ATI Allegheny Ludlum's response to DOE's May 29, 2012 Notice of Public Meeting (NOPM)

Four new TSLs were proposed by the DOE for medium voltage liquid immersed distribution transformers in two documents (the NOPM and Appendix 8-A) issued in advance of a public meeting held on June 20, 2012. All were found to have significant impacts on the competitiveness of grain-oriented electrical steel relative to amorphous ribbon and other higher-performance, lower availability cores, which was corroborated by results presented by Navigant and LLBL during the economic analysis section of the public meeting. These TSLs, particularly TSLs B, C and D, were found to result in nearly complete conversion of MVLT cores to amorphous ribbon. A new TSL is also proposed that is based on the cross-over points where multiple materials are competitive for MVLT.

TSL 1 and TSL A

TSL A is similar to the NOPR TSL (TSL 1), which, while flawed, has been met with acceptance by a diverse group consisting of steelmakers, utilities/associations, and transformer manufacturers. The primary issue with both TSL 1 and TSL A is that the efficiency levels assigned to Design Lines DL02 and DL05 are both set well above the cross-over point for competition between multiple core materials (see Figures 3, 4, 9 and 10).* This is particularly important for DL02, as it also serves to establish efficiency levels for Equipment Class 2B. Implementation of TSL 1 or TSL A would curtail the availability of multiple options for core material choices for MVLT.

Proposed TSL

An alternate TSL is proposed consisting of cross-over points, where there is equitable competition between multiple options for core materials – no option is given a significant pricing advantage. Note that for DL02, the mandated efficiency in the proposed TSL remains well above the cross-over point. This is due to the baseline efficiency being set extremely high during the 2007 process. This cannot be corrected without backsliding from the 2010 Final Rule. Details are provided at the end of this report to support the choices of these efficiency levels.

Table 1 – Proposed cross-over TSL

Design Line	Equipment Class	Efficiency Level	Efficiency
DL01	1A	EL 1.3	99.18%
DL02	1B	baseline	98.91%
DL03	1B	EL 0.7	99.46%
DL04	2A	EL 1	99.16%
DL05	2A	EL 0.7	99.44%

* The cross-over points have been determined solely using the data provided by Navigant, specifically the medium cost scenario (often referred to as 2010 pricing). The core steel distribution by TSL is taken directly from the LLBL analysis. There has been considerable debate regarding the Navigant/LLBL analysis and its accuracy and relevance. While input from transformer manufacturers and end-users has obvious value, in the writer's opinion, the Navigant analysis is comprehensive, self-consistent, verified, and free of obvious bias. As such, it is the best tool available to complete the task at hand.

Effect of implementation of higher efficiency TSLs on core steel pricing and availability

Implementation of TSLs B, C or D would significantly restrict or potentially eliminate the availability of multiple options for core material choices for MVLT, as the cost of transformers with grain-oriented electrical steel cores would increase rapidly relative to MVLT with amorphous ribbon cores (see Figures 1-10 for reference). This is illustrated below in Table 2, showing the cost penalty for a MVLT unit with an M-3 core compared to an equivalent MVLT with an SA1 amorphous ribbon core at the four different TSL levels, based solely on the data provided by Navigant (medium cost scenario). This was supported by the economic analysis slides shown during the June 20, 2012 public meeting, which indicated that most designs were transitioned entirely to amorphous ribbon cores, or to an amorphous-heavy mix of SA1 and M-2 grain-oriented electrical steel, which is also restricted in supply.

Table 2 –Average price disadvantage for M-3 core MVLT unit relative to an equivalent SA1 amorphous ribbon core MVLT unit at mandated TSL efficiency levels

	TSL B	TSL C	TSL D
M-3 core MVLT average unit price disadvantage relative to an equivalent SA1 amorphous ribbon core MVLT	12%	24%	18%

To produce a competitively priced MVLT unit with an M-3 core at higher mandated efficiency levels, cost recovery from the standpoint of the transformer manufacturer would necessarily focus on the increasing amount of grain-oriented electrical steel in the core in order to maintain per-unit profitability levels. As approximately one-third to one-half of the cost of a transformer is directly related to the core steel, it is expected that the necessary percent reduction in price for the core steel would be magnified by a similar factor. Table 3 shows the resulting projected reduction in M-3 grain-oriented electrical steel acquisition cost.

Table 3 – Projected reduction in M-3 grain-oriented electrical steel acquisition cost relative to current baseline scenario at mandated TSL efficiency levels

	TSL B	TSL C	TSL D
Projected reduction in M-3 grain-oriented electrical steel acquisition cost relative to current baseline scenario	24-36%	48-72%	36-54%

Such deep reductions in the price of electrical steel for MVLT cores would likely result in either a disruption of the core steel supply chain, leaving transformer manufacturers dependent on a single foreign owned supplier of amorphous ribbon which has the bulk of its production capacity located overseas; or significantly increased selling prices for amorphous ribbon, which would preserve core material options but would reduce or eliminate any savings which are projected from the LCC analysis. As such, these TSLs should be discarded.

Details

The NOPM proposal (including Appendix 8-A) splits Equipment Classes 1 and 2 into "A" class units, which cover only pad-mount MVLT applications, and "B" class units, which specifically cover pole-mount MVLT applications. There are seven specific designs in this proposal, up from five, although two are derivative.

- The first five designs (Design Lines DL01-DL05) are parametrically equivalent to their counterparts in the original Engineering Analysis and the NOPR.
- The other two are larger three phase pole mounted (B class) units constructed of three linked single-phase units. The proposed efficiency for these two units is scaled – set at 100% of the proposed efficiency levels for the single phase units, with no correction factor for interference between the units.

The efficiency levels established by the NOPR TSL already place significant cost pressure (unit cost increases by about 10%) on Design Lines DL02, DL03 and DL05 when an M-3 GOES core is specified, relative to an amorphous SA1 ribbon core units. Design Lines DL01 and DL04 are the only two specific units set at or below the first-cost cross-over points in the NOPR TSL. The new proposal establishes four unique new TSLs (A, B and C were added in the document published on May 29, 2012, with D added in supplemental Appendix 8-A) which are presented as alternatives to the NOPR TSL.

- **TSL A** is similar to the NOPR TSL with one exception. Design Lines DL01 and DL02, which were previously coupled as part of Equipment Class 1 in the NOPR, are now separated by the establishment of the A and B demarcations in the Equipment Classes. This has several important ramifications.
    - The NOPR scaled the nominal efficiency levels for DL01 and DL02 so they both fit on a smooth efficiency curve in Equipment Class 1. DL01 was nominally set at EL1, and DL02 was nominally set at baseline (EL0), but both ended up at an actual efficiency of approximately EL ½.
    - TSL A establishes DL01 at a full EL1, but leaves DL02 at EL ½. This is not a major issue for DL01, as it is now at the cross-over point, but DL02 should be restored to baseline efficiency, as DL02 units with a core made of M-3 have difficulty competing at even the baseline level.
    - Design Line DL02 is particularly important, as it also establishes the efficiency level for the 75 kVA three-phase pole unit in Equipment Class 2B.
- **TSL B** increases the efficiency level to EL 1.5 for Design Lines 01, 04, and 05. This results in mandatory efficiency levels for all of the Design Lines above the cross-over points for grain-oriented electrical steel, and places DL02, DL04 and DL05 units built with grain-oriented electrical steel cores at a significant economic disadvantage relative to amorphous SA1 ribbon core units.
- **TSL C** increases efficiency for MVLT to EL2 across the board. As has been, establishing standards for MVLT based on EL2 results in units built with grain-oriented electrical steel cores being economically non-competitive. This has been thoroughly documented in written submissions to the DOE and extensively discussed at the working group and public comment meetings. Cost penalties for the finished transformers will be in the 25-30% range on average, which will heavily impact the cost of the core steel. As such, it should not be considered.
- **TSL D** is intermediate to TSLs B and C. It holds the efficiency level at EL1 for DL03, increases the efficiency level to EL1 for DL02, and increases the efficiency level to EL 2 for Design Lines 01, 04, and 05. This results in mandatory efficiency levels for all of the Design Lines above the cross-over points for grain-oriented electrical steel, and places DL02, DL04 and DL05 units built with grain-oriented electrical steel cores at a significant economic disadvantage relative to amorphous SA1 ribbon core units.

Table 4 – Summary of New Equipment Classes and Equivalent Designs from the NOPR

NOPR		New EC Groupings				
EC	**Design Line**	**EC**	**Design Line**	**Phases**	**kVA**	**Use**
1	DL01	1A	DL01	1	50	Pad
1	DL02	1B	DL02	1	25	Pole
1	DL03	1B	DL03	1	500	Pole
2	DL04	2A	DL04	3	150	Pad
2	DL05	2A	DL05	3	1500	Pad
1	Three units assembled into a single installation	2B	Scaled from DL02	3	75	Pole
1		2B	Scaled from DL03	3	1500	Pole

Table 5 – Summary of new TSLs (Efficiency Levels and Actual Mandated Efficiency)

EC	Design Line	TSL A	TSL B	TSL C	TSL D	TSL A	TSL B	TSL C	TSL D
1A	DL01	1	1.5	2	2	99.16%	99.19%	99.22%	99.22%
1B	DL02	0.5	0.5	2	1	98.96%	98.96%	99.07%	99.00%
1B	DL03	1	1	2	1	99.48%	99.48%	99.51%	99.48%
2A	DL04	1	1.5	2	2	99.16%	99.19%	99.22%	99.22%
2A	DL05	1	1.5	2	2	99.48%	99.50%	99.51%	99.51%
2B	Scaled from DL02	Scaled							
2B	Scaled from DL03								

Table 6 – Efficiency Levels – Comparison of NOPR and new TSLs, along with proposed TSL for core material cross-over

NOPR		New EC Groupings								
EC	**Design Line**	**EC**	**Design Line**	**Baseline**	**TSL 1 NOPR**	**TSL A**	**TSL B**	**TSL C**	**TSL D**	**TSL cross-over**
1	DL01	1A	DL01	99.08%	99.11%	99.16%	99.19%	99.22%	99.22%	99.18%
1	DL02	1B	DL02	98.91%	98.95%	98.96%	98.96%	99.07%	99.00%	<98.91%
1	DL03	1B	DL03	99.42%	99.49%	99.48%	99.48%	99.51%	99.48%	99.46%
2	DL04	2A	DL04	99.08%	99.16%	99.16%	99.19%	99.22%	99.22%	99.16%
2	DL05	2A	DL05	99.42%	99.48%	99.48%	99.50%	99.51%	99.51%	99.44%
1		2B	Scaled from DL02	98.91%	98.95%	98.96%	98.96%	99.07%	99.00%	<98.91%
1		2B	Scaled from DL03	99.42%	99.49%	99.48%	99.48%	99.51%	99.48%	99.45%

Table 7 –Impact on cost of transformers with an M-3 core relative to baseline case (EL0) from Navigant data

NOPR		New EC Groupings						
EC	**Design Line**	**EC**	**Design Line**	**NOPR**	**TSL A**	**TSL B**	**TSL C**	**TSL D**
1	DL01	1A	DL01	0%	0%	-3%	-19%	-19%
1	DL02	1B	DL02	-12%	-12%	-12%	-30%	-10%
1	DL03	1B	DL03	-5%	-4%	-4%	-16%	-4%
2	DL04	2A	DL04	-6%	-6%	-18%	-30%	-30%
2	DL05	2A	DL05	-14%	-14%	-21%	-25%	-25%

Figure 1 – Design Line DL01 Unit Cost M-3 Core Relative to SA1 Core (Navigant/LLBL medium cost scenario), cross-over point is at 1.0

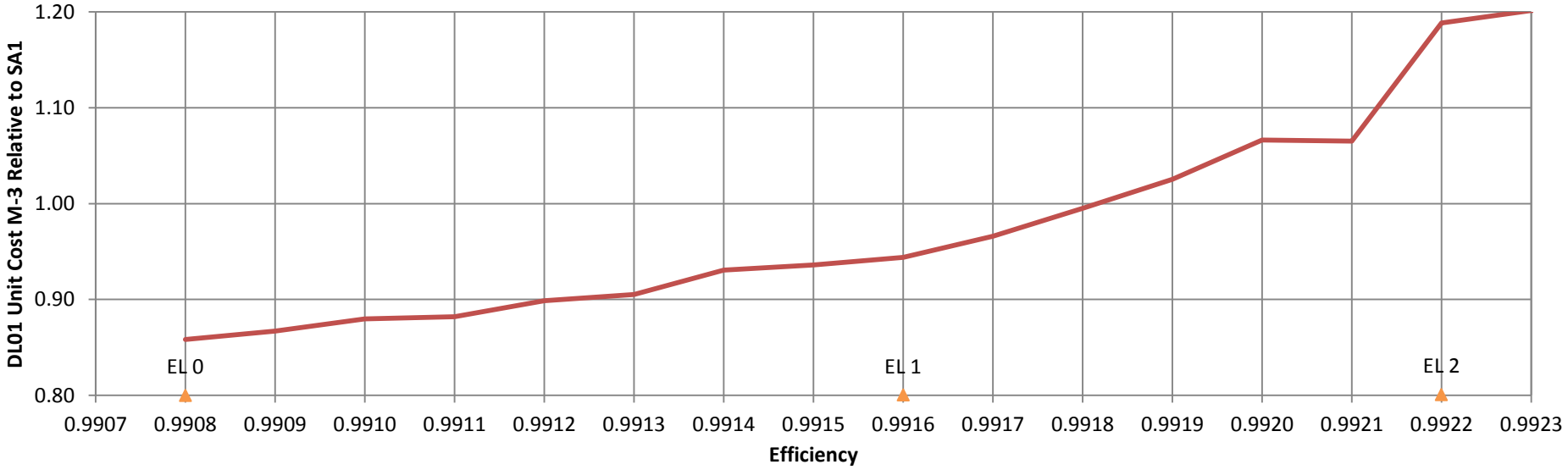

Figure 2 – Design Line DL01 core material distribution by TSL as per Navigant/LLBL analysis (NOPR and NOPM TSLs)

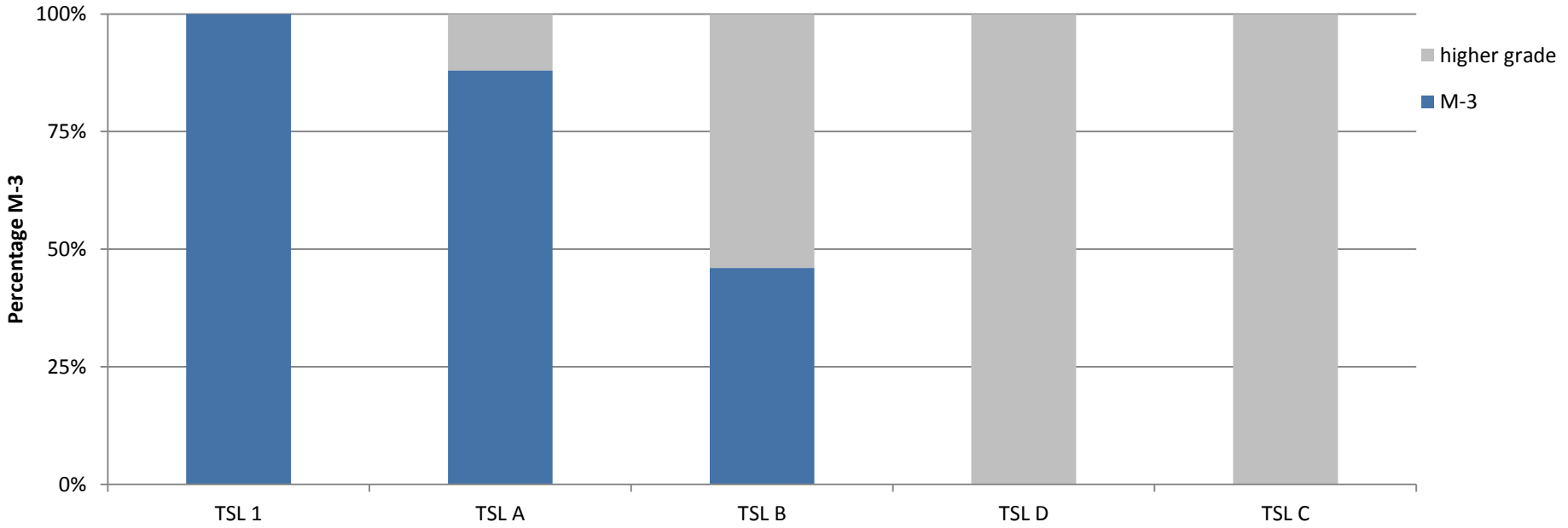

Figure 3 – Design Line DL02 Unit Cost M-3 Core Relative to SA1 Core (Navigant/LLBL medium cost scenario), cross-over point is at 1.0

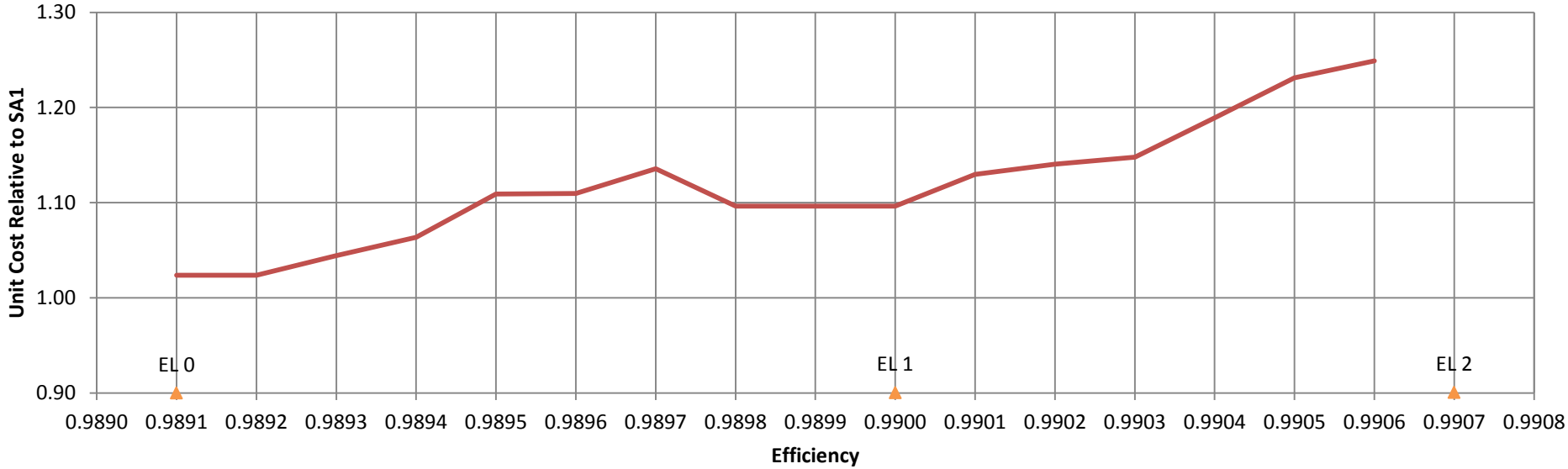

Figure 4 – Design Line DL02 predicted core material distribution by TSL as per Navigant/LLBL analysis (NOPR and NOPM TSLs)

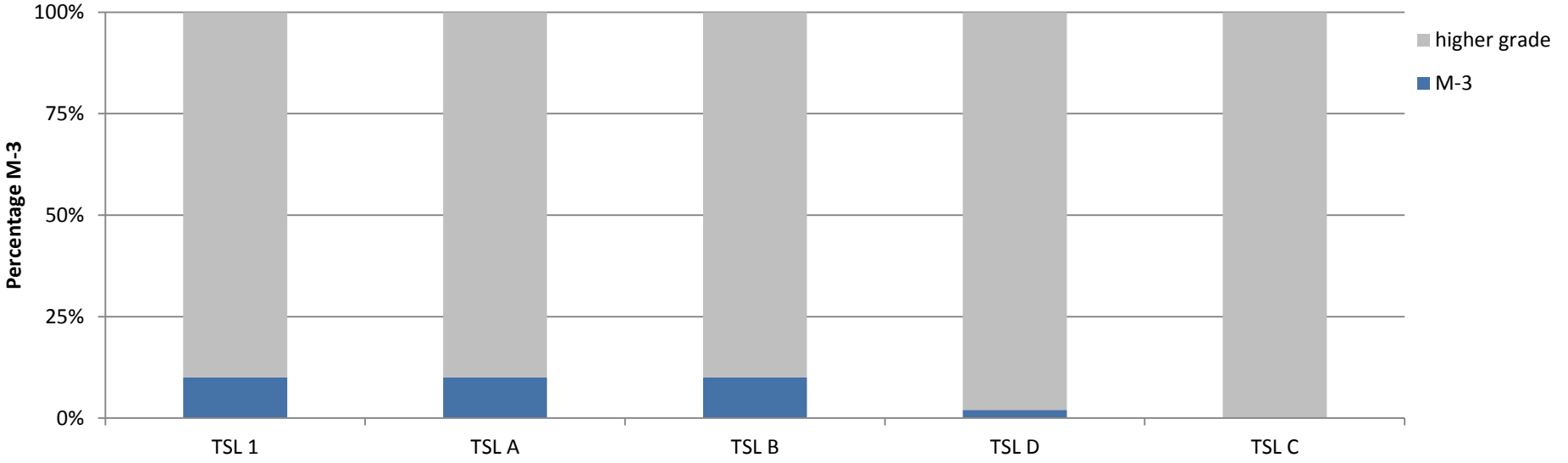

Figure 5 – Design Line DL03 Unit Cost M-3 Core Relative to SA1 Core (Navigant/LLBL medium cost scenario), cross-over point is at 1.0

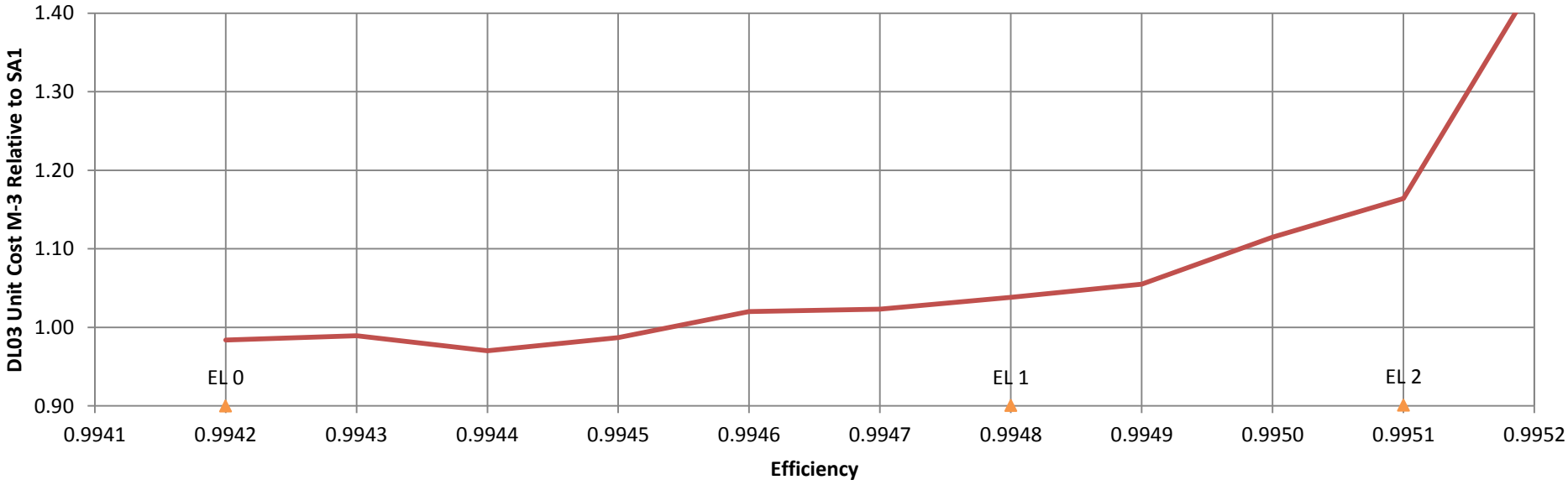

Figure 6 – Design Line DL03 predicted core material distribution by TSL as per Navigant/LLBL analysis (NOPR and NOPM TSLs)

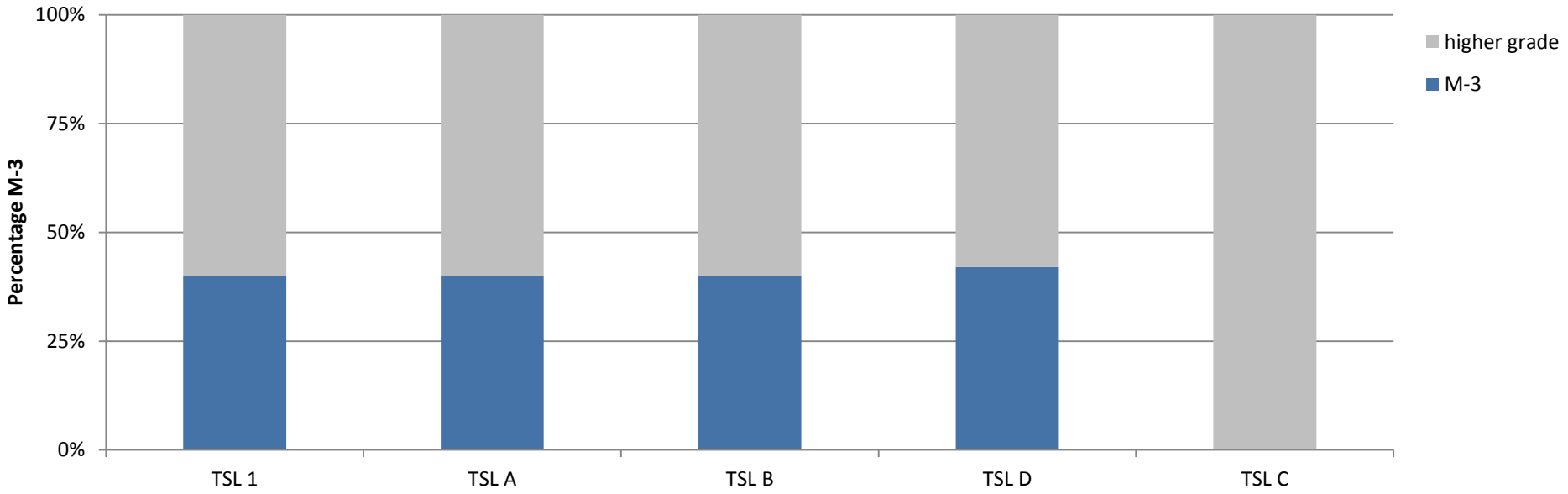

Figure 7 – Design Line DL04 Unit Cost M-3 Core Relative to SA1 Core (Navigant/LLBL medium cost scenario), cross-over point is at 1.0

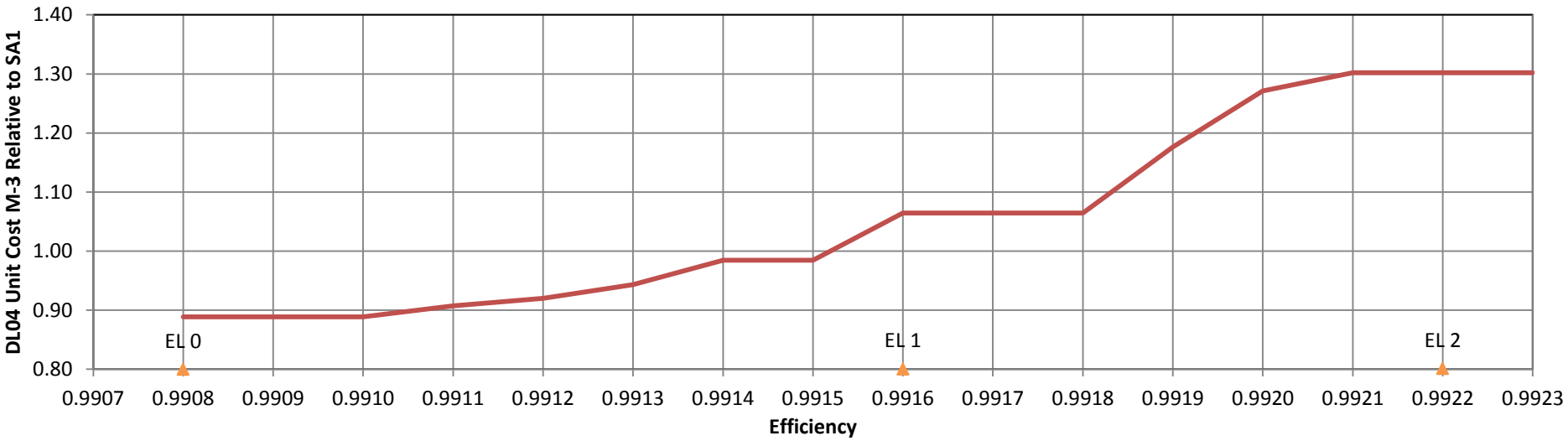

Figure 8 – Design Line DL04 predicted core material distribution by TSL as per Navigant/LLBL analysis (NOPR and NOPM TSLs)

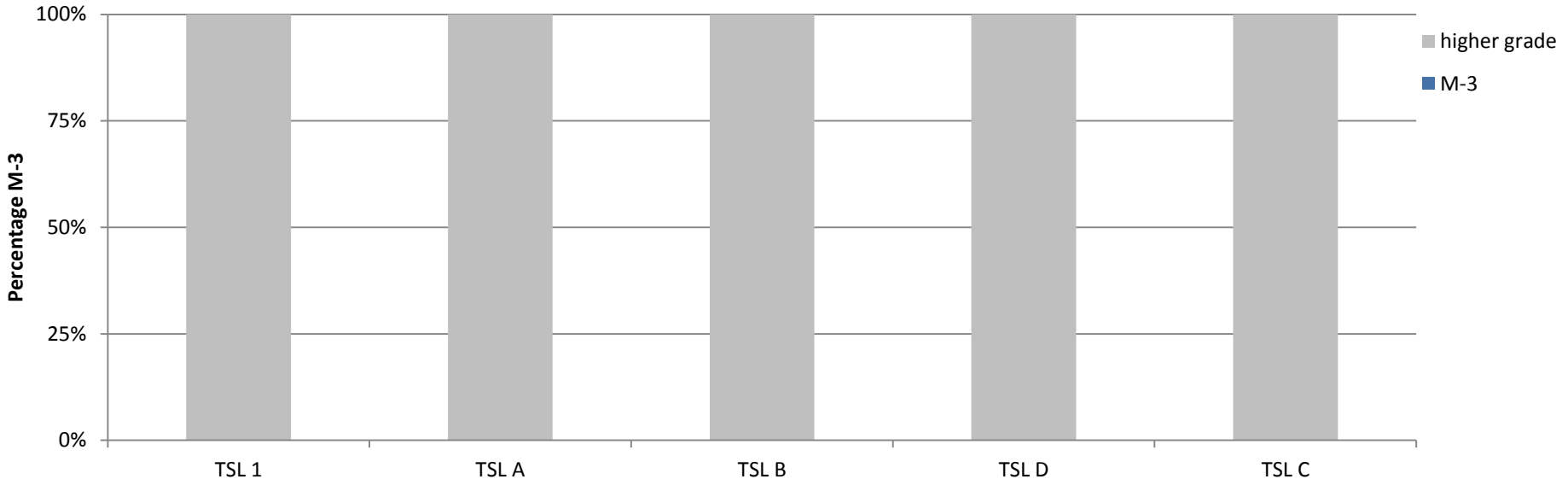

Figure 9 – Design Line DL05 Unit Cost M-3 Core Relative to SA1 Core (Navigant/LLBL medium cost scenario), cross-over point is at 1.0

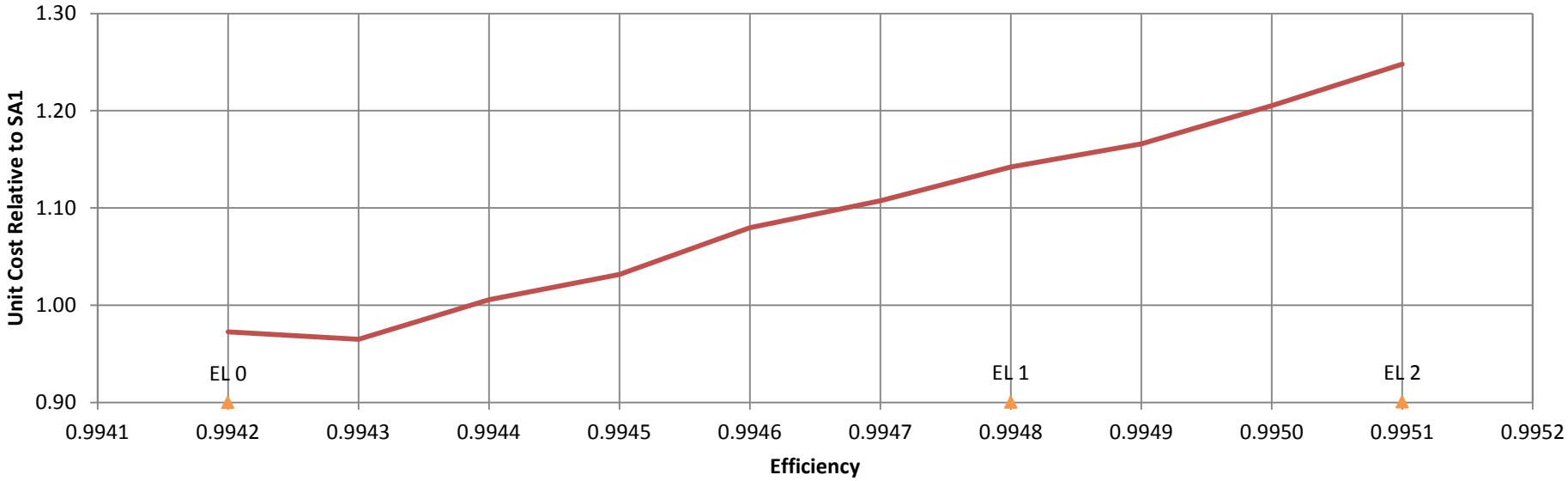

Figure 10 – Design Line DL05 predicted core material distribution by TSL as per Navigant/LLBL analysis (NOPR and NOPM TSLs)