requirements, legal processes, penalties, specific prohibited acts, and testing protocols related to testing covered equipment to determine or verify compliance with standards.

DOE proposes to apply the same general enforcement provisions contained in subpart C of part 429 to the proposed expanded scope of pumps.

Additionally, given that DOE is proposing to allow the use of AEDMs, DOE is also proposing in the product specific enforcement provisions in 10 CFR 429.134 that if the model of pump unit was rated using an AEDM, DOE may conduct enforcement testing using either a testing approach or calculation approach.

Issue 43: DOE requests comment on its proposal related to enforcement provisions.

4. Basic Model Definition

This section discusses the definition of basic model as it relates to the existing general pumps scope. DOE will make any proposals related to the basic model definition for its proposed expanded scope in any energy conservation standards rulemaking for pumps. DOE's regulations for pumps at 10 CFR 429.59 require that the represented values for each basic model be determined through testing in accordance with the sampling provisions specified in that section. As applied to pumps, DOE defines the term ''basic model'' in 10 CFR 431.462.

In the April 2021 RFI, DOE stated that pump manufacturers may elect to group similar individual pump models within the same equipment class into the same basic model to reduce testing burden, provided all representations regarding the energy use of pumps within that basic model are identical and based on the most consumptive unit 86 FR 20075, 20083). Accordingly, manufacturers may pair a given bare pump with several different motors (or motor and controls) and can include all combinations under the same basic model if the certification of energy use and all representations made by the manufacturer are based on the most consumptive bare pump/motor (or motor and controls) combination for each basic model and all individual models are in the same equipment class. 86 FR 20075, 20083–20084.

In the case of pumps, the term ''basic model'' means all units of a given class of pump manufactured by one manufacturer, having the same primary energy source, and having essentially identical electrical, physical, and functional (or hydraulic) characteristics that affect energy consumption, energy efficiency, water consumption, or water efficiency; and, in addition, for pumps that are subject to the standards specified in § 431.465(b), the following provisions also apply:

(1) All variations in numbers of stages of bare RSV and ST pumps must be considered a single basic model;

(2) Pump models for which the bare pump differs in impeller diameter, or impeller trim, may be considered a single basic model; and

(3) Pump models for which the bare pump differs in number of stages or impeller diameter and which are sold with motors (or motors and controls) of varying horsepower may only be considered a single basic model if:

(i) For ESCC, ESFM, IL, and RSV pumps, each motor offered in the basic model has a nominal full load motor efficiency rated at the Federal minimum (see the current table for NEMA Design B motors at § 431.25) or the same number of bands above the Federal minimum for each respective motor horsepower (see Table 3 of appendix A to subpart Y of this part); or

(ii) For ST pumps, each motor offered in the basic model has a full load motor efficiency at the default nominal full load submersible motor efficiency shown in Table 2 of appendix A to subpart Y of this part or the same number of bands above the default nominal full load submersible motor efficiency for each respective motor horsepower (see Table 3 of appendix A to subpart Y of this part).

10 CFR 431.462.

Clauses (1) and (2) of the basic model definition, which are applicable to pumps that are subject to the standards specified in 10 CFR 431.465(b), align the scope of the ''basic model'' definition for pumps with the requirements that testing be conducted at a certain number of stages for RSV and ST pumps and at full impeller diameter. (10 CFR 431.462.) Clause (3) of the definition, which is applicable to pumps that are subject to the standards specified in 10 CFR 431.465(b), addresses basic models inclusive of pump models for which the bare pump differs in number of stages or impeller diameter. (*Id.*) Specifically, variation in motor sizing (*i.e.,* variation in the horsepower rating of the paired motor as a result of different impeller trims or stages within a basic model) is not a basis for requiring units to be rated as unique basic models. However, variation in motor sizing may also be associated with variation in motor efficiency, which is a performance characteristic; typically, larger motors are more efficient than smaller motors. 86 FR 20075, 20084.

In order to group pumps sold with motors into a single basic model, clause (3)(i) provides that for basic models inclusive of pump models for which the bare pump differs in number of stages or impeller diameter, each motor offered in a pump included in that basic model must have a full-load efficiency at the Federal minimum efficiency level for NEMA Design B electric motors (found in 10 CFR 431.25) or the same number of efficiency bands above the Federal minimum for each respective motor horsepower as described in Table 3 of appendix A.[50] (*Id.*) Clause (3)(ii) provides a similar allowance for submersible turbine pumps, where, in order to group pumps sold with motors into a single basic model, each motor offered in a pump included in that basic model must have a full-load motor efficiency at the default nominal full-load submersible motor efficiency shown in Table 2 of appendix A, or the same number of bands above the default nominal full-load submersible motor efficiency for each respective motor horsepower as described in Table 3 of appendix A. (*Id.*) DOE requested comment on how manufacturers are currently making use of the basic model grouping provisions when rating their pumps, and whether any general clarifications or modifications are needed. 86 FR 20075, 20084.

HI and Grundfos stated there are no modifications or clarifications needed for basic model except to modify the language to reduce testing burden by allowing manufacturers to group inverter-only motors into a single basic model (HI, No. 20 at p. 8; Grundfos, No. 17 at p. 8), which DOE discusses later. Summit stated that all pumps are reported using basic model grouping of ''bare pump'' as defined in Section III, regardless of whether the pump is sold with a motor. (Summit Pump, No. 16 at p. 6)

Summit requested clarification on whether ''most consumptive'' refers to the highest power consumption or least efficient and requested clarification on the phrase ''same number of bands above federal minimum.'' Summit also requested examples for reporting a bare pump with different motor powers. (Summit, No. 16 at p. 6)

In response to Summit, ''most consumptive'' would refer to the highest PEI, given that lower numbers of PEI are better. The phrase ''same number of bands above federal minimum'' means that the manufacturer should: (1) Identify the motor efficiency of the motor in question, (2) find the Federal minimum for the relevant horsepower/pole combination NEMA Design B electric motors in 10 CFR 431.25, (3) find both of those values in Table 3 of appendix A, and (4) count how many rows the motor efficiency is above the federal minimum. This process would be repeated for the other motors that the manufacturer may seek to group into the basic model to ensure that the motor efficiency for each motor is the same number of rows (''bands'') above the relevant Federal minimum in each case. Regarding Summit's request for examples of reporting a bare pump with different motor powers, DOE understands Summit to be referring to the case where a bare pump with varying number of stages or impeller diameters is sold with motors of varying horsepower. In this case, the manufacturer may choose to group those combinations into a single basic model, if all the motors are the ''same number of bands above [the] federal minimum'' as described in the process above. If so, the manufacturer would report the performance of that basic model following the steps in 10 CFR 429.59(b). The performance of the basic model would be based on the specific motor tested with the bare pump (using a testing-based approach or calculation-based approach) in accordance with 10 CFR 429.59(a). The manufacturer would report the basic model number as well as the individual model numbers for the bare pump and for all motors of varying horsepower that the manufacturer elected to group into a single basic model, in accordance with 10 CFR 429.59(c). Alternatively, the manufacturer could choose to report each of the bare pump + motor combinations as separate basic models.

In the April 2021 RFI, DOE stated that it received several inquiries related to the application of the basic model definition to pumps sold with VFDs of varying phase, voltage, and/or efficiency; pumps sold with inverter-only motors such as PMAC motors; and pumps sold with both single-phase and polyphase motors. 86 FR 20075, 20084.

For pumps sold with motors, when determining how to group models within a basic model, manufacturers must consider clause (3), which currently allows the grouping of models to be based on the number of bands above ''nominal full-load motor efficiency rated at the Federal minimum (see the current table for NEMA Design B electric motors at § 431.25),'' or for submersible turbine pumps, the number of bands above the default nominal full-load submersible motor efficiency. DOE stated that it may consider inclusion of explicit language that applies this clause to pumps sold with specific kinds of motors, or to pumps sold with VFDs. For example, inverter-only motors may have a rated efficiency (*i.e.,* nameplate efficiency) that exceeds the Federal minimum for NEMA Design B electric motors (10 CFR 431.25) (based on hp, poles, and enclosure construction of that motor), as might certain single-phase motors subject to the energy efficiency standards in 10 CFR 431.446 and tested in accordance with 10 CFR 431.444. DOE also noted that stakeholders have recommended that DOE develop default nominal full-load efficiency values for inverter-only motors, which could also provide a baseline for grouping pumps sold with those motors. 86 FR 20075, 20084.

DOE noted that for motors not currently subject to the DOE test procedure for electric motors, it is not clear how manufacturers would determine the full-load efficiency of a given motor, or specifically, determine the number of bands above the Federal minimum or, for submersible pumps, above the default efficiency. For inverter-only motors, DOE noted that the IEC recently published an industry test procedure that provides test methods for measuring the efficiency of these motors: IEC 60034–2–3:2020, ''Rotating electrical machines—Part 2–3: Specific test methods for determining losses and efficiency of converter-fed

[50] The efficiency bands in Table 3 of appendix A are derived from Tables 12–10 and 12–12 of NEMA MG1–2016, with 2018 supplements. Each higher incremental level of nominal full-load efficiency represents a loss reduction of approximately 10 percent or one ''NEMA Band.''

AC motors'' (''IEC 60034'') and IEC 61800–9–2:2017 (discussed in section III.F.1 of this RFI). DOE requested comment on whether to amend clause (3) in the basic model definition for pumps to provide additional detail regarding pumps sold with inverter-only motors, single-phase motors, or other non-NEMA Design B electric motors. DOE requested comment on which motor categories not currently subject to DOE's test procedure and standards are commonly combined with pumps, as well as their relative efficiency compared to regulated NEMA Design B electric motors, and which corresponding industry test procedure (if any) should be used to establish their ''rated'' efficiency. Finally, DOE requested comment on how VFDs are typically paired with pumps and motors; for example, whether motors of various sizes are paired with the same VFD. DOE also sought comment on whether a pump manufacturer would know which VFD commonly paired with its pumps would result in the most consumptive rating. 86 FR 20075, 20084.

Summit stated that the majority of supplied motors are covered. (Summit, No. 16 at p. 6) Grundfos stated that their inverter-only motors are IE5 compliant as defined in IEC TS 60034–30–2 and tested according to IEC 60034–2–3. (Grundfos, No. 17 at p. 8) HI stated that IEEE 114 applies for efficiency testing of single-phase induction motors and IEC 60034–2–3 applies for efficiency testing of inverter-only motors. (HI, No. 20 at p. 8) NEEA provided a list of all test procedures applicable to all motor technologies that DOE considered in the 2017 Electric Motors test procedure RFI and stated that in particular they supported consideration of IEC 61800–9:2017 and 60034–2–3:2020, which appear to be applicable to all inverter-fed motors. (NEEA, No. 21 at p. 9–10)

HI recommended modifying the language of the basic model definition to reduce testing burden by allowing manufacturers to group inverter-only motors into a single basic model as long as all motors had an efficiency above the Federal minimum for each respective motor horsepower for NEMA Design B motors at 10 CFR 431.25, or above the default for submersible motors. (HI, No. 20 at p. 8) Grundfos supported HI's comment on modifying the ''Band Rule'' requirements to allow for all inverter-only motors [51] to be grouped in a single basic model for purposes of testing, regardless of how many bands above the Federal minimum efficiency standard each motor of a given hp rating may be. Grundfos noted that this would remove burdensome testing requirements when products meet IE4 and IE5 efficiency levels but the number of bands can vary greatly due to inconsistent efficiency levels in the Federal minimum. (Grundfos, No. 17 at p. 8)

Grundfos stated that it sells products with VFDs in two configurations: (1) For products with integrated inverter-only motors, the VFD is specifically designed for the motor hp it is paired with, and (2) for external Grundfos VFDs, the VFD is designed for a specific hp motor. Grundfos also noted that VFDs can be used on differing hp motors where the kVA rating of the VFD is not exceeded. Finally, Grundfos noted that products can be used by end users with many different VFDs with which they are not sold, and so Grundfos could not determine the most consumptive of the entire market. (Grundfos, No. 17 at p. 9) HI stated that in many cases VFDs and pumps are purchased separately, but where manufacturers include VFDs with pumps, the test procedure is sufficient for determining a basic model and testing. (HI, No. 20 at p. 8)

As discussed in section III.F.1 and III.F.2, DOE proposed as part of its Motors TP NOPR to address single-phase induction motors (SNEMs) and inverter-only motors. As such, DOE does not need to reference external test procedures as part of the basic model definition. In addition, DOE proposed that PER_{STD} for inverter-only motors would still be based on DOE's standards for NEMA Design B motors. In regard to the issue Grundfos raised with the difference in number of bands between IE4 or IE5 efficiency levels and Federal minimums across hp for inverter-only motors, DOE proposes to amend clause (3) so that the current band rule does not apply and instead the grouping can be based on anything above the Federal minimum for NEMA Design B motors as long as the rating is based on the lowest number of bands above the minimum.

With regard to addressing VFDs in the basic model definition, HI stated that the test procedure is sufficient for determining a basic model, and Grundfos stated that it would be unable to determine which VFD was most consumptive. (HI, No. 20 at p. 8; Grundfos, No. 17 at p. 9) As such, DOE has tentatively determined that there is no viable option to more explicitly address VFDs in the basic model definition and that it does not need to change the basic model definition to address VFDs.

In the April 2021 RFI, DOE noted that to group pumps sold with both single-phase motors and pumps sold with polyphase motors into a single basic model, manufacturers would need to utilize a testing-based approach on the most consumptive configuration, as pumps sold with polyphase motors cannot be rated as bare pumps, and pumps sold with single-phase motors cannot be rated using a calculation-based approach (see Table 1 to appendix A). DOE requested comment on whether allowing such a grouping under the same basic model for pumps sold with both single-phase and polyphase motors would require more explicit direction in 10 CFR part 431. 86 FR 20075, 20084.

Grundfos stated that grouping single-phase products with polyphase product would not meet the definition of basic model because the characteristics that affect energy consumption are not ''essentially identical.'' Grundfos stated that if the intention of this grouping is to reduce testing burden, this is not accomplished because testing is still required on both versions to determine whether the single-phase or polyphase equipment would be ''most consumptive,'' unless DOE clearly states in the regulation what method(s) DOE determines to be valid to determine ''most consumptive'' before actual testing. Grundfos does not believe grouping single-phase with polyphase equipment should be allowed. (Grundfos, No. 17 at p. 9) HI stated that attempting to include regulated single-phase equipment would be limited because the current DOE regulation only includes general purpose open drip proof products. (HI, No. 20 at p. 8) HI recommended that pumps sold with single-phase and polyphase motors not be combined into a single basic model and recommended that DOE continue to allow pumps sold with single-phase motors to be rated with section III for bare pumps. (HI, No. 20 at p. 8)

Following consideration of HI and Grundfos' comments, DOE is not proposing to allow the grouping of single-phase and polyphase products into a single basic model. Instead, DOE proposes to require that pumps sold with single-phase motors can continue to be rated as bare pumps (with the exception of SVIL as discussed in section III.G).

Issue 44: DOE requests comment on the proposed amendments to the definition of basic model.

[51] The comment uses the term ''induction-only motors''; however, DOE believes this to be referring to ''inverter-only'' motors since this comment was in response to Issue 25, which requested detail about inverter-only motors. Additionally, the HI comment referenced by Grundfos also specified inverter-only motors.

J. Representations of Energy Use and Energy Efficiency

DOE understands manufacturers often make representations (graphically or in numerical form) of energy use metrics, including pump efficiency, overall (wire-to-water) efficiency, bowl efficiency, driver power input, pump power input (brake or shaft horsepower), and/or pump power output (hydraulic horsepower). Manufacturers often make these representations at multiple impeller trims, operating speeds, and number of stages for a given pump. DOE proposes to allow manufacturers to continue making these representations. To ensure consistent and standardized representations across the pump industry and to ensure such representations are not in conflict with the reported PEI for any given pump model, DOE proposes to establish optional testing procedures for these parameters that are part of the DOE test procedure. DOE also proposes that, to the extent manufacturers wish to make representations regarding the performance of commercial and industrial pumps using these additional metrics, they would be required to do so based on testing in accordance with the DOE test procedure.

DOE notes that overall (wire-to-water) efficiency, driver power input, and/or pump power output (hydraulic horsepower) are already parameters that are described in HI 40.6–2021, which DOE proposes to incorporate by reference in the DOE test procedure (section III.C.1). DOE expects that further specification is not necessary regarding the determination of these parameters.

Issue 45: DOE requests comment on its proposal to adopt optional test provisions for the measurement of several other circulator pump metrics, including overall (wire-to-water) efficiency, driver power input, and/or pump power output (hydraulic horsepower).

Issue 46: DOE also requests comment on its understanding that HI 40.6–2021 contains all the necessary methods to determine overall (wire-to-water) efficiency, driver power input, and/or pump power output (hydraulic horsepower) and that further specification is not necessary.

K. Labeling Requirements

DOE specifies labeling requirements for pumps at 10 CFR 431.466. DOE requires that the permanent nameplate must be marked clearly with the following information: (A) For bare pumps and pumps sold with electric motors but not continuous or non-continuous controls, the rated pump energy index—constant load (PEI_{CL}), and for pumps sold with motors and continuous or non-continuous controls, the rated pump energy index—variable load (PEI_{VL}); (B) The bare pump model number; and (C) If transferred directly to an end-user, the unit's impeller diameter, as distributed in commerce. Otherwise, a space must be provided for the impeller diameter to be filled in. 10 CFR 431.466(a)(1)(i).

DOE also specifies that all orientation, spacing, type sizes, typefaces, and line widths to display this required information must be the same as or similar to the display of the other performance data on the pump's permanent nameplate. DOE also specifies the form in which PEI_{CL}, PEI_{VL}, model number, and impeller diameter must be identified. 10 CFR 431.466(a)(1)(ii).

Regarding disclosure of efficiency information in marketing materials, DOE requires that the same information that must appear on a pump's permanent nameplate must also be prominently displayed on each page of a catalog that lists the pump; and in other materials used to market the pump. 10 CFR 431.466(a)(2)(i).

In the April 2021 RFI, DOE requested comment on whether the test procedure should explicitly specify how to determine the information required to be marked on a label in accordance with 10 CFR 431.466, and if so, how. 86 FR 20075, 20085.

Summit stated that labeling requirements seem straightforward but requested clarification on who is considered the manufacturer. (Summit, No. 16 at p. 6) DOE notes that 10 CFR 431.2 defines the term ''manufacturer'' as ''any person who manufactures industrial equipment . . .'' and defines manufacture as ''to manufacture, produce, assemble, or import.'' *See also* 42 U.S.C. 6311(5) (defining ''manufacturer''), 42 U.S.C. 6311(7) (referencing the definition for ''manufacture'' under 42 U.S.C. 6291) *and* 42 U.S.C. 6291(10) (defining ''manufacture'').

Grundfos stated that individual model numbers should be the only data mandated by DOE on labels and marketing materials, and that basic models should not be mandated on product nameplates since they are only a reference with the manufacturers and DOE. (Grundfos, No. 17 at p. 9) HI requested that DOE clarify that only the individual model number and PEI need to be on the nameplate and marketing materials. (HI, No. 20 at p. 9)

Grundfos stated that mandating the actual impeller diameter on the nameplate of a product serves no purpose with respect to the regulation, EPCA, or consumers referencing this information. Grundfos added that there is also ample evidence from consumers that marking the ''actual impeller diameter'' on the product causes confusion because the PEI on the label is based on full impeller diameter. Grundfos recommended that the impeller diameter mandate for nameplates and marketing materials be removed to reduce substantial burden for global products. (Grundfos, No. 17 at p. 9–10) HI recommended that DOE not mandate that the impeller diameter appear on the pump nameplate or marketing materials, asserting that this requirement has no impact on EPCA and increases manufacturer burden for global products. (HI, No. 20 at p. 9)

DOE agrees that if the pump is sold only as a unit including motor (with or without controls) and is not sold as a bare pump, then using the manufacturer's individual model number on the label rather than the bare pump model number would be appropriate. DOE also notes that in the current regulations, impeller diameter does not have to be provided if the pump is not transferred directly to an end user. However, DOE will address these comments and consider proposals related to them in a separate rulemaking.

DOE also requested comment on whether the term ''full impeller diameter'' should be modified to explicitly address pumps with multiple stages and varying impeller diameters, and if so, how. 86 FR 20075, 20085.

Grundfos and HI stated that the definition of ''full impeller diameter'' is sufficient for testing purposes but could be clarified to ensure that multi-stage products are properly included by a slight modification to the definition by adding an ''(s)'' to the phrase ''maximum diameter impeller.'' (Grundfos, No. 17 at p. 10) HI offered a similar solution, suggesting that the definition be modified as to refer to ''the maximum diameter impeller or *impellers (in the case of multistage pumps)* with which a given pump basic model is distributed in commerce.'' (HI, No. 20 at p. 9 (emphasis added)) Summit stated that it had no issue with the definition of ''full impeller diameter'' and did not request any changes. (Summit, No. 16 at p. 6)

After considering the submitted comments, DOE proposes to revise the definition of full impeller diameter to mean ''the maximum impeller diameter(s) with which a given pump basic model is distributed in commerce.'' DOE notes that where a pump includes different-sized impellers for different stages, manufacturers may include the largest impeller size only, as well as sufficient identifying information in the individual model number to identify inclusion of reduced impeller sizes.

L. Test Procedure Costs and Harmonization

1. Test Procedure Costs and Impact

In this NOPR, DOE proposes to amend the existing test procedure at appendix A for pumps by: (1) Expanding the scope to include SVIL pumps; (2) expanding the scope to include other specified clean water pumps; (3) reducing the pump bowl diameter restriction to include more ST pumps; (4) changing the definitions of ESFM and ESCC pumps to cover all end-suction pumps; (5) incorporating a nominal speed of 1,200 rpm, in addition to 1,800 rpm and 3,600 rpm; (6) providing a calculation method for pumps sold with inverter-only motors; and (7) updating the part-load loss coefficients for pumps sold with induction motors. DOE has tentatively determined that the test procedure as proposed in this NOPR will not be unduly burdensome for manufacturers to conduct. Further discussion of the cost impacts of the test procedure amendments are presented in the following paragraphs.

As discussed in the April 2021 RFI, DOE received comments from stakeholders in response to the September 2020 Early Assessment RFI regarding costs to test pumps to the DOE test procedure. 86 FR 20075, 20082. Specifically, DOE noted HI's statement that, based on a survey of HI members, industry testing costs significantly exceeded DOE's estimates, and that wire-to-water testing represented 20 percent of total industry testing. *Id.* Comments from Grundfos were also noted by DOE in which Grundfos stated that approximately 45 percent of its testing was wire-to-water testing—specifically, for pumps sold with motors that can only operate when driven by an inverter (*i.e.,* inverter-only motors). *Id.* In response to the April 2021 RFI, DOE received additional comments specific to cost and burden of the current DOE pumps test procedure. Summit stated that testing cost has the largest impact to small businesses since the time that employees spend testing products is time that cannot be used to support the business in other ways (*i.e,* testing has high opportunity cost), but also stated that DOE has generally managed test burden for pumps well. (Summit, No. 16 at p. 7) HI stated that DOE's estimates of testing costs in the January 2016 Final Rule were too low based on data from HI member surveys. (HI, No. 20 at p. 1) HI also stated that some manufacturers have not been able to provide additional features due to testing requirements. (HI, No. 20 at p. 9)

Issue 47: DOE requests comment on the details of the pump features which have been limited due to the burdens imposed by DOE's current test procedure, including, but not limited to, the nature of the features that manufacturers have had to forego providing, the extent of the limits that manufacturers have had to place, and the manner in which manufacturers have had to apply these limits—such as on the basis of intended markets (*e.g.,* higher-end vs. budget-end). DOE also seeks information regarding how these burdens may be mitigated to reduce the likelihood of manufacturers from having to limit the inclusion of features with their pumps.

DOE notes that pump manufacturers must comply with the energy conservation standards that were established in 2016 and required beginning on January 27, 2020. 81 FR 4368 (January 26, 2016) (''January 2016 ECS Final Rule''). First-time compliance costs associated with meeting those energy conservation standards included testing costs, potential capital costs, and other one-time manufacturer costs associated with developing a testing and certification protocol. DOE also recognizes that the current test procedure does not provide a calculation method for pumps sold with motors that do not have a DOE energy efficiency standard; therefore, for pumps that rely on such motors, wire-to-water testing is required for each basic model. Finally, DOE notes that for all pumps currently subject to the energy conservation standards, the applicable energy efficiency values must be determined for all basic models according to the DOE test procedure, which includes the calculation method for certain pumps.

DOE notes that HI's response to the September 2020 Early Assessment RFI, included an estimate of the overall industry cost ($8.76 million) to test general pumps to certify compliance with the energy conservation standards established in the January 2016 ECS Final Rule. (HI, No. 6, at p. 2) Using its Compliance Certification Management System (''CCMS'') database, DOE estimates that a total of 2,745 basic models have been certified using the testing-based approach. Assuming that two individual pumps are tested to rate a basic model (the minimum as specified in 10 CFR 429.11, the number of pumps tested is 5,490. This results in an estimated per unit test cost of $1,600.[52]

A total of 6,645 basic models are included in DOE's CCMS database, which means that 3,900 basic models, or 59 percent, were certified using the calculation-based approach. DOE estimates that it will take a mechanical engineer two hours to calculate and determine a rating for each basic model. Assuming a fully burdened engineering hourly wage of $65.07,[53] DOE estimates the labor cost to perform the pump calculation method to be $130.14 per basic model. These cost estimates apply to the discussion in the following sections.

DOE has tentatively determined that the test procedure amendments proposed in this NOPR would impact testing costs as discussed in the following sections.

a. Scope Expansions

As stated previously, DOE is proposing to expand the scope of this test procedure to include SVIL pumps, other specified clean water pumps, ST pumps with bowl diameters greater than 6 inches, currently uncovered end-suction pumps, and pumps designed to operate with a 6-pole induction motor or with a non-induction motor with an operating range that includes speeds of rotation between 960 and 1,440 rpm. As these pumps would also be newly regulated equipment, DOE currently has no test procedures or standards for the equipment. The proposed test procedure and metrics would be consistent with the requirements established in the January 2016 Final Rule. DOE also assumed a sampling plan consistent with that for pumps currently subject to the test procedure, which requires a sample size of at least two units per pump basic model be tested when determining representative values of PEI, as well as other pump performance metrics.

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[52] $8,784,000 (total testing costs) ÷ 5,490 (total number of pumps tested) = $1,600 (per pump tested).

[53] DOE used the mean hourly wage of $45.94, taken from BLS's ''Occupational Employment and Wages, May 2020'' using the Occupation Profile of ''Mechanical Engineers'' (17–2141). *See: www.bls.gov/oes/current/oes172141.htm.* Last accessed on December 8, 2021.

Additionally, DOE used data from the ''Employer Costs for Employee Compensation—June 2021'' to estimate that a Private Industry Worker's wages and salary are 70.6% of an employee's total compensation. *See: www.bls.gov/news.release/archives/ecec_09162021.pdf.* Last accessed on December 8, 2021.

Therefore, total employer hourly cost is $65.07 = $45.94 ÷ 0.706.

DOE recognizes that some manufacturers of these newly-covered pump categories may not manufacture general pumps, and therefore may not be currently testing pumps to the DOE test procedure. Manufacturers may opt to test their products either in-house or at a third-party laboratory. To estimate the test burden for newly-covered pumps as proposed in this TP NOPR, DOE assumed that manufacturers will test pumps in-house. In order to test a pump in-house, each manufacturer may have to undertake the construction and maintenance of a test facility that is capable of testing pumps in compliance with the test procedure, including acquisition and calibration of any necessary measurement equipment. DOE also assumed that manufacturers have a pump test facility available but may not have the equipment required to conduct the DOE test procedure and that the cost of purchasing such equipment is approximately $4,000 based on a review of available testing equipment on the market.

DOE assumes that for pump manufacturers who are member companies of HI or who conduct testing in accordance with the January 2016 Final Rule for other product offerings, these manufacturers already conduct testing in accordance with HI 40.6–2014 and would not incur any additional capital expenditures to be able to conduct the proposed DOE pump test procedure.

Pump manufacturers who are not members of HI may need to purchase electrical measurement equipment with ±2.0 percent accuracy to conduct the proposed pump test procedure. DOE estimates that calibrating the flowmeter, torque sensor, power quality meter, pressure transducer, and laser tachometer, together, will cost a manufacturer about $1,250 per year.

Issue 48: DOE requests comment on its assumptions and understanding of the anticipated impact and potential costs to pump manufacturers if DOE expands the scope of the general pumps test procedure. Additionally, DOE requests comment on any potential cost manufacturers may incur, if any, from this NOPR's proposed scope expansion.

b. Calculation Method for Testing Pumps With Inverter-Only Motors

In this NOPR, DOE is proposing a calculation method for testing pumps with inverter-only motors. The current test procedure does not include a calculation method for motors that do not have a DOE efficiency standard; therefore, manufacturers are required to conduct wire-to-water testing for pumps sold with these (*i.e.,* inverter) motors. Aside from the proposed calculation approach, the test procedure, metrics, and sampling plan for general pumps remains consistent with the requirements established in the January 2016 Final Rule and, among other things, require a sample size of at least two units per pump basic model be tested when determining representative values of PEI, as well as other pump performance metrics.

For general pumps already certified, DOE would not expect any additional costs to manufacturers. DOE has tentatively determined that the calculation method for inverter-only motors proposed in this NOPR would provide results that are conservative as compared to results from wire-to-water testing—consequently, DOE does not expect manufacturers will need to rerate their basic models. For new basic models where the bare pump is already certified (*i.e.,* the only change is in the inverter-only motor sold with the pump), DOE expects a manufacturer's cost to be the labor required to run the calculations (*i.e.,* $130.14 per basic model), providing an estimated savings of $3,070 per basic model (*i.e.,* test cost savings).[54] DOE expects that there would be no change in test cost for new bare pump basic models paired with an inverter-only motor, since the bare pump would need to be tested.

Issue 49: DOE requests comment on its assumptions and understanding of the anticipated impact and potential cost savings to manufacturers of pumps sold with inverter-only motors if DOE adopts the proposed calculation method. Additionally, DOE requests comment on any potential costs or savings that manufacturers may incur, if any, from this proposal.

c. Updated Calculation Method for Testing Pumps With Induction Motors

In this NOPR, DOE is proposing an updated calculation method for testing pumps with induction motors. The updated calculation method provides less conservative part-load loss coefficients than those provided in the current test procedure; however, DOE has tentatively determined that the proposed coefficients would still be conservative relative to wire-to-water testing. Aside from the proposed updated part-load motor coefficients, the test procedure, metrics, and sampling plan for general pumps remains consistent with the requirements established in the January 2016 Final Rule and, among other things, require a sample size of at least two units per pump basic model be tested when determining representative values of PEI, as well as other pump performance metrics.

For general pumps already certified, DOE would not expect any additional costs to manufacturers since the current calculation method provides the most conservative results. DOE expects that there will be no change in test cost for new bare pump basic models paired with an inverter-only motor, since the bare pump will need to be tested.

Issue 50: DOE requests comment on its assumptions and understanding that there will be no cost impact to manufacturers if DOE adopts the proposed updated coefficients for part-load motor losses. Additionally, DOE requests comment on any potential costs or savings that manufacturers may incur, if any, from this proposal.

d. Additional Amendments

DOE does not anticipate that the remaining amendments proposed in this NOPR, listed below, would impact test costs.

(1) Incorporate by reference HI 40.6–2021 into 10 CFR 431.463;

(2) Remove the incorporations by reference of ANSI/HI 1.1–1.2–2014 and ANSI/HI 2.1–2.2–2014;

DOE has tentatively determined that manufacturers would be able to rely on data generated under the current test procedure should any of these additional proposed amendments be finalized.

2. Harmonization With Industry Standards

DOE's established practice is to adopt relevant industry standards as DOE test procedures unless such methodology would be unduly burdensome to conduct or would not produce test results that reflect the energy efficiency, energy use, water use (as specified in EPCA) or estimated operating costs of that product during a representative average use cycle or period of use. *See* 10 CFR part 430, subpart C, appendix A, section 8(c). In cases where the industry standard does not meet EPCA's statutory criteria for test procedures, DOE will make modifications through the rulemaking process to these testing standards as needed to adopt the procedure as the DOE test procedure.

The test procedures for pumps at subpart Y incorporates by reference FM Class Number 1319, ANSI/HI 1.1–1.2–2014, ANSI/HI 2.1–2.2–2014, HI 40.6–2014, NFPA 20–2016, ANSI/UL 448–2013, and ANSI/UL 1081–2016. FM Class Number 1319, ANSI/HI 1.1–1.2–

[54] As previously stated, DOE estimated that the per unit test cost is $1,600 and at least two units need to be tested. Therefore, the calculation method is estimated to save approximately $3,070 = ($1,600 × 2) − $130.14.

2014, ANSI/HI 2.1–2.2–2014, NFPA 20–2016, ANSI/UL 448–2013, and ANSI/UL 1081–2016 all provide definitions for 10 CFR 431.462. HI 40.6–2014 provides test methods for the determinations of the energy efficiency of pumps. The industry standard DOE proposes to incorporate by reference via amendments described in this document are discussed in further detail in section IV.M of this document.

Issue 51: DOE requests comments on the benefits and burdens of the proposed updates and additions to industry standards referenced in the test procedure for pumps.

M. Compliance Date

EPCA prescribes that, if DOE amends a test procedure, all representations of energy efficiency and energy use, including those made on marketing materials and product labels, must be made in accordance with that amended test procedure, beginning 180 days after publication of such a test procedure final rule in the **Federal Register**. (42 U.S.C. 6314(d)(1)) To the extent the modified test procedure proposed in this document is required only for the evaluation and issuance of updated efficiency standards, use of the modified test procedure, if finalized, would not be required by manufacturers until the compliance date of any amended standards that DOE may set. 10 CFR 431.4; 10 CFR part 430, subpart C, appendix A, section 8(e).

Manufacturers of commercial and industrial pumps newly-covered under the proposed scope of the DOE pump test procedure, if finalized, would not be required to test such pumps to the proposed test procedure, if made final, until such time as compliance were required with energy conservation standards was required, should such standards be established. However, to the extent manufacturers choose to make voluntary representations as to the energy efficiency of such pumps, beginning 180 days following publication of the final test procedure, if finalized, any such representations would be required to be based on testing of the pumps in accordance with the finalized test procedure and such representation must fairly discloses the results of such testing. (42 U.S.C. 6314(d))

If DOE were to publish an amended test procedure, EPCA provides an allowance for individual manufacturers to petition DOE for an extension of the 180-day period if the manufacturer may experience undue hardship in meeting the deadline. (42 U.S.C. 6314(d)(2)) To receive such an extension, petitions must be filed with DOE no later than 60 days before the end of the 180-day period and must detail how the manufacturer will experience undue hardship. (*Id.*)

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866 and 13563

Executive Order (''E.O.'') 12866, 58 FR 51735 (Oct. 4, 1993), ''Regulatory Planning and Review,'' as supplemented and reaffirmed by E.O. 13563, ''Improving Regulation and Regulatory Review, 76 FR 3821 (Jan. 21, 2011), requires agencies, to the extent permitted by law, to (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public. DOE emphasizes as well that E.O. 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, the Office of Information and Regulatory Affairs (''OIRA'') in the Office of Management and Budget (''OMB'') has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. For the reasons stated in the preamble, this proposed regulatory action is consistent with these principles.

Section 6(a) of E.O. 12866 also requires agencies to submit ''significant regulatory actions'' to OIRA for review. OIRA has determined that this proposed regulatory action does not constitute a ''significant regulatory action'' under section 3(f) of E.O. 12866. Accordingly, this action was not submitted to OIRA for review under E.O. 12866.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of an initial regulatory flexibility analysis (''IRFA'') for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the DOE rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's website: *www.energy.gov/gc/office-general-counsel.* DOE reviewed this proposed rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003.

The following sections detail DOE's IRFA for this test procedure rulemaking:

1. Descriptions of Reasons Why Action Is Being Considered

DOE is proposing to amend the existing DOE test procedures for commercial and industrial pumps. DOE shall amend test procedures with respect to covered equipment, if the Secretary determines that amended test procedures would more accurately produce test results which measure energy efficiency, energy use, or estimated annual operating cost of a covered equipment during a representative average use cycle or period of use. (42 U.S.C. 6314(a)(2)) This proposed rulemaking is in accordance with DOE's obligations under EPCA.

2. Objectives of, and Legal Basis for, Rule

DOE is required to review existing DOE test procedures for all covered equipment every 7 years. (42 U.S.C. 6314(a)(1))

3. Description and Estimate of Small Entities Regulated

DOE has recently conducted a focused inquiry into small business manufacturers of the equipment covered by this proposed rulemaking. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. The size standards are listed by North American Industry Classification System (''NAICS'') code as well as by industry description and are available at *www.sba.gov/document/support—table-size-standards.* Manufacturing commercial and industrial pumps is classified under NAICS 333914, ''measuring, dispensing, and other pumping equipment manufacturing.'' The SBA sets a threshold of 750 employees or fewer for an entity to be considered as a small business for this category. DOE used available public information to identify potential small manufacturers. DOE accessed the Compliance Certification Database [55] to create a list of companies that import or otherwise manufacture the equipment covered by this proposal. Once DOE created a list of potential manufacturers, DOE used market research tools to determine whether any met the SBA's definition of a small entity, based on the total number of employees for each company including parent, subsidiary, and sister entities.

Based on DOE's analysis, 46 companies potentially selling commercial and industrial pumps covered by this proposed test procedure were identified. DOE screened out companies that do not meet the small entity definition and additionally screened out companies that are largely or entirely foreign owned and operated. Of the 46 companies, 21 were further identified as a small business. Based on a review of publicly available model databases, DOE estimated the number of models currently covered by the test procedure for each small business, excluding four small businesses not reflected in the model databases. DOE attributes a total of 779 unique basic models of covered pumps to small businesses, ranging from one model to 503 models for an average of approximately 46 models per small business. DOE was able to find revenue estimates for all 21 small businesses.

4. Description and Estimate of Compliance Requirements

DOE estimates that this proposed test procedure would not require any manufacturer to incur any additional testing burden associated with the proposed test procedure. If finalized, DOE recognizes that commercial and industrial pump energy conservation standards may be proposed or promulgated in the future and pump manufacturers would then be required to test all covered pumps in accordance with the proposed test procedures. (*See* Docket No. EERE–2020–BT–STD–0013) Therefore, although such is not yet required, DOE is presenting the costs associated with testing equipment and procedure consistent with the requirements of the proposed test procedure, as would be required to comply with any future energy conservation standards for pumps. Additionally, since the list of small businesses was drawn from manufacturers with products covered by the current test procedure, DOE assumes that each noted small business already possesses the necessary equipment for testing under the proposed test procedure. Impacts for each test procedure amendment are reviewed below:

SVIL Product Class Scope Expansion

DOE examined the websites and, when available, product catalogs of all previously identified 21 potential small businesses for listings of SVIL pumps. DOE identified three small businesses manufacturing SVIL pumps—producing an estimated total of 73 basic models, with one small business producing nine basic models, another producing as many as 56 basic models, and other small business producing eight basic models. DOE estimated that it would cost approximately $1,600 per unique basic model tested. Accordingly, all small businesses combined would incur costs of approximately $116,800—with the first small business incurring a cost of $14,400, the second incurring a cost of $89,600, and the third incurring a cost of $12,800.

DOE was able to find revenue estimates for both small businesses. Testing costs for newly-covered SVIL pumps would represent significantly less than one percent of estimated annual revenue for both small businesses.

Other Clean Water Pump Scope Expansion

DOE examined the websites and, when available, product catalogs of all previously identified 21 potential small businesses for listings of any of the clean water pumps that would be newly-covered under this proposed test procedure, if finalized. DOE identified five small businesses manufacturing clean water pumps potentially covered by this rulemaking that are not covered by the current test procedure. Although a newly-covered model count estimate was not possible for two small businesses, the remaining three small businesses produce an estimated total of 255 newly-covered basic models, with the first small business producing 189 basic models, the second producing 13 basic models, and the third producing 53 basic models. For the first small business, DOE conservatively estimated 65 newly-covered models of between-bearing pumps, 27 models of newly-covered vertical turbine pumps, and 97 models covered by the 1200 RPM scope expansion—excluding models also covered by the other scope expansions. The second small business produces approximately 13 models that would fall under the 1200 RPM scope expansion. For the third small business, approximately one-third of newly-covered unique basic models are submersible pumps and two-thirds are vertical turbine pumps, several of which also fall under the 1200 RPM scope expansion. DOE estimated that it would cost approximately $1,600 per unique basic model tested. Accordingly, the three small businesses combined would incur costs of approximately $408,000—with the first incurring a cost of $302,400, the second incurring accost of $20,800, and the third incurring a cost of $84,800. The first and second small businesses produce both SVIL pumps and newly-covered clean water pumps and would incur an approximate total testing cost of $315,200 and $35,200 respectively.

DOE was able to find revenue estimates for both small businesses. Testing costs for newly-covered clean water pumps would represent significantly less than one percent of estimated annual revenue for both small businesses.

Calculation Method Changes

Because, relative to the amended test procedure calculations, the proposed calculation changes are conservative, manufacturers would not have to recalculate or re-rate existing models. Accordingly, DOE does not anticipate that updating the part-load loss coefficients for pumps sold with induction motors or providing a calculation method for pumps sold with inverter-only motors would impose any costs on small businesses if the amended test procedures are adopted. Likewise, permitting the use of AEDMs in lieu of the calculation-based test is not expected to result in additional costs for affected small businesses, as they will continue to be able to employ the calculation-based test.

DOE requests comment on the number of small businesses DOE identified; the estimated number of covered models these small businesses manufacture; the per testing costs and total testing costs DOE estimated small businesses may incur to test models to appendix A; and any other potential

[55] U.S. Department of Energy Compliance Certification Database, available at: *www.regulations.doe.gov/certification-data.*

costs small businesses may incur due to the proposed amended test procedures, if finalized.

5. Duplication, Overlap, and Conflict With Other Rules and Regulations

DOE is not aware of any rules or regulations that duplicate, overlap, or conflict with the proposed rule being considered today.

6. Significant Alternatives to the Rule

As previously stated in this section, DOE is required to review existing DOE test procedures for all covered products and equipment every 7 years. Additionally, DOE shall amend test procedures with respect to any covered equipment, if the Secretary determines that amended test procedures would more accurately produce test results which measure energy efficiency, energy use, or estimated annual operating cost of a covered equipment type during a representative average use cycle or period of use. (42 U.S.C. 6314(a)(1)) DOE has initially determined that the proposed amendments for the existing DOE test procedure for commercial and industrial pumps would more accurately produce test results to measure the efficiency of this equipment.

DOE has tentatively determined that there are no better alternatives than the proposed amendments in terms of meeting the agency's objectives to measure energy efficiency more accurately and to reduce burden on manufacturers. Therefore, DOE is proposing in this NOPR to amend the existing DOE test procedure for commercial and industrial pumps.

Additional compliance flexibilities may be available through other means. Notably, section 504 of the Department of Energy Organization Act, 42 U.S.C. 7194, provides authority for the Secretary to adjust a rule issued under EPCA in order to prevent ''special hardship, inequity, or unfair distribution of burdens'' that may be imposed on that manufacturer as a result of such rule. Manufacturers should refer to 10 CFR part 430, subpart E, and part 1003 for additional details.

C. Review Under the Paperwork Reduction Act of 1995

Under the procedures established by the Paperwork Reduction Act of 1995 (''PRA''), a person is not required to respond to a collection of information by a Federal agency unless that collection of information displays a currently valid OMB Control Number.

OMB Control Number 1910–1400, Compliance Statement Energy/Water Conservation Standards for Appliances, is currently valid and assigned to the certification reporting requirements applicable to covered equipment, including pumps.

DOE's certification and compliance activities ensure accurate and comprehensive information about the energy and water use characteristics of covered products and covered equipment sold in the United States. Manufacturers of all covered products and covered equipment must submit a certification report before a basic model is distributed in commerce, annually thereafter, and if the basic model is redesigned in such a manner to increase the consumption or decrease the efficiency of the basic model such that the certified rating is no longer supported by the test data. Additionally, manufacturers must report when production of a basic model has ceased and is no longer offered for sale as part of the next annual certification report following such cessation. DOE requires the manufacturer of any covered product or covered equipment to establish, maintain, and retain the records of certification reports, of the underlying test data for all certification testing, and of any other testing conducted to satisfy the requirements of 10 CFR part 429, 10 CFR part 430, and/or 10 CFR part 431. Certification reports provide DOE and consumers with comprehensive, up-to date efficiency information and support effective enforcement.

Certification data would be required for pumps that would be covered under the proposed expansion of the test procedure scope at such time compliance is required with energy conservation standards for such pumps, should such standards be established; however, DOE is not proposing certification or reporting requirements for pumps in this NOPR. Instead, DOE may consider proposals to establish certification requirements and reporting for the pumps covered under the proposed expansion of the test procedure scope under a separate rulemaking regarding appliance and equipment certification. DOE will address changes to OMB Control Number 1910–1400 at that time, as necessary.

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number.

D. Review Under the National Environmental Policy Act of 1969

DOE is analyzing this proposed regulation in accordance with the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*) and DOE's implementing regulations at 10 CFR part 1021. DOE's regulations include a categorical exclusion for rulemakings interpreting or amending an existing rule or regulation that does not change the environmental effect of the rule or regulation being amended as well as a categorical exclusion for those rulemakings that are strictly procedural. *See* 10 CFR part 1021, appendix A to subpart D, A5 and A6. In this NOPR, DOE proposes test procedure amendments that it expects will be used to develop and implement future energy conservation standards for pumps. DOE has determined that this rule falls into a class of actions that are categorically excluded from review under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*) and DOE's implementing regulations at 10 CFR part 1021. Specifically, DOE has tentatively determined that adopting test procedures for measuring energy efficiency of consumer products and industrial equipment is consistent with activities identified in 10 CFR part 1021, appendix A to subpart D, A5 and A6. *See also* 10 CFR 1021.410. DOE will complete its NEPA review before issuing the final rule.

E. Review Under Executive Order 13132

Executive Order 13132, ''Federalism,'' 64 FR 43255 (Aug. 10, 1999) imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or that have federalism implications. The Executive order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. DOE has examined this proposed rule and has determined that it would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of this proposed rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297(d)) No further action is required by Executive Order 13132.

F. Review Under Executive Order 12988

Regarding the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, ''Civil Justice Reform,'' 61 FR 4729 (Feb. 7, 1996), imposes on Federal agencies the general duty to adhere to the following requirements: (1) Eliminate drafting errors and ambiguity, (2) write regulations to minimize litigation, (3) provide a clear legal standard for affected conduct rather than a general standard, and (4) promote simplification and burden reduction. Section 3(b) of Executive Order 12988 specifically requires that executive agencies make every reasonable effort to ensure that the regulation (1) clearly specifies the preemptive effect, if any, (2) clearly specifies any effect on existing Federal law or regulation, (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction, (4) specifies the retroactive effect, if any, (5) adequately defines key terms, and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in sections 3(a) and 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, the proposed rule meets the relevant standards of Executive Order 12988.

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (''UMRA'') requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Public Law 104–4, sec. 201 (codified at 2 U.S.C. 1531). For a proposed regulatory action likely to result in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a proposed ''significant intergovernmental mandate,'' and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect small governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820; also available at *www.energy.gov/gc/office-general-counsel.* DOE examined this proposed rule according to UMRA and its statement of policy and determined that the rule contains neither an intergovernmental mandate, nor a mandate that may result in the expenditure of $100 million or more in any year, so these requirements do not apply.

H. Review Under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. This proposed rule would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

I. Review Under Executive Order 12630

DOE has determined, under Executive Order 12630, ''Governmental Actions and Interference with Constitutionally Protected Property Rights'' 53 FR 8859 (March 18, 1988), that this proposed regulation would not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

J. Review Under Treasury and General Government Appropriations Act, 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516 note) provides for agencies to review most disseminations of information to the public under guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). Pursuant to OMB Memorandum M–19–15, Improving Implementation of the Information Quality Act (April 24, 2019), DOE published updated guidelines which are available at *www.energy.gov/sites/prod/files/2019/12/f70/DOE%20;Final%20Updated%20;IQA%20Guidelines%20;Dec%202019.pdf.* DOE has reviewed this proposed rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

Executive Order 13211, ''Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use,'' 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OMB, a Statement of Energy Effects for any proposed significant energy action. A ''significant energy action'' is defined as any action by an agency that promulgated or is expected to lead to promulgation of a final rule, and that (1) is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (3) is designated by the Administrator of OIRA as a significant energy action. For any proposed significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use should the proposal be implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

The proposed regulatory action to amend the test procedure for measuring the energy efficiency of pumps is not a significant regulatory action under Executive Order 12866. Moreover, it would not have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as a significant energy action by the Administrator of OIRA. Therefore, it is not a significant energy action, and, accordingly, DOE has not prepared a Statement of Energy Effects.

L. Review Under Section 32 of the Federal Energy Administration Act of 1974

Under section 301 of the Department of Energy Organization Act (Pub. L. 95–91; 42 U.S.C. 7101), DOE must comply with section 32 of the Federal Energy Administration Act of 1974, as amended by the Federal Energy Administration Authorization Act of 1977. (15 U.S.C.

788; ''FEAA'') Section 32 essentially provides in relevant part that, where a proposed rule authorizes or requires use of commercial standards, the notice of proposed rulemaking must inform the public of the use and background of such standards. In addition, section 32(c) requires DOE to consult with the Attorney General and the Chairman of the Federal Trade Commission (''FTC'') concerning the impact of the commercial or industry standards on competition.

The proposed modifications to the test procedure for pumps would incorporate testing methods contained in certain sections of the following commercial standards: HI 40.6–2021. DOE has evaluated these standards and is unable to conclude whether they fully comply with the requirements of section 32(b) of the FEAA (*i.e.,* whether it was developed in a manner that fully provides for public participation, comment, and review.) DOE will consult with both the Attorney General and the Chairman of the FTC concerning the impact of these test procedures on competition, prior to prescribing a final rule.

M. Description of Materials Incorporated by Reference

In this NOPR, DOE proposes to incorporate by reference the test standard published by The Hydraulic Institute titled ''HI 40.6–2021, Methods for Rotodynamic Pump Efficiency Testing.'' HI 40.6–2021 is an industry-accepted test procedure for measuring the performance of rotodynamic pumps. The test procedure proposed in this NOPR references various sections of HI 40.6–2021 that address test setup, instrumentation, test conduct, and calculations. Copies of HI 40.6–2021 can be obtained from the Hydraulic Institute at 6 Campus Drive, First Floor North, Parsippany, NJ, 07054–4406, or by going to *www.pumps.org.*

V. Public Participation

A. Participation in the Webinar

The time and date for the webinar meeting are listed in the **DATES** section at the beginning of this document. Webinar registration information, participant instructions, and information about the capabilities available to webinar participants will be published on DOE's website: *www.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=41.* Participants are responsible for ensuring their systems are compatible with the webinar software.

B. Procedure for Submitting Prepared General Statements for Distribution

Any person who has an interest in the topics addressed in this document, or who is representative of a group or class of persons that has an interest in these issues, may request an opportunity to make an oral presentation at the webinar. Such persons may submit to *ApplianceStandardsQuestions@ee.doe.gov.* Persons who wish to speak should include with their request a computer file in WordPerfect, Microsoft Word, PDF, or text (ASCII) file format that briefly describes the nature of their interest in this rulemaking and the topics they wish to discuss. Such persons should also provide a daytime telephone number where they can be reached.

DOE requests persons selected to make an oral presentation to submit an advance copy of their statements at least two weeks before the webinar. At its discretion, DOE may permit persons who cannot supply an advance copy of their statement to participate, if those persons have made advance alternative arrangements with the Building Technologies Office. As necessary, requests to give an oral presentation should ask for such alternative arrangements.

C. Conduct of the Webinar

DOE will designate a DOE official to preside at the webinar/public meeting and may also use a professional facilitator to aid discussion. The meeting will not be a judicial or evidentiary-type public hearing, but DOE will conduct it in accordance with section 336 of EPCA (42 U.S.C. 6306). A court reporter will be present to record the proceedings and prepare a transcript. DOE reserves the right to schedule the order of presentations and to establish the procedures governing the conduct of the webinar/public meeting. There shall not be discussion of proprietary information, costs or prices, market share, or other commercial matters regulated by U.S. anti-trust laws. After the webinar/public meeting and until the end of the comment period, interested parties may submit further comments on the proceedings and any aspect of the rulemaking.

The webinar will be conducted in an informal, conference style. DOE will present a general overview of the topics addressed in this proposed rulemaking, allow time for prepared general statements by participants, and encourage all interested parties to share their views on issues affecting this proposed rulemaking. Each participant will be allowed to make a general statement (within time limits determined by DOE), before the discussion of specific topics. DOE will permit, as time permits, other participants to comment briefly on any general statements.

At the end of all prepared statements on a topic, DOE will permit participants to clarify their statements briefly. Participants should be prepared to answer questions by DOE and by other participants concerning these issues. DOE representatives may also ask questions of participants concerning other matters relevant to this proposed rulemaking. The official conducting the webinar/public meeting will accept additional comments or questions from those attending, as time permits. The presiding official will announce any further procedural rules or modification of the above procedures that may be needed for the proper conduct of the webinar/public meeting.

A transcript of the webinar will be included in the docket, which can be viewed as described in the *Docket* section at the beginning of this document. In addition, any person may buy a copy of the transcript from the transcribing reporter.

D. Submission of Comments

DOE will accept comments, data, and information regarding this proposed rule no later than the date provided in the **DATES** section at the beginning of this proposed rule.[56] Interested parties may submit comments using any of the methods described in the **ADDRESSES** section at the beginning of this document.

Submitting comments via www.regulations.gov. The *www.regulations.gov* web page will require you to provide your name and

[56] DOE has historically provided a 75-day comment period for test procedure NOPRs pursuant to the North American Free Trade Agreement, U.S.-Canada-Mexico (''NAFTA''), Dec. 17, 1992, 32 I.L.M. 289 (1993); the North American Free Trade Agreement Implementation Act, Public Law 103–182, 107 Stat. 2057 (1993) (codified as amended at 10 U.S.C.A. 2576) (1993) (''NAFTA Implementation Act''); and Executive Order 12889, ''Implementation of the North American Free Trade Agreement,'' 58 FR 69681 (Dec. 30, 1993). However, on July 1, 2020, the Agreement between the United States of America, the United Mexican States, and the United Canadian States (''USMCA''), Nov. 30, 2018, 134 Stat. 11 (*i.e.,* the successor to NAFTA), went into effect, and Congress's action in replacing NAFTA through the USMCA Implementation Act, 19 U.S.C. 4501 *et seq.* (2020), implies the repeal of E.O. 12889 and its 75-day comment period requirement for technical regulations. Thus, the controlling laws are EPCA and the USMCA Implementation Act. Consistent with EPCA's public comment period requirements for consumer products, the USMCA only requires a minimum comment period of 60 days. Consequently, DOE now provides a 60-day public comment period for test procedure NOPRs.

contact information. Your contact information will be viewable to DOE Building Technologies staff only. Your contact information will not be publicly viewable except for your first and last names, organization name (if any), and submitter representative name (if any). If your comment is not processed properly because of technical difficulties, DOE will use this information to contact you. If DOE cannot read your comment due to technical difficulties and cannot contact you for clarification, DOE may not be able to consider your comment.

However, your contact information will be publicly viewable if you include it in the comment or in any documents attached to your comment. Any information that you do not want to be publicly viewable should not be included in your comment, nor in any document attached to your comment. Persons viewing comments will see only first and last names, organization names, correspondence containing comments, and any documents submitted with the comments.

Do not submit to *www.regulations.gov* information for which disclosure is restricted by statute, such as trade secrets and commercial or financial information (hereinafter referred to as Confidential Business Information (''CBI'')). Comments submitted through *www.regulations.gov* cannot be claimed as CBI. Comments received through the website will waive any CBI claims for the information submitted. For information on submitting CBI, see the Confidential Business Information section.

DOE processes submissions made through *www.regulations.gov* before posting. Normally, comments will be posted within a few days of being submitted. However, if large volumes of comments are being processed simultaneously, your comment may not be viewable for up to several weeks. Please keep the comment tracking number that *www.regulations.gov* provides after you have successfully uploaded your comment.

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Include contact information each time you submit comments, data, documents, and other information to DOE. No faxes will be accepted.

Comments, data, and other information submitted to DOE electronically should be provided in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format. Provide documents that are not secured, written in English and free of any defects or viruses. Documents should not contain special characters or any form of encryption and, if possible, they should carry the electronic signature of the author.

Campaign form letters. Please submit campaign form letters by the originating organization in batches of between 50 to 500 form letters per PDF or as one form letter with a list of supporters' names compiled into one or more PDFs. This reduces comment processing and posting time.

Confidential Business Information. Pursuant to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via email two well-marked copies: One copy of the document marked confidential including all the information believed to be confidential, and one copy of the document marked non-confidential with the information believed to be confidential deleted. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

It is DOE's policy that all comments may be included in the public docket, without change and as received, including any personal information provided in the comments (except information deemed to be exempt from public disclosure).

E. Issues on Which DOE Seeks Comment

Although DOE welcomes comments on any aspect of this proposal, DOE is particularly interested in receiving comments and views of interested parties concerning the following issues:

Issue 1: Consistent with the Circulator Pump Working Group recommendation and based on the concerns expressed in the comments summarized above regarding SVILs being a part of the same model family as IL pumps and serving as an unregulated alternative to pumps currently subject to DOE test procedures and energy conservation standards, DOE proposes to include SVIL pumps within the test procedure's scope. DOE has tentatively determined that SVIL pumps can be tested using the current DOE pumps test procedure with certain additional modifications The proposed test procedure and metric for SVIL pumps are discussed in sections III.G and III.D of this document. Moreover, DOE expects that including SVIL pumps within the scope of the pumps test procedure would reduce confusion over which inline pumps are and are not regulated. DOE requests comment on its proposal to expand the scope of the test procedure to cover SVIL pumps.

Issue 2: DOE requests comment on its proposal to expand the current test procedure's scope to include BB pumps. Additionally, DOE requests comment on the repeatability and representativeness of testing BB pumps using the current DOE test procedure. DOE also requests comment on any additional burdens associated with testing BB pumps that are different from those burdens associated with pumps currently covered by the DOE test procedure.

Issue 3: DOE requests comment on its proposal to expand the current test procedure's scope to include VT pumps. Additionally, DOE requests comment on the repeatability and representativeness of testing VT pumps using the current DOE test procedure. DOE also requests comment on any additional burdens associated with testing VT pumps that differ from those burdens associated with pumps currently covered by the DOE test procedure.

Issue 4: DOE requests comment on its proposal to expand scope to include RSH pumps. Additionally, DOE requests comment on the repeatability and representativeness of testing RSH pumps using the current DOE test procedure. DOE also requests comment on any additional burdens associated with testing RSH pumps which are different from those burdens associated with pumps currently covered by the DOE test procedure.

Issue 5: DOE requests comment on its tentative determination that there are certain ends suction pumps excluded from the current test procedure due to the ESFM and ESCC definitions. DOE also requests comment on the number of pump models that may fall into this category and whether they are currently being tested according to the DOE test procedure.

Issue 6: DOE requests comment on its proposal to remove the 6-inch maximum bowl diameter restriction from ST pumps, including whether there are any testing limitations for larger bowl diameters.

Issue 7: DOE requests comment on its proposal to expand the scope of the test procedure to include pumps designed to operate with a 6-pole induction motor, and pumps designed to operate with non-induction motors with an operating range that includes speeds of rotation between 960 rpm and 1,440.

Issue 8: DOE requests comment on its tentative determination that incorporating SVILs into the test procedure will largely eliminate the issue of higher speed 1 hp pumps falling out of scope when they rate at a nominal speed of 3600 rpm.

Issue 9: DOE seeks comment on its proposal to clarify the scope of the pumps test procedure with respect to design temperature. Specifically, DOE requests comment on whether 15 °F and 250 °F are more appropriate than 14 °F and 248 °F, or whether other minor adjustments could be made to the range to assist with clarity and enforceability.

Issue 10: DOE requests comment on the proposed changes to the definitions for ''in-line pump'' and ''end-suction pump'' to remove the distinction that liquid is discharged ''through a volute''.

Issue 11: DOE requests comment on the proposed changes to the definitions for ESCC, ESFM, IL, RSV, and ST pumps to remove references to ANSI/HI 1.1–1.2–2014 pump classes. Specifically, DOE requests comment on the ability of the modified definitions to clearly communicate the intended pump categories to industry stake holders.

Issue 12: DOE requests comment on the proposed change to the definition of bowl diameter to include a more specific definition of intermediate bowl instead of referring to the term as defined in ANSI/HI 1.1–1.2–2014.

Issue 13: DOE also proposes to revise the IL definition to explicitly exclude circulator pumps. DOE requests comment on its proposed definitions for ''small vertical in-line pumps'' and ''small vertical twin-head pump.''

Issue 14: DOE requests comment on the percentage of SVIL pumps, if any, that are not sold with a motor, and whether the definition of SVIL pump should be limited to those sold with a motor.

Issue 15: DOE requests comment on its proposed revision to the IL pump definition to explicitly exclude circulator pumps.

Issue 16: DOE requests comment on its proposed definition for between-bearing pumps, specifically if it is sufficient to identify the intended scope.

Issue 17: DOE request comment on the proposed definition for axially-split pump.

Issue 18: DOE requests comment on the proposed definition for vertical turbine pump.

Issue 19: DOE requests comment on the proposed definitions for RSH, RSHIL, and RSHES pumps—particularly whether they are sufficient to identify the intended scope of such pumps as discussed in section III.A.3.c of this document.

Issue 20: DOE requests comment on the proposed definitional changes to ESFM and ESCC pumps in defining both categories based on the location of the bearings which bear the axial load of the pump. Specifically, DOE seeks comment on whether these proposed changes will capture the end-suction pumps identified by stakeholders as not currently meeting the ESCC or ESFM definitions.

Issue 21: DOE requests comment on its proposal that pumps designed to operate between 960 and 1,440 rpm or with 6-pole motors be assigned a nominal speed of 1,200 rpm.

Issue 22: DOE requests comment on the proposed number of stages for testing RSH, VT, and BB pumps.

Issue 23: DOE requests comment on whether the alternate flow points for pumps with BEP at run-out should be determined with respect to expected maximum flow rate or expected BEP flow rate.

Issue 24: DOE requests comment on how manufacturers are currently performing motor sizing for bare pumps with BEP at run-out, and whether using 100 percent of the BEP flow rate is appropriate.

Issue 25: DOE requests comment on whether manufacturers would use a hybrid mapping approach, and if so, whether manufacturers would conduct the motor tests or request the tests from their suppliers. In addition, DOE requests comment on what additional provisions would need to be added to Appendix H of AMCA 214 to make it applicable to pumps, such as speed and load corresponding to pump rating points.

Issue 26: DOE requests: (1) Data indicating whether AHRI 1210-certified data is applicable to pumps; (2) data indicating whether 15 percent and 25 percent incremental losses, which are specified as part of IE3 ratings that are not commonly used in the U.S., are applicable to the U.S. and do not overstate performance, and if not, what incremental losses would be appropriate to apply, and (3) data indicating an appropriate VFD efficiency penalty by hp.

Issue 27: DOE requests comment on its proposed part-load loss factors for induction motors and controls greater than 50 hp.

Issue 28: DOE requests comment on whether inverter-only motors used by pump manufacturers are typically tested in accordance with IEC 61800–9–2:2017.

Issue 29: DOE requests comment on its proposed inverter-only part-load loss coefficients. DOE specifically requests comment on the appropriateness of the delta used to derive these coefficients as well as any other available comparable motor data with which DOE could vet these coefficients.

Issue 30: DOE requests comment on the merits of using a hybrid mapping approach for inverter-only motors and whether it would reduce or increase manufacturer burden compared to the current proposals.

Issue 31: DOE requests comment on its proposal to apply PEI_{VL} to pumps sold with inverter-only synchronous motors without controls, including application of the testing method in section VI of appendix A and the calculation method in section VII of appendix A.

Issue 32: DOE requests comment on its proposal for the calculation-based approach for pumps sold with submersible pumps to require use of the rated motor efficiency marked on the nameplate that has been tested in accordance with the relevant DOE test procedure after such time as compliance is required with an energy conservation standard for submersible motors, should such a standard be established.

Issue 33: DOE seeks comment on whether the efficiency standards found at 10 CFR 431.446 are appropriate for use in the determination of PER_{STD} for SVILs, whether certain motor topologies that would be classified as SNEM are more prevalent and significantly less efficient, and whether the minimum efficiency of the polyphase and CSCR/CSIR standards for the relevant number of poles and motor horsepower is appropriate or whether there should be differences depending on the phase of the motor with which the pump is sold.

Issue 34: DOE seeks comment on: (1) How many models of SVILs are sold with motors with a nominal horsepower less than 0.25 hp, (2) whether such motors could be tested in accordance with the relevant test procedures in 10 CFR 431.446 or proposed in the Motors TP NOPR, and if not, how such motors are tested, and (3) whether the efficiency values in Table III.3 are appropriate for such motors, and if not, how those values should be determined.

Issue 35: DOE seeks comment on its proposal to require testing of SVIL pumps distributed in commerce with motors not regulated by DOE's current electric motor regulations or any motor regulations finalized after January 1, 2022. DOE also seeks comment on whether it should allow such pumps to be rated as bare pumps only if any motor regulations finalized after January

1, 2022, do not include SNEMs and inverter-only synchronous electric motors.

Issue 36: DOE seeks comment on whether the market for SVIL pumps has changed such that the data collected by DOE in 2017 would no longer be applicable, and whether the use of AEDM would address concerns related to part-load loss curves specific to low-horsepower motors.

Issue 37: DOE requests comment on whether the proposed test procedure is appropriate for BB, RSH, and VT pumps.

Issue 38: DOE seeks comment on whether BB, RSH, and VT pumps are typically sold with motors not subject to the energy conservation standards in 10 CFR 431.25 or synchronous inverter-only electric motors, and if so, what kind of motors they are sold with, and what calculation modifications would be needed to accommodate such motors.

Issue 39: DOE requests comment and data on the proposed default submersible motor efficiency values for 6-pole motors.

Issue 40: DOE request comment on its tentative determinations that SVIL, BB, RSH, VT, and pumps tested at a nominal speed of 1,200 rpm have the same testing uncertainty and manufacturing variability as currently regulated pumps. DOE also requests comment on its proposal to adopt the same statistical sampling plans which are currently in place for commercial industrial pumps for SVIL, BB, RSH, VT, and pumps tested at a nominal speed of 1,200 rpm.

Issue 41: DOE requests comment on the proposed statistical sampling procedures and certification requirements.

Issue 42: DOE requests feedback regarding all aspects of its proposal to permit use of an AEDM for general pumps, and any data or information comparing modeled performance with the results of physical testing. DOE specifically seeks comment on its proposed validation classes, and whether groupings should be considered where performance variation between two equipment classes or nominal speeds is well established. In addition, DOE requests comment on whether the calculation-based methods would still be necessary if manufacturers were permitted to use AEDMs in addition to physical testing.

Issue 43: DOE requests comment on its proposal related to enforcement provisions.

Issue 44: DOE requests comment on the proposed amendments to the definition of basic model.

Issue 45: DOE requests comment on its proposal to adopt optional test provisions for the measurement of several other circulator pump metrics, including overall (wire-to-water) efficiency, driver power input, and/or pump power output (hydraulic horsepower).

Issue 46: DOE also requests comment on its understanding that HI 40.6–2021 contains all the necessary methods to determine overall (wire-to-water) efficiency, driver power input, and/or pump power output (hydraulic horsepower) and that further specification is not necessary.

Issue 47: DOE requests comment on the details of the pump features which have been limited due to the burdens imposed by DOE's current test procedure, including, but not limited to, the nature of the features that manufacturers have had to forego providing, the extent of the limits that manufacturers have had to place, and the manner in which manufacturers have had to apply these limits—such as on the basis of intended markets (*e.g.* higher-end vs. budget-end). DOE also seeks information regarding how these burdens may be mitigated to reduce the likelihood of manufacturers from having to limit the inclusion of features with their pumps.

Issue 48: DOE requests comment on its assumptions and understanding of the anticipated impact and potential costs to pump manufacturers if DOE expands the scope of the general pumps test procedure. Additionally, DOE requests comment on any potential cost manufacturers may incur, if any, from this NOPR's proposed scope expansion.

Issue 49: DOE requests comment on its assumptions and understanding of the anticipated impact and potential cost savings to manufacturers of pumps sold with inverter-only motors if DOE adopts the proposed calculation method. Additionally, DOE requests comment on any potential costs or savings that manufacturers may incur, if any, from this proposal.

Issue 50: DOE requests comment on its assumptions and understanding that there will be no cost impact to manufacturers if DOE adopts the proposed updated coefficients for part-load motor losses. Additionally, DOE requests comment on any potential costs or savings that manufacturers may incur, if any, from this proposal.

Issue 51: DOE requests comments on the benefits and burdens of the proposed updates and additions to industry standards referenced in the test procedure for pumps.

VI. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this notice of proposed rulemaking and announcement of public webinar.

List of Subjects

10 CFR Part 429

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Intergovernmental relations, Reporting and recordkeeping requirements, Small businesses.

10 CFR Part 431

Administrative practice and procedure, Confidential business information, Energy conservation test procedures, Incorporation by reference, Reporting and recordkeeping requirements.

Signing Authority

This document of the Department of Energy was signed on March 17, 2022, by Kelly J. Speakes-Backman, Principal Deputy Assistant Secretary for Energy Efficiency and Renewable Energy, pursuant to delegated authority from the Secretary of Energy. That document with the original signature and date is maintained by DOE. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, the undersigned DOE **Federal Register** Liaison Officer has been authorized to sign and submit the document in electronic format for publication, as an official document of the Department of Energy. This administrative process in no way alters the legal effect of this document upon publication in the **Federal Register**.

Signed in Washington, DC, on March 18, 2022.

Treena V. Garrett,

Federal Register Liaison Officer, U.S. Department of Energy.

For the reasons stated in the preamble, DOE is proposing to amend parts 429 and 431 of chapter II of title 10, Code of Federal Regulations as set forth below:

PART 429—CERTIFICATION, COMPLIANCE, AND ENFORCEMENT FOR CONSUMER PRODUCTS AND COMMERCIAL AND INDUSTRIAL EQUIPMENT

■ 1. The authority citation for part 429 continues to read as follows:

Authority: 42 U.S.C. 6291–6317; 28 U.S.C. 2461 note.

■ 2. Amend § 429.59 by:
■ a. Revising the introductory text of paragraph (a); and
■ b. Adding paragraphs (a)(2)(iv) and (a)(3).

The revision and additions read as follows:

§ 429.59 Pumps.

(a) *Determination of represented value.* Manufacturers must determine the represented value, which includes the certified rating, for each basic model of general purpose pump either by testing (which includes the calculation-based methods in the test procedure), in conjunction with the following sampling provisions, or by application of an AEDM that meets the requirements of § 429.70 and the provisions of this section. Manufacturers must determine the represented value, which includes the certified rating, for each basic model of dedicated-purpose pool pump by testing, in conjunction with the following sampling provisions. Manufacturers must update represented values to account for any change in the applicable motor standards in subpart B of part 431 of this chapter and certify amended values as of the next annual certification.

* * * * *

(2) * * *

(iv) *General pumps.* The representative values for pump total head in feet at BEP and nominal speed, volume per unit time in gallons per minute at BEP and nominal speed, and calculated driver power input at each load point must be the arithmetic mean of the value determined for each tested unit of general pump.

(3) Alternative efficiency determination methods. In lieu of testing, a represented value of efficiency or consumption for a basic model of pump must be determined through the application of an AEDM pursuant to the requirements of § 429.70 and the provisions of this section, where:

(i) Any represented value of energy consumption or other measure of energy use of a basic model for which consumers would favor lower values shall be greater than or equal to the output of the AEDM and less than or equal to the Federal standard for that basic model; and

(ii) Any represented value of energy efficiency or other measure of energy consumption of a basic model for which consumers would favor higher values shall be less than or equal to the output of the AEDM and greater than or equal to the Federal standard for that basic model.

* * * * *

■ 3. Amend § 429.70 by adding paragraph (i) to read as follows:

§ 429.70 Alternative methods for determining energy efficiency and energy use.

* * * * *

(i) Alternative efficiency determination method (AEDM) for general pumps—(1) *Criteria an AEDM must satisfy.* A manufacturer may not apply an AEDM to a basic model to determine its efficiency pursuant to this section, unless:

(i) The AEDM is derived from a mathematical model that estimates the energy efficiency or energy consumption characteristics of the basic model as measured by the applicable DOE test procedure;

(ii) The AEDM is based on engineering or statistical analysis, computer simulation or modeling, or other analytic evaluation of performance data; and

(iii) The manufacturer has validated the AEDM, in accordance with paragraph (i)(2) of this section.

(2) *Validation of an AEDM.* Before using an AEDM, the manufacturer must validate the AEDM's accuracy and reliability as follows:

(i) *AEDM overview.* The manufacturer must select at least the minimum number of basic models for each validation class specified in paragraph (i)(2)(iv) of this section to which the particular AEDM applies. Using the AEDM, calculate the PEI for each of the selected basic models. Test each basic model and determine the represented value(s) in accordance with § 429.63(a). Compare the results from the testing and the AEDM output according to paragraph (i)(2)(ii) of this section. The manufacturer is responsible for ensuring the accuracy and repeatability of the AEDM.

(ii) *AEDM basic model tolerances.* (A) The predicted representative PEI for each basic model calculated by applying the AEDM may not be more than five percent less than the represented PEI determined from the corresponding test of the model.

(B) The predicted constant or variable load pump energy index for each basic model calculated by applying the AEDM must meet or exceed the applicable federal energy conservation standard.

(iii) *Additional test unit requirements.* (A) Each AEDM must be supported by test data obtained from physical tests of current models; and

(B) Test results used to validate the AEDM must meet or exceed current, applicable Federal standards as specified in part 431 of this chapter; and

(C) Each test must have been performed in accordance with the applicable DOE test procedure with which compliance is required at the time the basic models used for validation are distributed in commerce.

(iv) *Pump validation classes.*

Validation class	Minimum number of distinct basic models that must be tested
Constant Load End-suction Closed-Coupled Pumps and Constant Load End-suction Frame-Mounted Pumps	2 Basic Models.
Variable Load End-suction Closed-Coupled Pumps and Variable Load End-suction Frame-Mounted Pumps	2 Basic Models.
Constant Load Inline Pumps and Constant Load Small Volute Inline Pumps	2 Basic Models.
Variable Load Inline Pumps and Variable Load Small Volute Inline Pumps	2 Basic Models.
Constant Load Radially-Split Multi-Stage Vertical Pumps and Constant Load Radially-Split Multi-Stage Horizonal Pumps	2 Basic Models.
Variable Load Radially-Split Multi-Stage Vertical Pumps and Variable Load Radially-Split Multi-Stage Horizontal Pumps	2 Basic Models.
Constant Load Submersible Turbine Pumps and Constant Load Vertical Turbine Pumps	2 Basic Models.
Variable Load Submersible Turbine Pumps and Variable Load Vertical Turbine Pumps	2 Basic Models.
Constant Load Between-Bearing Pumps	2 Basic Models.
Variable Load Between-Bearing Pumps	

(3) *AEDM Records Retention Requirements.* If a manufacturer has used an AEDM to determine representative values pursuant to this section, the manufacturer must have available upon request for inspection by the Department records showing:

(i) The AEDM, including the mathematical model, the engineering or statistical analysis, and/or computer simulation or modeling that is the basis of the AEDM;

(ii) Regarding the units tested that were used to validate the AEDM pursuant to paragraph (i)(2) of this section, equipment information, complete test data, AEDM calculations, and the statistical comparisons; and

(iii) For each basic model to which the AEDM was applied, equipment information and AEDM calculations.

(4) *Additional AEDM requirements.* If requested by the Department, the manufacturer must:

(i) Conduct simulations before representatives of the Department to predict the performance of particular basic models of the equipment to which the AEDM was applied;

(ii) Provide analyses of previous simulations conducted by the manufacturer; and/or

(iii) Conduct certification testing of basic models selected by the Department.

(5) AEDM verification testing. DOE may use the test data for a given individual model generated pursuant to § 429.104 to verify the certified rating determined by an AEDM as long as the following process is followed:

(i) *Selection of units.* DOE will obtain units for test from retail, where available. If units cannot be obtained from retail, DOE will request that a unit be provided by the manufacturer.

(ii) *Lab requirements.* DOE will conduct testing at an independent, third-party testing facility of its choosing. In cases where no third-party laboratory is capable of testing the equipment, it may be tested at a manufacturer's facility upon DOE's request.

(iii) *Manufacturer participation.* Testing will be performed without manufacturer representatives on-site.

(iv) *Testing.* All verification testing will be conducted in accordance with the applicable DOE test procedure, as well as each of the following to the extent that they apply:

(A) Any active test procedure waivers that have been granted for the basic model;

(B) Any test procedure guidance that has been issued by DOE;

(C) If during test set-up or testing, the lab indicates to DOE that it needs additional information regarding a given basic model in order to test in accordance with the applicable DOE test procedure, DOE may organize a meeting between DOE, the manufacturer and the lab to provide such information.

(D) At no time during the process may the lab communicate directly with the manufacturer without DOE present.

(v) *Failure to meet certified rating.* If a model's test results are worse than its certified rating by an amount exceeding the tolerance prescribed in paragraph (f)(5)(vi) of this section, DOE will notify the manufacturer. DOE will provide the manufacturer with all documentation related to the test set up, test conditions, and test results for the unit. Within the timeframe allotted by DOE, the manufacturer may then present all claims regarding testing validity.

(vi) *Tolerances.* For consumption metrics, the result from a DOE verification test must be less than or equal to the certified rating × (1 + the applicable tolerance).

TABLE 4 TO PARAGRAPH (I)(5)(VI)

Equipment	Metric	Applicable tolerance (%)
General Pumps	Constant or Variable Load Pump Energy Index	5

(vii) *Invalid rating.* If, following discussions with the manufacturer and a retest where applicable, DOE determines that the testing was conducted appropriately in accordance with the DOE test procedure, the rating for the model will be considered invalid. The manufacturer must conduct additional testing and re-rate and re-certify the basic models that were rated using the AEDM based on all test data collected, including DOE's test data.

(viii) *AEDM use.* This paragraph (i)(5)(viii) specifies when a manufacturer's use of an AEDM may be restricted due to prior invalid represented values.

(A) If DOE has determined that a manufacturer made invalid ratings on two or more models rated using the same AEDM within a 24 month period, the manufacturer must take the action listed in the table corresponding to the number of invalid certified ratings. The twenty-four month period begins with a DOE determination that a rating is invalid through the process outlined above. Additional invalid ratings apply for the purposes of determining the appropriate consequences if the subsequent determination(s) is based on selection of a unit for testing within the twenty-four month period (*i.e.,* subsequent determinations need not be made within 24 months).

TABLE 5 TO PARAGRAPH (i)(5)(viii)(A)

Number of invalid certified ratings from the same AEDM [1] within a rolling 24-month period [2]	Required manufacturer actions
2	Submit different test data and reports from testing to validate that AEDM within the validation classes to which it is applied.[3] Adjust the ratings as appropriate.
4	Conduct double the minimum number of validation tests for the validation classes to which the AEDM is applied. Note, the tests required under this paragraph (i)(5)(viii) must be performed on different models than the original tests required under paragraph (i)(2) of this section.
6	Conduct the minimum number of validation tests for the validation classes to which the AEDM is applied at a third-party test facility; And Conduct additional testing, which is equal to ½ the minimum number of validation tests for the validation classes to which the AEDM is applied, at either the manufacturer's facility or a third-party test facility, at the manufacturer's discretion. Note, the tests required under this paragraph (i)(5)(viii) must be performed on different models than the original tests performed under paragraph (i)(2) of this section.

TABLE 5 TO PARAGRAPH (i)(5)(viii)(A)—Continued

Number of invalid certified ratings from the same AEDM[1] within a rolling 24-month period[2]	Required manufacturer actions
> = 8	Manufacturer has lost privilege to use AEDM. All ratings for models within the validation classes to which the AEDM applied should be rated via testing. Distribution cannot continue until certification(s) are corrected to reflect actual test data.

[1] The "same AEDM" means a computer simulation or mathematical model that is identified by the manufacturer at the time of certification as having been used to rate a model or group of models.

[2] The twenty-four month period begins with a DOE determination that a rating is invalid through the process outlined above. Additional invalid ratings apply for the purposes of determining the appropriate consequences if the subsequent determination(s) is based on testing of a unit that was selected for testing within the twenty-four month period (*i.e.,* subsequent determinations need not be made within 24 months).

[3] A manufacturer may discuss with DOE's Office of Enforcement whether existing test data on different basic models within the validation classes to which that specific AEDM was applied may be used to meet this requirement.

(B) If, as a result of eight or more invalid ratings, a manufacturer has lost the privilege of using an AEDM for rating, the manufacturer may regain the ability to use an AEDM by:

(*1*) Investigating and identifying cause(s) for failures;

(*2*) Taking corrective action to address cause(s);

(*3*) Performing six new tests per validation class, a minimum of two of which must be performed by an independent, third-party laboratory to validate the AEDM; and

(*4*) Obtaining DOE authorization to resume use of the AEDM.

■ 3. Section 429.134 is amended by revising paragraph (i)(1)(ii):

§ 429.134 Product-specific enforcement provisions.

* * * * *

(i) * * *

(1) * * *

(ii) DOE will test each pump unit according to the test method specified by the manufacturer in the certification report submitted pursuant to § 429.59(b); if the model of pump unit was rated using an AEDM, DOE may use either a testing approach or calculation approach.

* * * * *

PART 431—ENERGY EFFICIENCY PROGRAM FOR CERTAIN COMMERCIAL AND INDUSTRIAL EQUIPMENT

■ 4. The authority citation for part 431 continues to read as follows:

Authority: 42 U.S.C. 6291–6317; 28 U.S.C. 2461 note.

■ 5. Amend § 431.462 by:

■ a. Revising the introductory text;

■ b. Adding in alphabetical order the definition for "Axially-split pump";

■ c. Revising the definition for "Basic model";

■ d. Adding in alphabetical order the definition for "Between-bearing pump";

■ e. Revising the definitions for "Bowl diameter", "Close-coupled pump",

■ f. Removing the definitions for "End suction close-coupled (ESCC) pump", "End suction frame mounted/own bearings (ESFM) pump", "End suction pump", and adding, in their respective places, the definitions for "End-suction close-coupled (ESCC) pump", "End-suction frame mounted/own bearings (ESFM) pump", and "End-suction pump;

■ g. Revising the definition for "In-line (IL) pump";

■ h. Adding in alphabetical order the definition for "Intermediate bowl";

■ i. Revising the definition for "Mechanically-coupled pump";

■ j. Adding in alphabetical order the definitions for "Radially-split, multi-stage, horizontal, diffuser casing (RSH) pump", "Radially-split, multi-stage, horizontal, end-suction diffuser casing (RSHES) pump", "Radially-split, multi-stage, horizontal, in-line diffuser casing (RSHIL) pump";

■ k. Removing the definition for "Radially split, multi-stage, vertical, diffuser casing (RSV) pump" and adding, in its place, the definition for "Radially-split, multi-stage, vertical, diffuser casing (RSV) pump"

■ j. Adding in alphabetical order the definitions for "Small vertical in-line (SVIL) pump"; "Small vertical twin-head pump";

■ k. Revising the definition for "Submersible turbine (ST) pump"; and

■ l. Adding in alphabetical order the definition for "Vertical turbine pump".

The revisions and additions read as follows:

§ 431.462 Definitions.

The following definitions are applicable to this subpart, including appendices A, B, and C. In cases where definitions reference design intent, DOE will consider marketing materials, labels and certifications, and equipment design to determine design intent.

Axially-split pump means a pump with a casing that can be separated or split in a plane that is parallel to, and which contains, the axis of the impeller shaft.

* * * * *

Basic model means all units of a given class of pump manufactured by one manufacturer, having the same primary energy source, and having essentially identical electrical, physical, and functional (or hydraulic) characteristics that affect energy consumption, energy efficiency, water consumption, or water efficiency; and, in addition, for pumps that are subject to the test procedures specified in § 431.464(a), the following provisions also apply:

(1) All variations in numbers of stages of bare RSV and ST pumps must be considered a single basic model;

(2) Pump models for which the bare pump differs in impeller diameter, or impeller trim, may be considered a single basic model; and

(3) Pump models for which the bare pump differs in number of stages or impeller diameter and which are sold with motors (or motors and controls) of varying horsepower may only be considered a single basic model if:

(i) For ESCC, ESFM, IL, and RSV pumps, each motor offered in the basic model has a nominal full load motor efficiency rated at the Federal minimum (see the applicable table at § 431.25) or the same number of bands above the Federal minimum for each respective motor horsepower (*see* table 3 of appendix A to subpart Y of this part); or for pumps sold with inverter-only synchronous electric motors, any number of bands above the Federal minimum for each respective motor horsepower provided that the rating is based on the lowest number of bands; or

(ii) For ST pumps, each motor offered in the basic model has a full load motor efficiency at the default nominal full load submersible motor efficiency shown in table 2 of appendix A to subpart Y of this part or the same number of bands above the default nominal full load submersible motor efficiency for each respective motor horsepower (*see* table 3 of appendix A to subpart Y of this part) or for inverter-only synchronous electric motors, any number of bands above the default nominal full load submersible motor efficiency provided the rating is based on the lowest number of bands.

* * * * *

Between-bearing (BB) pump means an axially-split, mechanically-coupled, one- or two-stage, dry rotor, rotodynamic pump with bearings on both ends of the rotating assembly that has a shaft input power greater than or equal to 1 hp and less than or equal to 200 hp at BEP and full impeller diameter and at the number of stages required for testing.

Bowl diameter means the maximum dimension of an imaginary straight line passing through and in the plane of the circular shape of the intermediate bowl of the bare pump that is perpendicular to the pump shaft and that intersects the outermost circular shape of the intermediate bowl of the bare pump at both of its ends.

* * * * *

Close-coupled pump means a pump in which the driver's bearings absorb the pump's axial load.

* * * * *

End-suction close-coupled (ESCC) pump means a close-coupled, dry rotor, end-suction pump that has a shaft input power greater than or equal to 1 hp and less than or equal to 200 hp at BEP and full impeller diameter and that is not a dedicated-purpose pool pump.

End-suction frame mounted/own bearings (ESFM) pump means a mechanically-coupled, dry rotor, end-suction pump that has a shaft input power greater than or equal to 1 hp and less than or equal to 200 hp at BEP and full impeller diameter and that is not a dedicated-purpose pool pump.

End-suction pump means a single-stage, rotodynamic pump in which the liquid enters the bare pump in a direction parallel to the impeller shaft and on the side opposite the bare pump's driver-end. The liquid is discharged in a plane perpendicular to the shaft.

* * * * *

In-line (IL) pump means a pump that is either a twin-head pump or a single-stage, single-axis flow, dry rotor, rotodynamic pump that has a shaft input power greater than or equal to 1 hp and less than or equal to 200 hp at BEP and full impeller diameter, in which liquid is discharged in a plane perpendicular to the shaft. Such pumps do not include circulator pumps.

* * * * *

Intermediate bowl means the enclosure within which the impeller rotates and which serves as a guide for the flow from one impeller to the next.

* * * * *

Mechanically-coupled pump means a pump in which bearings external to the driver absorb the pump's axial load.

* * * * *

Radially-split, multi-stage, horizontal, diffuser casing (RSH) pump means a horizontal, multi-stage, dry rotor, rotodynamic pump:

(1) That has a shaft input power greater than or equal to 1 hp and less than or equal to 200 hp at BEP and full impeller diameter and at the number of stages required for testing;

(2) In which liquid is discharged in a plane perpendicular to the impeller shaft;

(3) For which each stage (or bowl) consists of an impeller and diffuser; and

(4) For which no external part of such a pump is designed to be submerged in the pumped liquid.

Radially-split, multi-stage, horizontal, end-suction diffuser casing (RSHES) pump means a RSH pump in which the liquid enters the bare pump in a direction parallel to the impeller shaft and on the side opposite the bare pump's driver-end.

Radially-split, multi-stage, horizontal, in-line diffuser casing (RSHIL) pump means a single-axis flow RSH pump in which the liquid enters the pump in a plane perpendicular to the impeller shaft.

Radially-split, multi-stage, vertical, diffuser casing (RSV) pump means a vertically suspended, multi-stage, single-axis flow, dry rotor, rotodynamic pump:

(1) That has a shaft input power greater than or equal to 1 hp and less than or equal to 200 hp at BEP and full impeller diameter and at the number of stages required for testing;

(2) In which liquid is discharged in a plane perpendicular to the impeller shaft;

(3) For which each stage (or bowl) consists of an impeller and diffuser; and

(4) For which no external part of such a pump is designed to be submerged in the pumped liquid.

* * * * *

Small vertical in-line (SVIL) pump means a small vertical twin-head pump or a single stage, single-axis flow, dry rotor, rotodynamic pump that:

(1) Has a shaft input power less than 1 horsepower at its BEP at full impeller diameter; and

(2) In which liquid is discharged in a plane perpendicular to the shaft; and

(3) Is not a circulator pump.

Small vertical twin-head pump means a dry rotor, single-axis flow, rotodynamic pump that contains two equivalent impeller assemblies, each of which:

(1) Contains an impeller, impeller shaft (or motor shaft in the case of close-coupled pumps), shaft seal or packing, driver (if present), and mechanical equipment (if present); and

(2) Has a shaft input power that is less than or equal to 1 hp at BEP and full impeller diameter; and

(3) Has the same primary energy source (if sold with a driver) and the same electrical, physical, and functional characteristics that affect energy consumption or energy efficiency; and

(4) Is mounted in its own volute; and

(5) Discharges liquid through its volute and the common discharge in a plane perpendicular to the impeller shaft.

* * * * *

Submersible turbine (ST) pump means a single-stage or multi-stage, dry rotor, rotodynamic pump that is designed to be operated with the motor and stage(s) fully submerged in the pumped liquid; that has a shaft input power greater than or equal to 1 hp and less than or equal to 200 hp at BEP and full impeller diameter and at the number of stages required for testing; and in which each stage of this pump consists of an impeller and diffuser, and liquid enters and exits each stage of the bare pump in a direction parallel to the impeller shaft.

* * * * *

Vertical turbine (VT) pump means a vertically suspended, single-stage or multi-stage, dry rotor, rotodynamic pump:

(1) That has a shaft input power greater than or equal to 1 hp and less than or equal to 200 hp at BEP and full impeller diameter and at the number of stages required for testing;

(2) For which no external part of such pump is designed to be submerged in the pumped liquid;

(3) That has a single pressure containing boundary (*i.e.,* is single casing), which may consist of, but is not limited, to bowls, columns, and discharge heads; and

(4) That discharges liquid through the same casing in which the impeller shaft is contained.

* * * * *

■ 6. Section 431.463 is amended by:

■ a. Revising paragraph (a);

■ b. Removing paragraphs (d)(1) and (2);

■ c. Redesignating paragraphs (d)(3) and (4) as paragraphs (d)(2) and (1), respectively; and.
■ d. Revising newly redesignated paragraph (d)(2).

The revisions read as follows:

§ 431.463 Materials incorporated by reference.

(a) Certain material is incorporated by reference into this part with the approval of the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in this section, DOE must publish a document in the **Federal Register** and the material must be available to the public. All approved material is available for inspection at DOE and at the National Archives and Records Administration (NARA). Contact DOE at the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, Sixth Floor, 950 L'Enfant Plaza SW, Washington, DC 20024, (202) 586–9127, *Buildings@ee.doe.gov, https://www.energy.gov/eere/buildings/building-technologies-office.* For information on the availability of this material at NARA, email: *fr.inspection@nara.gov,* or go to: *www.archives.gov/federal-register/cfr/ibr-locations.html.* The material may be obtained from the sources in the following paragraphs of this section.

* * * * *

(d) * * *

(2) HI 40.6–2021, ''Methods for Rotodynamic Pump Efficiency Testing'', IBR approved for appendix A to this subpart.

* * * * *

■ 7. Section 431.464 is amended by:
■ a. Revising the introductory text of paragraph (a)(1)(i);
■ b. Redesignating paragraphs (a)(1)(ii) and (iii) as (a)(1)(iii) and (iv);
■ c. Adding new paragraph (a)(1)(ii); and
■ d. Revising newly redesignated paragraph (a)(1)(iii).

The revisions and addition read as follows:

§ 431.464 Test procedure for measuring and determining energy consumption of pumps.

(a) * * *

(1) * * *

(i) The following categories of clean water pumps that have the characteristics listed in paragraph (a)(1)(iii) of this section.

* * * * *

(ii) The additional following categories of clean water pumps that have the characteristics listed in paragraph (a)(1)(iii) of this section:

(A) Between-bearing (BB);

(B) Radially-split, multi-stage, horizontal, end-suction diffuser casing (RSHES);

(C) Radially-split, multi-stage, horizontal, in-line diffuser casing (RSHIL);

(D) Small vertical in-line (SVIL); and

(E) Vertical Turbine (VT).

(iii) Pump characteristics:

(A) Flow rate of 25 gpm or greater at BEP and full impeller diameter;

(B) Maximum head of 459 feet at BEP and full impeller diameter and the number of stages required for testing (*see* section 1.2.2 of appendix A of this subpart);

(C) Design temperature range wholly or partially in the range of 15 to 250 °F;

(D) Designed to operate with either:

(*1*) A 2- or 4- or 6-pole induction motor, or

(*2*) A non-induction motor with a speed of rotation operating range that includes speeds of rotation between 2,880 and 4,320 revolutions per minute (rpm) and/or 1,440 and 2,160 rpm and/or 960 and 1,440 revolutions per minute, and in each case, the driver and impeller must rotate at the same speed; and

(E) For ESCC and ESFM pumps, a specific speed less than or equal to 5,000 when calculated using U.S. customary units.

* * * * *

■ 8. Appendix A to subpart Y of part 431 is amended by:
■ a. Revising the note to the beginning of the appendix;
■ b. Revising Section I;
■ c. In section II,
■ i. Revising paragraphs A.1, A.2, B.1.2.1.2, B.1.2.1.2.1., and B.1.2.1.2.2; and
■ ii. Adding paragraph B.1.2.1.2.3;
■ d. In Section III, revising paragraphs A through D, E.1.2.1.2, E.1.2.1.2.1., and E.1.2.1.2.2.;
■ e. In Section IV, revising paragraphs A through D;
■ f. In Section V, revising paragraphs A through D, E.1.1, E.1.2.1.1, E.1.2.1.1.1. and E.1.2.1.1.2.;
■ g. In Section VI, revising paragraphs A through D;
■ h. In Section VII,
■ i. Revising paragraphs A through D, the definition of L_{full} in paragraph E.1.2, paragraphs E.1.2.1, E.1.2.1.1, E.1.2.1.1.1, and E.1.2.1.1.2,
■ ii. Adding E.1.2.1.1.3; and
■ iii. Revising paragraph E.1.2.2;
■ i. Revising Tables 2 and 4; and
■ j. Adding Table 5.

The revisions and additions read as follows:

Appendix A to Subpart Y of Part 431—Uniform Test Method for the Measurement of Energy Consumption of Pumps

Note: Prior to [*date 180 days after publication of final rule*], representations with respect to the energy use or efficiency (including compliance certifications) of pumps specified in § 431.464(a)(1)(i), excluding pumps listed in § 431.464(a)(1)(iv), must be based on testing conducted in accordance with the applicable provisions of this appendix as they appeared in the January 1, 2022 edition of the Code of Federal Regulations of subpart Y of part 431 in 10 CFR parts 200 through 499.

On or after [*date 180 days after publication of final rule*], representations with respect to the energy use or efficiency (including compliance certifications) of pumps specified in § 431.464(a)(1)(i), excluding pumps listed in § 431.464(a)(1)(iv), must be based on testing conducted in accordance with the applicable provisions of this appendix.

Any representations with respect to the energy use or efficiency of pumps specified in 431.464(a)(1)(ii), excluding pumps listed in § 431.464(a)(1)(iv), made on or after [*date 180 days after publication of final rule*] must be made in accordance with the results of testing pursuant to this appendix. Manufacturers must use the results of testing under this appendix to determine compliance with any energy conservation standards established for pumps specified in § 431.464(a)(1)(ii), excluding pumps listed in § 431.464(a)(1)(iv), that are published after January 1, 2022.

I. Test Procedure for Pumps

0. Incorporation by Reference. DOE incorporated by reference in § 431.463 the entire standard for HI 40.6–2021; however, certain enumerated provisions of HI 40.6–2021, as set forth below are inapplicable. To the extent that there is a conflict between the terms or provisions of a referenced industry standard and the CFR, the CFR provisions control.

0.1 Section 40.6.1 Scope
0.2 Section 40.6.5.3 Test report
0.3 Appendix B Reporting of test results (informative)
0.3 Appendix E Testing Circulator Pumps (normative)
0.4 Appendix G DOE Compared to HI 40.6 Nomenclature

A. *General.* To determine the constant load pump energy index (PEI_{CL}) for bare pumps and pumps sold with electric motors or the variable load pump energy index (PEI_{VL}) for pumps sold with electric motors and continuous or non-continuous controls, perform testing in accordance with HI 40.6–2021, except Section 40.6.5.3, ''Test report;'' Appendix E, ''Testing Circulator Pumps (normative)'', and Appendix G ''DOE Compared to HI 40.6 Nomenclature'' with the modifications and additions as noted throughout the provisions below. Where HI 40.6–2021 refers to ''pump,'' the term refers to the ''bare pump,'' as defined in § 431.462. Also, for the purposes of applying this appendix, the term ''volume per unit time,'' as defined in Section 40.6.2, ''Terms and definitions,'' of HI 40.6–2021 shall be deemed to be synonymous with the term ''flow rate'' used throughout that standard and this appendix. In addition, the specifications in Section 40.6.4.1 of HI 40.6–2021, ''Vertically suspended pumps'' do not apply to ST pumps and the performance of ST bare pumps considers bowl performance only.

A.1 *Scope.* Section II of this appendix applies to all pumps and describes how to calculate the pump energy index (section II.A) based on the pump energy rating for the minimally-compliant reference pump (PER_{STD}; section II.B) and the constant load pump energy rating (PER_{CL}) or variable load pump energy rating (PER_{VL}) determined in accordance with one of sections III through VII of this appendix, based on the configuration in which the pump is distributed in commerce and the applicable testing method specified in sections III through VII and as described in Table 1 of this appendix.

TABLE 1—APPLICABILITY OF CALCULATION-BASED AND TESTING-BASED TEST PROCEDURE OPTIONS BASED ON PUMP CONFIGURATION

Pump configuration	Pump sub-configuration	Applicable test methods
Bare Pump	Bare Pump OR Pump + Single-Phase Induction Motor (Excluding SVIL) OR Pump + Driver Other Than Electric Motor.	Section III: Test Procedure for Bare Pumps.
Pump + Motor OR Pump + Motor + Controls other than continuous or non-continuous controls (*e.g.,* ON/OFF switches).	Pump + Motor Listed at § 431.25(g) OR SVIL Pump + Motor Covered by DOE's Energy Conservation Standards * OR Pump + Submersible Motor.	Section IV: Testing-Based Approach for Pumps Sold with Motors OR Section V: Calculation-Based Approach for Pumps Sold with Motors.
	Pump (Including SVIL)+ Motor Not Covered by DOE's Motor Energy Conservation Standards (Except Submersible Motors) ** OR Pump (Other than SVIL) + Single-Phase Induction Motor (if Section III is not used).	Section IV: Testing-Based Approach for Pumps Sold with Motors.
Pump + Motor + Continuous Controls OR Pump + Motor + Non-Continuous Controls OR Pump + Inverter-Only Synchronous Electric Motor *** (With or Without Controls).	Pump + Motor Listed at § 431.25(g) + Continuous Control OR SVIL Pump + Motor Covered by DOE's Energy Conservation Standards * + Continuous Control OR Pump + Submersible Motor + Continuous Control OR Pump + Inverter-Only Synchronous Electric Motor *** (With or Without Continuous Control).	Section VI: Testing-Based Approach for Pumps Sold with Motors and Controls OR Section VII: Calculation-Based Approach for Pumps Sold with Motors Controls.
	Pump + Motor Listed at § 431.25(g) + Non-Continuous Control OR SVIL Pump + Motor Covered by DOE's Energy Conservation Standards * + Non-Continuous Control OR Pump + Submersible Motor + Non-Continuous Control.	Section VI: Testing-Based Approach for Pumps Sold with Motors and Controls.
	Pump (Including SVIL) + Motor Not Covered by DOE's Motor Energy Conservation Standards ** (Except Submersible Motors) + Continuous or Non-Continuous Controls OR Pump (Other than SVIL) + Single-Phase Induction Motor + Continuous or Non-Continuous Controls (if Section III is not used).	Section VI: Testing-Based Approach for Pumps Sold with Motors and Controls.

* All references to ''Motor Covered by DOE's Motor Energy Conservation Standards'' refer to those listed at § 431.446 or those for Small Non-Small Electric Motor Electric Motors (SNEMs) at subpart B of this part, including motors of such varieties that are less than 0.25 hp.

** All references to ''Motor Not Covered by DOE's Motor Energy Conservation Standards'' refer to motors not listed at § 431.25 or, for SVIL, not listed at either § 431.446 or in subpart B of this part (excluding motors of such varieties that are less than 0.25 hp).

*** All references to ''Inverter-Only Synchronous Electric Motor'' refer to inverter-only electric motors than are synchronous electric motors, both as defined in subpart B of this part.

A.2 Section III of this appendix addresses the test procedure applicable to bare pumps. This test procedure also applies to pumps sold with drivers other than motors and BB, ESCC, ESFM, IL, RSHES, RSHIL, RSV, ST, and VT pumps sold with single-phase induction motors.

A.3 Section IV of this appendix addresses the testing-based approach for pumps sold with motors, which applies to all pumps sold with electric motors, except for pumps sold with inverter-only synchronous electric motors, but including pumps sold with single-phase induction motors. This test procedure also applies to pumps sold with controls other than continuous or non-continuous controls (*e.g.,* on/off switches).

A.4 Section V of this appendix addresses the calculation-based approach for pumps sold with motors, which applies to:

A.4.1 Pumps sold with polyphase electric motors regulated by DOE's energy conservation standards for electric motors at § 431.25(g), and

A.4.2 SVIL pumps sold with small electric motors regulated by DOE's energy conservation standards at § 431.446 or sold with SNEMs regulated by DOE's energy conservation standards in subpart B of this part but including motors of such varieties that are less than 0.25 hp, and

A.4.3 Pumps sold with submersible motors.

A.5 Section VI of this appendix addresses the testing-based approach for pumps sold with motors and controls, which applies to all pumps sold with electric motors (including single-phase induction motors) and continuous or non-continuous controls and to pumps sold with inverter-only synchronous electric motors with or without controls.

A.6 Section VII of this appendix discusses the calculation-based approach for pumps sold with motors and controls, which applies to:

A.6.1 Pumps sold with polyphase electric motors regulated by DOE's energy conservation standards for electric motors at § 431.25(g) and continuous controls and

A.6.2 Pumps sold with inverter-only synchronous electric motors,

A.6.3 SVIL pumps sold with small electric motors regulated by DOE's energy conservation standards at § 431.446 (but including motors of such varieties that are less than 0.25 hp) and continuous controls or with SNEMs regulated by DOE's energy conservation standards at subpart B of this part (but including motors of such varieties that are less than 0.25 hp) and continuous controls, and

A.6.4 Pumps sold with submersible motors and continuous controls.

B. *Measurement Equipment.*

B.1 Instrument Accuracy. For the purposes of measuring pump power input, driver power input to the motor or controls, and pump power output, the equipment specified in HI 40.6–2021 Appendix C necessary to measure head, speed of rotation, flow rate, temperature, torque, and electrical power must be used and must comply with the stated accuracy requirements in HI 40.6–2021 Table 40.6.3.2.3 except as noted in sections III.B, IV.B, V.B, VI.B, and VII.B of this appendix. When more than one instrument is used to measure a given parameter, the combined accuracy, calculated as the root sum of squares of individual instrument accuracies, must meet the specified accuracy requirements.

B.2 Calibration. Calibration requirements for instrumentation are specified in Appendix D of HI 40.6–2021.

C. *Test Conditions.* Conduct testing at full impeller diameter in accordance with the test conditions, stabilization requirements, and specifications of HI 40.6–2021 Section 40.6.3, ''Pump efficiency testing;'' Section 40.6.4, ''Considerations when determining the efficiency of certain pumps;'' Section 40.6.5.4 (including appendix A), ''Test arrangements;'' and Section 40.6.5.5, ''Test conditions.'' For ST pumps, head measurements must be based on the bowl assembly total head as described in Section A.5 of 40.6–2021 and the pump power input or driver power input, as applicable, must be based on the measured input power to the driver or bare pump, respectively; Section 40.6.4.1, ''Vertically suspended pumps,'' does not apply to ST pumps.

C.1 Nominal Speed of Rotation. Determine the nominal speed of rotation based on the range of speeds of rotation at which the pump is designed to operate, in accordance with sections I.C.1.1, I.C.1.2, and I.C.1.3 of this appendix, as applicable. When determining the range of speeds at which the pump is designed to operate, DOE will refer to published data, marketing literature, and other publicly-available information about the pump model and motor, as applicable.

C.1.1 For pumps sold without motors, select the nominal speed of rotation based on the speed for which the pump is designed.

C.1.1.1 For bare pumps designed for speeds of rotation including 2,880 to 4,320 revolutions per minute (rpm), the nominal speed of rotation shall be 3,600 rpm.

C.1.1.2 For bare pumps designed for speeds of rotation including 1,440 to 2,160 rpm, the nominal speed of rotation shall be 1,800 rpm.

C1.1.3 For bare pumps designed for speeds of rotation including 960 to 1,440 rpm, the nominal speed of rotation shall be 1,200 rpm.

C.1.2 For pumps sold with induction motors, select the appropriate nominal speed of rotation.

C1.2.1 For pumps sold with 6-pole induction motors, the nominal speed of rotation shall be 1,200 rpm.

C.1.2.2 For pumps sold with 4-pole induction motors, the nominal speed of rotation shall be 1,800 rpm.

C.1.2.3 For pumps sold with 2-pole induction motors, the nominal speed of rotation shall be 3,600 rpm.

C.1.3 For pumps sold with non-induction motors, select the appropriate nominal speed of rotation.

C.1.3.1 Where the operating range of the pump and motor includes speeds of rotation between 2,880 and 4,320 rpm, the nominal speed of rotation shall be 3,600 rpm.

C.1.3.2 Where the operating range of the pump and motor includes speeds of rotation between 1,440 and 2,160 rpm, the nominal speed of rotation shall be 1,800 rpm.

C.1.3.3 Where the operating range of the pump and motor includes speeds of rotation between 960 and 1,440, the nominal speed of rotation shall be 1,200 rpm.

C.2 Multi-Stage Pumps. Perform testing on the pump with two stages for BB pumps, three stages for RSH and RSV pumps, and nine stages for ST and VT pumps. If the basic model of pump being tested is only available with fewer than the required number of stages, test the pump with the maximum number of stages with which the basic model is distributed in commerce in the United States. If the basic model of pump being tested is only available with greater than the required number of stages, test the pump with the lowest number of stages with which the basic model is distributed in commerce in the United States. If the basic model of pump being tested is available with both fewer and greater than the required number of stages, but not the required number of stages, test the pump with the number of stages closest to the required number of stages. If both the next lower and next higher number of stages are equivalently close to the required number of stages, test the pump with the next higher number of stages.

C.3 Twin-Head Pumps. For twin-head pumps, perform testing on an equivalent single impeller IL or SVIL pump as applicable, constructed by incorporating one of the driver and impeller assemblies of the twin-head pump being rated into an adequate IL-style or SVIL-style, single impeller volute and casing. An adequate IL-style or SVIL-style, single impeller volute and casing means a volute and casing for which any physical and functional characteristics that affect energy consumption and energy efficiency are the same as their corresponding characteristics for a single impeller in the twin-head pump volute and casing.

D. *Data Collection and Analysis.*

D.1 Damping Devices. Use of damping devices, as described in Section 40.6.3.2.2 of HI 40.6–2021, are only permitted to integrate up to the data collection interval used during testing.

D.2 Stabilization. Record data at any tested load point only under stabilized conditions, as defined in HI 40.6–2021 Section 40.6.5.5.1, where a minimum of two measurements are used to determine stabilization.

D.3 Calculations and Rounding. Normalize all measured data to the nominal speed of rotation of 3,600 or 1,800 or 1,200 rpm based on the nominal speed of rotation selected for the pump in section I.C.1 of this appendix, in accordance with the procedures specified in Section 40.6.6.1.1 of HI 40.6–2021. Except for the ''expected BEP flow rate,'' all terms and quantities refer to values determined in accordance with the procedures set forth in this appendix for the rated pump. Perform all calculations using raw measured values without rounding. Round PER_{CL} and PER_{VL} to three significant digits, and round PEI_{CL}, and PEI_{VL} values, as applicable, to the hundredths place (*i.e.,* 0.01).

D.4 Pumps with BEP at Run Out. Test pumps for which the expected BEP corresponds to a volume rate of flow that is within 20 percent of the expected maximum flow rate at which the pump is designed to operate continuously or safely (*i.e.,* pumps with BEP at run-out) in accordance with the test procedure specified in this appendix, but with the following exceptions:

D.4.1 Use the following seven flow points—40, 50, 60, 70, 80, 90, and 100 percent of the expected maximum flow rate for determination of BEP in sections III.D, IV.D, V.D, VI.D, and VII.D of this appendix instead of the flow points specified in those sections.

D.4.2 Use flow points of 60, 70, 80, 90, and 100 percent of the expected maximum flow rate of the pump to determine pump power input or driver power input instead of the flow points of 60, 75, 90, 100, 110, and 120 percent of the expected BEP flow rate specified in sections III.E.1.1, IV.E.1, V.E.1.1, VI.E.1, and VII.E.1.1 of this appendix.

D.4.3 To determine PER_{CL} in sections III.E, IV.E, and V.E and to determine PER_{STD} in section II.B, use load points of 65, 90, and 100 percent of the BEP flow rate determined with the modified flow points specified in this section I.D.4 of this appendix instead of 75, 100, and 110 percent of BEP flow. In section II.B.1.1, where alpha values are specified for the load points 75, 100, and 110 percent of BEP flow rate, instead apply the alpha values to the load points of 65, 90, and 100 percent of the BEP flow rate determined with the modified flow points specified in this section I.D.4 of this appendix. However, in sections II.B.1.1.1 and II.B.1.1.1.1 of this appendix, use 100 percent of the BEP flow rate as specified to determine $\eta_{pump,STD}$ and Ns as specified. To determine motor sizing for bare pumps in sections II.B.1.2.1.1 and III.E.1.2.1.1 of this appendix, use a load point of 100 percent of the BEP flow rate instead of 120 percent.

E. *Determination of Additional Performance Parameters*.

E.1 To determine overall (wire-to-water) efficiency, driver power input, and/or pump power output (hydraulic horsepower), conduct testing in accordance with HI 40.6–2021.

II. Calculation of the Pump Energy Index

A. * * *

A.1. For pumps rated as bare pumps or pumps sold with motors (other than inverter-only synchronous electric motors), determine the PEI_{CL} using the following equation:

$$PEI_{CL} = \frac{PER_{CL}}{PER_{STD}}$$

Where:

PEI_{CL} = the pump energy index for a constant load (hp),

PER_{CL} = the pump energy rating for a constant load (hp), determined in accordance with either section III (for bare pumps; BB, ESCC, ESFM, IL, RSHES, RSHIL, RSV, ST or VT pumps sold with single-phase induction motors; and pumps sold with drivers other than electric motors), section IV (for pumps sold with motors and rated using the testing-based approach), or section V (for pumps sold with motors and rated using the calculation-based approach) of this appendix, and

PER_{STD} = the PER_{CL} for a pump that is minimally compliant with DOE's energy conservation standards with the same flow and specific speed characteristics as the tested pump (hp), as determined in accordance with section II.B of this appendix.

A.2 For pumps rated as pumps sold with motors and continuous controls or non-continuous controls (including pumps sold with inverter-only synchronous electric motors with or without controls), determine the PEI_{VL} using the following equation:

$$PEI_{VL} = \frac{PER_{VL}}{PER_{STD}}$$

PEI_{VL} = the pump energy index for a variable load (hp),

PER_{VL} = the pump energy rating for a variable load (hp), determined in accordance with section VI (for pumps sold with motors and continuous or non-continuous controls rated using the testing-based approach) or section VII of this appendix (for pumps sold with motors and continuous controls rated using the calculation-based approach), and

PER_{STD} = the PER_{CL} for a pump that is minimally compliant with DOE's energy conservation standards with the same flow and specific speed characteristics as the tested pump (hp), as determined in accordance with section II.B of this appendix.

B. * * *

B.1.2.1.2 Determine the default nominal full load motor efficiency as described in section II.B.1.2.1.2.1 of this appendix for BB, ESCC, ESFM, IL, RSHES, RSHIL, RSV, and VT pumps; section II.B.1.2.1.2.2 of this appendix for ST pumps; and section II.B.1.2.1.2.3 for SVIL pumps.

B.1.2.1.2.1. For BB, ESCC, ESFM, IL, RSHES, RSHIL, RSV, and VT pumps, the default nominal full load motor efficiency is the minimum of the nominal full load motor efficiency standards (open or enclosed) from the table containing the current energy conservation standards for NEMA Design B motors at § 431.25, with the number of poles relevant to the speed at which the pump is being tested (see section I.C.1 of this appendix) and the motor horsepower determined in section II.B.1.2.1.1 of this appendix.

B.1.2.1.2.2. For ST pumps, prior to the compliance date of any energy conservation standards for submersible motors in subpart B of this part, the default nominal full load motor efficiency is the default nominal full load submersible motor efficiency listed in table 2 of this appendix, with the number of poles relevant to the speed at which the pump is being tested (see section I.C.1 of this appendix) and the motor horsepower determined in section II.B.1.2.1.1 of this appendix. Starting on the compliance date of any energy conservation standards for submersible motors in subpart B of this part, the default nominal full load motor efficiency shall be the minimum of any nominal full load motor efficiency standard from the table containing energy conservation standards for submersible motors in subpart B of this part, with the number of poles relevant to the speed at which the pump is being tested (see section I.C.1 of this appendix) and the motor horsepower determined in section II.B.1.2.1.1 of this appendix.

B.1.2.1.2.3. For SVIL pumps, the default nominal full load motor efficiency is the minimum full load motor efficiency standard from the tables containing the current energy conservation standards for polyphase or CSCR/CSIR small electric motors at § 431.446, with the number of poles relevant to the speed at which the pump is being tested (see section I.C.1 of this appendix) and the motor horsepower determined in section II.B.1.2.1.1 of this appendix, or for SVIL pumps sold with motors less than 0.25 hp, the default nominal full load motor efficiency is 58.3% for 6-pole, 64.6% for 4-pole, and 61.7% for 2-pole motors.

* * * * *

III. Test Procedure for Bare Pumps

A. Scope. This section III applies only to:

A.1 Bare pumps,

A.2 Pumps sold with drivers other than electric motors, and

A.3 BB, ESCC, ESFM, IL, RSHES, RSHIL, RSV, ST, and VT pumps sold with single-phase induction motors.

B. Measurement Equipment. The requirements regarding measurement equipment presented in section I.B of this appendix apply to this section III. In addition, when testing pumps using a calibrated motor, electrical measurement equipment shall meet the requirements of Section C.4.3 of HI 40.6–2021 and motor power input shall be determined according to Section 40.6.3.2.3 of HI 40.6–2021 and meet the requirements in Table 40.6.3.2.3 of HI 40.6–2021.

C. Test Conditions. The requirements regarding test conditions presented in section I.C of this appendix apply to this section III. In addition, when testing pumps using a calibrated motor, the conditions in Section C.4.3.1 of HI 40.6–2021 shall be met.

D. Testing BEP for the Pump. Determine the best efficiency point (BEP) of the pump as follows:

D.1. Adjust the flow by throttling the pump without changing the speed of rotation of the pump and conduct the test at a minimum of the following seven flow points: 40, 60, 75, 90, 100, 110, and 120 percent of the expected BEP flow rate of the pump at the nominal speed of rotation, as specified in Section 40.6.5.5.1 of HI 40.6–2021.

D.2. Determine the BEP flow rate as the flow rate at the operating point of maximum pump efficiency on the pump efficiency curve, as determined in accordance with Section 40.6.6.3 of HI 40.6–2021, where the pump efficiency is the ratio of the pump power output divided by the pump power input, as specified in Table 40.6.2 of HI 40.6–2021, disregarding the calculations provided in Section 40.6.6.2.

* * * * *

E.1.2.1.2 Determine the default nominal full load motor efficiency as described in section III.E.1.2.1.2.1 of this appendix for BB, ESCC, ESFM, IL, RSHES, RSHIL, RSV, and VT pumps; or section III.E.1.2.1.2.2. of this appendix for ST pumps.

E.1.2.1.2.1. For BB, ESCC, ESFM, IL, RSHES, RSHIL, RSV, and VT pumps, the default nominal full load motor efficiency is the minimum of the nominal full load motor efficiency standards (open or enclosed) from the table containing the current energy conservation standards for NEMA Design B motors at § 431.25, with the number of poles relevant to the speed at which the pump is being tested (see section I.C.1 of this appendix) and the motor horsepower determined in section III.E.1.2.1.1 of this appendix.

E.1.2.1.2.2. For ST pumps, prior to the compliance date of any energy conservation standards for submersible motors in subpart B of this part, the default nominal full load motor efficiency is the default nominal full load submersible motor efficiency listed in table 2 of this appendix, with the number of poles relevant to the speed at which the pump is being tested (see section I.C.1 of this appendix) and the motor horsepower determined in section III.E.1.2.1.1 of this appendix. Starting on the compliance date of any energy conservation standards for submersible motors in subpart B of this part, the default nominal full load motor efficiency is the minimum of any nominal full load motor efficiency standard from the table containing energy conservation standards for submersible motors in subpart B of this part, with the number of poles relevant to the speed at which the pump is being tested (see section I.C.1 of this appendix) and the motor horsepower determined in accordance with section III.E.1.2.1.1 of this appendix.

* * * * *

IV. Testing-Based Approach for Pumps Sold With Motors

A. Scope. This section IV applies only to pumps sold with electric motors (excluding pumps sold with inverter-only synchronous electric motors), including single-phase induction motors.

B. Measurement Equipment. The requirements regarding measurement equipment presented in section I.B of this appendix apply to this section IV. In addition, when testing pumps using a calibrated motor, electrical measurement equipment shall meet the requirements of Section C.4.3 of HI 40.6–2021 and motor power input shall be determined according to Section 40.6.3.2.3 of HI 40.6–2021 and meet the requirements in Table 40.6.3.2.3 of HI 40.6–2021.

C. *Test Conditions.* The requirements regarding test conditions presented in section I.C of this appendix apply to this section IV. In addition, when testing pumps using a calibrated motor, the conditions in Section C.4.3.1 of HI 40.6–2021 shall be met.

D. *Testing BEP for the Pump.* Determine the best efficiency point (BEP) of the pump as follows:

D.1. Adjust the flow by throttling the pump without changing the speed of rotation of the pump and conduct the test at a minimum of the following seven flow points: 40, 60, 75, 90, 100, 110, and 120 percent of the expected BEP flow rate of the pump at the nominal speed of rotation, as specified in Section 40.6.5.5.1 of HI 40.6–2021.

D.2. Determine the BEP flow rate as the flow rate at the operating point of maximum pump efficiency on the pump efficiency curve, as determined in accordance with Section 40.6.6.3 of HI 40.6–2021, where the pump efficiency is the ratio of the pump power output divided by the pump power input, as specified in Table 40.6.2 of HI 40.6–2021, disregarding the calculations provided in Section 40.6.6.2 of HI 40.6–2021.

* * * * *

V. Calculation-Based Approach for Pumps Sold With Motors

A. *Scope.* This section V can only be used in lieu of the test method in section IV of this appendix to calculate the index for pumps sold with motors listed in section V.A.1, V.A.2, or V.A.3 of this appendix.

A.1 Pumps sold with motors subject to DOE's energy conservation standards for polyphase electric motors at § 431.25(g),

A.2 SVIL pumps sold with small electric motors regulated by DOE's energy conservation standards at § 431.446 or with SNEMs regulated by DOE's energy conservation standards in subpart B of this part but including motors of such varieties that are less than 0.25 hp, and

A.3. Pumps sold with submersible motors.

A.4. Pumps sold with motors not listed in sections V.A.1, V.A.2, or V.A.3 of this appendix cannot use this section V and must apply the test method in section IV of this appendix.

B. *Measurement Equipment.* The requirements regarding measurement equipment presented in section I.B of this appendix apply to this section V. In addition, when testing pumps using a calibrated motor, electrical measurement equipment shall meet the requirements of Section C.4.3 of HI 40.6–2021 and motor power input shall be determined according to Section 40.6.3.2.3 of HI 40.6–2021 and meet the requirements in Table 40.6.3.2.3 of HI 40.6–2021.

C. *Test Conditions.* The requirements regarding test conditions presented in section I.C of this appendix apply to this section V. In addition, when testing pumps using a calibrated motor, the conditions in Section C.4.3.1 of HI 40.6–2021 shall be met.

D. *Testing BEP for the Pump.* Determine the best efficiency point (BEP) of the pump as follows:

D.1. Adjust the flow by throttling the pump without changing the speed of rotation of the pump and conduct the test at a minimum of the following seven flow points: 40, 60, 75, 90, 100, 110, and 120 percent of the expected BEP flow rate of the pump at the nominal speed of rotation, as specified in Section 40.6.5.5.1 of HI 40.6–2021.

D.2. Determine the BEP flow rate as the flow rate at the operating point of maximum pump efficiency on the pump efficiency curve, as determined in accordance with Section 40.6.6.3 of HI 40.6–2021, where the pump efficiency is the ratio of the pump power output divided by the pump power input, as specified in Table 40.6.2 of HI 40.6–2021, disregarding the calculations provided in Section 40.6.6.2.

* * * * *

E.1.1 Determine the pump power input at 75, 100, and 110 percent of the BEP flow rate by employing a least squares regression to determine a linear relationship between the pump power input at the nominal speed of rotation of the pump and the measured flow rate at the following load points: 60, 75, 90, 100, 110, and 120 percent of the expected BEP flow rate. Use the linear relationship to determine the pump power input at the nominal speed of rotation for the load points of 75, 100, and 110 percent of the BEP flow rate.

* * * * *

E.1.2.1.1 For pumps sold with motors other than submersible motors, determine the represented nominal full load motor efficiency as described in section V.E.1.2.1.1.1 of this appendix. For pumps sold with submersible motors, determine the default nominal full load submersible motor efficiency as described in section V.E.1.2.1.1.2 of this appendix.

E.1.2.1.1.1 For pumps sold with motors other than submersible motors, the represented nominal full load motor efficiency is that of the motor with which the given pump model is being tested, as determined in accordance with the DOE test procedure for electric motors at § 431.16 or, for SVIL, the DOE test procedure for small electric motors at § 431.444, or the DOE test procedure for SNEMs in subpart B to this part, as applicable (including for motors less than 0.25 hp), and if available, applicable representation procedures in 10 CFR part 429 and this part.

E.1.2.1.1.2 For pumps sold with submersible motors, prior to the compliance date of any energy conservation standards for submersible motors in subpart B of this part, the default nominal full load submersible motor efficiency is that listed in table 2 of this appendix, with the number of poles relevant to the speed at which the pump is being tested (see section I.C.1 of this appendix) and the motor horsepower of the pump being tested, or if a test procedure for submersible motors is provided in subpart B to this part, the represented nominal full load motor efficiency of the motor with which the given pump model is being tested, as determined in accordance with the applicable test procedure in subpart B to this part and applicable representation procedures in 10 CFR part 429 and this part, may be used instead. Starting on the compliance date of any energy conservation standards for submersible motors in subpart B of this part, the default nominal full load submersible motor efficiency may no longer be used. Instead, the represented nominal full load motor efficiency of the motor with which the given pump model is being tested, as determined in accordance with the applicable test procedure in subpart B of this part and applicable representation procedures in 10 CFR part 429 and this part, must be used.

* * * * *

VI. Testing-Based Approach for Pumps Sold With Motors and Controls

A. Scope. This section VI applies only to pumps sold with electric motors, including single-phase induction motors, and continuous or non-continuous controls, as well as to pumps sold with inverter-only synchronous electric motors (with or without controls). For the purposes of this section VI, all references to ''driver input power'' in this section VI or HI 40.6–2021 refer to the input power to the continuous or non-continuous controls.

B. *Measurement Equipment.* The requirements regarding measurement equipment presented in section I.B of this appendix apply to this section VI. In addition, when testing pumps using a calibrated motor, electrical measurement equipment shall meet the requirements of Section C.4.3 of HI 40.6–2021 and motor power input shall be determined according to Section 40.6.3.2.3 of HI 40.6–2021 and meet the requirements in Table 40.6.3.2.3 of HI 40.6–2021.

C. *Test Conditions.* The requirements regarding test conditions presented in section I.C of this appendix apply to this section VI. In addition, when testing pumps using a calibrated motor, the conditions in Section C.4.3.1 of HI 40.6–2021 shall be met.

D. *Testing BEP for the Pump.* Determine the best efficiency point (BEP) of the pump as follows:

D.1. Adjust the flow by throttling the pump without changing the speed of rotation of the pump and conduct the test at a minimum of the following seven flow points: 40, 60, 75, 90, 100, 110, and 120 percent of the expected BEP flow rate of the pump at the nominal speed of rotation, as specified in Section 40.6.5.5.1 of HI 40.6–2021.

D.2. Determine the BEP flow rate as the flow rate at the operating point of maximum pump efficiency on the pump efficiency curve, as determined in accordance with Section 40.6.6.3 of HI 40.6–2021, where the pump efficiency is the ratio of the pump power output divided by the pump power input, as specified in Table 40.6.2 of HI 40.6–2021, disregarding the calculations provided in Section 40.6.6.2.

* * * * *

VII. Calculation-Based Approach for Pumps Sold With Motors and Controls

A. *Scope.* This section VII can only be used in lieu of the test method in section VI of this appendix to calculate the index for pumps listed in sections VII.A.1, VII.A.2, VII.A.3, and VII.A.4 of this appendix.

A.1. Pumps sold with motors regulated by DOE's energy conservation standards for polyphase NEMA Design B electric motors at § 431.25(g) and continuous controls,

A.2 Pumps sold with inverter-only synchronous electric motors regulated by DOE's energy conservation standards in subpart B of this part,

A.3 SVIL pumps sold with small electric motors regulated by DOE's energy conservation standards at § 431.446 or with SNEMs regulated by DOE's energy conservation standards in subpart B of this part (but including motors of such varieties that are less than 0.25 hp) and continuous controls,

A.4. Pumps sold with submersible motors and continuous controls, and

A.5. Pumps sold with motors not listed in sections VII.A.1, VII.A.2, VII.A.3, and VII.A.4 of this appendix and pumps sold without continuous controls, including pumps sold with non-continuous controls, cannot use this section and must apply the test method in section VI of this appendix.

B. *Measurement Equipment.* The requirements regarding measurement equipment presented in section I.B of this appendix apply to this section VII. In addition, when testing pumps using a calibrated motor, electrical measurement equipment shall meet the requirements of Section C.4.3 of HI 40.6–2021 and motor power input shall be determined according to Section 40.6.3.2.3 of HI 40.6–2021 and meet the requirements in Table 40.6.3.2.3 of HI 40.6–2021.

C. *Test Conditions.* The requirements regarding test conditions presented in section I.C of this appendix apply to this section VII. In addition, when testing pumps using a calibrated motor, the conditions in Section C.4.3.1 of HI 40.6–2021 shall be met.

D. *Testing BEP for the Pump.* Determine the best efficiency point (BEP) of the pump as follows:

D.1. Adjust the flow by throttling the pump without changing the speed of rotation of the pump and conduct the test at a minimum of the following seven flow points: 40, 60, 75, 90, 100, 110, and 120 percent of the expected BEP flow rate of the pump at the nominal speed of rotation, as specified in HI 40.6–2021, except Section 40.6.5.3, and appendix B.

D.2. Determine the BEP flow rate as the flow rate at the operating point of maximum pump efficiency on the pump efficiency curve, as determined in accordance with Section 40.6.6.3 of HI 40.6–2021, where the pump efficiency is the ratio of the pump power output divided by the pump power input, as specified in Table 40.6.2 of HI 40.6–2021, disregarding the calculations provided in Section 40.6.6.2.

* * * * *

E.1.2 * * *

* * * * *

L_{full} = motor losses at full load or, for inverter-only synchronous electric motors, motor + inverter losses at full load, as determined in accordance with section VII.E.1.2.1 of this appendix (hp),

* * * * *

E.1.2.1 Determine the full load motor losses using the appropriate motor efficiency value and horsepower as shown in the following equation:

$$L_{full} = \frac{MotorHP}{\left[\eta_{motor,full}/_{100}\right]} - MotorHP$$

Where:

L_{full} = motor losses at full load (hp), or for inverter-only synchronous electric motors, motor + inverter losses at full load,

MotorHP = the horsepower of the motor with which the pump model is being tested (hp), and

$\eta_{motor,full}$ = the represented nominal full load motor efficiency (*i.e.,* nameplate/DOE-certified value) or the represented nominal full load motor + inverter efficiency or the default nominal full load submersible motor efficiency as determined in accordance with section VII.E.1.2.1.1 of this appendix (%).

E.1.2.1.1 For pumps sold with motors other than inverter-only synchronous electric motors or submersible motors, determine the represented nominal full load motor efficiency as described in section VII.E.1.2.1.1.1 of this appendix. For pumps sold with inverter-only synchronous electric motors, determine the represented nominal full load motor + inverter efficiency as described in section VII.E.1.2.1.1.2 of this appendix. For pumps sold with submersible motors, determine the default nominal full load submersible motor efficiency as described in section VII.E.1.2.1.1.3 of this appendix.

E.1.2.1.1.1 For pumps sold with motors other than inverter-only synchronous electric motors or submersible motors, the represented nominal full load motor efficiency is that of the motor with which the given pump model is being tested, as determined in accordance with the DOE test procedure for electric motors at § 431.16 or, for SVIL, the DOE test procedure for small electric motors at § 431.444 or the DOE test procedure for SNEMs in subpart B of this part, as applicable (including for motors less than 0.25 hp), and, if available, applicable representation procedures in 10 CFR part 429 and this part.

E.1.2.1.1.2 For pumps sold with inverter-only synchronous electric motors, the represented nominal full load motor + inverter efficiency is that of the motor with which the given pump model is being tested, as determined in accordance with any DOE test procedure for inverter-only synchronous electric motors in subpart B of this part, and, if available, applicable representation procedures in 10 CFR part 429 and this part.

E.1.2.1.1.3 For pumps sold with submersible motors, prior to the compliance date of any energy conservation standards for submersible motors in subpart B of this part, the default nominal full load submersible motor efficiency is that listed in table 2 of this appendix, with the number of poles relevant to the speed at which the pump is being tested (see section I.C.1 of this appendix) and the motor horsepower of the pump being tested, or if a test procedure for submersible motors is provided in subpart B of this part, the represented nominal full load motor efficiency of the motor with which the given pump model is being tested, as determined in accordance with the applicable test procedure in subpart B of this part and applicable representation procedures in 10 CFR part 429 and this part, may be used instead. Starting on the compliance date of any energy conservation standards for submersible motors in subpart B of this part, the default nominal full load submersible motor efficiency may no longer be used and instead the represented nominal full load motor efficiency of the motor with which the given pump model is being tested, as determined in accordance with the applicable test procedure in subpart B of this part and applicable representation procedures in 10 CFR part 429 and this part, must be used instead.

E.1.2.2 For load points corresponding to 25, 50, 75, and 100 percent of the BEP flow rate, determine the part load loss factor at each load point as follows:

$$z_i = a \times \left(\frac{P_i}{MotorHP}\right)^2 + b \times \left(\frac{P_i}{MotorHP}\right) + c$$

Where:

z_i = the motor and control part load loss factor at load point i,

a,b,c = coefficients listed in either Table 4 of this appendix for induction motors or Table 5 of this appendix for inverter-only synchronous electric motors, based on the horsepower of the motor with which the pump is being tested,

P_i = the pump power input to the bare pump at load point i, as determined in accordance with section VII.E.1.1 of this appendix (hp),

MotorHP = the horsepower of the motor with which the pump is being tested (hp),

i = load point corresponding to 25, 50, 75, or 100 percent of BEP flow rate, and

$\frac{P_i}{MotorHP} \leq 1.000$. If $\frac{P_i}{MotorHP} > 1.000$, then set $\frac{P_i}{MotorHP} = 1.000$ in the equation in section VII.E.1.2.2 of this appendix to calculate the part load loss factor at load point i.

TABLE 2—DEFAULT NOMINAL FULL LOAD SUBMERSIBLE MOTOR EFFICIENCY BY MOTOR HORSEPOWER AND POLE

Motor horsepower (hp)	Default nominal full load submersible motor efficiency		
	2 poles	4 poles	6 poles
1	55	68	64
1.5	66	70	72
2	68	70	74
3	70	75.5	75.5
5	74	75.5	75.5
7.5	68	74	72
10	70	74	72
15	72	75.5	74
20	72	77	74
25	74	78.5	77
30	77	80	78.5
40	78.5	81.5	81.5
50	80	82.5	81.5
60	81.5	84	82.5
75	81.5	85.5	82.5
100	81.5	84	82.5
125	84	84	82.5
150	84	85.5	85.5
200	85.5	86.5	85.5
250	86.5	86.5	85.5

* * * * *

TABLE 4—INDUCTION MOTOR AND CONTROL PART LOAD LOSS FACTOR EQUATION COEFFICIENTS FOR SECTION VII.E.1.2.2 OF THIS APPENDIX A

Motor horsepower (hp)	Coefficients for induction motor and control part load loss factor (z_i)		
	a	b	c
≤5	−0.4658	1.4965	0.5303
>5 and ≤20	−1.3198	2.9551	0.1052
>20 and ≤50	−1.5122	3.0777	0.1847
>50 and ≤100	−0.6629	2.1452	0.1952
>100	−0.7583	2.4538	0.2233

TABLE 5—INVERTER-ONLY SYNCHRONOUS ELECTRIC MOTOR AND CONTROL PART LOAD LOSS FACTOR EQUATION COEFFICIENTS FOR SECTION VII.E.1.2.2 OF THIS APPENDIX A

Motor horsepower (hp)	Coefficients for induction motor and control part load loss factor (z_i)		
	a	b	c
≤5	−0.0898	1.0251	0.0667
>5 and ≤20	−0.1591	1.1683	−0.0085
>20 and ≤50	−0.4071	1.4028	0.0055
>50 and ≤100	−0.3341	1.3377	−0.0023
>100	−0.0749	1.0864	−0.0096

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