BUILDING TECHNOLOGIES PROGRAM

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Distribution Transformers
Energy Conservation Program
Notice of Proposed Rulemaking (NOPR) Analysis

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February 23, 2012

Welcome and Introduction

- Introductions
- Role of the Facilitator
- Ground Rules (norms)
  - Listen as an ally
  - Use short, succinct statements/keep to the point
  - Hold sidebar conversations outside the room
  - Focus on issues, not personalities
  - One person speak at a time (raise hand to be recognized; state your name for the record)
  - Set cell phones to silent/vibrate
- Housekeeping Items
- Agenda Review
- Opening Remarks

Purpose of the Public Meeting

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- Invite comment on proposed energy conservation levels.
- Present methodologies and characterize results of the rulemaking analyses.
- Provide a forum for public discussion of rulemaking issues.
- Encourage interested parties to submit data, information, and written comments.
- Describe next steps in the rulemaking.

Comments from Participants

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- Participants are invited to provide summary comments or statements and raise additional issues for discussion.
- NOPR comment period closes April 10, 2012.

Issues for Comment

Issue Box The Department welcomes comments, data, and information concerning its NOPR for distribution transformers. Throughout this presentation, specific issues will be raised for discussion on slides such as this, with identifying numbers corresponding to issues for comment from section VII.E of the NOPR. ***Whether invited by an issue box or not, comments concerning any part of the document or presentation are welcome.***

Issue box numbering corresponds to the list of issues published at the end of the NOPR, available at:

http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/distribution_transformers_nopr_notice.pdf

Feedback Is Requested

- **In all correspondence, please refer to the Distribution Transformers rulemaking by:**
  - Distribution Transformers Rulemaking,
  - Docket Number EE–2010–BT–STD–0048, and
  - Regulatory Identification Number (RIN) 1904–AC04

- **Email:** DistributionTransformers-2010-STD-0048@ee.doe.gov

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- **Comment period closes: April 10, 2012**

Regulatory History

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- EPACT 2005 set standards for low-voltage dry-type (LVDT) distribution transformers at the NEMA TP 1-2002 level.

- October 2007 – DOE issued a final rule establishing standards for liquid-immersed and medium-voltage dry-type (MVDT) distribution transformers. (72 FR 58190). DOE was sued on that rule concerning issues of environmental compliance. That suit was settled.

- As a result of the settlement agreement, compliance was required in 2010 with the standards established in 2007 final rule. However, DOE agreed to an expedited timeline to determine whether to amend standards for liquid-immersed and MVDT distribution transformers.

- DOE issued a Notice of Proposed Rulemaking on February 1, 2012.

- Final Rule must be published by October 1, 2012.

Distribution Transformers Rulemaking Schedule

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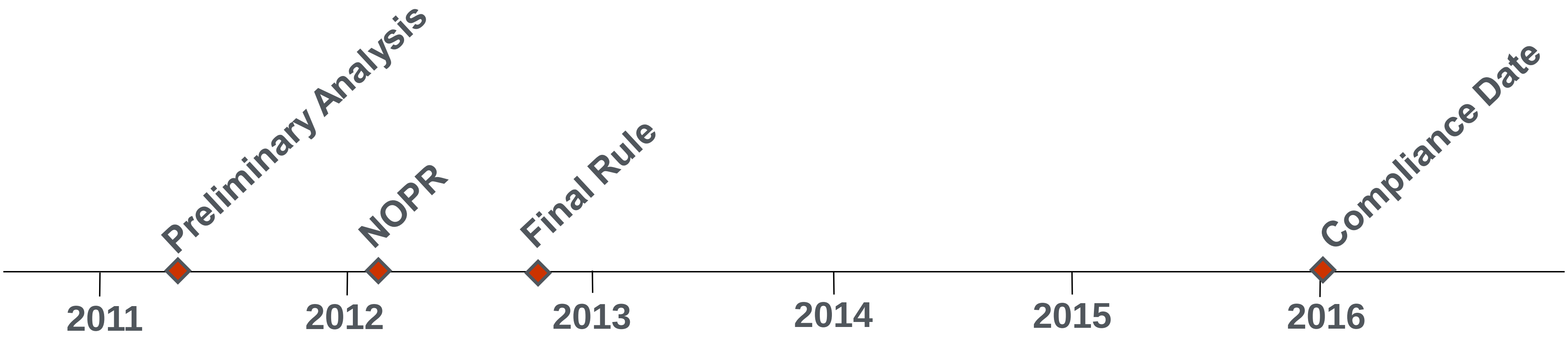

Milestone	Date
Issuance of NOPR	***February 1, 2012***
Federal Register Notice of Public Meeting and Availability of the NOPR Technical Support Document	***February 10, 2012***
Issue Final Rule	***October 1, 2012***
Compliance Date	***January 1, 2016***

Negotiated Rulemaking Subcommittees

- DOE established two subcommittees under the Energy Efficiency and Renewable Energy Advisory Committee (ERAC) to negotiate proposed Federal standards for distribution transformers.
  - One for liquid-immersed and MVDT (established in July 2011) and one for LVDT (established in August 2011)
  - Both included manufacturers of transformers and steel, utilities, energy advocacy groups, trade associations, and others.
  - Each committee met 4 times in-person and had 2 webinars between September and December 2011.
- Stakeholders and DOE felt that a negotiated rulemaking would result in a better-informed analysis and reduce potential negative impacts of the NOPR.

Negotiated Rulemaking Results

- The liquid-immersed and MVDT committee reached consensus regarding proposed standards for MVDT distribution transformers only.

    The consensus addressed one design line and authorized DOE to undertake certain technical calculations to scale the agreement to other MVDT design lines

- The LVDT committee was unable to reach consensus regarding proposed standards for LVDT distribution transformers.

EPCA Factors

42 U.S.C. 6295(o)(2)(B)(i) directs DOE to consider seven factors when setting energy conservation standards for distribution transformers:

EPCA Factors	DOE Analysis
1. Economic impact on consumers and manufacturers	Life-Cycle Cost Analysis Manufacturer Impact Analysis
2. Lifetime operating cost savings compared to increased cost for the product	Life-Cycle Cost Analysis
3. Total projected energy savings	National Impact Analysis
4. Impact on utility or performance	Engineering Analysis Screening Analysis
5. Impact of any lessening of competition	Manufacturer Impact Analysis
6. Need for national energy conservation	National Impact Analysis
7. Other factors the Secretary considers relevant	Environmental Assessment Utility Impact Analysis Employment Impact Analysis

Steps in the Standards Rulemaking: NOPR

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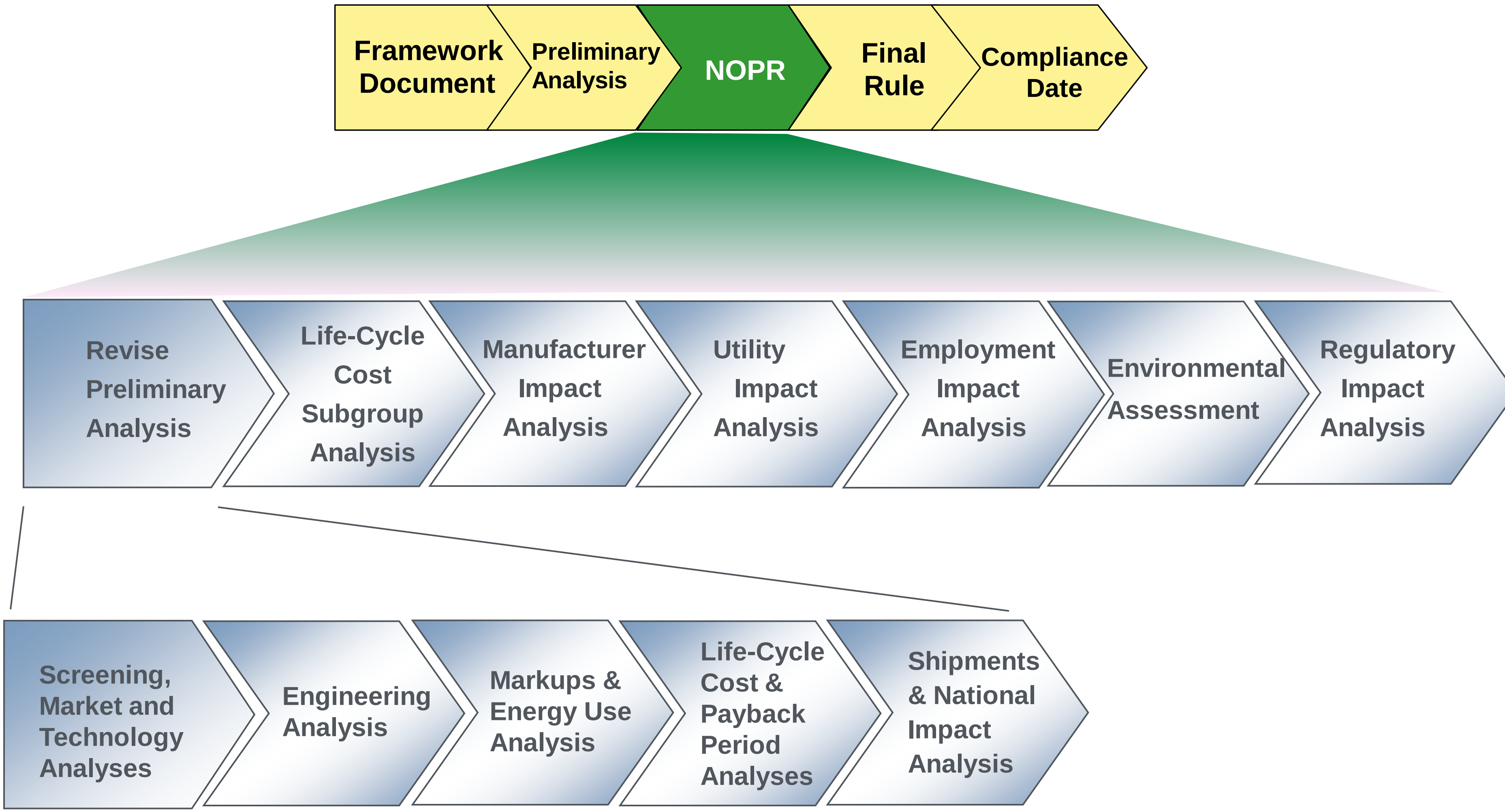

Analyses for Final Rule

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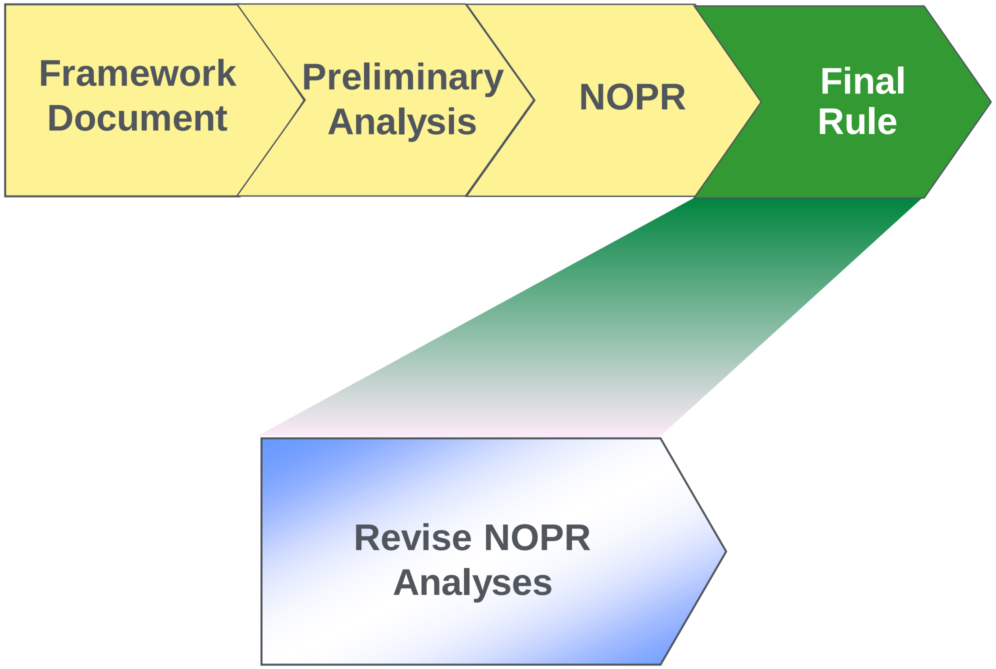

Rulemaking Scope and Current Efficiency Standards for Distribution Transformers

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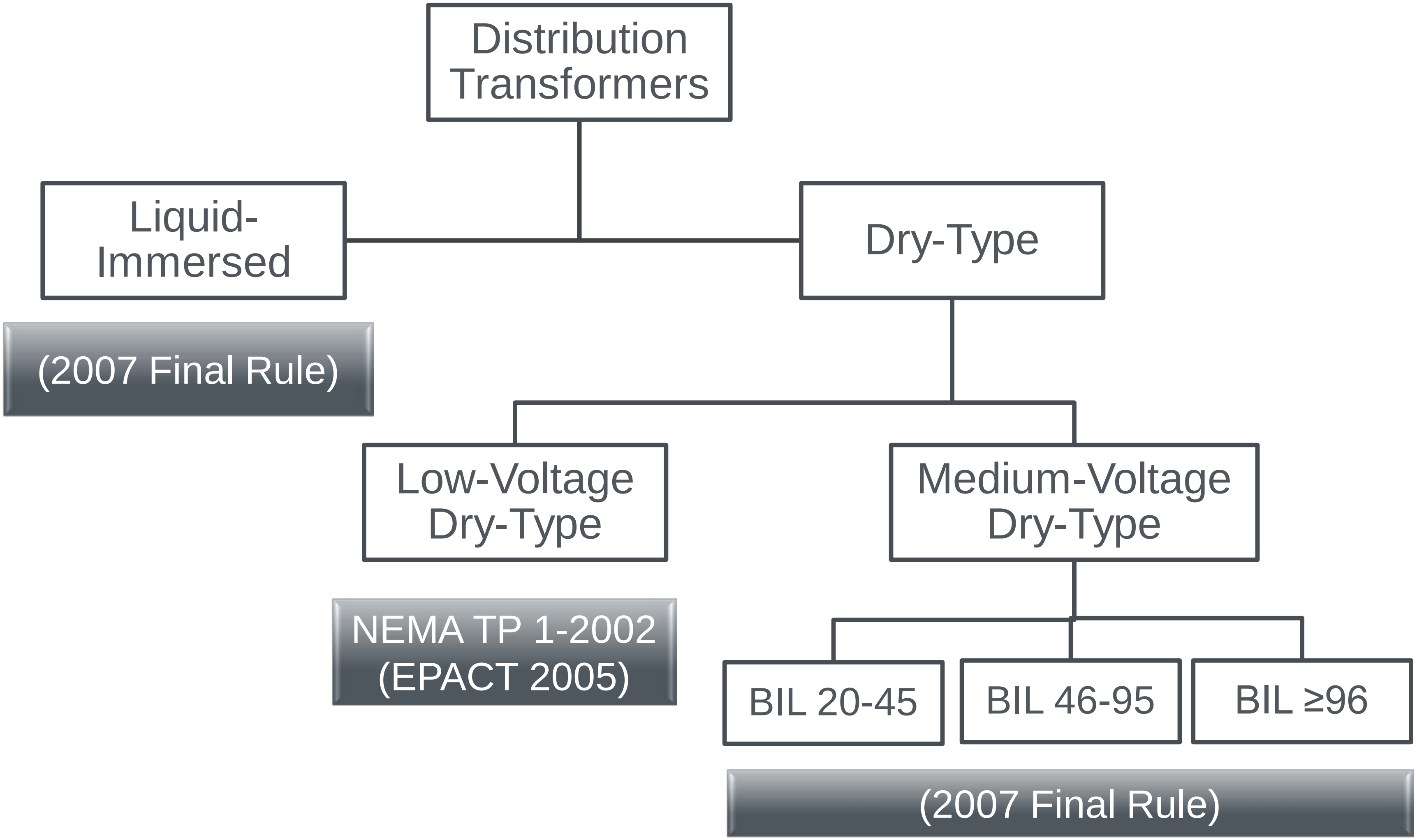

Distribution Transformers Definitions

- EPACT 2005 presented the definition of a distribution transformer, and DOE refined the definition during the 2006 test procedure rulemaking. (71 FR 24972)

- Under 10 CFR 431.192, the term 'distribution transformer' means a transformer that:
  - Has an input voltage of 34.5 kilovolts or less
  - Has an output voltage of 600 volts or less;
  - Is rated for operation at a frequency of 60 Hertz; and
  - Has a capacity of 10 kVA to 2500 kVA for liquid-immersed units and 15 kVA to 2500 kVA for dry-type units; but
  - Is not an: **a**utotransformer, **d**rive (isolation) transformer, **g**rounding transformer, **m**achine-tool (control) transformer, **n**onventilated transformer, **r**ectifier transformer, **r**egulating transformer, **s**ealed transformer, **s**pecial-impedance transformer, **t**esting transformer, **t**ransformer with tap range of 20 percent or more, **u**ninterruptible power supply transformer, or **w**elding transformer.

Distribution Transformers Definitions (Continued)

- 'Liquid-immersed distribution transformer' means a distribution transformer in which the core and coil assembly is immersed in an insulating liquid. (10 CFR 431.192)

- 'Low-voltage dry-type (LVDT) distribution transformer' means a distribution transformer that :
  - has an input voltage of 600 volts or less;
  - is air-cooled; and
  - does not use oil as a coolant. (42 U.S.C. 6291(38))

- 'Medium-voltage dry-type (MVDT) distribution transformer' means a distribution transformer in which the core and coil assembly is immersed in a gaseous or dry compound insulating medium, and which has a rated primary voltage between 601 V and 35 kV. (10 CFR 431.192)

Definitions:
Request for Comment

Issue 5: DOE requests comment on its proposal to require rectifier and testing transformers to indicate on their nameplates that they are for such purposes exclusively.

- "Underground mining transformer" means an MVDT transformer that:
  - Is built only for installation in an underground mine or inside equipment for use in an underground mine, and
  - Has a nameplate which identifies the transformer as being for this use only. (10 CFR 431.192)

Issue 6: DOE requests comment on its proposal to maintain the definition of mining transformer but also requests information useful in precisely expanding the definition to encompass any activity that entails the removal of material underground, such as digging or tunneling.

Test Procedure Overview

- DOE published a test procedure (TP) final rule for distribution transformers on April 27, 2006. (71 FR 24972)
  - Based on NEMA TP-2 test procedure.
  - Same TP for all three transformer types
- The test procedure is codified in 10 CFR Part 431, Appendix A to Subpart K, "Uniform Test Method for Measuring the Energy Consumption of Distribution Transformers."

Test Procedure Issues

- **Multiple Voltage Secondaries:** DOE currently requires testing at the voltage with the highest losses, which is usually in the parallel configuration, but it is considering allowing manufacturers to meet amended standards in any secondary configuration and at the lowest BIL.

Issue 1: DOE seeks comment on primary and secondary winding configurations, on how testing should be required, on efficiency differences related to different winding configurations, and on how frequently transformers are operated in various winding configurations.

- **Multiple kVA Ratings:** Currently, DOE does not specify which kVA rating should be used to assess compliance in the case of distribution transformers with more than one kVA rating.

Issue 2: DOE requests comment on its proposal to require transformers with multiple nameplate kVA ratings to comply only at those ratings corresponding to passive cooling.

Test Procedure Issues (Continued)

- **Primary Configurations:** Although DOE is considering allowing testing in any secondary configuration, primaries must still be tested in their highest loss configuration.
  - Primaries exhibit larger differences in efficiency between the series and parallel configurations.

Issue 3 - DOE requests comment on its proposal to maintain the requirement that transformers comply with standards for the BIL rating of the configuration that produces the highest losses.

- **Reference Loads:** Currently, the reference loading points are:
  - 50 percent for liquid-immersed and MVDT.
  - 35 percent for LVDT.

Issue 4 - DOE requests comment on its proposal to maintain the current test loading value requirements for all types of distribution transformers.

Steps in the Standards Rulemaking: Screening and Technology Analysis

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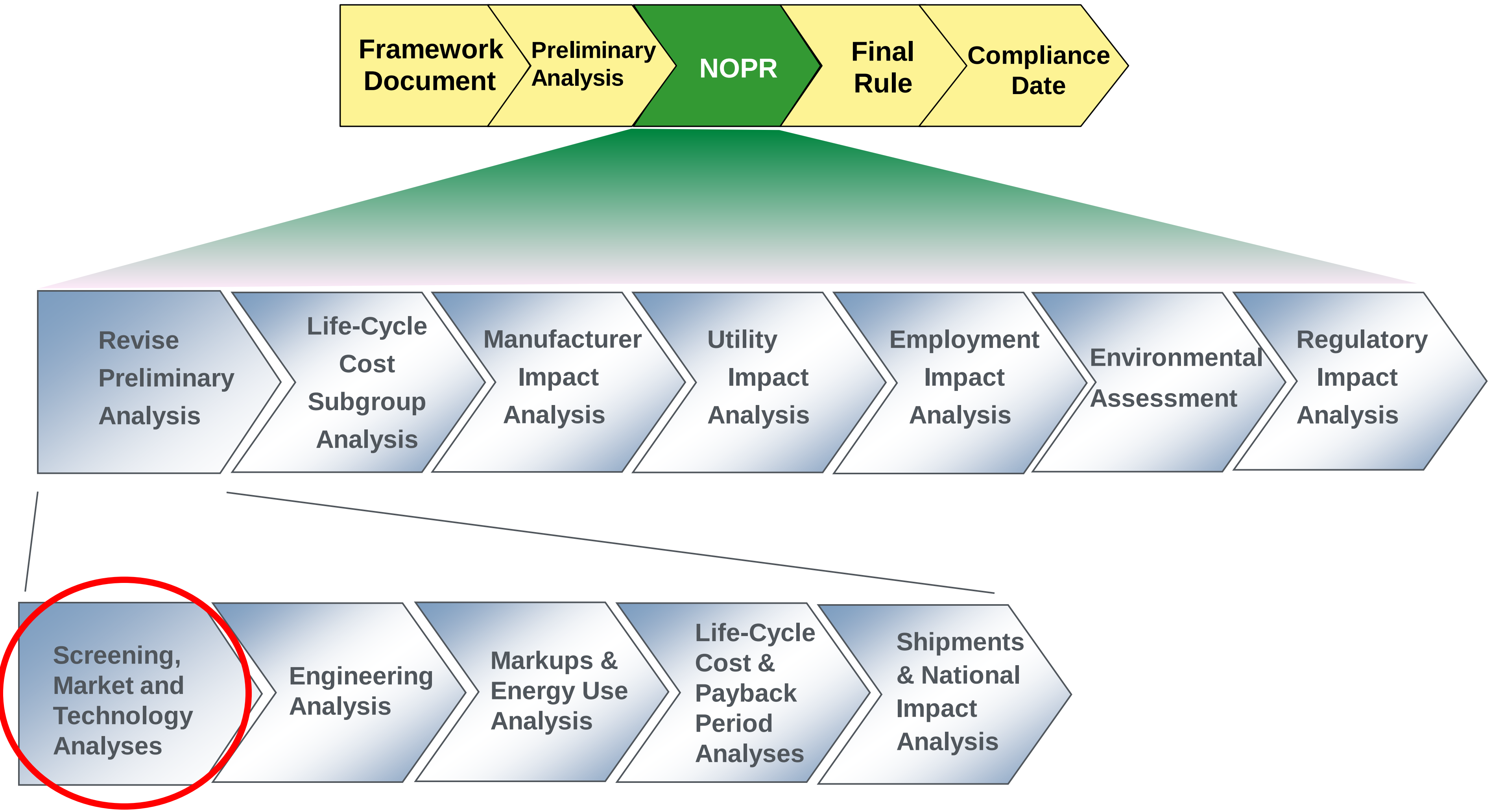

Distribution Transformers Equipment Class Groupings

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- There are 115 discrete kVA ratings across 10 equipment class groupings (EC):

EC		Phases	Voltage	BIL	kVA Range
1	Liquid-Immersed	Single	Medium	---	10-833 kVA
2	Liquid-Immersed	Three	Medium	---	15-2500 kVA
3	Dry-Type	Single	Low	---	15-333 kVA
4	Dry-Type	Three	Low	---	15-1000 kVA
5	Dry-Type	Single	Medium	20-45 kV BIL	15-833 kVA
6	Dry-Type	Three	Medium	20-45 kV BIL	15-2500 kVA
7	Dry-Type	Single	Medium	46-95 kV BIL	15-833 kVA
8	Dry-Type	Three	Medium	46-95 kV BIL	15-2500 kVA
9	Dry-Type	Single	Medium	$\geq$96 kV BIL	75-833 kVA
10	Dry-Type	Three	Medium	$\geq$96 kV BIL	225-2500 kVA

Issue 7: DOE requests comment on its proposal to keep current kVA scope.

Rulemaking Scope: Step-Up Transformers

- DOE proposes to continue to not set standards for step-up transformers, which do not ordinarily perform power distribution functions.

- However, DOE is aware that step-up transformers may be used in place of step-down transformers and may present a potential loophole as standards increase.

Issue 8: DOE requests comment on its proposal to continue to not set standards for step-up transformers.

Rulemaking Scope: Negotiated Rulemaking Subcommittee Proposals

The negotiated rulemaking subcommittee proposed that DOE establish separate definitions and equipment classes for network, vault, and data center transformers.

- Network transformer
  - Designed for use in a vault, for occasional submerged operation in water, and to feed a variable capacity system of interconnected secondary windings
  - Built per the requirements of IEEE C57.12.40
- Vault-type transformer
  - Designed for use in a vault and for occasional submerged operation in water
  - Built per the requirements of IEEE C57.12.23 or IEEE C57.12.24

Issue 9: DOE requests comment on the negotiation committee's proposal to establish a separate equipment class for network/vault transformers and on how such transformers might be defined.

Rulemaking Scope: Negotiated Rulemaking Subcommittee Proposals

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- Data center transformer: a three-phase LVDT distribution transformer that:
  - Is designed for use in a data center distribution system and has a nameplate identifying the transformer as being for this use only
  - Has a maximum peak energization (or in-rush) current less than or equal to four times its rated full load current multiplied by the square root of 2, as measured certain conditions.
  - Is manufactured with at least two of six additional attributes

Issue 10: DOE requests comment on the proposal to establish a separate equipment class for data center transformers and on how such transformers might be defined.

Rulemaking Scope: Negotiated Rulemaking Subcommittee Proposals

The negotiated rulemaking subcommittee also proposed that DOE establish separate equipment classes for pole-mounted and pad-mounted liquid-immersed transformers.

Issue 11: DOE requests comment on whether separate equipment classes are warranted for pole-mounted, pad-mounted, or other types of liquid-immersed transformers.

Steps in the Standards Rulemaking: Engineering Analysis

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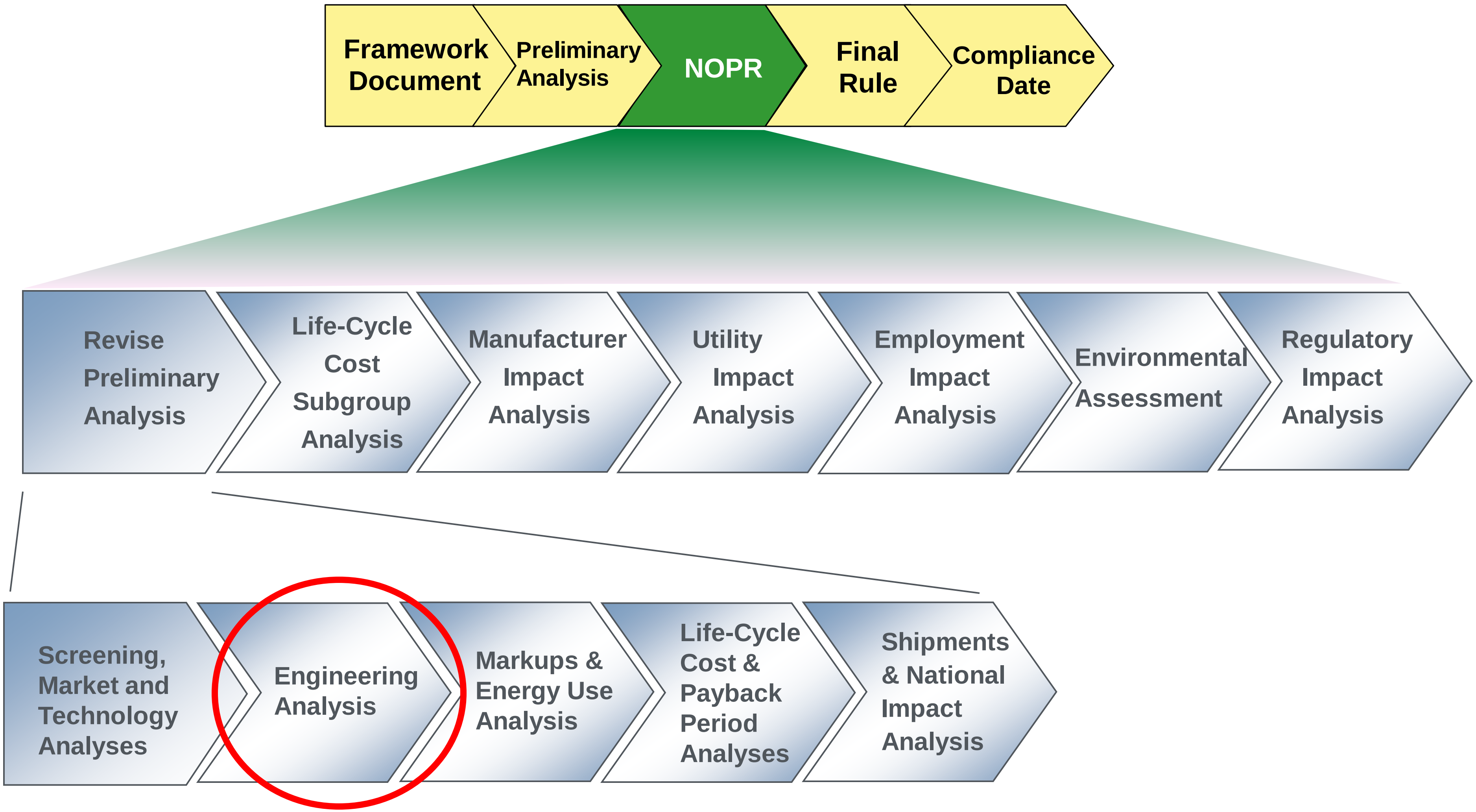

Liquid-Immersed Design Lines and Representative Units

Equipment Class	Design Line	Type of Distribution Transformer	kVA Range	Representative Unit
1	1	Liquid-immersed, single-phase, rectangular tank	10–167	50 kVA, 65°C, single-phase, 60Hz, 14400V primary, 240/120V secondary, rectangular tank, 95 kV BIL
	2	Liquid-immersed, single-phase, round tank	10–167	25 kVA, 65°C, single-phase, 60Hz, 14400V primary, 240/120V secondary, round tank, 125 kV BIL
	3	Liquid-immersed, single-phase	250–833	500 kVA, 65°C, single-phase, 60Hz, 14400V primary, 277V secondary, 150 kV BIL

Issue 12: DOE requests comment on setting standards by BIL rating for liquid-immersed distribution transformers as it currently does for medium voltage, dry-type units.

Design Option Combinations: Negotiated Rulemaking Subcommittee Input

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- Step-lap mitering
  - May not be cost-effective in smaller dry-type designs
  - DOE removed step-lap mitering from its list of options for design line 6.
  - Added mitering processing cost to LVDT and MVDT designs
- Core Materials
  - In the U.S. market, there are few, if any, transformers built with ZDMH
  - DOE removed ZDMH designs from its base-case scenario.

Engineering Analysis: Materials Prices

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Item and Description	2010 Price	2011 Price
M36 core steel (26 gauge)	0.60	0.66
M19 core steel (26 gauge)	0.83	0.91
M12 core steel	0.95	0.78
M6 core steel	1.33	1.04
M5 core steel	1.38	1.10
M4 core steel	1.45	1.20
M3 core steel	1.88	1.30
M3 Lite Carlite core steel	1.95	1.95
M2 core steel	2.00	1.40
M2 Lite Carlite core steel	2.10	2.10
ZDMH (mechanically-scribed core steel)	2.05	1.90
H-0 DR core steel (laser-scribed)	2.06	1.70
SA1 (amorphous) - finished core, volume production	2.38	2.20
Impregnation (per gallon)	22.55	22.55
Winding Combs (per pound)	12.34	12.34
Mineral oil	3.35	3.35
Tank Steel	0.38	0.38

Engineering Analysis: Materials Prices (Continued)

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Item and Description	2010 Price	2011 Price
Copper wire, formvar, round #10-20	4.87	4.87
Copper wire, enameled, round #7-10	4.84	4.84
Copper wire, enameled, rectangular sizes	4.97	4.97
Aluminum wire, formvar, round #9-17	3.07	3.07
Aluminum wire, formvar, round #7-10	2.57	2.57
Copper wire, rectangular 0.1 x 0.2, Nomex wrapped	4.52	4.52
Aluminum wire, rectangular 0.1 x 0.2, Nomex wrapped	2.97	2.97
Copper strip, thickness range 0.02-0.045	4.97	4.97
Copper strip, thickness range 0.030-0.060	4.97	4.97
Aluminum strip, thickness range 0.02-0.045	2.08	2.08
Aluminum strip, thickness range 0.045-0.080	2.08	2.08
Kraft insulating paper with diamond adhesive	1.52	1.52
Nomex insulation (per pound)	24.50	24.50
Cequin insulation (per pound)	5.53	5.53

Issue 17: DOE requests comment on its materials prices for both the 2010 and 2011 cases.

Engineering Analysis: Scaling Results

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- Costs of construction and losses can be scaled when design parameters are held constant, including:
  - frequency, magnetic flux density, current density and insulation level.

- DOE scaled the total losses (TL) from a representative unit to other unanalyzed kVA ratings (S) within a design line using the following Scaling Rule:

$$TL_1 = TL_0 \text{ x } (S_1 / S_0)^X$$

- The exponent X is equal to 0.75 for ideal transformers.

- However, DOE recognized that deriving unique exponents for each equipment class would produce better results.

Engineering Analysis: Scaling Exponents

- DOE instead fit a straight line in logarithmic space to selected ELs in each design line, producing slopes that were not equal to 0.75.

Equipment Class	Scaling Exponent
1. Liquid-immersed 1-phase	0.76
2. Liquid-immersed 3-phase	0.79
3. LVDT 1-phase	0.75
4. LVDT 3-phase	0.67
5. MVDT 1-phase, low BIL	0.67
6. MVDT 3-phase, low BIL	0.67
7. MVDT 1-phase, mid-BIL	0.67
8. MVDT 3-phase, mid-BIL	0.67
9. MVDT 1-phase, high BIL	0.68
10. MVDT 3-phase, high BIL	0.68

Scaling Results: Request for Comment

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Issue 13: DOE requests comment on how best to scale across phase counts for each transformer type and how standards for either single- or three-phase transformers may be derived from the other type.

Issue 14: DOE requests comment on its proposal to scale standards to unanalyzed kVA ratings by fitting a straight line in logarithmic space to selected efficiency levels (ELs) with the understanding that the resulting line may not have a slope equal to 0.75.

Engineering Design Constraints

DOE is aware that many core steels, including amorphous steels, have constraints on their supply.

Issue 18: DOE requests comment on the current and future availabilities of high-grade steels, particularly amorphous and mechanically-scribed steel in the United States.

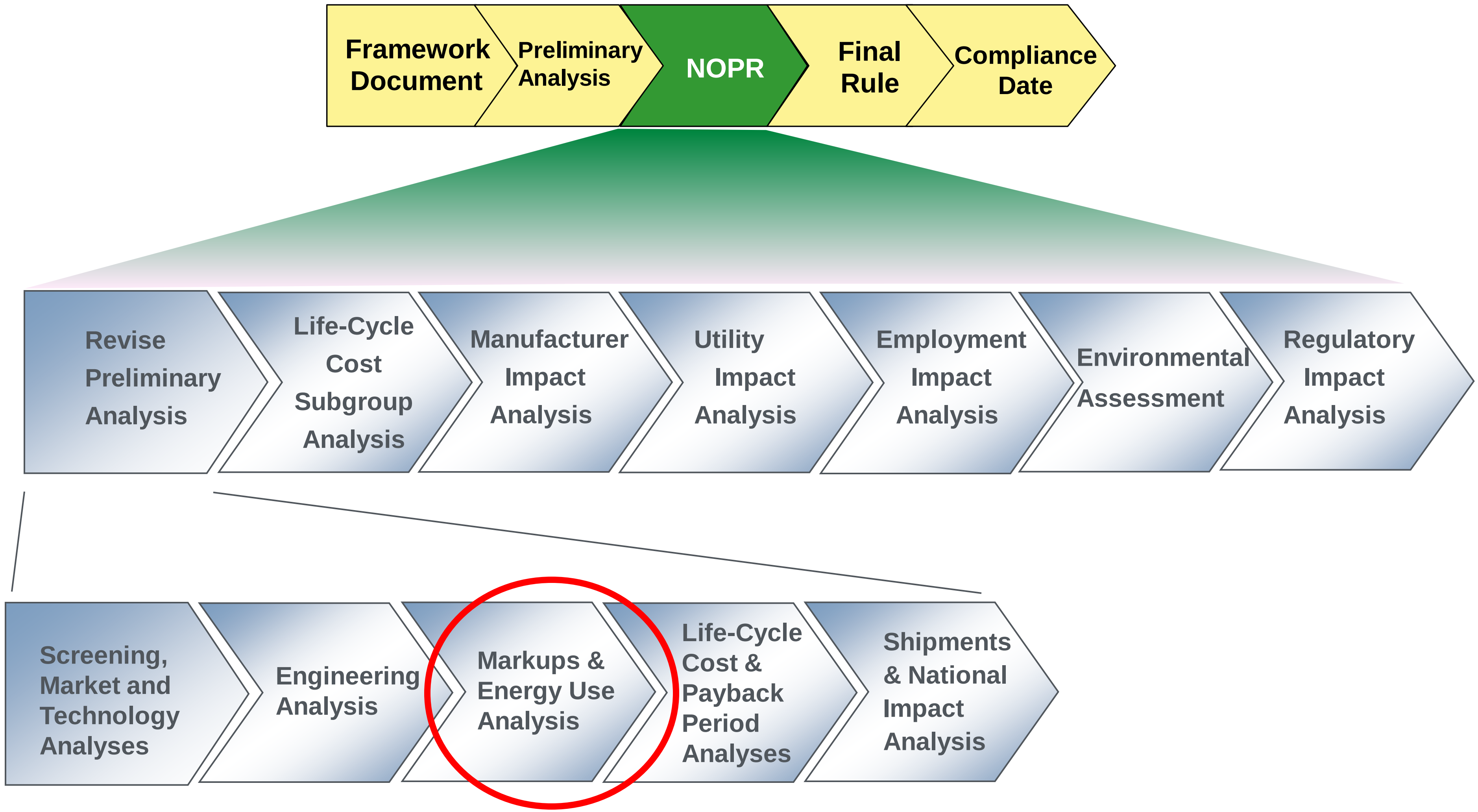
Issue 20: DOE requests comment on its steel supply availability analysis, presented in Appendix 3A of the TSD.

Engineering Design Constraints

DOE also understands that, particularly for liquid-immersed designs, larger transformers may have size or weight constraints that would necessitate pole replacements or vault expansions.

Issue 19: DOE requests comment on particular applications in which transformer size and weight are likely to be a constraint and any data that may be used to characterize the problem.

Steps in the Standards Rulemaking: Markups and Energy Use



Loading: Request for Comment

- Loading data for liquid-immersed transformers was compiled from:
  - FERC Form 714 filings for 2008, which were aggregated by region were used to develop the price-load correlation.
  - hourly metered building data were used to develop the transformer loading model
  - Stakeholder submitted load data - this was used to verify loading for single-phase transformers
- For dry-type transformers, load data came from:
  - CBECS 1992 and 1995 surveys, which sampled ~5000 commercial and industrial buildings.
  - hourly metered building data were used to develop the transformer loading model

Issue 21: DOE seeks comment on any additional sources of distribution transformer load data that could be used to validate the Energy Use and End-Use Load Characterization analysis. DOE is specifically interested in additional load data for higher capacity three-phase distribution transformers.

Distribution Channels: Markup Factors

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- **Liquid-immersed and dry-type transformers have different distribution channels.**
- The majority of liquid-immersed transformers are purchased by utilities directly from manufacturers or from the manufacturers' representative or distributor.
  - DOE estimated the size of the direct sales distribution channel on the volume of electricity sales if IOUs. For direct utility purchases there is no distributor markup, this is estimated to occur 80% of the time.
- Dry-type transformers are purchased and installed primarily by electrical contractors. For dry-type transformers, markups are applied at all points in the distribution channel.

Liquid-Immersed		Dry-Type	
Distributor	1.07 (1.0 Direct Sale)	Distributor	1.26 (1.15 LV)
Installation Materials	1.00	Contractor Materials	1.16 (1.10 LV)
Installation Labor/Equip	1.47	Contractor Labor/Equip	1.47
Sales Tax Markup	1.069	Sales Tax Markup	1.069
Overall	**1.61 (1.54 Direct Sale)**		**1.96 (1.79 LV)**

Distribution Channels: Markup Factors

Issue 22: DOE seeks comment on its proposed additional distribution channel for liquid-immersed transformers that estimates that approximately 80 percent of transformers are sold by manufacturers directly to utilities.

Pole Replacement Costs (Design Line 2)

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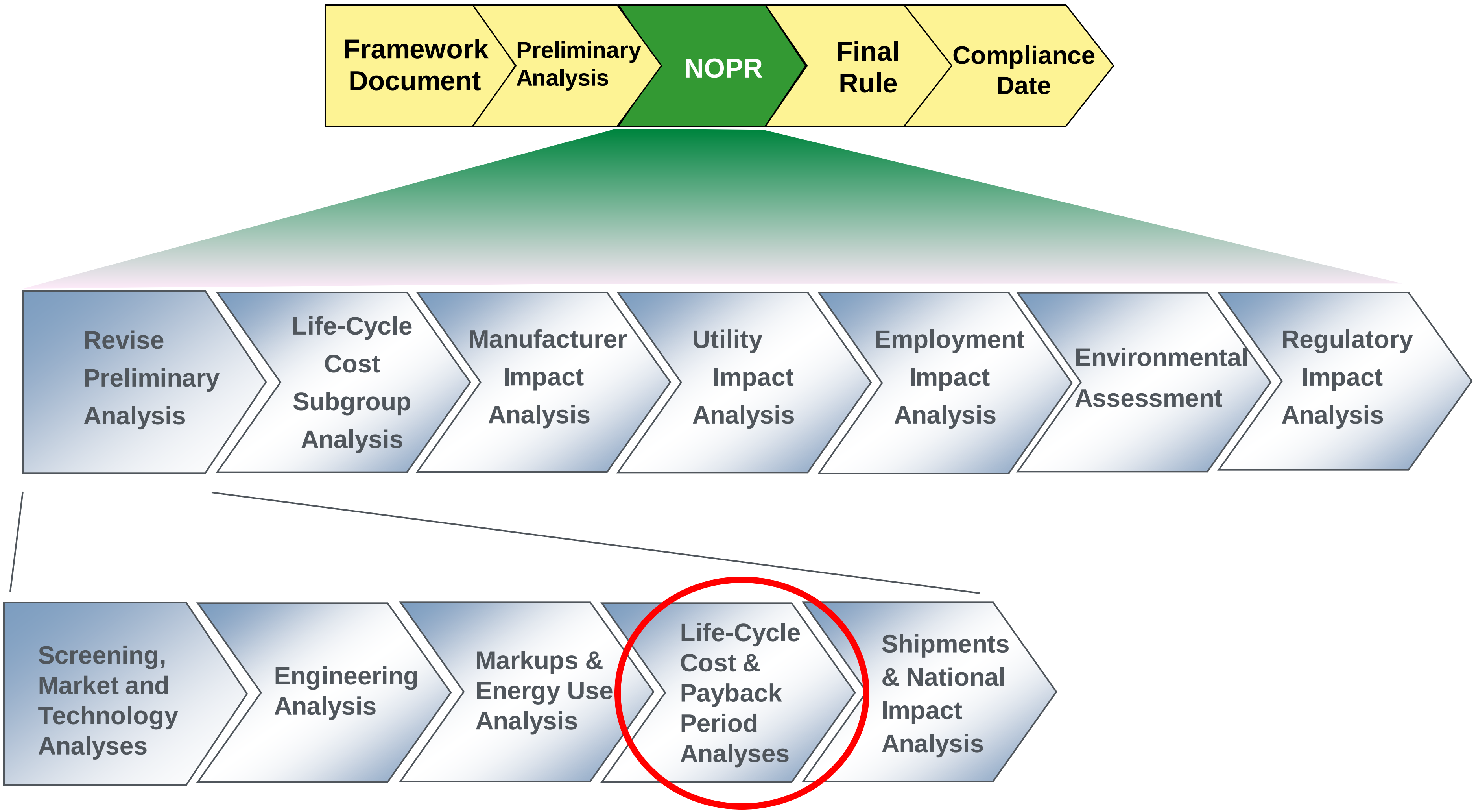
- Pole replacement is triggered when a transformer in the standards case is greater than150 pounds and 15 percent heavier then the transformer in the base case.
  - DOE assumed that up to a maximum of 25% of total pole-mounted transformer population may require pole replacements.
- Replacement costs are represented as a triangular distribution with and average cost of $4,012 bounded by $2,025 to $5,999. This large distribution of possible costs is used to capture wide range of pole replacement circumstances and costs.
- In addition, the full cost of a pole replacement is not be attributed to transformer purchases, since pole lifetimes are finite.
  - Pole installation costs were multiplied by a factor *n/pole-lifetime*, which approximately represents the value of the additional years of life. The parameter *n* was chosen from a flat distribution between 1 and the pole lifetime, which was assumed to be 30 years.

Pole Replacement Costs (Design Line 2)

Issue 24: DOE seeks comment on its pole replacement methodology that is used estimate increased installation costs resulting from increased transformer weight due the proposed standard

Steps in the Standards Rulemaking: LCC and PBP Analysis

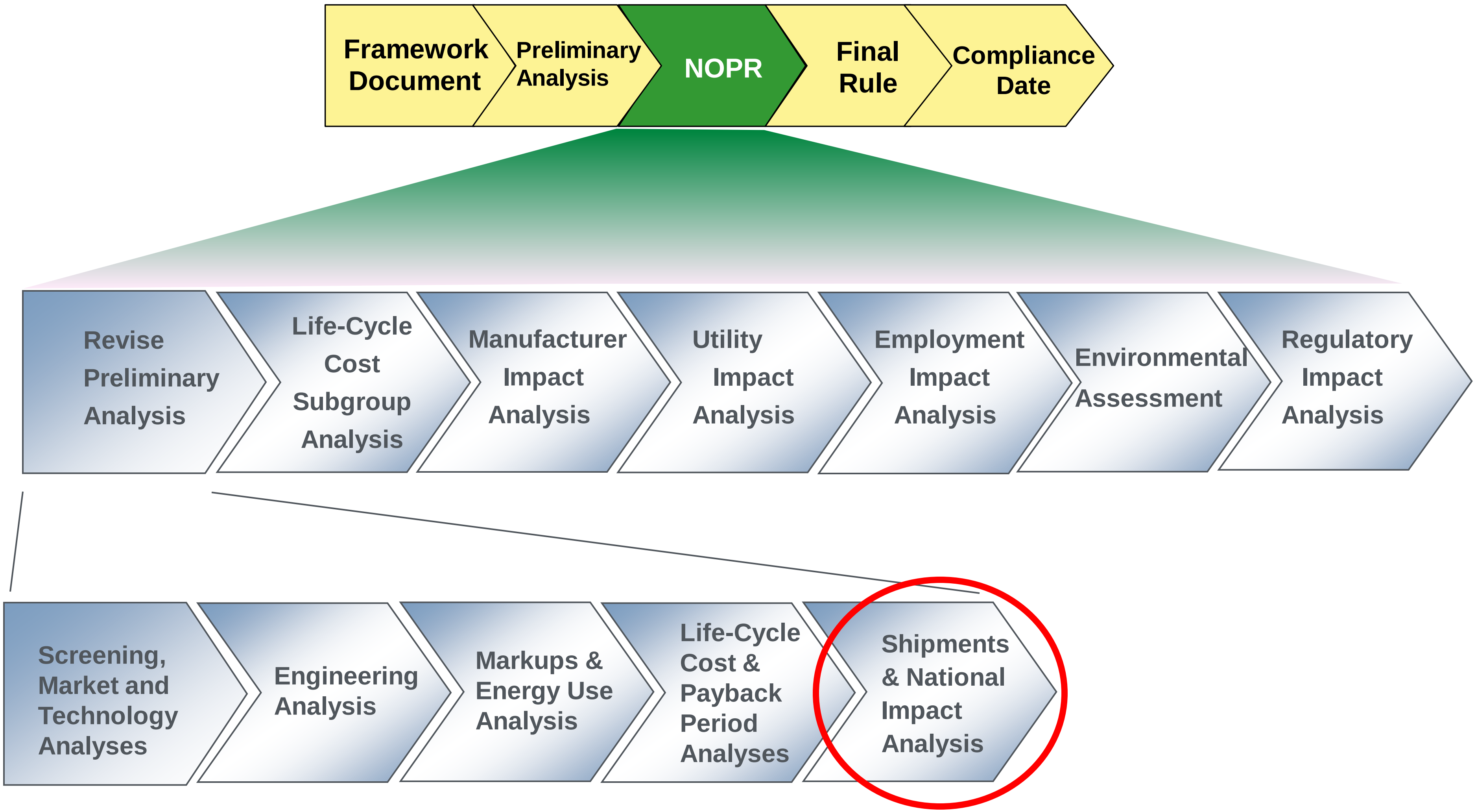


Customer Evaluation Rates: Negotiated Rulemaking Subcommittee Input

- Some transformer purchasers assign value to losses: these purchasers are referred to as "Evaluators".
- No-load loss value is defined by the parameter A ($/watt), load loss value is defined by the parameter B.
- Distributions for A and B were determined from survey data.
- For Evaluators, the A and B values were used to define the base case transformer choice, which may have an efficiency above the current standard.
- Evaluation percentages are shown in the table below.
- The evaluation rates used in the LCC analysis affect the average values (purchase cost, NLL, LL, PRF, RMS loading) that are carried over to the National Impact Analysis.

	Design Lines	**Evaluation Scenario**		
		Non-evaluators	Default	All-evaluators
Liquid-immersed	1 — 5	0%	10%	100%
Low-voltage Dry-type	6 — 8	0%	2%	100%
Medium-voltage Dry-type	9 — 13B	0%	2%	100%

Steps in the Standards Rulemaking: National Impact Analysis



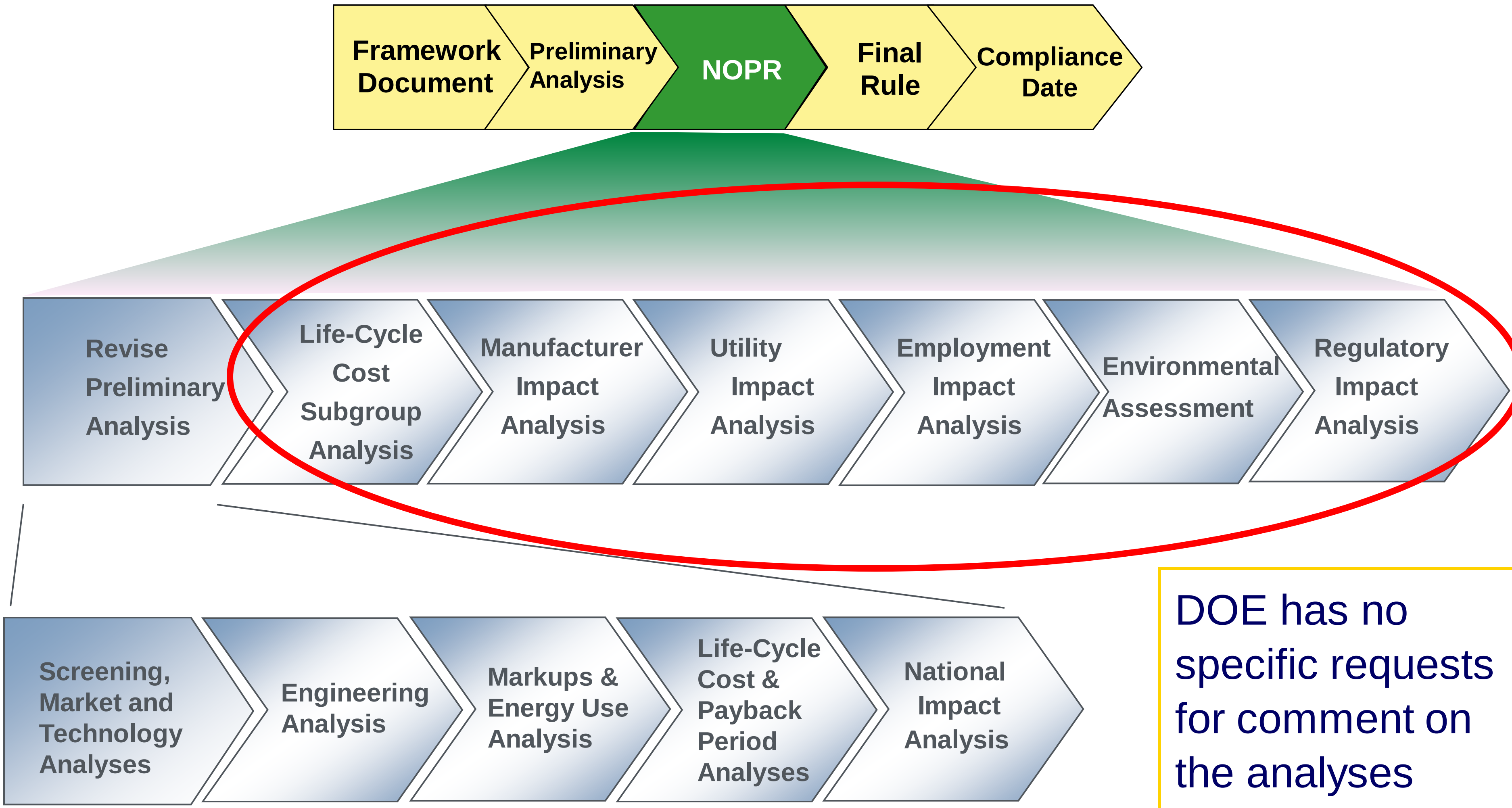
Refurbished Transformers: Request for Comment

DOE is aware that some utilities may purchase re-wound transformers.

Issue 22: DOE seeks comment on the economic criteria that a utility would use in making a decision to re-wind a transformer rather than purchase a new unit, and on the expected lifetime of a re-wound unit.

Issue 23: DOE seeks comment on other potential changes to maintenance practices that could extend the service life of a distribution transformer.

Steps in the Standards Rulemaking: Other Analyses



DOE has no specific requests for comment on the analyses circled above.

Liquid-Immersed Trial Standard Levels (TSLs)

There are 7 TSLs for liquid-immersed distribution transformers:

TSL 1	• A diversity of core materials are cost-competitive and economically feasible for all design lines.
TSL 2	• EL 1 for all design lines.
TSL 3	• Maximum efficiency achievable with M3 steel.
TSL 4	• Maximum NPV with 7% discounting.
TSL 5	• EL 3 for all design lines.
TSL 6	• Maximum source energy savings with positive NPV (7% discounting).
TSL 7	• Maximum technologically feasible (max tech).

LVDT Trial Standard Levels (TSLs)

There are 6 TSLs for LVDT distribution transformers:

TSL 1	• Maximum efficiency achievable with M6 steel.
TSL 2	• NEMA Premium levels.
TSL 3	• Maximum efficiency achievable using butt-lap core mitering for single-phase designs and full mitering for three-phase designs.
TSL 4	• Maximum NPV with 7% discounting.
TSL 5	• Maximum source energy savings with positive NPV (7% discounting).
TSL 6	• Maximum technologically feasible (max tech).

MVDT Trial Standard Levels (TSLs)

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There are 5 TSLs for MVDT distribution transformers:

	TSL 1	• EL 1 for all design lines.
Negotiated Consensus	TSL 2	• A diversity of core materials are cost-competitive and economically feasible for all design lines.
	TSL 3	• Maximum NPV with 7% discounting.
	TSL 4	• Maximum source energy savings with positive NPV (7% discounting).
	TSL 5	• Maximum technologically feasible (max tech).

Proposed Energy Conservation Standards: Liquid-Immersed

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- DOE is proposing TSL 1 for liquid-immersed distribution transformers:

1-Phase (Equipment Class 1)		3-Phase (Equipment Class 2)	
kVA	**Efficiency (%)**	**kVA**	**Efficiency (%)**
10	98.70	**15**	98.65
15	98.82	**30**	98.83
25	98.95	**45**	98.92
37.5	99.05	**75**	99.03
50	99.11	**112.5**	99.11
75	99.19	**150**	99.16
100	99.25	**225**	99.23
167	99.33	**300**	99.27
250	99.39	**500**	99.35
333	99.43	**750**	99.40
500	99.49	**1000**	99.43
667	99.52	**1500**	99.48
833	99.55	**2000**	99.51
		2500	99.53

Proposed Energy Conservation Standards: LVDT

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- DOE is proposing TSL 1 for LVDT distribution transformers:

1-Phase (Equipment Class 3)		3-Phase (Equipment Class 4)	
kVA	**Efficiency (%)**	**kVA**	**Efficiency (%)**
15	97.73	**15**	97.44
25	98.00	**30**	97.95
37.5	98.20	**45**	98.20
50	98.31	**75**	98.47
75	98.50	**112.5**	98.66
100	98.60	**150**	98.78
167	98.75	**225**	98.92
250	98.87	**300**	99.02
333	98.94	**500**	99.17
		750	99.27
		1000	99.34

Proposed Energy Conservation Standards: MVDT (Negotiated Consensus)

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- DOE is proposing TSL 2 for MVDT distribution transformers:

EC 5		EC 6		EC 7		EC 8		EC 9		EC 10	
kVA	**%**	**kVA**	**%**	**kVA**	**%**	**kVA**	**%**	**kVA**	**%**	**kVA**	**%**
15	98.10	**15**	97.50	**15**	97.86	**15**	97.18				
25	98.33	**30**	97.90	**25**	98.12	**30**	97.63				
37.5	98.49	**45**	98.10	**37.5**	98.30	**45**	97.86				
50	98.60	**75**	98.33	**50**	98.42	**75**	98.13				
75	98.73	**112.5**	98.52	**75**	98.57	**112.5**	98.36	**75**	98.53		
100	98.82	**150**	98.65	**100**	98.67	**150**	98.51	**100**	98.63		
167	98.96	**225**	98.82	**167**	98.83	**225**	98.69	**167**	98.80	**225**	98.57
250	99.07	**300**	98.93	**250**	98.95	**300**	98.81	**250**	98.91	**300**	98.69
333	99.14	**500**	99.09	**333**	99.03	**500**	98.99	**333**	98.99	**500**	98.89
500	99.22	**750**	99.21	**500**	99.12	**750**	99.12	**500**	99.09	**750**	99.02
667	99.27	**1000**	99.28	**667**	99.18	**1000**	99.20	**667**	99.15	**1000**	99.11
833	99.31	**1500**	99.37	**833**	99.23	**1500**	99.30	**833**	99.20	**1500**	99.21
		2000	99.43			**2000**	99.36			**2000**	99.28
		2500	99.47			**2500**	99.41			**2500**	99.33

Summary of Proposed Rule Impacts

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- Energy Savings:
  - 1.58 quads over 30 years (2016-2045)
  - Eliminate the need for 2.4 GW of generating capacity by 2045

- Cost Savings:
  - Cumulative Net Present Value ranges from $2.9 billion (7% discount rate) to $12.1 billion (3% discount rate).

- Environmental Benefits:
  - CO_2 emission reduction of 122.1 Mt
  - NO_X emission reduction of 99.7 kt
  - Hg emission reduction of 0.819 ton

Summary of Annualized Benefits and Costs of Proposed Standards

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	Discount Rate	Primary Estimate*	Low Net Benefits Estimate*	High Net Benefits Estimate*
		Monetized (million 2010$/year)		
Operating Cost Savings	7%	631	594	659
	3%	1,026	950	1,075
CO_2 Reduction at $4.9/t	5%	58.6	58.6	58.6
CO_2 Reduction at $22.3/t	3%	244	244	244
CO_2 Reduction at $36.5/t	2.5%	389	389	389
CO_2 Reduction at $67.6/t	3%	742	742	742
NO_X Reduction at $2,537/ton	7%	7.78	7.78	7.78
	3%	12.4	12.4	12.4
Total†	7% plus CO_2 range	697 to 1380	660 to 1343	726 to 1409
	7%	883	846	911
	3% plus CO_2 range	1097 to 1780	1021 to 1704	1146 to 1829
	3%	1,283	1,207	1,331
Costs				
Incremental Product Costs	7%	302	338	285
	3%	308	351	289
Total Net Benefits				
Total	7% plus CO_2 range	**400 to 1083**	**327 to 1010**	**445 to 1128**
	7%	**581**	**507**	**626**
	3% plus CO_2 range	**789 to 1472**	**670 to 1353**	**857 to 1540**
	3%	**975**	**855**	**1,043**

How to Submit Written Comments

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- **In all correspondence, please refer to the Distribution Transformers rulemaking by:**
  - Distribution Transformers Rulemaking,
  - Docket Number EE–2010–BT–STD–0048 , and
  - Regulatory Identification Number (RIN) 1904–AC04

- **Email:** DistributionTransformers-2010-STD-0048@ee.doe.gov

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- **Comment period closes: April 10, 2012**