DOE NOPR 2022 for Distribution Transformer Energy Efficiency

Impact Examination by our Taskforce

PJ Hopkinson, PE

March 24, 2023

The DOE NOPR and impact Issues

Philip J Hopkinson, PE

ENERGY.GOV
Office of
ENERGY EFFICIENCY &
RENEWABLE ENERGY

DOE Issues a Notice of Proposed Rulemaking and Announcement of Public Meeting Pertaining to Standards for Distribution Transformers

December 29, 2022

December 29, 2022 started the scramble to understand impacts

The DOE NOPR and impact Issues

The IEEE Team

Phil Hopkinson: HVOLT Inc

Al Traut: Howard Industries

Aaron Meyers: Eaton

Colby Lovins: Federal Pacific

Joe Tedesco: Hitachi Energy

Bryan Marquardt: Cleveland Cliffs Electrical Steel (formerly AK Steel)

Dan Mulkey: Mulkey Consulting

Our analytical look at the impacts

The DOE NOPR and impact Issues

Philip J Hopkinson, PE

1. The DOE NOPR announcement
2. Timing by 2027
3. Scope of Proposal
4. Proposed loss reductions
5. A look at liquid filled transformers
6. Single Phase
7. Three Phase
8. Dry Types
9. Impact on the steel Industry
10. Thoughts on the Users
11. Summary of Impacts
12. Written Comments due March 27
13. Discussion

Topics for discussion

The DOE NOPR and impact Issues

Philip J Hopkinson, PE

Part 431 Energy Efficiency Program for Certain Commercial and Industrial Equipment

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

Authority

42 U.S.C. 6291-6317; 28 U.S.C. 2461 note.

2. Section 431.192 is amended by:

a. Revising the definitions of "Distribution transformer", "Drive (isolation) transformer", "Nonventilated transformer", "Sealed transformer", "Special-impedance transformer", "Transformer with a tap range of 20 percent or more", "Uninterruptible power supply transformer"; and

b. Adding in alphabetical order, definition for "Submersible distribution transformer"

The revisions and addition read as follows:

Topics for discussion

The DOE NOPR and impact Issues

Philip J Hopkinson, PE

Part 431 Energy Efficiency Program for Certain Commercial and Industrial Equipment

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

Authority

42 U.S.C. 6291-6317; 28 U.S.C. 2461 note.

2. Section 431.192 is amended by:

a. Revising the definitions of "Distribution transformer", "Drive (isolation) transformer", "Nonventilated transformer", "Sealed transformer", "Special-impedance transformer", "Transformer with a tap range of 20 percent or more", "Uninterruptible power supply transformer"; and

b. Adding in alphabetical order, definition for "Submersible distribution transformer"

The revisions and addition read as follows:

Topics for discussion

The DOE NOPR and impact Issues

Philip J Hopkinson, PE

§ 431.19
Definitions.
* * * * *

Distribution transformer means a transformer that:

(1) Has an input line voltage of 34.5 kV or less;

(2) Has an output line voltage of 600 V or less;

(3) Is rated for operation at a frequency of 60 Hz; and

(4) Has a capacity of 10 kVA to 5000 kVA for liquid-immersed units and 15 kVA to 5000 kVA for dry-type units; but

Topics for discussion

The DOE NOPR and impact Issues

Philip J Hopkinson, PE

(5) The term "distribution transformer" does not include a transformer that is an -

(i) Autotransfromer;

(ii) Drive (isolation) transformer;

(iii) Grounding transformer;

(iv) Machine-tool (control transformer);

(v) Nonventilated transformer;

(vi) Rectified transformer;

(vii) Regulating transformer;

(viii) Sealed transformer;

(ix) Special-impedance transformer;

(x) Testing transformer;

(xi) Transformer with tap range of 20 percent or more;

(xii) Uninterruptible power supply transformer; or

(xiii) Welding transformer.

Drive (isolation) transformer means a transformer that:

(1) Isolates an electric motor from the line;

(2) Accommodates the added loads of drive-created harmonics;

(3) Is designed to withstand the additional mechanical stressed resulting from an alternating current adjustable frequency motor drive or a direct current motor drive; and

(4) Has a rated output voltage that is neither "208Y/120" nor "480Y/277".

Other definitions of exclusions
1. Nonventilated dry-no air flow
2. Sealed dry means hermetically sealed
3. Special impedance outside normal range

Excluded transformers

The DOE NOPR and impact of Dry Types

Table IV.8 Efficiency Levels as Percentage Reduction of Baseline Losses

Equipment Type	EL				
	1	2	3	4	5 (Max-tech)
Liquid-immersed					
≤ 2500 kVA	2.5	5	10	20	40
> 2500 kVA	40*	5**	10**	20**	40**
Low-voltage Dry-type					
1ϕ	10	20	30	40	50
3ϕ	5	10	20	30	40
Medium-voltage Dry-type					
< 46 kV BIL	5	10	20	30	40
≥ 46 and < 96 kV BIL, and ≤ 2500 kVA	5	10	20	30	40
≥ 46 and < 96 kV BIL, and > 2500 kVA	43*	10**	20**	30**	40**
≥ 96 kV BIL and ≤ 2500 kVA	5	10	20	30	35
≥ 96 kV BIL and > 2500 kVA	34*	10**	20**	30**	35**

*Equipment currently not subject to standards. Therefore, reduction in losses relative to least efficient product on market.

**Reduction in losses relative to EL1

losses proposed to drop: liquid 20%. 1-Phase Dry by 50%, 3-Phase by 40%

1-Phase Liquid losses proposed to drop by 20%

1. Al Traut on single phase products
2. Aaron Meyers on 3 Phase products

Liquid-Immersed Losses Reduced 20%

Single Phase Minimum Efficiency

KVA	DOE 2016	DOE NOPR	Watt Reduction
10	98.70%	98.96%	20.2%
15	98.82%	99.05%	19.7%
25	98.95%	99.16%	20.2%
37.5	99.05%	99.24%	20.2%
50	99.11%	99.29%	20.4%
75	99.19%	99.35%	19.9%
100	99.25%	99.40%	20.1%
167	99.33%	99.46%	19.5%
250	99.39%	99.51%	19.8%
333	99.43%	99.54%	19.4%
500	99.49%	99.59%	19.7%
667	99.52%	99.62%	20.9%
833	99.55%	99.64%	20.1%

Three Phase Minimum Efficiency

KVA	DOE 2016	DOE NOPR	Watt Reduction
15	98.65%	98.92%	20.2%
30	98.83%	99.06%	19.8%
45	98.92%	99.13%	19.6%
75	99.03%	99.22%	19.7%
112.5	99.11%	99.29%	20.4%
150	99.16%	99.33%	20.4%
225	99.23%	99.38%	19.6%
300	99.27%	99.42%	20.7%
500	99.35%	99.48%	20.1%
750	99.40%	99.52%	20.1%
1000	99.43%	99.54%	19.4%
1500	99.48%	99.58%	19.3%
2000	99.51%	99.61%	20.5%
2500	99.53%	99.62%	19.2%
3750	0.00%	99.66%	
5000	0.00%	99.68%	

Submersible and Network Transformers will remain at the DOE 2016 Efficiency Levels

DOE has added 3750kVA and 5000kVA to the scope of three phase ratings

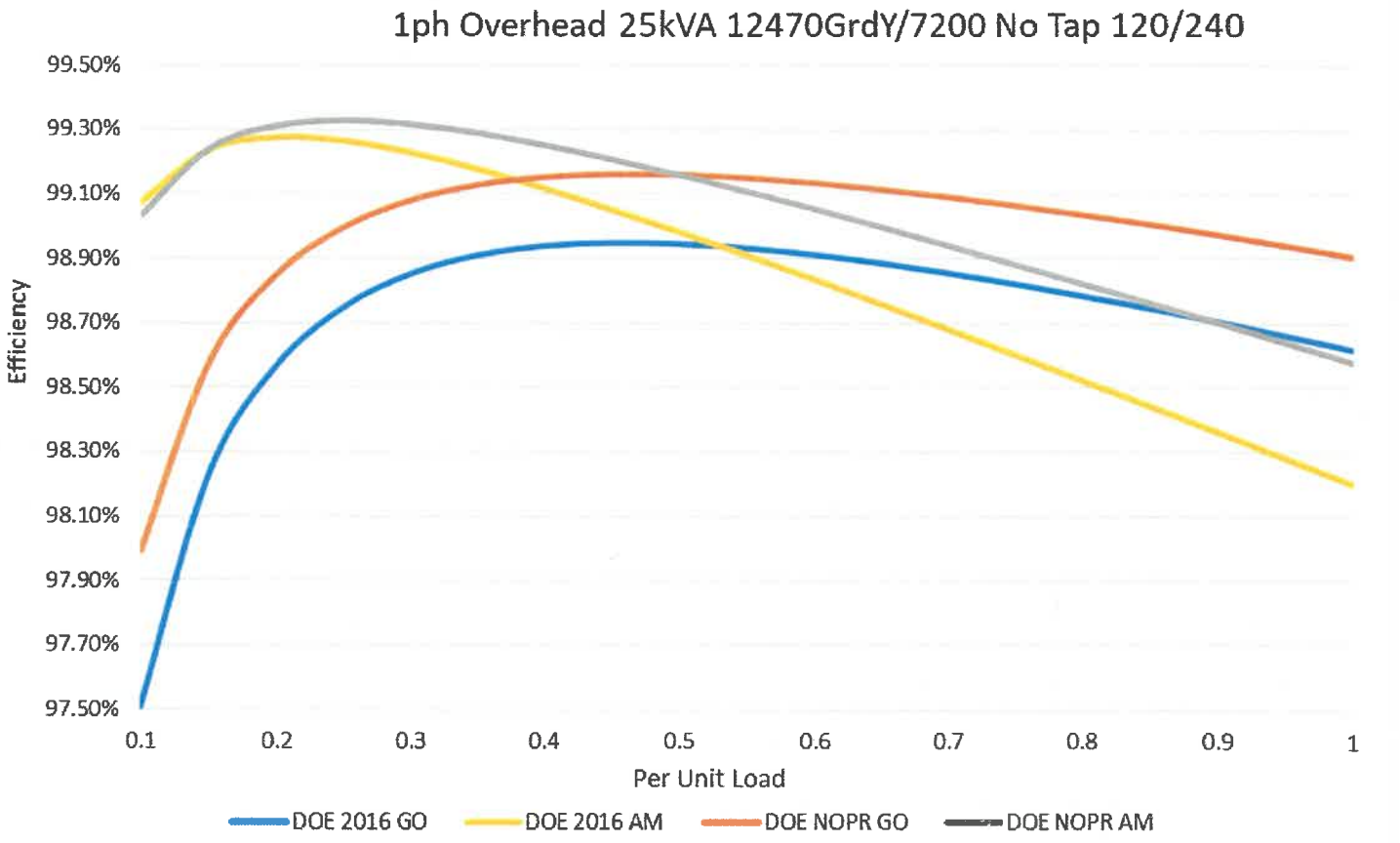
1-Phase Liquid-Immersed Transformers

25kVA Overhead	2016 GO	NOPR GO	2016 AM	NOPR AM
Efficiency 50% 55C	98.95%	99.16% (-20%)	98.95%	99.16% (-20%)
No-load W @ 20C	60	48 (-20%)	19	21 (+10%)
Load W @ 85C	306	240 (-22%)	465	359 (-23%)
Total W @ 100%	366	288 (-21%)	484	380 (-21%)
Total Weight	348	486 (+40%)	342	373 (+9%)

50kVA Padmount	2016 GO	NOPR GO	2016 AM	NOPR AM
Efficiency 50% 55C	99.11%	99.29% (-20%)	99.11%	99.29% (-20%)
No-load W @ 20C	96	83 (-14%)	27	30 (+11%)
Load W @ 85C	547	410 (-25%)	853	643 (-25%)
Total W @ 100%	643	493 (-23%)	880	673 (-24%)
Total Weight	810	1173 (+45%)	885	948 (+7%)

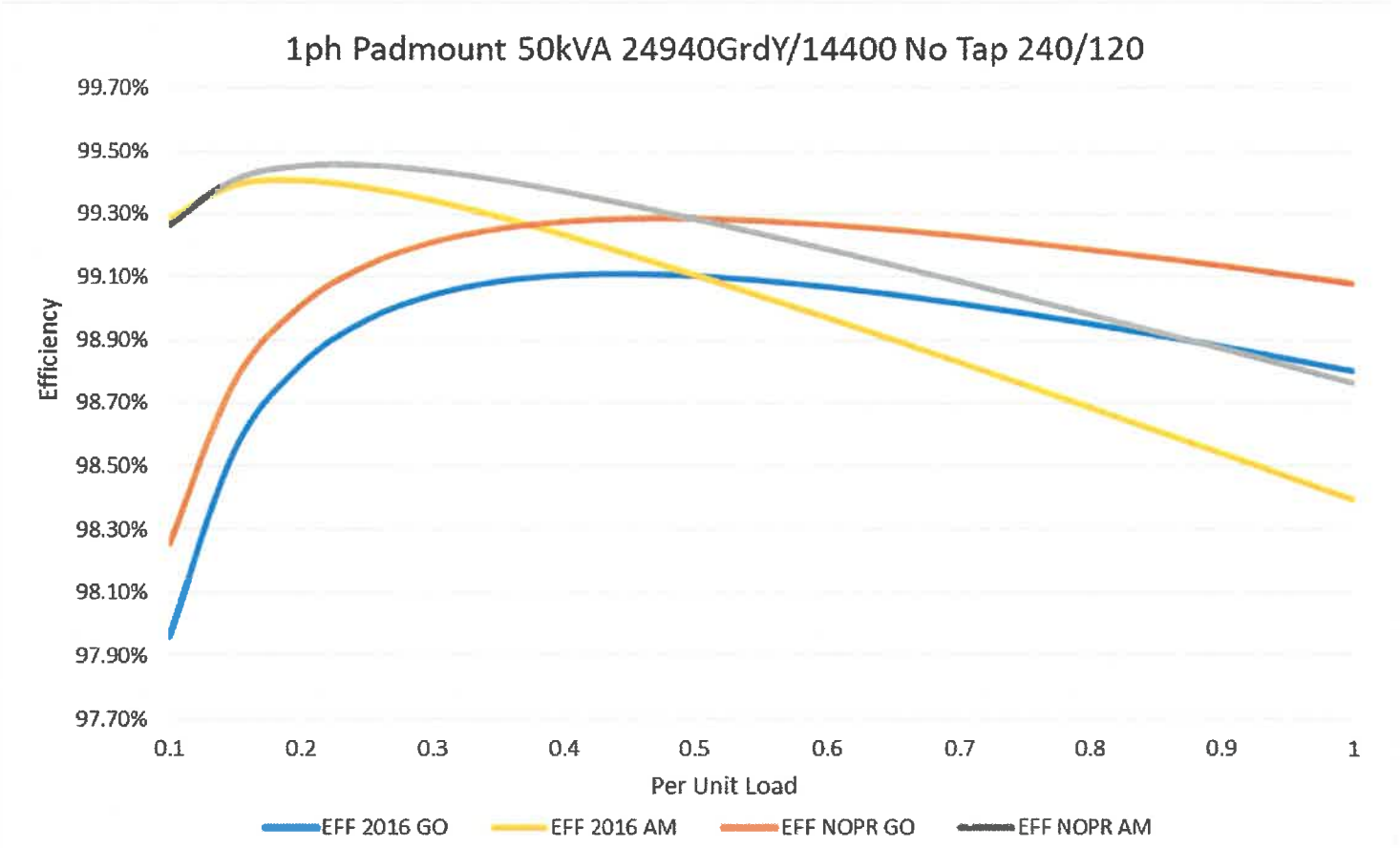
Amorphous Winding loss up > 50% over Grain Oriented transformer

1-Phase Liquid-Immersed – Overhead Transformers



With Loading increasing, best choice transformers are Grain Oriented Electrical Steels

1-Phase Liquid-Immersed – Padmount Transformers

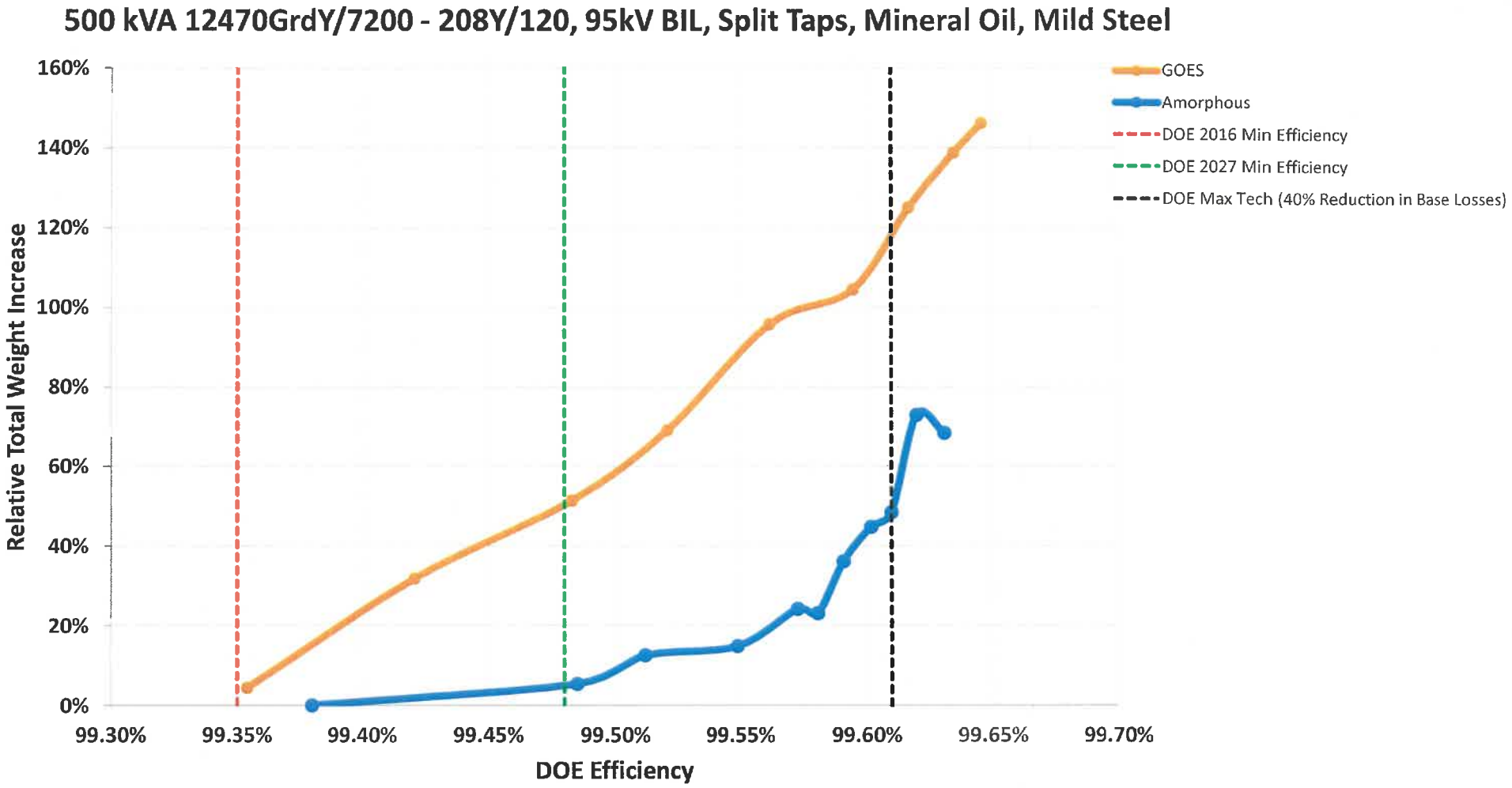


With Loading increasing, best choice transformers are Grain Oriented Electrical Steels

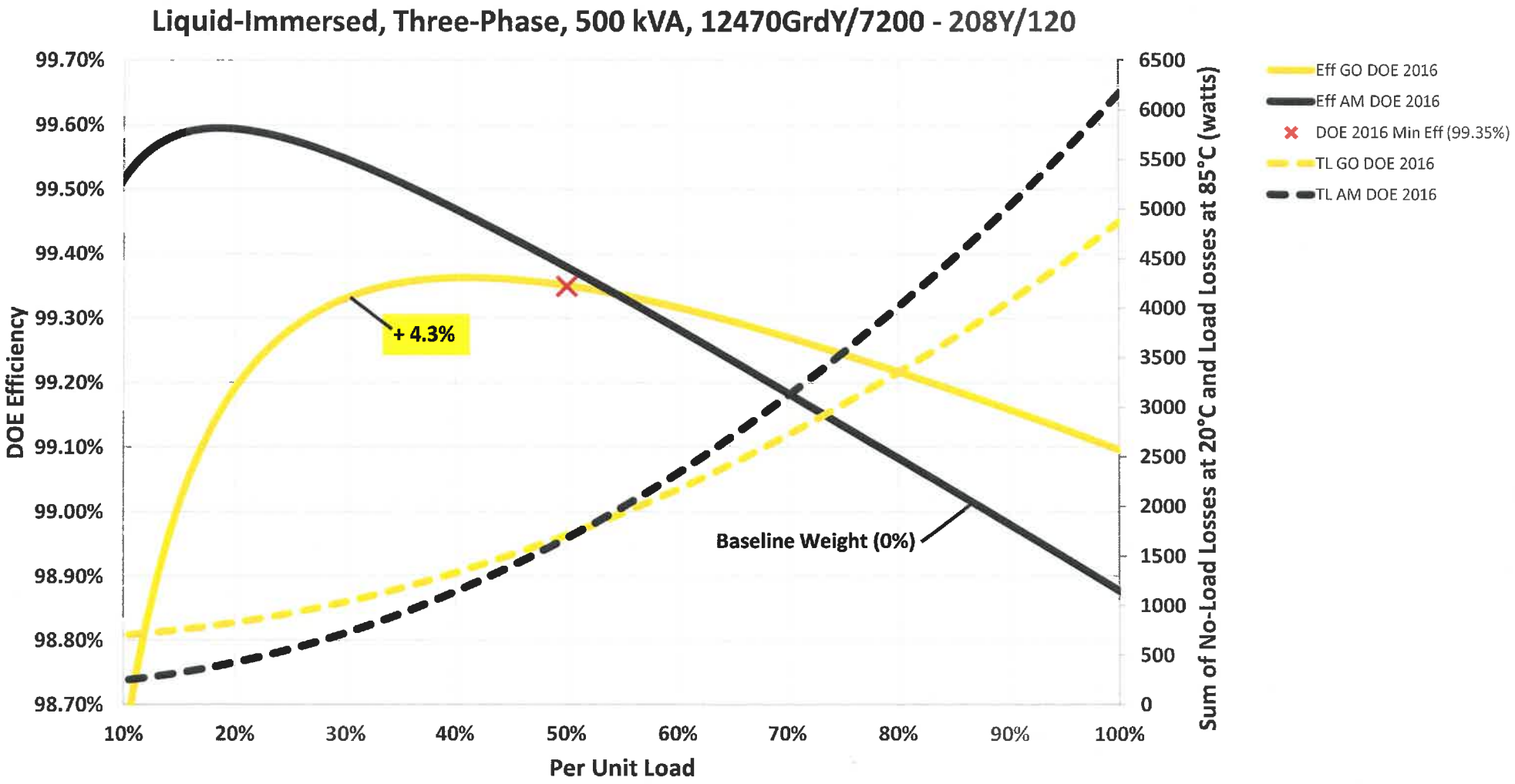
1-Phase Liquid-Immersed Transformers

Observations

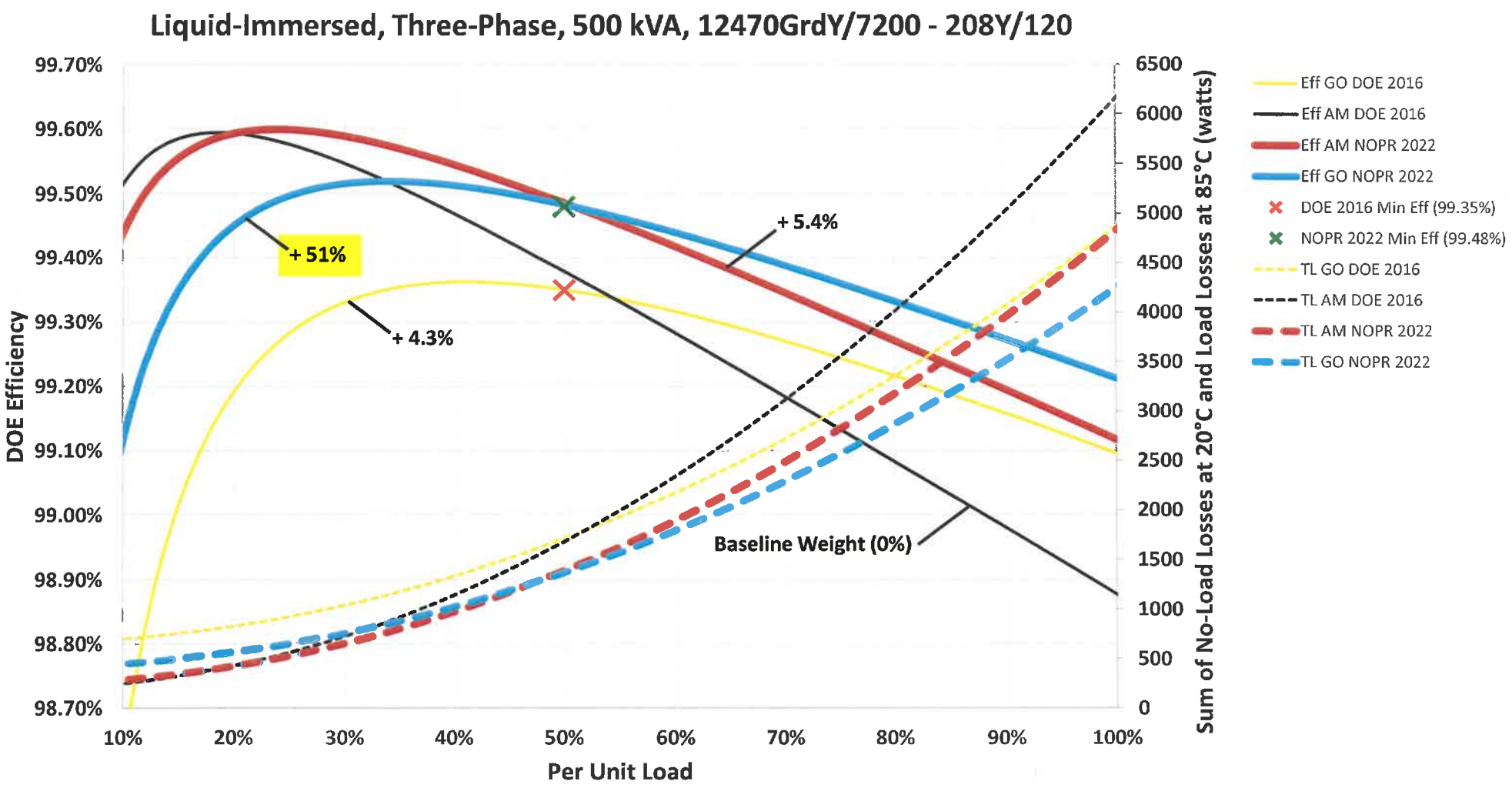
1. **Total weight of GOES designs are 30 – 50% higher than the 2016 rule.**
2. **Amorphous designs are < 10% heavier.**
3. **Core flux density of GOES designs are less than Amorphous designs.**
4. **Copper HV conductor is needed for many NOPR GOES designs while NOPR Amorphous designs are able to use aluminum HV conductors.**
5. **GOES peak efficiency occurs at 40-50% load while Amorphous peak efficiency occurs at 15-25% load.**
6. **Amorphous core loss is 60-70% lower than GOES DOE 2016 designs, but load loss is 20-30% higher.**
7. **Cannot get NOPR designs for some single phase ratings > 250kVA**
8. **For overhead transformers, some NOPR GOES design weight exceeds the capability of the transformer support lugs. Also an issue for cluster mounting brackets.**
9. **Core material supply "flips" from 95% GOES and 5% amorphous to 15% GOES and 85% amorphous**
10. **Core fabrication and assembly of Amorphous cores does not use the same equipment and process as GOES.**



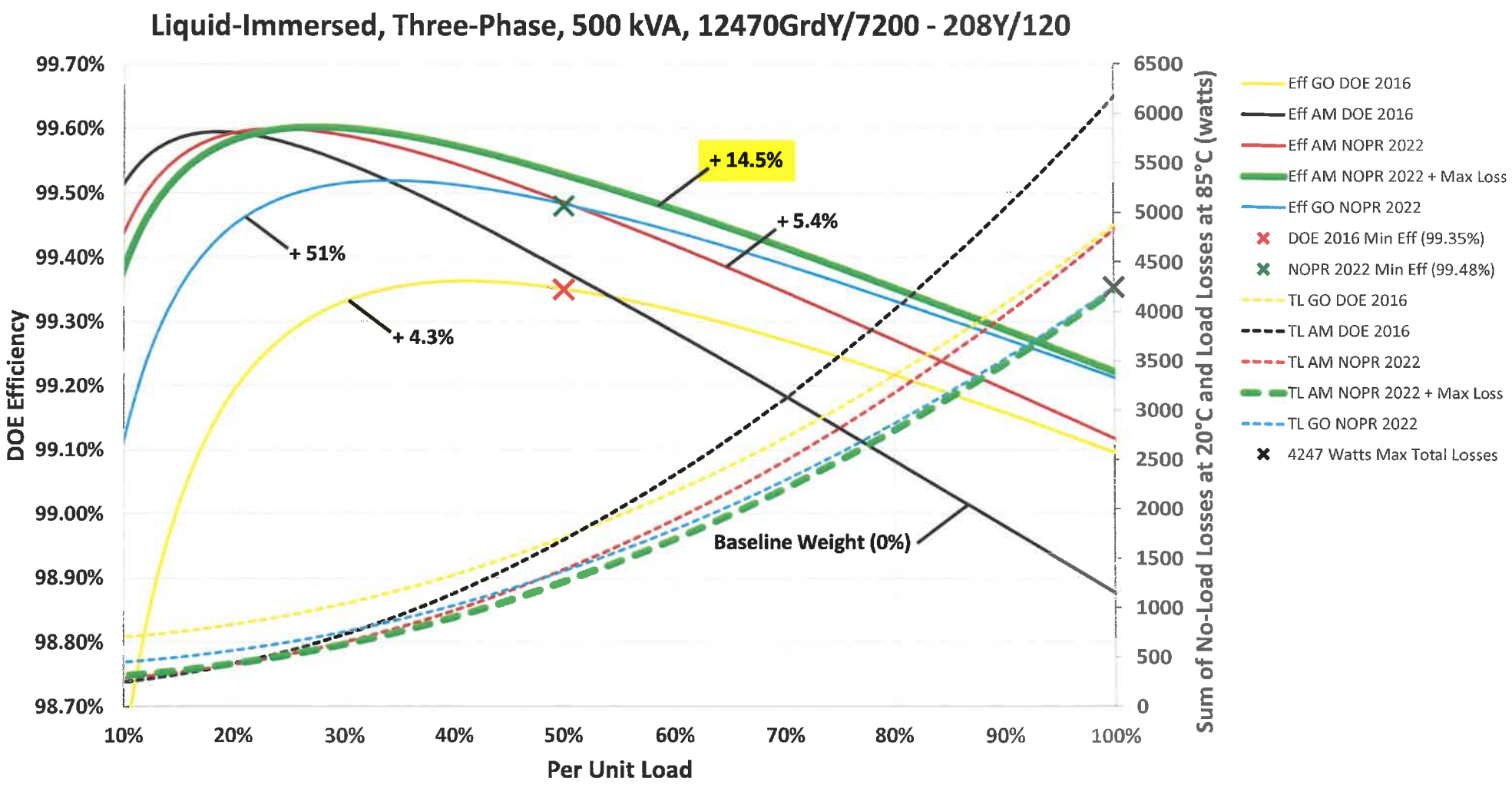
Max-tech confirmed for this design, amorphous achieves NOPR-2022 efficiency with minimal increase in weight



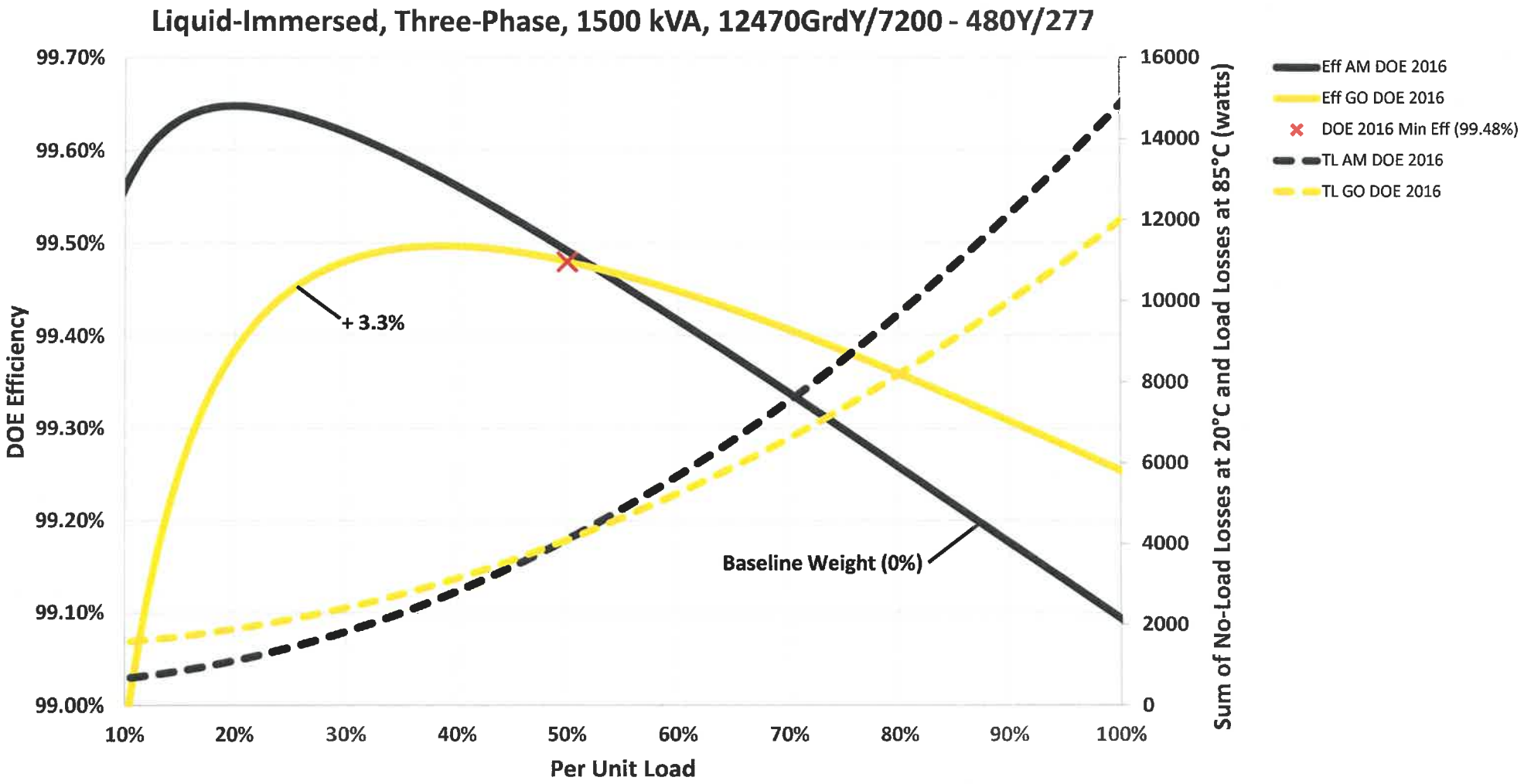
Amorphous cores reduce no-load losses by >70%, non-evaluated designs trade-off no-load for load losses



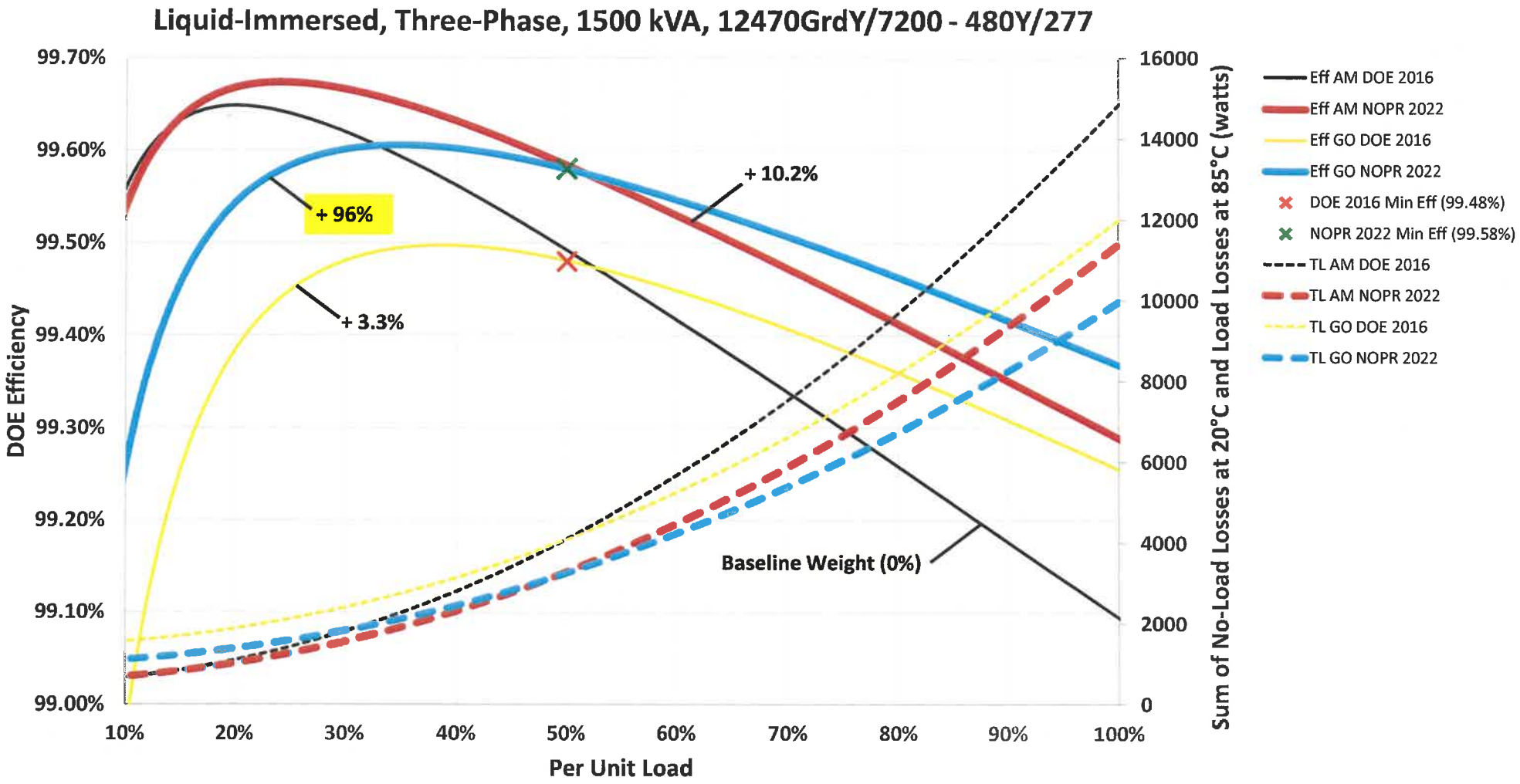
Amorphous-core designs achieve NOPR-2022 efficiencies with minimal increase in weight



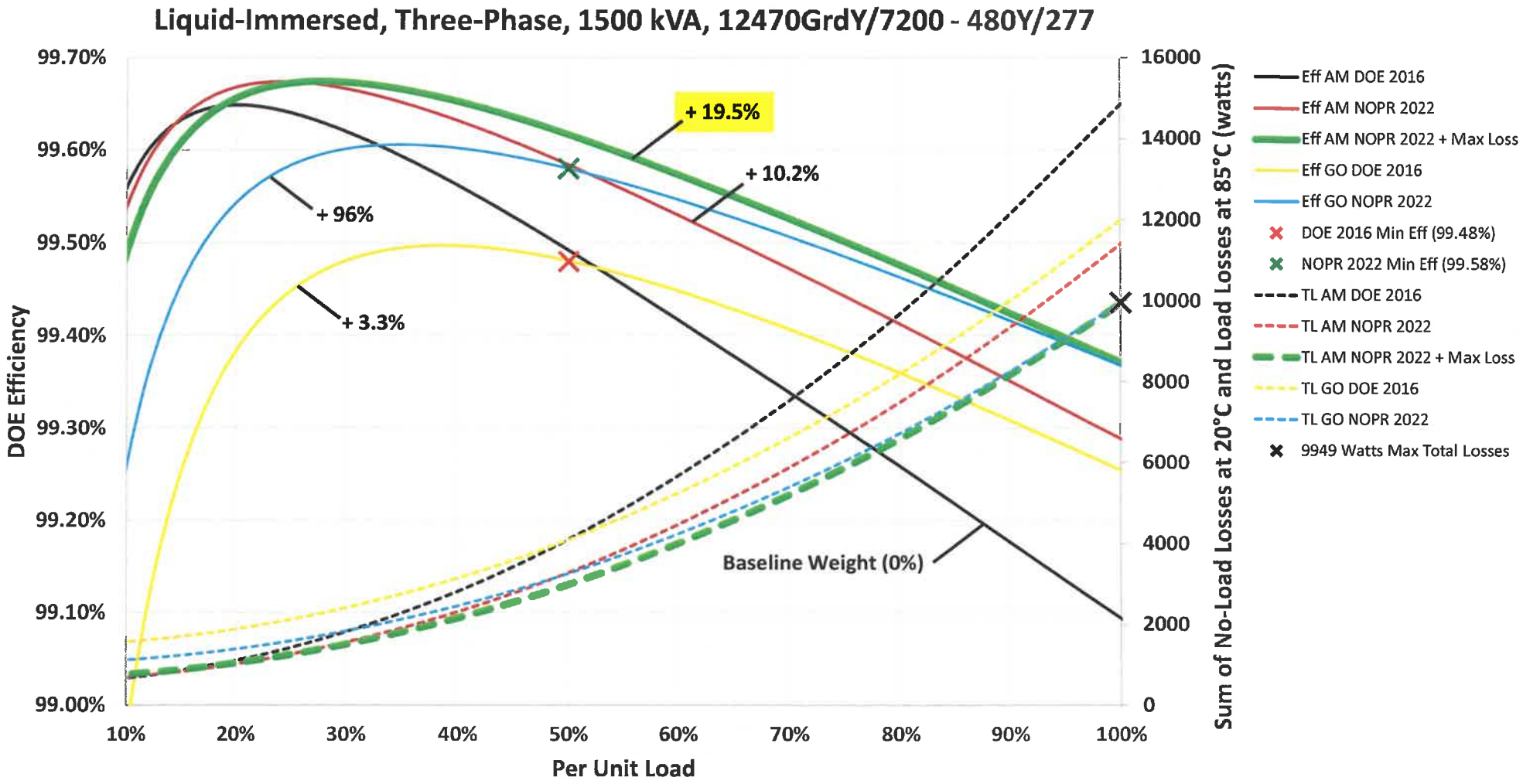
Amorphous-core designs with efficiencies surpassing GOES beyond 100% load attainable with reasonable increase in weight



Amorphous cores reduce no-load losses by >60%, non-evaluated designs trade NLL for LL



Higher kVA & higher current amplify challenges for GOES designs



Amorphous-core designs with efficiencies surpassing GOES beyond 100% load attainable with reasonable increase in weight

The DOE NOPR

MV Liquid proposed efficiencies translate to the following:

1. Weights with GOES will increase by up to 50% as will selling prices
2. Aluminum conductors will be replaced by Copper
3. Generally, GOES steel will be replaced by Amorphous for smaller transformers
4. Stacked core construction will be replaced by wound cores up to 1500 kVA
5. Whether 3-leg or 5-leg construction, circulating 3rd harmonic fluxes will raise losses by 30%
6. Audible noise will increase an average of >14+ %
7. No more domestic steel for transformers up to 1500 kVA
8. In-house core making will largely cease
9. Cores will need to be sourced from Amorphous Core maker
10. Large kVA transformers cannot meet the NOPR

3-Phase MV Liquid losses proposed to drop by 20%

The DOE NOPR

3-Phase Low Voltage

	2016		NOPR 2022 FOR 2027		
KVA	Eff	Losses	Eff	Losses	Loss %
15	97.89	113	98.72	68	-39.8%
30	98.23	189	98.93	114	-39.7%
45	98.40	256	99.03	154	-39.8%
75	98.60	373	99.16	222	-40.5%
112.5	98.74	502	99.24	302	-39.8%
150	98.83	622	99.29	375	-39.7%
225	98.94	844	99.36	507	-39.9%
300	99.02	1039	99.41	623	-40.0%
500	99.14	1518	99.48	915	-39.7%
750	99.23	2037	99.54	1213	-40.5%
1000	99.28	2538	99.57	1511	-40.5%

1-Phase Low Voltage

	2016		NOPR 2022 FOR 2027		
KVA	Eff	Losses	Eff	Losses	Loss %
15	97.7	124	98.84	62	-50.0%
25	98	179	98.99	89	-50.3%
37.5	98.20	241	99.09	121	-49.8%
50	98.30	303	99.14	152	-49.8%
75	98.5	400	99.24	201	-49.8%
100	98.6	497	99.3	247	-50.3%
167	98.70	770	99.35	382	-50.4%
250	98.80	1063	99.4	528	-50.3%
333	98.90	1296	99.45	645	-50.2%

3-Phase LV Dry losses proposed to drop by 40%

1-Phase LV Dry losses proposed to drop by 50%

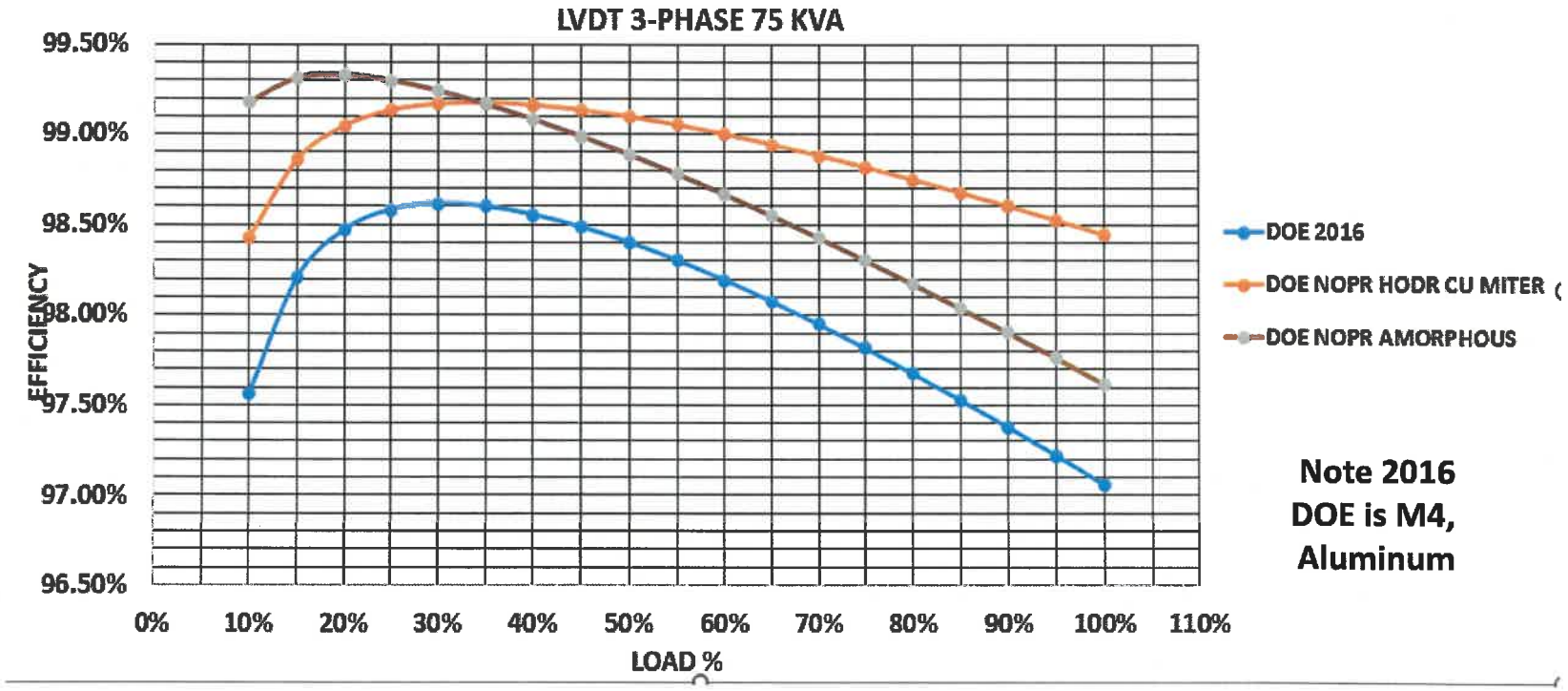
The DOE NOPR

LV Dry proposed efficiencies translate to the following:

1. Single Phase Weights with GOES will increase by 250% as will selling prices
2. Aluminum conductors will be replaced by Copper
3. Generally, GOES steel will be replaced by Amorphous
4. Stacked core construction will be replaced by wound cores
5. For 3-phase, Whether 3-leg or 5-leg construction, circulating 3rd harmonic fluxes will raise losses by 30%
6. Audible noise will increase
7. No more domestic steel
8. In-house core making will cease
9. Cores will need to be sourced from Amorphous Core maker

LV Dry losses proposed to drop 1-Phase by 50%
3-Phase by 40%

The DOE NOPR



Note 2016 DOE is M4, Aluminum

3-Phase LV Dry losses proposed to drop by 40%

The DOE NOPR

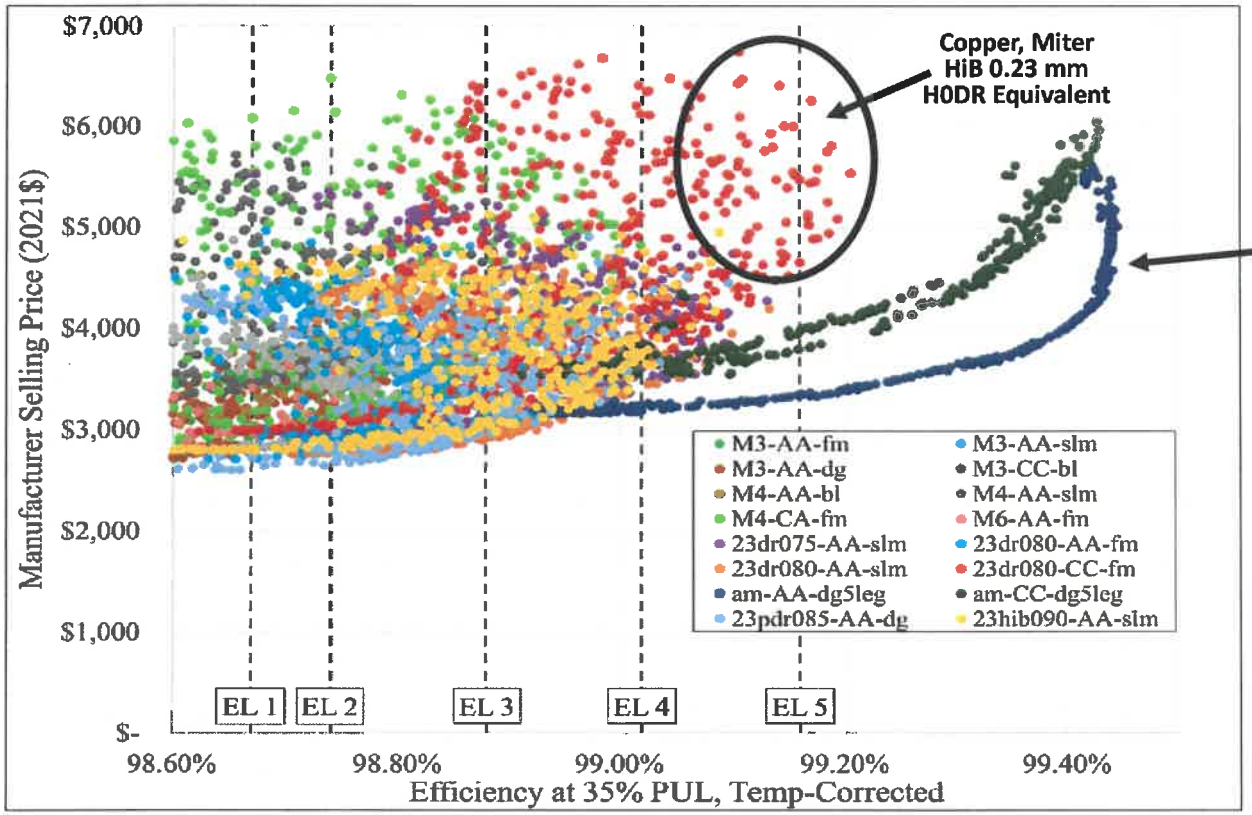


Figure 5.6.7 Engineering Analysis Results, RU7, 2021

Ventilated Low Voltage Dry-Type
3 Phase, 75 kVA
480-208Y/120

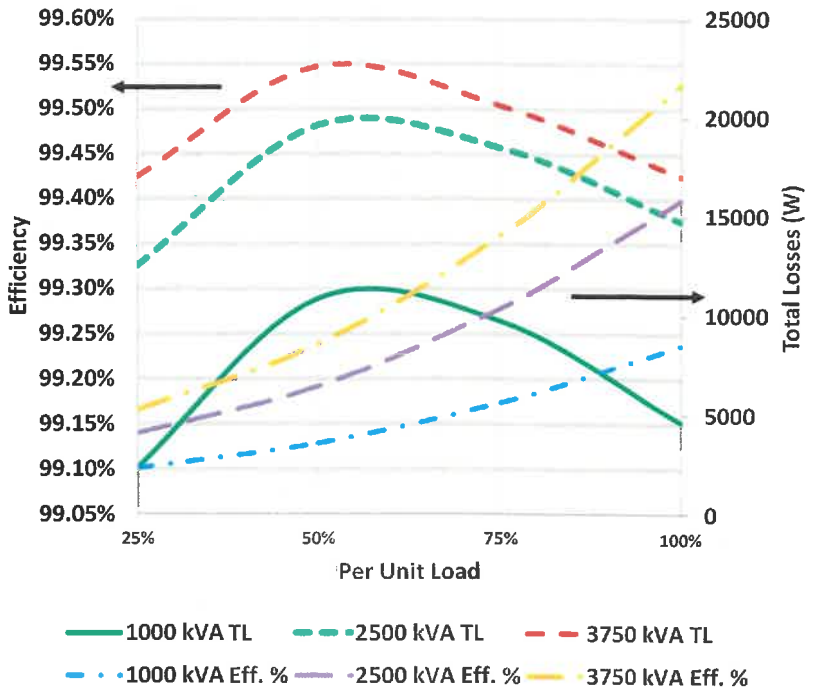
3-Phase LV Dry losses proposed to drop by 40%

The DOE NOPR

Dry-type Medium Voltage Transformers

	500 kVA Cu/Cu	2500 kVA Cu/Cu	3750 kVA Cu/Cu
Materials Cost	10%	11%	37%
Dimensions	1%	2%	8%
Total Weight	5%	6%	20%
	500 kVA Al/Al	**2500 kVA Al/Al**	**3750 kVA Al/Al**
Materials Cost	10%	11%	55%
Dimensions	1%	2%	9%
Total Weight	7%	9%	40%

- **Aspects of units increase to be compliant with DOE 2027 NOPR**
- **Grain-oriented steel sufficient to meet 2027 efficiency levels**
- **Generally speaking Amorphous not needed.**



3-Phase MV Dry losses proposed to drop by 10%

Dry-type Medium Voltage Transformers

The DOE NOPR Impact

- 15 kV primary, 480 V secondary
  - Aluminum to 4250 kVA
  - Copper > 4250 kVA
- 15 kV primary, 208 V secondary
  - Aluminum to 1750 kVA
  - Copper > 1750 kVA maximum

- Can only reach these kVAs with highest grades of steel, such as 23D
  - For some smaller kVAs (500 kVA and below), it may be possible to use 27D

- Size, weight, and cost of large kVA aluminum units comparable to size, weight, and cost of large kVA copper units
  - May drive market away from large aluminum units

3-Phase MV Dry losses proposed to drop by 10%

Core Steel

Cleveland Cliffs

Cleveland-Cliffs

2020 Transformational Acquisitions

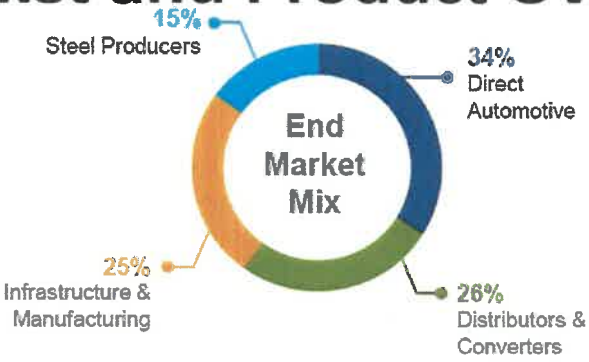
March 2020  AK Steel

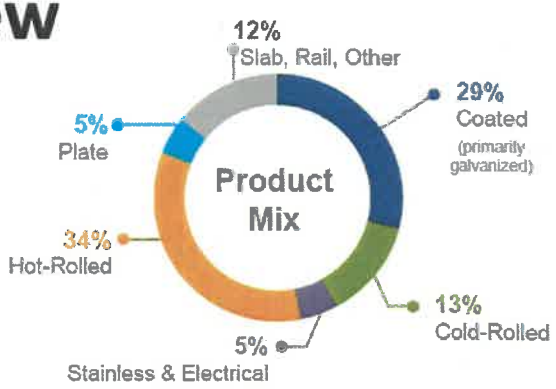
December 2020  ArcelorMittal USA

CLIFFS

Cleveland-Cliffs

End Market and Product Overview





Extensive Product Offering

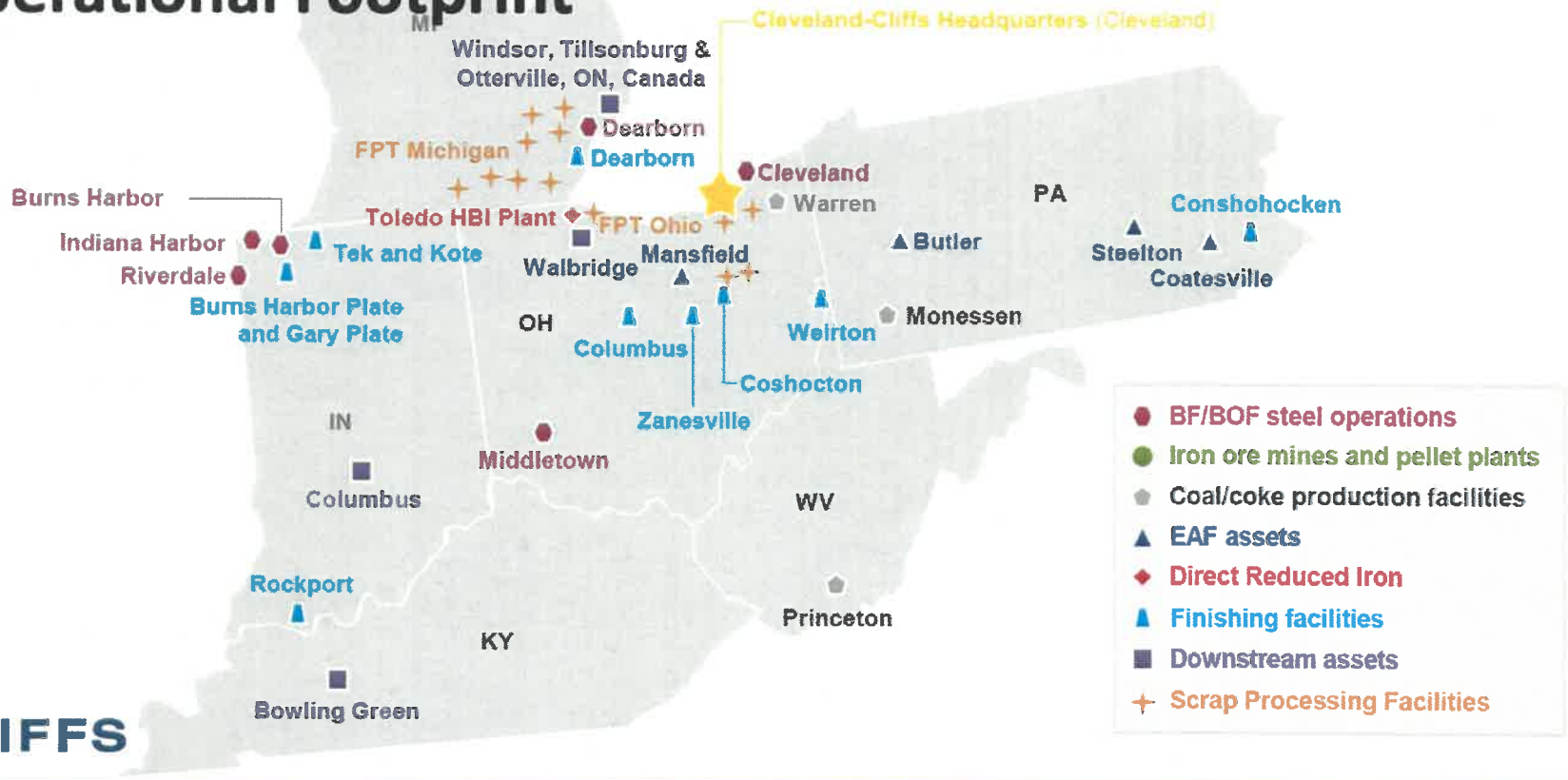
- Advanced High-strength Steels
- Aluminized
- Cold-rolled Coil
- Electrogalvanized
- Galvalume
- Galvanneal
- Grain Oriented Electrical Steels
- Hot-dipped Galvanized
- Hot-rolled Coil
- Non-oriented Electrical Steels
- Plate
- Rail
- Slabs
- Stainless Steels
- Stamped Components
- Tinplate
- Tool & Die
- Tubing

Note: Based on Q4 2022– Product Mix includes steel products shipments

CLIFFS

Cleveland-Cliffs

Operational Footprint



CLIFFS

Cleveland-Cliffs

Electrical Steels

Grain Oriented Electrical Steel
CARLITE®,
LITE CARLITE®
Mill Anneal

Non-oriented Electrical Steel
DI-MAX®

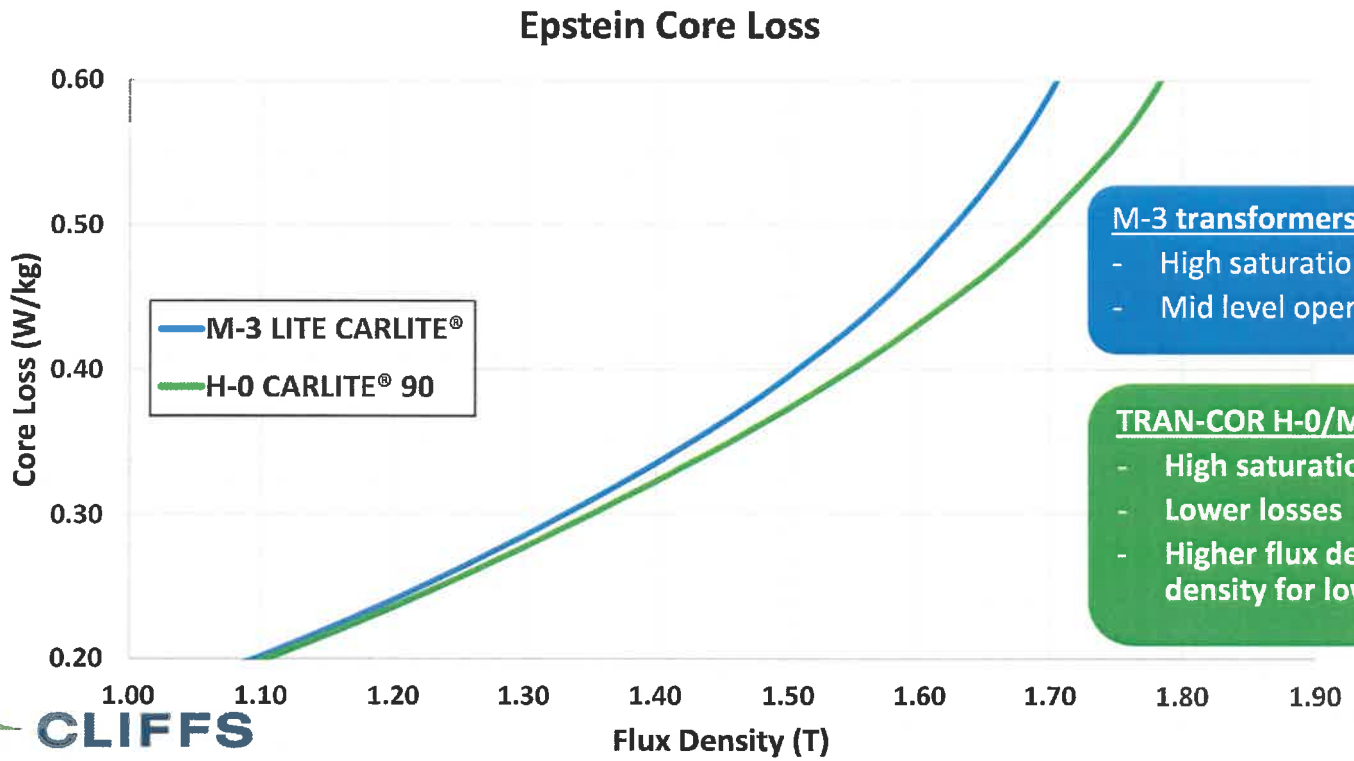
TRAN-COR® H
TRAN-COR X
Grain Oriented Electrical Steel

MOTOR-MAX™
Non-oriented Electrical Steel

CLIFFS

Cleveland-Cliffs

Core losses for GOES products



M-3 transformers

- High saturation – 2.01T
- Mid level operating flux density → "small" core

TRAN-COR H-0/M-0H transformers

- High saturation – 2.01T
- Lower losses
- Higher flux density for smaller core OR same flux density for lower losses

CLIFFS

Cleveland-Cliffs

Impact of 2010 standard

Product	Grade	Approximate ASTM Grades	Nominal Thickness, in. (mm)	Assumed Density, g/cm³	Resistivity, Ω-m, x10⁻⁶	Maximum Core Loss, W/lb.				Minimum Inducation at 10 Oe, kG
						50 Hz		60 Hz		
						15 kG	17 kG	15 kG	17 kG	
Oriented LITE CARLITE	M-2	–	0.007 (0.18)	7.65	51	0.307	0.479	0.395	0.609	18.0
	M-3X	–	0.009 (0.23)			0.305	0.453	0.395	0.580	18.0
	M-3	–	0.009 (0.23)			0.313	0.477	0.405	0.610	18.0
Oriented Mill-Anneal	M-2	18G041	0.007 (0.18)	7.65	51	0.307	0.488	0.395	0.620	18.0
	M-3	23G045 23H070	0.009 (0.23)			0.316	0.484	0.410	0.630	18.0
	M-4	27G051 27H074	0.011 (0.27)			0.390	0.560	0.510	0.740	18.0
	M-5	30G058 30H083	0.012 (0.30)			0.440	0.630	0.580	0.830	17.8
	M-6	35G066 35H094	0.014 (0.35)			0.500	0.710	0.660	0.940	17.8

CLIFFS

Cleveland-Cliffs

Impact of 2016 standard

Product	Grade	Approximate ASTM Grades	Nominal Thickness, in. (mm)	Assumed Density, g/cm³	Resistivity, Ω-m, x10⁻⁶	Maximum Core Loss, W/lb.				Minimum Induction at 10 Oe, kG
						50 Hz		60 Hz		
						15 kG	17 kG	15 kG	17 kG	
Oriented LITE CARLITE	M-2	–	0.007 (0.18)	7.65	51	0.307	0.479	0.395	0.609	18.0
	M-3X	–	0.009 (0.23)			0.305	0.453	0.395	0.580	18.0
	M-3	–	0.009 (0.23)			0.313	0.477	0.405	0.610	18.0
Oriented Mill-Anneal	M-2	18G041	0.007 (0.18)			0.307	0.488	0.395	0.620	18.0
	M-3	23G045 23H070	0.009 (0.23)			0.316	0.484	0.410	0.630	18.0
	M-4	27G051 27H074	0.011 (0.27)	7.65	51	0.390	0.560	0.510	0.740	18.0
	M-5	30G058 30H083	0.012 (0.30)			0.440	0.630	0.580	0.830	17.8
	M-6	35G066 35H094	0.014 (0.35)			0.500	0.710	0.660	0.940	17.8

CLIFFS

Cleveland-Cliffs

Impact of 2022 standard

Product	Grade	Approximate ASTM Grades	Nominal Thickness, in. (mm)	Assumed Density, g/cm³	Resistivity, Ω-m, x10⁻⁶	Maximum Core Loss, W/lb.				Minimum Induction at 10 Oe, kG
						50 Hz		60 Hz		
						15 kG	17 kG	15 kG	17 kG	
Oriented LITE CARLITE	M-2	–	0.007 (0.18)	7.65	51	0.307	0.479	0.395	0.609	18.0
	M-3X	–	0.009 (0.23)			0.305	0.453	0.395	0.580	18.0
	M-3	–	0.009 (0.23)			0.313	0.477	0.405	0.610	18.0
Oriented Mill-Anneal	M-2	18G041	0.007 (0.18)	7.65	51	0.307	0.488	0.395	0.620	18.0
	M-3	23G045 23H070	0.009 (0.23)			0.316	0.484	0.410	0.630	18.0
	M-4	27G051 27H074	0.011 (0.27)			0.390	0.560	0.510	0.740	18.0
	M-5	30G058 30H083	0.012 (0.30)			0.440	0.630	0.580	0.830	17.8
	M-6	35G066 35H094	0.014 (0.35)			0.500	0.710	0.660	0.940	17.8

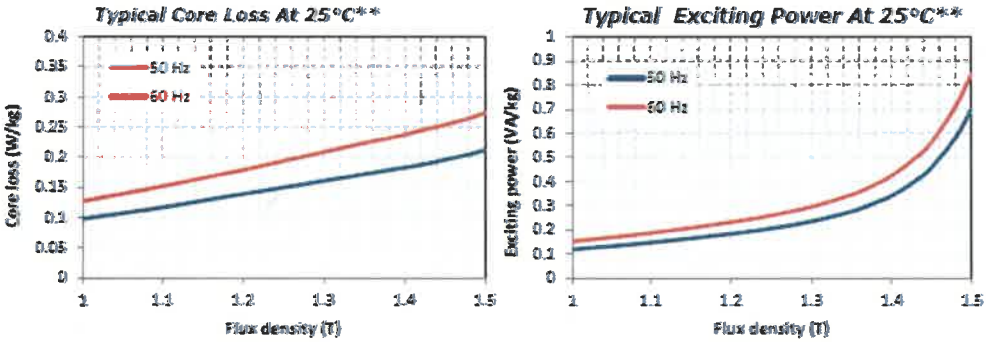
CLIFFS

Core Steel Types-Amorphous

Metglas a subset of Proterial and Bain Holdings

Magnetic Properties

Saturation Induction (T)	Remnant Induction (T)	Coercivity, Hc (A/m)	Max DC Permeability	Electrical Resistivity (μΩm)	Curie Temperature (°C)	Magnetostriction (x10-6)
	Annealed	Annealed	Annealed			
1.63	1.53	0.9	1,000,000	1.2	364	27



**DT Core Data – 142.2 mm wide ribbon

Operating Flux Density

Design induction is dependent upon various considerations such as operating temperature, overvoltage requirements, sound level etc.

Typical Single Phase / Three Phase: 1.42Tesla

Maximum operating induction 13.5 kG To allow for 10% overvoltage

Proterial is headquartered in Tokyo, Japan

Core Steel Types-Amorphous

Metglas a subset of Proterial and Bain Holdings

Metglas® ***Amorphous Metal Transformer Core***

www.metglas.com *Product Release*

Metglas has capabilities in-house to make distribution transformer cores in order to support our customer designs and their production needs.

Our Amorphous Transformer cores are manufactured from low loss **Metglas® 2605HB1M transformer core alloy.** This low loss, high permeability alloy has excellent performance for **Single and Three phase** commercial, industrial and distribution transformer applications.

Metglas cores are installed using industry standard transformer assembly techniques.

General Properties & Characteristics for Metglas® 2605HB1M transformer core alloy

Physical Properties

Alloy	Nominal Composition	Density (g/cm3)	Standard Available Widths (mm)*	Vickers Hardness Hv-50 g load	Tensile Strength (N/mm2)	Thermal Expansion Coefficient (x10-6 /°C) 30 - 300°C	Crystallization Temperature (°C)
2605HB1M	FeBSi	7.33	142.2 170.2 213.4	900	2,100	4.3	489

*Please contact sales representative for custom ribbon width

Usable in small cores

Common available widths of steel

5.59”, 6.70”, 8.40”

Amorphous impact is both the metal and the core making

Core Steel forecast by the DOE

If no new increase in efficiencies

Table IV.10—Core Material Limits in the No-New Standards Case

Baseline Steel for Liquid-Immersed:	*Baseline Steel for Dry-Type:*
• 87% M3 or 23hib090.	• 97% M4 or hib-M4 (M3 as modeled).
• 3% Amorphous (mostly in TOC applications above standards).	• 3% PDR.
• 10% 23PDR085.	• 0% AM.

Note the small impact of amorphous on the Domestic industry today
To fully displace GOES, production must rise from 16000 tons to 200,000

User Perspective

Load Changes

- **Changes taking place:**
  - **Solar Panels**
  - **Electric Cars**
  - **Powerwalls**
- **The latest wrinkle:**
  - **Local government regulations banning new natural gas appliances**
- **What loading effect will these have?**

User Perspective

DOE Efficiency Changes

- Too much attention on no-load losses
- Load-losses are more critical to utility as:
  - Most single-phase distribution transformer sizing is driven by voltage/flicker drop
  - Most three-phase distribution transformer sizing is driven by customer main switch size

Utility Load growth not Addressed by DOE NOPR, but now in 2023 EIA Forecast

Summary

Transportation Electrification

- Increasing number of electric light duty vehicles
- Increasing number of commercial electric vehicles
- More applications of autonomous electric vehicles
- 3.3 million US EV's in 2022

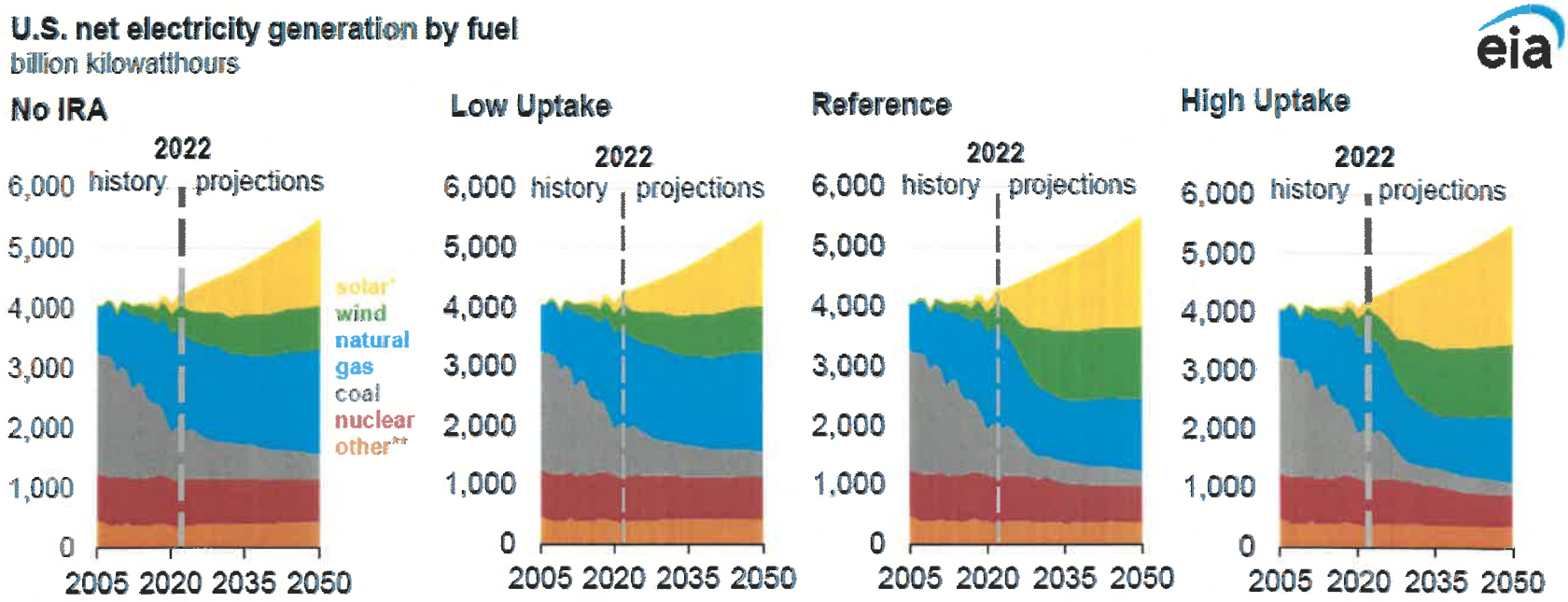
Building Electrification

- Higher efficiency of newer electric end-uses
- Corporate "green" goals and policies
- Impact of LEED, Energy Star, and other "green" codes

1. EIA has projected 35% increased load over 2022 by 2050, 0.9%/yr.
2. 2021 to 2022 actual load grew 3.3%

Summary..Total Electric Growth now predicted by the EIA to be 35% by 2050

Solar and wind generate a majority of U.S. electricity by 2050 in the Reference and High Uptake cases



Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2023* (AEO2023)
Note: IRA=Inflation Reduction Act
*Includes utility-scale and end-use photovoltaic generation and excludes off-grid photovoltaics.
**Includes petroleum, conventional hydroelectric power, geothermal, wood and other biomass, pumped storage, non-biogenic municipal waste in the electric power sector, refinery gas, still gas, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, and miscellaneous technologies.

Flaws in DOE Model

Flaws in DOE Model

1. Electric loads will actually increase, not stay stagnant, especially for transportation.
2. Higher loads will prefer GOES over Amorphous Cores
3. OPS Model for scaling to other power ratings inaccurate using the ¾ power of kVA.
4. Stray and Eddy losses greatly understated affecting high current LV ratings particularly
5. METGLAS can cover demand as GOES Disappear
6. Incorrect that Consumers will tolerate up to a 250% increase in cost of transformers
7. Incorrect that Manufacturers will absorb spent costs in disappearing infrastructure
8. Incorrect that Manufacturers will not disappear
9. Incorrect that Lead times will not increase
10. Incorrect that The industry will remain viable

The NOPR will cripple the Distribution Transformer industry

SUMMARY

Summary

A. DOE proposed new efficiency standards Unrealistic

B. DOE Designs by OPS not accurate

1. Apply ¾ Power for scaling
2. Assume eddy losses vary as conductor thickness squared, actual to thickness^4
3. Material costs in designs off by 50%
4. High kVA efficiencies not reachable

Recommendations

- DOE needs to rerun designs
- Efficiencies need to be reduced to keep GOES available

Summary

Comments to DOE by email due March 27, 2023

- **DOE will accept comments, data, and information regarding this NOPR until March 27, 2023.**
- **Interested persons may submit comments identified by docket number EERE-2019-BT-STD-0018, by email (DistributionTransformers2019STD0018@ee.doe.gov), Federal eRulemaking portal (http://www.regulations.gov).**
- **Find product information for Distribution Transformers including current standards and test procedures, statutory authority, waivers, exceptions and contact information.**

Generally Speaking, the more comments, the better the outcome