DEPARTMENT OF ENERGY

Office of Energy Efficiency and Renewable Energy

10 CFR Part 432

[Docket No. EE–TP–98–550]

RIN 1904–AA85

Energy Conservation Program: Test Procedures for Distribution Transformers

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

ACTION: Notice of Proposed Rulemaking and public hearing.

SUMMARY: Pursuant to Section 346(a) of the Energy Policy and Conservation Act as amended (EPCA), 42 U.S.C. 6317(a), the Department of Energy (DOE or the Department) proposes to adopt test procedures for measuring the energy efficiency of distribution transformers. The Department proposes to use these test procedures in the process of evaluating whether and what efficiency standards are appropriate for distribution transformers. If standards are promulgated, then use of these test procedures would be required to determine compliance and as a basis for representations. The proposed rule would incorporate by reference clauses from test procedures contained in commercial standards. The Department is proposing to use one of two alternative sets of standards as the primary references: alternative (A) is primarily based on American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE) standards C57.12.90–1993 and C57.12.91–1995, and alternative (B) is based on National Electrical Manufacturers Association (NEMA) standard TP 2–1998, pending its approval by ANSI.

DATES: The Department will accept comments, data, and information regarding the proposed rule no later than February 5, 1999. Ten (10) copies must be submitted. In addition, the Department requests that an electronic copy (3½″ diskette) of the comments on WordPerfect™ 6.1 be provided.

A public hearing will be held on January 6, 1999, in Washington, DC. Requests to speak at the hearing must be received by the Department no later than 4:00 p.m., December 23, 1998. Ten (10) copies of statements to be given at the public hearing must be received by the Department no later than 4:00 p.m., December 23, 1998, and the Department requests that a computer diskette (WordPerfect™ 6.1) of each statement also be provided at that time.

ADDRESSES: Requests to make statements at the public hearing and copies of such statements should be addressed to Ms. Brenda Edwards-Jones, and written comments should be addressed to Ms. Kathi Epping, each at the following address: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, EE–43, 1000 Independence Avenue, SW, Washington, DC 20585–0121. All such documents should be identified both on the envelope and on the documents as ''Energy Conservation Program for Commercial Products: Test Procedures for Distribution Transformers, Docket No. EE–TP–98–550.'' The hearing will begin at 9:00 a.m., on January 6, 1999, and will be held in Room 1E–245 at the U.S. Department of Energy, Forrestal Building, 1000 Independence Avenue, SW, Washington, DC. For more information concerning public participation in this rulemaking proceeding, see section IV, ''Public Comment,'' of this notice.

Copies of the transcript of the public workshop and public comments received may be read in the Freedom of Information Reading Room (Room No. 1E–190) at the U.S. Department of Energy, Forrestal Building, 1000 Independence Avenue, SW, Washington, DC between the hours of 9:00 a.m. and 4:00 p.m., Monday through Friday, except Federal holidays.

Copies of the standards to be incorporated by reference may be viewed at the Department of Energy's Freedom of Information Reading Room at the address stated above. Copies of the referenced standards may be obtained by request from Global Engineering Documents World Headquarters (for NEMA Standards TP 1–1996 and TP 2–1998), 15 Iverness Way East, Inglewood, CO 80112–5776 or the American National Standards Institute (for ISO Standard 9001–1993 and ANSI standards C57.12.90–1993, C57.12.91–1995, C57.12.00–1993, and C57.12.01–1989), 11 West 42nd Street, New York, N.Y. 10036.

FOR FURTHER INFORMATION CONTACT: Kathi Epping, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, EE–43, 1000 Independence Avenue, S.W., Washington, D.C. 20585–0121, (202) 586–7425, e-mail: Kathi.Epping@ee.doe.gov, or Edward Levy, Esq., U.S. Department of Energy, Office of General Counsel, GC–72, 1000 Independence Avenue, S.W., Washington, D.C. 20585, (202) 586–9507, e-mail: Edward.Levy@hq.doe.gov.

SUPPLEMENTARY INFORMATION:

I. Introduction

A. Authority

The National Energy Conservation Policy Act of 1978, Pub. L. 95–619, amended the Energy Policy and Conservation Act (EPCA) to add a Part C of Title III, which established an energy conservation program for certain industrial equipment. The most recent amendments to EPCA, in the Energy Policy Act of 1992 (EPAct), Public Law 102–486, included amendments that expanded Title III of EPCA to include certain commercial water heaters and heating and air-conditioning equipment, incandescent and fluorescent lamps, electric motors, and electric distribution transformers.

Among these amendments is Section 124(a) of EPACT, which amended Section 346 of EPCA, 42 U.S.C. 6317, to provide that the Secretary of Energy must prescribe testing requirements and energy conservation standards for those distribution transformers for which the Secretary determines that standards ''would be technologically feasible and

economically justified, and would result in significant energy savings.'' 42 U.S.C. 6317(a). On October 22, 1997, the Department issued a notice setting forth its determination (''Determination notice'') that, based on the best information currently available, energy conservation standards for electric distribution transformers are technologically feasible and economically justified and would result in significant energy savings. 62 FR 54809. Consequently, the Department is now proceeding to establish, by notice and comment rulemaking, test procedures for distribution transformers.

In the Determination notice, the Department construed the term ''distribution transformer'' in section 346 of EPCA to mean ''all transformers with a primary voltage of 480 V to 35 kV, a secondary voltage of 120 V to 480 V, and a capacity of either 10 to 2500 kVA for liquid-immersed transformers or 0.25 kVA to 2500 kVA for dry-type transformers,'' except for transformers which are not continuously connected to a power distribution system as a distribution transformer. The Department believes this exception would include regulating transformers, machine tool transformers, welding transformers, grounding transformers, testing transformers, and other transformers which are not designed to transfer electrical energy from a primary distribution circuit to a secondary distribution circuit, or within a secondary distribution circuit, or to a consumer's service circuit. The Department indicated that all products included in this definition of ''distribution transformer'' would be addressed in its rulemakings on energy efficiency test procedures and standards for transformers.

Subsequently, the Department has learned that industry typically classifies transformers with a secondary voltage up to 600 V as distribution transformers. These transformers are included, for example, in the scope of NEMA standard TP 1. In light of industry usage and practice, the Department has decided that the term ''distribution transformer'', in the statute, includes transformers with a secondary voltage 480 V to 600 V, in addition to those transformers in the above-mentioned definition. These additional transformers are covered by today's proposed test procedures, and will be included in the Department's consideration of efficiency standards for transformers.

B. Background

The Secretary's Determination notice was based, in part, on analyses conducted by the Oak Ridge National Laboratory (ORNL). In July 1996, ORNL published a report, entitled ''Determination Analysis of Energy Conservation Standards for Distribution Transformers, ORNL–6847'' which assessed several options for setting efficiency standards. The report was based on information from annual sales data, average load data, and surveys of existing and potential transformer efficiencies that were obtained from several organizations. In September 1997, ORNL published a second report, entitled ''Supplement to the ''Determination Analysis'' (ORNL–6847) and Analysis of the NEMA Efficiency Standard for Distribution Transformers, ORNL–6925''. The purpose of this report was to assess NEMA TP 1 along with the options considered in the determination study, using the more accurate analysis model and transformer market and loading data developed subsequent to the publication of the original ORNL report.

On February 10, 1998, the Department held a public workshop with representatives from the National Electrical Manufacturers Association (NEMA), manufacturers, utilities, Federal and state agencies, foreign government, and other interested parties in Washington, DC. Draft Test Procedures were presented as a basis for discussion. In addition, the following issues were discussed: (a) adoption of national and international consensus standards in the test procedures for determining energy efficiency of distribution transformers, (b) burden imposed on industry, especially on manufacturers, by additional testing and data processing, (c) the definition of ''basic model'' for distribution transformers, (d) sampling plan for units to be tested, (e) selection of a measure of energy consumption for distribution transformers, (f) selection of reference temperatures, (g) requirement for applying corrections to measurement data of both liquid-immersed and dry-types of transformers, (h) requirements for quality assurance in testing, and (i) defining the transformers which are to be covered by the test procedures. A transcript of the public workshop is available at the Freedom of Information Reading Room.

NEMA submitted a written statement at the workshop, and 5 comments were received subsequent to the public workshop. A letter from Don Ballard (industry consultant) and a letter from the US Department of Agriculture concerning issues relating to today's notice were submitted to DOE prior to the public workshop. The Department will consider these two letters as part of the public comment received. The comments made at the workshop as well as the written comments were considered in preparing the test procedure presented in today's proposed rule, and recommendations were incorporated where appropriate. The reasons for not incorporating any significant recommendations are explained in section II of today's proposed rule.

C. Summary of the Proposed Test Procedures

The Department will use the test procedures in today's proposed rule in the process of evaluating whether and what efficiency standard levels are appropriate for distribution transformers. If efficiency standards are promulgated, then manufacturers would be required to use these test procedures to determine compliance with the standards and as a basis for representations they make as to the efficiency levels of the transformers they produce.

The Department is proposing that a uniform set of test procedures be applied to all distribution transformers for which standards will be considered, and to all for which standards are ultimately adopted. This does not necessarily mean, however, that a single standard or set of labeling requirements will be adopted for all transformers. In possible future rulemakings addressing standards and labeling, distribution transformers will be divided into classes, if appropriate. A separate class and an appropriate standard will be created for each group of products where the record indicates the product includes a utility or performance-related feature that affects energy efficiency. Moreover, in evaluating an efficiency standard in a future rulemaking, the Department will consider whether the standard would result in any lessening of the utility or performance of the transformer(s) that would be covered by the standard. Finally, even if standards are promulgated for distribution transformers, some classes of transformers may be excluded from standards.

The Department proposes today to incorporate by reference clauses from industry standards for measuring the energy efficiency of distribution transformers. The proposed rule contains two alternative sets of standards for testing transformers for energy consumption and efficiency, and the Department intends to select one of

these alternatives for inclusion in the final rule. Alternative (A) is primarily based on American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE) standards C57.12.90–1993 and C57.12.91–1995, and alternative (B) is based on National Electrical Manufacturers Association (NEMA) standard TP 2–1998. The two reference test standards under alternative (A) are well established within the industry and have been used for over two decades. Limited additional reference is made under alternative (A) to ANSI/IEEE C57.12.00–1993 regarding reference temperatures, loss tolerances, and measurement tolerances. With respect to actual tests and measurements for power losses leading to energy consumption and efficiency, the material in the C57 series standards and TP 2 is nearly identical. The NEMA standard TP 2–1998, referenced in alternative (B), combines all information applicable to tests, measurements for energy consumption, and calculation of efficiency in a single document applicable to both liquid-immersed and dry-type transformers.

The test procedure involves the measurement of electric power consumed by the transformer in the form of no-load and load losses, as well as the determination of certain other quantities needed to establish the test conditions: temperature of the windings and the core; current; voltage; frequency and waveform of voltage; and direct current resistance of the windings. Today's proposed rule also proposes a sampling plan for testing a basic model to establish its compliance with standards and to provide a basis for efficiency representations.

In addition to discussing the standards to be incorporated by reference, the following issues are discussed below: distribution transformers not subject to the test procedures, the reference conditions in the test procedure, measures of energy consumption, the definition of a ''basic model'' to permit grouping of models for testing purposes, and the sampling plan.

II. Discussion

A. Standards to be Incorporated by Reference

The Department is proposing to incorporate by reference specific portions of either three widely used commercial standards, or of a standard being developed by the National Electrical Manufacturers Association (NEMA), as a test procedure in Appendix A of 10 CFR part 432. The three national standards were prepared by the IEEE and approved by ANSI: (1) ANSI/IEEE C57.12.90–1993, ''IEEE Standard Test Code for Liquid-Immersed Distribution, Power and Regulating Transformers and IEEE Guide for Short Circuit Testing of Distribution and Power Transformers,'' (2) ANSI/IEEE C57.12.91–1995, ''IEEE Standard Test Code for Dry-Type Distribution and Power Transformers,'' and (3) ANSI/IEEE C57.12.00–1993, ''IEEE Standard General requirements for Liquid-Immersed Distribution, Power and Regulating Transformers.'' ANSI/IEEE C57.12.90–1993 and ANSI/IEEE C57.12.91–1995 are considered primary references as they address tests and measurements leading to the energy consumption and efficiency values. ANSI/IEEE C57.12.00–1993 complements the previous two ANSI/IEEE standards by specifying the reference temperatures and measurement tolerances, which are essential in fully defining the measurement data. The three aforementioned standards contain more material than the information that is applicable to loss or efficiency testing. Hence, only the applicable sections and clauses are incorporated by reference in today's proposed rulemaking.

The Department is considering referencing a single clause, 4.11.1, of International Standards Organization (ISO) Standard 9001–1993, ''Quality Systems—Model for quality assurance in design, development, production, installation, and servicing,'' for guidance purposes only, concerning compliance with requirements for quality assurance of the test and measuring equipment.

The remaining reference standard being considered by the Department was prepared by NEMA: TP 2–1998, ''Test Method for Measuring the Energy Consumption of Distribution Transformers.'' It is also considered a primary reference standard. This NEMA publication is planned for submission to the ANSI C57 committee for review and possible approval as a national standard, thus including in the approval process a broader constituency, such as the electric utility industry, which is the principal user group of distribution transformers.

In addition, IEEE PC57.123, ''Draft Guide for Transformer Loss Measurement'' is nearing completion and provides additional guidance on how to conduct transformer loss measurements. The Department is also aware that a revised version of ANSI/IEEE C57.12.01 is currently being balloted. If adopted, this revision would make C57.12.01 more consistent with C57.12.00 in specifying measurement tolerances. DOE will examine these documents for possible incorporation by reference in the final DOE test procedures, if they have been approved by IEEE, their sponsoring organization (and preferably by ANSI as well), prior to adoption of the final rule. After the final rule is published, however, any subsequent amendments to any of the referenced standards by the standard-setting organizations (ANSI, IEEE, NEMA, ISO) would become part of the DOE test procedure only if DOE amends the test procedure to incorporate them.

In comments on workshop issues, NEMA recommends TP 2–1998 as the sole primary reference to be incorporated in the DOE test procedure, because it combines in one document the subject matter that is now available in several documents. DOE recognizes the advantages of having all relevant testing requirements in a single primary reference because it enhances the convenience for users and will facilitate future harmonization. However, DOE also desires to incorporate consensus standards that have the broadest acceptance by the stakeholders, such as the cited ANSI standards.

The Department is concerned over whether TP 2 has undergone broad-based scrutiny. In order for DOE to accept TP 2, the Department would need to have sufficient evidence that all users and stakeholders have had an opportunity to review TP 2. The Department would like comments from stakeholders, such as utilities and contractors who specify transformers for commercial and industrial applications (e.g., retail, industrial, and office buildings), on the adequacy of TP 2 to measure transformer efficiency. The Department also is concerned that portions of the current version of TP 2 have been abbreviated from the ANSI/IEEE standards, and certain portions are ambiguous and should be made more explicit. There are also instances in which the terminology should be changed. In addition, certain portions do not read as if the current version of TP 2 is a final document. If these concerns with TP 2 are addressed during the ANSI approval process as the Department believes is likely, and if TP 2 receives approval from ANSI, the Department would be inclined to adopt alternative B.

B. Distribution Transformers Not Subject to the Test Procedures

The commercial standards on which today's proposed test procedures are based are intended to test 60 Hz transformers, although the standards allow for minor variations in frequency. Many manufacturers would need to

modify test equipment in order to accurately conduct tests for transformers that operate at frequencies that deviate substantially from 60 Hz. Because such distribution transformers comprise a small segment of the market, they have little potential for resulting in significant energy savings. In addition, transformers with frequencies other than 60 Hz were not included in the ORNL Determination analyses. Consequently, the Department is proposing that the test procedures in today's proposed rule cover only 55 to 65 Hz transformers, and the Department intends to evaluate only 60 Hz transformers in a possible future standards rulemaking. The Department does not believe this will cause ''loopholes'' because it would not be beneficial to the manufacturers to substitute transformers at substantially different frequencies for 60 Hz applications.

In addition, the Department recognizes that the efficiency of distribution transformers connected to rectifier and converter circuits cannot be readily tested or accurately measured by the conventional loss measurement test procedures outlined in today's proposed rule. The nameplates of these transformers contain a rating for the fundamental-frequency apparent output power and a rating for the apparent output power with non sinusoidal current produced by the converter. The latter is inherently smaller than the former, because harmonic currents produce losses in addition to those of the fundamental-frequency current. As a result of additional physical and electrical requirements in the design of converter and rectifier transformers, their performance is optimized for the output power rating with non sinusoidal current, yielding less than the optimal performance at fundamental frequencies, as would be required in a general purpose distribution transformer. Conversely, optimally designed distribution transformers of other types will not meet the optimal requirements of a converter and rectifier transformer. These transformers also were not included in the ORNL Determination analyses. In addition, rectifier and converter transformers generally have more than two windings per phase, requiring more magnetic material and resulting in higher no-load losses. For these reasons, the test procedures in today's proposed rule will not apply to converter and rectifier transformers with more than 2 windings per phase, and the Department is not inclined to evaluated these transformers in a possible future standards rulemaking.

For the purposes of these test procedures, the Department proposes to define the term ''distribution transformer'' to mean all transformers with a primary voltage of 480 V to 35 kV, a secondary voltage of 120 V to 600 V, a frequency of 55–65 Hz, and a capacity of either 10 kVA to 2500 kVA for liquid-immersed transformers or 0.25 kVA to 2500 kVA for dry-type transformers, except for transformers which are not designed to be connected to a power distribution system as a distribution transformer. These exceptions would include regulating transformers, machine tool transformers, welding transformers, grounding transformers, testing transformers, and other transformers which are not designed to transfer electrical energy from a primary distribution circuit to a secondary distribution circuit, or within a secondary distribution circuit, or to a consumer's service circuit. Converter and rectifier transformers with more than two windings per phase also would not be included.

C. Reference Conditions

There is considerable diversity in the reference conditions specified in the existing commercial standards. Under the current industrial practice, the load losses of liquid-immersed transformers are reported at the rated load and the reference temperature of 85° C, as specified by ANSI/IEEE C57.12.00. This reference temperature is based on an ambient temperature of 20° C and the temperature rise of 65° C. The load losses of dry-type transformers are reported at the rated load and, depending on the insulation system used, at one of five specified temperature rises in addition to an ambient temperature of 20° C, as specified by ANSI C57.12.01. The resulting reference temperatures are: 80, 100, 135, 150, and 170° C. ANSI standards C57.12.90 and C57.12.91 provide an identical algorithm for converting the measured load loss values to specified reference temperatures.

For no-load losses of liquid-immersed transformers, ANSI C57.12.00 specifies the reference temperature of 20° C, thus approximating ambient conditions. Additionally, ANSI C57.12.90 provides an algorithm for converting a no-load loss value measured at another temperature to that at the reference temperature. No reference temperature is specified for the no-load losses of the dry-type transformers.

Finally, NEMA TP 1–1996 recommends minimum efficiencies and the following reference conditions for distribution transformers:

	No-load losses	Load losses
Liquid-immersed (50% of rated load)	20° C	85° C
Medium-voltage dry-type (50% of the rated load)	20° C	75° C
Low-voltage dry-type (35% of the rated load)	20° C	75° C

In order to address the inconsistencies in the reference conditions among the industry standards, the proposed rule specifies the following: (1) Use a consistent reference temperature of 20° C for reporting the no-load losses of both liquid-immersed and dry-type transformers, and correct the measured no-load loss data of dry-type transformers to 20° C as required in ANSI standards for liquid-immersed transformers, if such a correction is significant relative to required measurement accuracy; (2) correct the measured load loss data of dry-type transformers for phase angle errors in the measuring equipment as required in ANSI standards for liquid-immersed transformers, if such errors are significant relative to required measurement accuracy; (3) use an efficiency selected at lower than the rated loading and using a reference temperature for load losses that approximates the temperature rise at new loading conditions, as opposed to using temperature rises, as in ANSI/IEEE standards, for rated nameplate loading; and (4) measure losses of dry-type transformers to the same accuracy as specified for liquid-immersed transformers.

These reference conditions enhance uniformity in requirements and facilitate comparison of products using both liquid-immersed and dry-type insulations. Therefore the proposed rule requires that test results be reported at the following loads and reference temperatures: [1]

[1] Establishing specific loading levels is properly part of the energy conservation standard, but correction of measurement data to new reference conditions (including loading levels) must be included in the test procedure. Today's proposed test procedures use the loading levels in NEMA TP 1, because they appear to be widely used in the industry and are reasonable for testing that is conducted to consider and develop standards. Any standards that are prescribed for transformers will include specific loading levels, which the Department will incorporate into the applicable test procedures.

	No-load losses	Load losses
Liquid-immersed (50% of rated load)	20 °C	55 °C
Medium-voltage [2] dry-type (50% of the rated load)	20 °C	75 °C
Low-voltage [3] dry-type (35% of the rated load)	20 °C	75 °C

Under the proposed rule, the measured no-load and load losses used in the efficiency computation would be adjusted to the stated reference conditions, the total uncertainty (including measurement inaccuracy and uncertainty resulting from lack of reference condition adjustments) exceeds 3 percent.

These reference temperatures were selected with the objectives of obtaining uniformity in reference conditions, having reference conditions that best reflect the actual operating conditions, and maintaining consistency with the practices of the current commercial standards as much as possible. Fully satisfying all three criteria, however, was not practical or even possible, due to the previously mentioned diversity in the existing practice and the inherent differences between liquid-immersed and dry-type transformers. The proposed reference temperature to which no-load losses would be adjusted for both types of transformers is 20 °C, which is consistent with C57.12.00 and TP 1, but not with C57.12.01 which does not specify the reference temperature for no-load losses of dry-type transformers. The 20 °C reference temperature is close to the ambient temperature; therefore losses can be easily measured when the transformer is cold, but this reference temperature does not represent operating conditions. However, because the changes in the core losses due to temperature are small (quoted in C57.12.90 as 6.5×10^{-4} per unit per °C), these differences will have only a small effect on the resulting calculated efficiency.

If a transformer is being tested for efficiency at less than full-rated or nameplate loading (as may be the case for a possible future efficiency standard), it is proper to adjust the reference temperature for load losses. A well established algorithm published in ANSI C57.12.90 and ANSI C57.12.91 is used to perform the computational operation to convert load losses measured at a given temperature to equivalent load losses at a different reference temperature. For load losses of dry-type transformers, TP 1 recommends a single reference temperature of 75 °C, as a substitute for the five temperatures at the rated load corresponding to the five insulation classes. To assess the adequacy of this adjustment, reduced operating temperatures were calculated at 50% and 35% of rated load for all five temperature classes of dry-type insulation and for liquid-immersed insulation. The relationship whereby the temperature rise (ΔT) is proportional to the 0.8th power of the dissipated power (W) was used for this calculation. Thus, $\Delta T = kW^{0.8}$, where k is a constant. The assumption was made that, at the rated load, 75% of dissipated power is the load loss and the remainder is no-load (core) loss.

The results are summarized in Table 1 for both 50% and 35% of the rated loads. Note that for dry-type transformers, out of 10 estimated reference temperatures, five are below 75 °C, four are above, and one is exactly on. Thus, the selected value in TP 1 represents a reasonable compromise, especially if each of the 10 groups were to have similar installed kVA capacity.

TABLE 1.—CALCULATED TEMPERATURE RISES FOR TRANSFORMERS OPERATED AT LOWER THAN THE RATED (NAMEPLATE) LOAD

Insulation system temperature rating °C	Temperature rise at rated load °C	Reference temperature °C	Temperature rise at 50% of rated load °C	Estm. reference temperature at 50% of rated load °C	Temperature rise at 35% of rated load °C	Estm. reference temperature at 35% of rated Load °C
Liquid-Immersed						
85	65	85	35	55	.....	.....
DryType						
130	60	80	30	50	25	45
150	80	100	40	60	35	55
185	115	135	60	80	50	70
200	130	150	65	85	55	75
220	150	170	75	95	65	85

Assumptions:
No-load losses 25%; load losses 75%.
Algorithm: $\Delta T = kW^{0.8}$.
ΔT—temperature rise.
W—dissipated power.
k—constant.
ΔT rounded off to the nearest 5 °C.

For liquid immersed transformers, in the proposed test procedure the reference temperature for the load losses is lowered from 85°C (in C57.12.00 and C57.12.90) to 55°C. This adjustment better approximates the conditions of the actual use of these transformers, and was arrived at using the same type of approach that was used to calculate the adjustment of the load loss reference temperature for dry-type transformers.

The written comments received in conjunction with the workshop on February 10, 1998, support 20°C as the reference temperature for no-load losses of both types of transformers and 75°C as the reference temperature for load

[2] Medium voltages are considered to be greater than 1200 volts.

[3] Low voltages are considered to be no greater than 1200 volts.

losses of dry-type transformers. For load losses of liquid-immersed transformers, stakeholders agreed with using a reference temperature lower than 85°C but did not recommend a specific value.

D. Measures of Energy Consumption

The test procedure provides for three interrelated measures of energy consumption: (a) total transformer losses, (b) transformer efficiency, and (c) estimated annual energy consumption (EAEC). Under the test procedure, each measure is computed at the loading parameters used in NEMA TP 1–1996: 50% of the rated load for liquid-immersed and medium-voltage dry-type transformers, and at 35% of the rated load for low-voltage dry-type transformers.

Transformer losses consist of load losses and no load losses. Load losses vary quadratically with the output current and, hence, with output power. No load losses vary with excitation volatge. The efficiency of a transformer varies with the output power as a result of varying losses.

The industry practice, as required by the cited ANSI standards, has been to measure and report transformer losses rather than energy efficiency. DOE believes that efficiency is the preferable energy descriptor because it is a normalized measure and allows trade-offs between the two types of losses, load losses and no-load losses. Workshop participants supported efficiency as a measure for energy conservation in distribution transformers. Consequently the Department is inclined to use efficiency as the energy descriptor for any standards that may be promulgated.

Expressing energy consumption in terms of efficiency presents some difficulties in calculations and adjustment of test data (e.g. to reference conditions) because accuracy may be lost in the rounding-off process to the nearest tenth of one percent. To avoid this loss of computational accuracy, under the proposed rule, the intermediate calculations would use transformer losses (in watts) or would use percent efficiency with two digits after the decimal point. Only the final efficiency percentage would be rounded off to the nearest one tenth of one percent.

E. Basic Model

It is common for a manufacturer to make numerous models of a product covered by EPCA, and under the Act each model is potentially subject to testing for energy efficiency. Moreover, for appliances covered by the EPCA energy conservation program, although not for distribution transformers, several models often are essentially the same, with each model having some refinement that does not significantly affect the energy efficiency or performance. In order to lessen the burden of test procedures, generally appliance models having essentially identical electrical and mechanical characteristics are categorized into a family of models. The Department has used the term ''basic model'' to identify a family of such models, which consist of products or items of equipment whose performance, design, mechanical, and functional characteristics are essentially the same. Components of similar design may be substituted in a basic model without requiring additional testing if the represented measures of energy consumption continue to satisfy applicable provisions for sampling and testing. Only representative samples within each ''basic model'' are tested.

Thus, the term ''basic model'' has been defined as follows: ''Basic model means all units of a given type of covered product (or class thereof) manufactured by one manufacturer and—* * *[as to dishwashers, for example] which have electrical characteristics that are essentially identical, and which do not have any differing physical or functional characteristics which affect energy consumption.'' 10 CFR 430.2.

At the February 1998 workshop, DOE presented a similar definition for transformers, but it was opposed by all groups and individuals because distribution transformers, unlike consumer appliances, are not produced in large numbers of virtually identical units. However, NEMA presented an approach in which a basic model could be defined to include all transformers having the same nominal power (kVA) rating, the same insulation type (liquid-immersed or dry-type), and the same number of phases (single or three), and operating within the same voltage range. Under NEMA's definition, ''rating'' means a standard output power rating, as tabulated in NEMA TP 1–1996, tables 4–1 and 4–2 (reproduced herein as tables 2 and 3), but will encompass some ratings that are close but not equal to the standard ratings. These power ratings are also the preferred ratings from ANSI/IEEE C57.12.00–1993 for liquid-immersed transformers and ANSI/IEEE C57.12.01–1989 for dry-type transformers.

The Department believes the foregoing approach to defining ''basic model'' is a sound means to reduce the burden of testing. It would apply an approach to distribution transformers that has proven effective in the residential appliance program, but with appropriate modifications given the nature of distribution transformers. The factors outlined in this approach are the design variables that affect a transformer's efficiency. Design considerations cause a transformer's efficiency to increase as its power rating increases. For dry type transformers, efficiency decreases as voltage increases, when all other factors are held constant. In addition, liquid-immersed insulation is inherently more efficient than dry-type insulation, and multiple phases slightly decrease efficiency. Consequently, the Department believes the assignment of minimum efficiencies will likely be made in accordance with such groupings. For example the Canadian energy conservation standard for distribution transformers implements this approach. Therefore, the Department is proposing the definition for ''basic model'' be based on NEMA's approach.

TABLE 2.—PREFERRED STANDARD KVA RATINGS LIQUID-IMMERSED DISTRIBUTION TRANSFORMERS

Single-Phase
Power Rating:
10
15
25
37.5
50
75
100
167
250
333
500
667
833
Three-phase
Power Rating:
15
30
45
75
112.5
150
225
300
500
750
1000
1500
2000
2500

TABLE 3.—PREFERRED STANDARD KVA RATINGS DRY-TYPE DISTRIBUTION TRANSFORMERS

Power rating, kVA	Low voltage, > 1.2 kV	Medium voltage, ≤ 1.2 kV
Single-Phase		
15		
25		
37.5		
50		
75		
100		
167		
250		
333		
500		
667		
833		
Three-Phase		
15		
30		
45		
75		
112.5		
150		
225		
300		
500		
750		
1000		
1500		
2000		
2500		

The Department has some concern, however, that this approach may allow manufacturers who sell some high efficiency models to deliberately under design other transformers within that basic model, while still meeting the standard for the average efficiency of the basic model. The Department is considering addressing this point by imposing a maximum efficiency variation within a basic model, similar to what is now done in ANSI/IEEE C57.12.00 and C57.12.01, as well as NEMA TP 2. The Department would like comments on this concern.

F. Number of Units to be Tested

As discussed above, the classification of transformers into ''basic models'' is one step to reduce the burden of testing. The Department also proposes to permit the use of a statistically meaningful sampling procedure for selecting test specimens, so as to further reduce the testing burden on manufacturers while giving sufficient assurance that the true mean energy efficiency of a basic model meets or exceeds the efficiency level claimed by the manufacturer.

Although the sampling plan presented in this test procedure rule might have some application during the evaluation of possible efficiency standards, it would become operative primarily if and when standards are promulgated. At that point, the efficiency of each basic model of distribution transformer would be established initially by ''compliance testing'' for the purposes of determining whether the transformer complies with the applicable efficiency standard and of labeling the transformer. A sampling plan for compliance is intended to provide a statistically meaningful sampling procedure for conducting tests, so as to reduce the testing burden while giving sufficient assurance that the true mean energy efficiency of a basic model (i.e., the average efficiency of all units manufactured) meets or exceeds a given performance level.

For this purpose, one product under 10 CFR Part 430, § 430.24, involves some similarities with distribution transformers. The required sampling plan for compliance testing of fluorescent lamp ballasts under § 430.24 (q)(1) states, ''For each basic model of fluorescent lamp ballasts, as defined in paragraph (14) of § 430.2, a sample of sufficient size, no less than four, shall be tested to insure that (i) any represented value of estimated annual operating costs, energy consumption, or other measure of energy consumption of a basic model for which consumers would favor a lower value shall be no less than the higher of (A) the mean of the sample or (B) the upper 99 percent confidence limit divided by 1.01, and (ii) any represented value of the ballast efficiency factor or other measure of energy consumption of a basic model for which consumers would favor a higher value shall be no greater than the lower of (A) the mean of the sample or (B) the lower 99 percent confidence limit of the true mean divided by 0.99.''

A sampling plan for enforcement, on the other hand, is intended to provide a statistically meaningful sampling procedure for conducting tests, so as to reduce the testing burden while giving sufficient assurance that a distribution transformer found to be in noncompliance will actually be in noncompliance. The sampling plan for enforcement testing under Part 430 is provided in 10 CFR 430.70, Appendix B. This sampling plan is based on the statistical t-test yielding 97.5 percent probability of obtaining a determination of compliance when the true mean efficiency is equal to the applicable standard.

At the February 1998 workshop, DOE presented both sampling approaches for consideration for compliance testing for distribution transformers. In the comments on workshop issues, NEMA recommended the enforcement sampling test also be used for demonstration of compliance. However, after reviewing these approaches more closely, the Department believes the sampling plan for compliance in Part 430 favors consumers by providing high statistical probability that the mean performance of the basic model meets or exceeds the performance level claimed by the manufacturer based on testing a small number of models. Most of the error introduced by estimating the performance of the basic model from a sample (rather than from testing all units) is absorbed by the producer (manufacturer). The probability of false determination of compliance is low and is quantifiable from the confidence limit and the divisor. For example, for transformer losses, using a lower confidence limit of 95%, 0.97 as the divisor, and assuming a standard deviation of 3% for a basic model and a minimum sample size of five, possible errors and corresponding probabilities for false determinations of compliance are:

Error in percent	1.5	2.0	2.9
Probability in percent	10	5	1

Under these constraints there is a probability of less than 5% that the estimated average losses of the entire population exceed the true average by 2%.

Conversely, the enforcement sampling approach in Part 430 is based on a Student's t-test; it generally tests whether there is a sufficiently high probability to conclude that the average performance of all units of the basic model is below the standard to warrant enforcement action. By selecting an upper confidence limit and a minimum sample size, the probability of the populations not meeting the standard by a certain amount can be established. For example, for transformer losses, using the upper 95% confidence limit and a sample size of five, on a population with standard deviation of 3%, the possible errors and corresponding probabilities for significant false determinations of compliance are high as shown in the table below:

Error in percent	0.8	2.9	5.7
Probability in percent	90	50	5

Under these constraints there is a probability of almost 50% that the estimated average losses of the entire population exceed the true average by 3%.

Thus, after considerable review, the Department is proposing in today's proposed rule to use Part 430's sampling

approach for compliance testing. For transformer losses, the proposed lower confidence limit is 95%, and the divisor is 0.97, with a minimum sample size of five.

Some manufacturers, however, particularly small companies, have limited output of certain basic models; consequently, under today's proposed sampling plan, a manufacturer would need to test a relatively high proportion of the units it manufactures of such a basic model. Moreover, although the Department could provide in its sampling plan that the minimum number of units tested of a low production basic model be reduced from five to two or three, any such basic model would be subject to increased risk of being determined to be in non-compliance due to the statistical probabilities associated with testing a small number of units. To allay these concerns, the Department is considering three possible approaches for sampling limited production models:

(1) Combine two or more limited production basic models of distribution transformer into an aggregate ''basic model'';

(2) Allow testing of a sample fewer than five units, and also permit the use of a represented efficiency value that exceeds, by a specified increment, the average efficiency of the sample, so long as each tested unit exceeds a minimum level of efficiency [4];

(3) Allow compliance testing over a period of time.

The third alternative would be similar to the Department's approach for lamps, which permits lamp manufacturers to submit a certification report up to one year after the date the manufacture of a new model commences, provided that prior to distribution the manufacturer submits a statement describing how it determined the model meets the energy conservation standard. See section 430.62(c)(2) and 42 U.S.C. 6295(i)(7). The Department solicits comments on these possible approaches.

G. New Part 432

10 CFR part 430 covers consumer products as distinct from commercial and industrial equipment. The Department proposed to create a new part 431 in the Code of Federal Regulations (10 CFR part 431) to cover certain commercial and industrial equipment 61 FR 60439 (November 27, 1996). The Department is now contemplating adding a new Part 432 which would include products addressed under 346 of EPCA.

III. Procedural Requirements

A. Review Under the National Environmental Policy Act of 1969

In this rulemaking, the Department proposes provisions to establish test procedures for electric distribution transformers. These test procedures would be used initially only for the purpose of considering the adoption of energy conservation standards. During a subsequent rulemaking concerning such standards, the Department will address the extent to which these test procedures would become generally applicable and binding for determining the energy efficiency of distribution transformers.

The Department has concluded that this rule would not have a significant effect on the human environment, and is covered under the categorical exclusion A.6 of appendix A to Subpart D, 10 CFR Part 1021, which applies to procedural rulemakings. (10 CFR Part 1021 is a DOE regulation implementing the National Environmental Policy Act of 1969 (NEPA), and Appendix A to Subpart D sets forth DOE actions excluded from NEPA review.) Accordingly, neither an environmental assessment nor an environmental impact statement is required.

B. Review Under Executive Order 12866, ''Regulatory Planning and Review''

Today's proposed rule has been determined not to be a ''significant regulatory action,'' as defined in section 3(f) of Executive Order 12866, ''Regulatory Planning and Review.'' 58 FR 51735 (October 4, 1993). Accordingly, this action was not subject to review under the Executive Order by the Office of Information and Regulatory Affairs.

C. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act, 5 U.S.C. 603, requires the preparation of an initial regulatory flexibility analysis for every rule which 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. A regulatory flexibility analysis examines the impact of the rule on small entities and considers alternative ways of reducing negative impacts.

Today's proposed rule prescribes test procedures that will be used to determine what standards, if any, DOE would adopt, and that would likely become generally applicable only upon adoption of standards. Unless and until such standards are adopted, the Department anticipates that manufacturers will use the test procedures to voluntarily test their transformers and provide to DOE efficiency information about their products. No entities, small or large, would be required to comply with these test procedures. Therefore DOE believes today's proposed rule does not have a ''significant economic impact on a substantial number of small entities,'' and the preparation of a regulatory flexibility analysis is not warranted.

D. Review Under Executive Order 12612, ''Federalism''

Executive Order 12612, ''Federalism,'' 52 FR 41685 (October 30, 1987), requires that regulations, rules, legislation, and any other policy actions be reviewed for any substantial direct effect on States, on the relationship between the National Government and States, or in the distribution of power and responsibilities among various levels of government. If there are substantial effects, then the Executive Order requires preparation of a federalism assessment to be used in all decisions involved in promulgating and implementing a policy action.

The proposed rule published today would not regulate the States. At this point, it primarily would affect the manner in which DOE determines whether standards should be adopted, as prescribed under the Energy Conservation and Policy Act. The proposed rule published today would not alter the distribution of authority and responsibility to regulate in this area. Accordingly, DOE has determined that preparation of a federalism assessment is unnecessary.

E. Review Under Executive Order 12630, ''Governmental Actions and Interference With Constitutionally Protected Property Rights''

It has been determined pursuant to Executive Order 12630, ''Governmental Actions and Interference with Constitutionally Protected Property Rights,'' 52 FR 8859 (March 18, 1988), that this regulation would not result in any takings which might require compensation under the Fifth Amendment to the United States Constitution.

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[4] DOE is considering, as a method of implementing this approach, the following: If fewer than 5 units of a basic model are manufactured in a period of 180 days, all units manufactured within this period shall be tested, and the average efficiency of the sample $\bar{E}$ shall satisfy the condition

$\bar{E} \geq E_S [1 - 0.04 \div \sqrt{n} (1 - E_S \div 100)]$

where n is the number of units in the sample, and E_s is the represented value of efficiency.

For sample sizes of two, three, or four transformers, the lowest efficiency in the sample E_{min} shall satisfy the condition

$E_{min} \geq E_S [1 - 0.08 (1 - E_S \div 100)]$

F. Review Under the Paperwork Reduction Act

Today's notice of proposed rulemaking would not impose any compliance certification, labeling or other reporting requirements. Accordingly, no OMB clearance is required under the Paperwork Reduction Act (44 U.S.C. 3501 *et seq.*).

G. Review Under Executive Order 12988, ''Civil Justice Reform''

With respect to the review of existing regulations and the promulgation of new regulations, Section 3(a) of Executive Order 12988, ''Civil Justice Reform,'' 61 FR 4729 (February 7, 1996), imposes on executive agencies the general duty to adhere to the following requirements: (1) eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; and (3) provide a clear legal standard for affected conduct rather than a general standard and promote simplification and burden reduction. With regard to the review required by Section 3(a), Section 3(b) of the Executive Order 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) provide 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 the Executive Order requires Executive agencies to review regulations in light of applicable standards Section 3(a) and Section 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE reviewed today's proposed regulation under the standards of Section 3 of the Executive Order and determined that, to the extent permitted by law, it meets the requirements of those standards.

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

Pursuant to Section 301 of the Department of Energy Organization Act (Pub. L. 95–91), the Department of Energy is required to comply with Section 32 of the Federal Energy Authorization Act (FEAA), as amended by Section 9 of the Federal Energy Administration Authorization Act of 1977 (Pub. L. 95–70). Section 32 provides in essence that, where a proposed rule contains or involves use of commercial standards, the notice of proposed rulemaking must inform the public of the use and background of such standards.

The rule proposed in this notice incorporates by reference commercial standards NEMA TP 2. The Department has evaluated these standards and concludes they were not developed in a manner which fully provides for public participation, comment, and review. The rule proposed in this notice also incorporates by reference commercial standards IEEE/ANSI C57.12.90–1993, C57.12.91–1995, C57.12.00–1993, and C57.12.01–1989, as well as ISO Standard 9001–1993. The Department has evaluated these standards and is unable to conclude whether they were developed in a manner which fully provides for public participation, comment, and review. However, the Department believes the IEEE/ANSI and ISO review processes provide for participation from a larger group of entities than the NEMA standards review process.

As required by Section 32(c) of the Federal Energy Administration Act, the Department will consult with the Attorney General and the Chairman of the Federal Trade Commission concerning the impact of these standards on competition, prior to prescribing a final rule.

I. Review Under Unfunded Mandates Reform Act of 1995

Section 202 of the Unfunded Mandates Reform Act of 1995 (''Unfunded Mandates Act'') requires that the Department prepare a budgetary impact statement before promulgating a rule that includes a Federal mandate that may result in expenditure by state, local, and tribal governments, in the aggregate, or by the private sector, of $100 million or more in any one year. The budgetary impact statement must include: (i) identification of the Federal law under which the rule is promulgated; (ii) a qualitative and quantitative assessment of anticipated costs and benefits of the Federal mandate and an analysis of the extent to which such costs to state, local, and tribal governments may be paid with Federal financial assistance; (iii) if feasible, estimates of the future compliance costs and of any disproportionate budgetary effects the mandate has on particular regions, communities, non-Federal units of government, or sectors of the economy; (iv) if feasible, estimates of the effect on the national economy; and (v) a description of the Department's prior consultation with elected representatives of state, local, and tribal governments and a summary and evaluation of the comments and concerns presented.

The Department has determined that the action proposed today does not include a Federal mandate that may result in estimated costs of $100 million or more to state, local or to tribal governments in the aggregate or to the private sector. Therefore, the requirements of Sections 203 and 204 of the Unfunded Mandates Act do not apply to this action.

IV. Public Comment

A. Written Comment Procedures

Interested persons are invited to participate in the proposed rulemaking by submitting data, comments, or information with respect to the proposed issues set forth in today's proposed rule to Ms. Kathi Epping, at the address indicated at the beginning of the notice. All submittals received by the date specified at the beginning of this notice will be considered by the Department in developing the final rule.

Pursuant to the provisions of 10 CFR 1004.11, any person submitting information which he or she believes to be confidential and exempt by law from public disclosure should submit one complete copy of the document and ten (10) copies, if possible, from which the information believed to be confidential has been deleted. The Department of Energy will make its own determination with regard to the confidential status of the information and treat it according to its determination.

Factors of interest to the Department when evaluating requests to treat as confidential information that has been submitted include: (1) a description of the items; (2) an indication as to whether and why such items are customarily treated as confidential within the industry; (3) whether the information is generally known by or available from other sources; (4) whether the information has previously been made available to others without obligation concerning its confidentiality; (5) an explanation of the competitive injury to the submitting person which would result from public disclosure; (6) an indication as to when such information might lose its confidential character due to the passage of time; and (7) why disclosure of the information would be contrary to the public interest.

B. Public Hearing

1. Procedures for Submitting Requests To Speak

The time and place of the public hearing are indicated at the beginning of this notice of proposed rulemaking. The Department invites any person who has an interest in today's notice of proposed rulemaking, or who is a representative of a group or class of persons that has an interest in these proposed issues, to make a request for an opportunity to make an oral presentation. If you would like to attend the public hearing, please notify Ms. Brenda Edwards-Jones at (202) 586–2945. Requests to speak may be hand delivered to the address indicated at the beginning of the notice between the hours of 8:00 a.m. and 4:00 p.m., Monday through Friday, except Federal holidays.

The person making the request should briefly describe the interest concerned and state why he or she, either individually or as a representative of a group or class of persons that has such an interest, is an appropriate spokesperson, and give a telephone number where he or she may be contacted.

Each person selected to be heard is requested to submit an advance copy of his or her statement prior to the hearing as indicated at the beginning of this notice. Any person wishing to testify who cannot meet this requirement, may at the Department's discretion be permitted to testify if that person has made alternative arrangements with the Office of Codes and Standards in advance. The letter making a request to give an oral presentation shall ask that such alternative arrangements be made.

2. Conduct of Hearing

A DOE official will be designated to preside at the hearing. The hearing will not be a judicial or an evidentiary-type hearing, but will be conducted in accordance with 5 U.S.C. 553 and Section 336 of the Act. The Department of Energy reserves the right to select the persons to be heard at the hearing, to schedule the respective presentations, and to establish the procedures governing the conduct of the hearing.

Each participant will be permitted to make a prepared general statement, limited to five (5) minutes, prior to the discussion of specific topics. The general statement should not address these specific topics, but may cover any other issues pertinent to this rulemaking. Other participants will be permitted to briefly comment on any general statements. The hearing will then be divided into segments, with each segment consisting of one or more topics covered by this notice, as follows: (1) proposed test procedures; (2) adequacy of TP 2 to meet the requirements of users; (3) distribution transformers not subject to the test procedures; (4) grouping of transformers for testing purposes, as manifested by the definition of a basic model; (5) sampling plan for compliance; and (6) general statutory requirements. Any issue concerning a definition in the proposed rule should be addressed during the discussion of the topic(s) to which that issue pertains.

The Department will introduce each topic with a brief summary of the relevant provisions of the proposed rule, and the significant issues involved. Participants in the hearing will then be permitted to make a prepared statement limited to five (5) minutes on that topic. At the end of all prepared statements on a topic, each participant will be permitted to briefly clarify his or her statement and comment on statements made by others. The Department is particularly interested in having participants address in their statements the specific issues set forth below in Section IV–C, ''Issues for Public Comment,'' and participants should be prepared to answer questions by the Department concerning these issues. Representatives of the Department may also ask questions of participants concerning other matters relevant to the hearing. The total cumulative amount of time allowed for each participant to make prepared statements shall be 20 minutes.

The official conducting the hearing will accept additional comments or questions from those attending, as time permits. Any further procedural rules, or modification of the above procedures, needed for the proper conduct of the hearing will be announced by the presiding official.

A transcript of the hearing will be made, and the entire record of this rulemaking, including the transcript, will be retained by the Department of Energy and made available for inspection in the Department's Freedom of Information Reading Room. Any person may purchase a copy of the transcript from the transcribing reporter.

C. Issues Requested for Comment

The Department of Energy is interested in receiving comments and/or data concerning the feasibility, workability and appropriateness of the test procedures proposed in today's proposed rulemaking. Also, DOE welcomes discussion on improvements or alternatives to these approaches. In particular, the Department is interested in gathering comments on the following:

- The adequacy of TP 2 to meet the requirements of non-NEMA manufacturers and users, such as utilities and contractors who specify transformers for commercial and industrial applications (e.g., retail, industrial, and office buildings);
- Distribution transformers not subject to the test procedures;
- Grouping of transformers for testing purposes, as manifested by the definition of a basic model; and
- The sampling plan for compliance (The Department is particularly interested in discussing how small populations should be handled.)

List of Subjects in 10 CFR Part 432

Administrative practice and procedure, Energy conservation, Household appliances. Incorporation by reference.

Issued in Washington, DC., on October 2, 1998.

Dan W. Reicher,

Assistant Secretary, Energy Efficiency and Renewable Energy.

For the reasons set forth in the preamble, Chapter II of Title 10, Code of Federal Regulations, is proposed to be amended by adding a new Part 432 to read as follows.

PART 432—ENERGY CONSERVATION PROGRAM FOR DISTRIBUTION TRANSFORMERS

Sec.

Authority: 42 U.S.C. 6317.

§ 432.1 Purpose and scope [Reserved].

§ 432.2 Definitions.

Basic model means all units of a given type of distribution transformer manufactured by a single manufacturer and which have a comparable nominal output power (kVA) rating, operate within the same voltage range, have the same insulation type (liquid-immersed or dry type), and have the same number of phases (single or three).

Converter transformer means a transformer designed for the dedicated applications of converting direct current (dc) to alternating current (ac), or converting alternating current to direct current. Its nameplate contains a rating for the fundamental-frequency apparent output power and a rating for the apparent output power with non

sinusoidal current produced by the converter.

Distribution transformer means a transformer with a primary voltage of 480 V to 35 kV, a secondary voltage of 120 V to 600 V, a frequency of 55–65 Hz, and a capacity of either 10 to 2500 kVA for liquid-immersed transformers or 0.25 kVA to 2500 kVA for dry-type transformers, except for:

(1) Converter and rectifier transformers with more than two windings per phase, and

(2) Transformers which are not designed to be continuously connected to a power distribution system as a distribution transformer. This second exception includes regulating transformers, machine tool transformers, welding transformers, grounding transformers, testing transformers, and other transformers which are not designed to transfer electrical energy from a primary distribution circuit to a secondary distribution circuit, or within a secondary distribution circuit, or to a consumer's service circuit.

Dry-type distribution transformer means a distribution transformer in which the core and coils are immersed in a gaseous or dry-compound insulating medium.

Efficiency means, for a distribution transformer, the ratio of the useful output power to the total input power.

Liquid-immersed distribution transformer means a distribution transformer in which the core and coils are immersed in an insulating liquid.

Load losses mean, for a distribution transformer, those losses which are incident to the carrying of a specified load. Load losses consist of ohmic (I^2R) loss in the windings due to load and eddy currents; the loss due to circulating currents in parallel windings or in parallel winding strands; and stray losses due to leakage fluxes in the windings, core clamps, and other parts.

Low-voltage dry-type transformer means a distribution transformer with a primary voltage rated at 1.2 kV and below.

Medium-voltage dry-type transformer means a distribution transformer with a primary voltage rated above 1.2 kV.

No-load losses mean, for a distribution transformer, those losses which are incident to the excitation of the transformer. No-load losses consist of core loss, dielectric loss, conductor loss in the windings due to exciting current, and conductor loss due to the circulating currents in parallel windings.

Rectifier transformer means a transformer designed for the dedicated application of converting alternating current to direct current. Its nameplate contains a rating for the fundamental-frequency apparent output power and a rating for the apparent output power with non sinusoidal current produced by the converter.

Total losses mean, for a distribution transformer, the total of the no-load and load losses. It does not include losses due to accessories, such as cooling fans.

Transformer means a static electromagnetic device consisting of a winding, or two or more coupled windings, with a magnetic core for introducing inductive coupling between electric circuits, designed to transfer power by electromagnetic induction between circuits at the same frequency.

§ 432.22 Reference Sources.

(a) Materials Incorporated by Reference. (1) General. The following standards which are not otherwise set forth in this part 432 are incorporated by reference. The material listed in paragraph (a)(2) of this section has been approved for incorporation by reference by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR Part 51. Any subsequent amendment to a standard by the standard-setting organization will not affect the DOE test procedures unless and until amended by DOE. Material is incorporated as it exists on the date of the approval and a notice of any change in the material will be published in the **Federal Register.**

(2) Availability of Standards.

Option One for Paragraph (a)(2)(i) [5]

(i) Copies of ANSI standards C57.12.90–1993, C57.12.91–1995, and C57.12.00–1993 can be obtained from the American National Standards Institute, 11 West 42nd Street, New York, N.Y., 10036;

Option Two for Paragraph (a)(2)(i)

(i) Copies of NEMA Standards Publication TP 2–1998 can be obtained from Global Engineering Documents World Headquarters, 15 Iverness Way East, Inglewood, CO 80112–5776;

(ii) All standards incorporated by reference are available for inspection at the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Hearings and Dockets, Forrestal Building, 1000 Independence Ave, SW, Washington, DC 20585.

[5] In the preamble to this proposed rule, the Department states its intention to adopt as the test procedure for distribution transformers either portions of standards prepared by IEEE and approved by ANSI, or portions of a standard being developed by NEMA. In the proposed rule language, passages introduced by the phrase ''OPTION ONE FOR PARAGRAPH_____'' constitute the language DOE proposes to use if it decides to adopt the ANSI/IEEE standards, and the phrase ''OPTION TWO FOR PARAGRAPH_____'' introduces the regulatory language proposes in the event the NEMA standard is adopted.

(iii) All standards incorporated by reference are available for inspection at the Office of the Federal Register Information Center, 800 North Capitol Street, N.W., Washington, DC.

Option One for Paragraph (a)(3)

(3) List of standards incorporated by reference. (i) ANSI/IEEE Standard C57.12.90–1993, ''IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and IEEE Guide for Short-Circuit Testing of Distribution and Power Transformers'', sections 5 through 5.3.2, sections 8 through 8.4, and sections 9 through 9.4.1.

(ii) ANSI/IEEE Standard C57.12.00–1993, IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers'' clause 9.4.

(iii) ANSI/IEEE Standard C57.12.91–1995, ''IEEE Standard Test Code for Dry-Type Distribution and Power Transformers'' clauses 5 through 5.4.2.3, clauses 8 through 8.3, and clauses 9 through 9.4.2.

Option Two for Paragraph (a)(3)

(3) Standard incorporated by reference. NEMA Standards Publication TP 2–1998, ''Standard Test Method for Measuring the Energy Consumption of Distribution Transformers'' sections 1, 2, 3, 4, 5, and 6. Deviations from these sections are set forth at Appendix A to Part 432 section 3.2(ii).

Option One for Paragraph (b)

(b) Reference Standard. The following standard is referred to in the DOE test procedure and elsewhere in 10 CFR part 432 but is not incorporated by reference and is provided here for guidance: ISO Standard 9001–1993, ''Quality Systems—Model for quality assurance in design, development, production, installation, and servicing'' clause 4.11.1.

Option Two Omits Paragraph (b)

§ 432.23 Test procedures for measures of energy consumption.

Option One for Paragraph (a)

(a) Total losses, expressed in kilowatts, of a liquid-immersed distribution transformer operated at 50% of the rated load shall be determined in accordance with clause 3.1.2 of Appendix A to this part. Total losses of a dry-type distribution transformer operated at either 50% or 35% of the rated load, as appropriate, shall be determined in accordance with clause 3.2.3 of Appendix A to this part.

Option Two for Paragraph (a)

(a) Total losses, expressed in kilowatts, of a liquid-immersed distribution transformer operated at 50% of the rated load shall be determined in accordance with clause 3.3 of Appendix A to this part. Total losses of a dry-type distribution transformer operated at either 50% or 35% of the rated load, as appropriate, shall be determined in accordance with clause 3.4 of Appendix A to this part.

Option One for Paragraph (b)

(b) Efficiency, expressed in percent, of a liquid-immersed distribution transformer

operated at 50% of the rated load shall be determined in accordance with clause 3.1.2 of Appendix A to this part. Efficiency of a dry-type distribution transformer, expressed in percent, operated at either 50% or 35% of the rated load shall be determined in accordance with clause 3.2.3 of Appendix A to this part.

Option Two for Paragraph (b)

(b) Efficiency, expressed in percent, of a liquid-immersed distribution transformer operated at 50% of the rated load shall be determined in accordance with clause 3.5 of Appendix A to this part. Efficiency of a dry-type distribution transformer, expressed in percent, operated at either 50% or 35% of the rated load shall be determined in accordance with clause 3.5 of Appendix A to this part.

(c) The estimated annual energy consumption (EAEC), expressed in kilowatt-hours per year, for a distribution transformer operating continuously at 50% or 35% of the rated output power, as appropriate, shall be the product of:

(1) The total losses in kilowatts as determined in paragraph (a) of this section; and

(2) The representative use cycle of 8766 hours per year.

§ 432.24 Units to be tested.

For each basic model of distribution transformers, a random sample of sufficient size, but no fewer than five production units, shall be tested to insure that any represented value of efficiency shall be no greater than the lower of the:

(a) Mean of the sample; or

(b) The lower 95% confidence limit of the estimated true mean divided by a number equal to $[1-0.03(1-E_s/100)]$, where E_s is the represented value of efficiency claimed for that particular basic model.

Appendix A to Part 432—Uniform Test Method for Measuring the Energy Consumption of Distribution Transformers

1. Definitions. Use the definitions in 10 CFR 432.21 and the following:

1.1 ANSI Standard means a standard approved by a committee accredited by the American National Standards Institute.

1.2 IEEE Standard means a standard developed and approved by the Institute of Electrical and Electronics Engineers. All IEEE standards referenced in Appendix A have been approved or recognized by ANSI.

1.3 ISO Standard means a standard developed and approved by the International Standards Organization.

1.4 NEMA Standards Publication means a standard developed and approved by National Electrical Manufacturers Association.

1.5 Phase angle error means an error introduced in the phase angle displacement between voltage and current phasors by the test equipment. Phase angle error, if significant, can introduce errors in measured transformer losses.

1.6 Phase angle correction means the adjustment (correction) of measurement data to negate the effects of phase angle error.

1.7 Reference temperature means the temperature, specified in a standard, to which the transformer losses shall be corrected and reported.

1.8 Temperature correction means the adjustment (correction) of measurements of no load losses and load losses, obtained with the distribution transformer under test at a temperature that is different from the reference temperature, to values that would have been obtained with the distribution transformer at the reference temperature.

1.9 Test voltage means the voltage of the electric power supplied to the distribution transformer under test.

1.10 Waveform correction means the adjustment (correction) of measurement data obtained with a test voltage that is non-sinusoidal (distorted) to values that would have been obtained with sinusoidal voltage.

Option One for Paragraph 2

2. References.

2.1 ANSI/IEEE Standard C57.12.90–1993, ''IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and IEEE Guide for Short-Circuit Testing of Distribution and Power Transformers'' (ANSI/IEEE C57.12.90).

2.2 ANSI/IEEE Standard C57.12.00–1993, IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers'' (ANSI/IEEE C57.12.00).

2.3 ANSI/IEEE Standard C57.12.91–1995, ''IEEE Standard Test Code for Dry-Type Distribution and Power Transformers'' (ANSI/IEEE C57.12.91).

2.4 ISO Standard 9001–1993, ''Quality Systems—Model for quality assurance in design, development, production, installation, and servicing.''

Option Two for Paragraph 2

2. References.

NEMA Standards Publication TP 2–1998, ''Standard Test Method for Measuring the Energy Consumption of Distribution Transformers'' (NEMA TP 2).

Option One for Paragraph 3

3. Test Procedures' Measurements and Instrumentation, Reference Conditions, Calculations.

The resistance of transformer windings, the no-load losses, and the load losses of transformers shall be measured, and the total losses and efficiency shall be computed at the specified loading levels and reference temperatures, using the methods described in the following industry standards (with certain specified modifications and exceptions): ANSI/IEEE standards C57.12.90–1993 and C57.12.91–1995 (primary references); ANSI/IEEE standard C57.12.00–1993 (supplemental reference). The methods to be used, including applicable sections and clauses in the referenced standards, as well as exceptions and modifications to such sections and clauses, are listed in this appendix: §§ 3.1–3.3 and their subclauses.

3.1 Liquid-Immersed Distribution Transformers.

Using the methods specified in ANSI/IEEE standard C57.12.90–1993 sections 5, 8, and 9, measure the resistance of transformer windings, the no-load losses and load losses of liquid-immersed distribution transformers. Perform waveform correction on the measured no-load losses and perform phase angle correction for the load losses.

3.1.1 Perform temperature corrections for the loss data of § 3.1 by converting the no-load losses to 20°C and converting the load losses to 55°C with the loading at 50% of the rated load. To perform these temperature corrections, the provisions in sections 8.4 and 9.4.2 of ANSI/IEEE standard C57.12.90–1993 are applicable. For the conversion to the 50% loading the quadratic relationship $P_{(L50)}=P_{(LM)}\ (50/M)^2$ applies, where $P_{(L50)}$ is the load loss power at 50% loading, $P_{(LM)}$ is the load loss power at M% loading, and (50/M) is the ratio of the loading at the 50% reference condition to the loading during the measurement (near 100% loading).

3.1.2 Calculate the total losses (P_{50}) at 50 % loading by adding the no-load losses and the load losses as computed in § 3.1.1, and calculate the efficiency at 50 % loading according to the equation:

$E_{50}=100\ [P_{0(50)}/(P_{0(50)}+P_{L(20)})]$,

where E_{50} is the efficiency at 50% loading, and $P_{0(50)}$ and $P_{L(50)}$ are the output power and total loss power, respectively, at 50% loading.

3.2 Dry-Type Transformers.

Using the methods specified in ANSI/IEEE standard C57.12.91–1995, sections 5, 8, and 9, measure the resistance of transformer windings, the no-load losses and load losses of dry-type distribution transformers. Perform waveform correction on the measured no-load losses and perform phase angle correction for the load losses.

3.2.1 In addition to the requirements of ANSI/IEEE standard C57.12.91–1995, the following two additional requirements apply to the measurements in section 3.2 of this appendix:

(i) Perform phase angle correction for the measured load losses as specified in ANSI/IEEE standard C57.12.90–1993, clause 9.4.1 and Table 1;

(ii) Measure the no-load losses with the transformer at the reference temperature of 20°C; a temperature tolerance of ±10°C is permissible; if no-load loss measurements are conducted outside this temperature tolerance, perform the appropriate temperature correction such as that specified in ANSI/IEEE standard C57.12.90–1993, clause 8.4.

3.2.2 Perform temperature corrections for the loss data by converting the load losses of medium-voltage dry-type transformers to 75°C, at 50% of the rated load, and converting the load losses of low-voltage dry-type transformers to 75°C, at 35% of the rated load. To perform these temperature corrections, the provisions of ANSI/IEEE standard C57.12.91-1995, clause 9.4.1 shall apply. For the conversions to the 50% and 35% loading levels the algorithm of § 3.1.1 applies.

3.2.3 Calculate the total losses, $P_{L(50)(35)}$, at either 50% or 35% loading, as appropriate, by adding the no-load losses and load losses as computed in § 3.2.2, and calculate the efficiency of the transformer at either 50% or 35% loadings according to the equation:

$E_{(50)(30)}=100\ [P_{0(50)(30)}/(P_{0(50)(30)}+P_{L(50)(30)})]$,

where $E_{(50)(30)}$ is the efficiency in percent, $P_{0(50)(30)}$ is the output power in kilowatts, and

$P_{L(50)(30)}$ is the loss power in kilowatts. The subscripts, (50) or (35), denote the loading levels, either 50% or 35%.

3.3 Quality Assurance in Testing.

Accuracies required for measuring the winding resistances, the no-load and load losses, and the temperature of distribution transformers shall be those specified in ANSI Standard C57.12.00–1993, Section 9.4.

Test equipment and measuring instruments shall be calibrated and maintained in their normal operating condition. Calibration records shall be maintained to demonstrate compliance with the required measurement accuracies. General guidance as to procedures that will aid in meeting these objectives is provided by the following Clause 4.11.1 of ISO Standard 9001–1993, ''Quality Systems—Model for quality assurance in design, development, production, installation, and servicing.'':

''The supplier shall establish and maintain documented procedures to control, calibrate and maintain inspection, measuring and test equipment (including test software) used by the supplier to demonstrate the conformance of product to the specified requirements. Inspection, measuring and test equipment shall be used in a manner which ensures that measurement uncertainty is known and is consistent with the required measurement capability.''

Option Two for Paragraph 3

3. Test Procedures—Measurements and Instrumentation, Reference Conditions, Calculations.

The resistance of transformer windings, the no-load losses, and the load losses of transformers shall be measured, and the total losses and efficiency shall be computed at the specified loading levels and reference temperatures, using the methods described in the following industry standards (with certain specified modifications and exceptions): NEMA standard TP 2. The methods to be used, including applicable sections and clauses in the referenced standards, as well as exceptions and modifications to such sections and clauses, are listed in this appendix: sections 3.1–3.5 and their subclauses.

3.1 Liquid-Immersed and Dry-Type Distribution Transformers.

In accordance with NEMA TP 2, sections 1, 2, 3, 4, 5, and 6, do the following: measure the resistance of transformer windings, the no-load losses, and the load losses of liquid-immersed and dry-type transformers; apply waveform corrections, phase angle corrections, and temperature corrections to the measured data for no-load losses and load losses; and ensure the quality assurance measures for testing operations.

3.2 Deviations from NEMA TP 2. For the purpose of this DOE test procedure the following deviations from TP 2 shall apply:

(i) Section 7 of TP 2, Demonstration of Compliance, shall not be a part of the DOE test procedure.

(ii) The reference conditions for reporting the data under the DOE test procedure shall be: 20 °C ± 10 °C for no-load losses of liquid-immersed distribution transformers and dry-type distribution transformers; 55 °C for load losses of liquid-immersed distribution transformers operated at 50% of the rated load; 75 °C for load losses of medium-voltage dry-type transformers operated at 50% of the rated load; and 75 °C for load losses of low-voltage dry-type transformers operated at 35% of the rated load.

(iii) The exceptions listed in item 4 of the Scope of TP 2 do not apply to the DOE test procedure.

3.3 The total losses of liquid-immersed distribution transformers, at the specified reference conditions, shall be computed according to clause 5.2.3 of TP 2.

3.4 The total losses of the dry-type distribution transformers, at the specified reference conditions, shall be computed data according to clause 5.3.3 of TP 2.

3.5 Compute the efficiency values of liquid-immersed distribution transformers and dry-type distribution transformers at the specified reference conditions using the algorithm provided in clause 5.4 of TP 2.

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