

**APPENDIX 8-A. ADDITIONAL TRIAL STANDARD LEVEL TO THE  
SUPPLEMENTAL POST-NOTICE OF PROPOSED RULEMAKING ANALYSES FOR  
DISTRIBUTION TRANSFORMERS**

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## APPENDIX 8-B. ADDITIONAL TRIAL STANDARD LEVEL TO THE SUPPLEMENTAL POST-NOTICE OF PROPOSED RULEMAKING ANALYSES FOR DISTRIBUTION TRANSFORMERS

### 8-B.1 INTRODUCTION

DOE presented analysis for liquid-immersed distribution transformers for a series of trial standard levels (TSLs) in the NOPR and at the NOPR public meeting. The proposed TSL composition for liquid-immersed transformers is shown below in Table 1-B.1.1. These TSL are described in detail in the chapter 10 of the NOPR TSD.

**Table 8-B.1.1 Notice of Proposed Rulemaking Trial Standard Levels for Liquid-Immersed Distribution Transformers**

| EC | DL | Trial Standard Levels by Efficiency Level |       |       |       |       |       |       |
|----|----|-------------------------------------------|-------|-------|-------|-------|-------|-------|
|    |    | TSL 1                                     | TSL 2 | TSL 3 | TSL 4 | TSL 5 | TSL 6 | TSL 7 |
| 1  | 1  | EL 1                                      | EL 1  | EL 1  | EL 2  | EL 3  | EL 4  | EL 6  |
| 1  | 2  | Base                                      | EL 1  | EL 1  | EL 2  | EL 3  | EL 4  | EL 6  |
| 1  | 3  | EL 1                                      | EL 1  | EL 2  | EL 4  | EL 3  | EL 5  | EL 7  |
| 2  | 4  | EL 1                                      | EL 1  | EL 1  | EL 2  | EL 3  | EL 4  | EL 7  |
| 2  | 5  | EL 1                                      | EL 1  | EL 2  | EL 4  | EL 3  | EL 5  | EL 6  |

DOE is presenting one additional TSL, TSL D, in addition to those presented in appendix 1A of this NOPR TSD. Table 8-B.1.2 shows the efficiency level composition of TSL D in addition to those presented in appendix 1A.

**Table 8-B.1.2 Notice of Public Meeting Trial Standard Level for Liquid-immersed Distribution Transformers**

| EC | DL | Phases | Type          | Trial Standard Levels by Efficiency Level |        |        |        |
|----|----|--------|---------------|-------------------------------------------|--------|--------|--------|
|    |    |        |               | A                                         | B      | C      | D      |
| 1A | 1  | 1      | all other     | EL 1                                      | EL 1.5 | EL 2   | EL 2   |
| 1B | 2  | 1      | pole          | EL 0.5                                    | EL 0.5 | EL 2   | EL 1   |
| 1B | 3  | 1      | pole          | EL 1                                      | EL 1   | EL 2   | EL 1   |
| 2A | 4  | 3      | all other     | EL 1                                      | EL 1.5 | EL 2   | EL 2   |
| 2A | 5  | 3      | all other     | EL 1                                      | EL 1.5 | EL 2   | EL 2   |
| 2B | -  | 3      | pole          | scaled                                    | scaled | scaled | scaled |
| 2C | -  | 3      | network/vault | EL 0                                      | EL 0   | EL 0   | EL 0   |
| 2D | -  | 3      | ≥ 200 kV BIL  | EL 0                                      | EL 0   | EL 0   | EL 0   |

## 8-B.2 ADDITIONAL NATIONAL IMPACTS ANALYSIS RESULTS

As described in appendix 1A of this NOPR TSD, the national impacts analysis results present here were estimated using the NOPR spreadsheet tool available from the DOE website.<sup>a</sup> To disaggregate the impacts of pole-mounted transformers from the other liquid-immersed distribution transformers represented by the equipment classes in the NOPR, DOE associated the fraction of savings with the volume of capacity shipment for each of the new proposed equipment classes. DOE assumed that 70% of shipments by capacity of single-phase liquid-immersed distribution transformers are pole-mounted, and that 5% of shipments by capacity of three-phase liquid-immersed distribution transformers are pole-mounted.

### 8-B.2.1 Summary National Impact Analysis Results

**Table 8-B.2.1 National Impact Analysis Results for Liquid-immersed Transformers**

|                                                    | NOPR Trial Standard Level |       |       |       |       |       |       |        | NOPM Trial Standard Level |       |       |       |
|----------------------------------------------------|---------------------------|-------|-------|-------|-------|-------|-------|--------|---------------------------|-------|-------|-------|
|                                                    | Base                      | 1     | 2     | 3     | 4     | 5     | 6     | 7      | A                         | B     | C     | D     |
| Transformer Shipments 2015-2044 (Billion KVA)      | 1.95                      | 1.95  | 1.95  | 1.95  | 1.94  | 1.94  | 1.94  | 1.91   | 1.95                      | 1.95  | 1.95  | 1.95  |
| Equipment Cost (\$Billions)                        | 32.28                     | -1.26 | -2.51 | -2.61 | -4.26 | -4.48 | -6.32 | -19.88 | -1.57                     | -2.00 | -3.72 | -3.28 |
| Operating Cost (Savings in TSLs) (\$Billions)      | 23.26                     | 2.01  | 4.03  | 4.33  | 7.22  | 7.13  | 8.08  | 11.64  | 2.50                      | 3.21  | 6.71  | 6.28  |
| Cumulative Source Savings 2044 (Quads)             |                           | 0.36  | 0.74  | 0.82  | 1.44  | 1.42  | 1.70  | 2.70   | 0.45                      | 0.60  | 1.30  | 1.20  |
| Net Present Value at 3% Discount Rate (\$Billions) |                           | 3.66  | 7.39  | 8.24  | 14.21 | 13.48 | 13.17 | -1.11  | 4.66                      | 6.04  | 13.51 | 12.93 |
| Net Present Value at 7% Discount Rate (\$Billions) |                           | 0.75  | 1.51  | 1.73  | 2.96  | 2.65  | 1.76  | -8.25  | 0.93                      | 1.21  | 2.99  | 3.00  |

### 8-B.2.2 Summary National Impact Analysis Results for Single-phase Liquid-immersed Distribution Transformers

**Table 8-B.2.2 Results for Notice of Proposed Rulemaking Equipment Class 1**

|                                               | NOPR Trial Standard Level |       |       |       |       |       |       |        | NOPM Trial Standard Level |       |       |       |
|-----------------------------------------------|---------------------------|-------|-------|-------|-------|-------|-------|--------|---------------------------|-------|-------|-------|
|                                               | Base                      | 1     | 2     | 3     | 4     | 5     | 6     | 7      | A                         | B     | C     | D     |
| Transformer Shipments 2015-2044 (Billion KVA) | 0.80                      | 0.80  | 0.80  | 0.80  | 0.80  | 0.80  | 0.80  | 0.79   | 0.80                      | 0.80  | 0.80  | 0.80  |
| Equipment Cost (\$Billions)                   | 22.36                     | -0.52 | -1.78 | -1.79 | -2.61 | -3.03 | -4.05 | -12.11 | -0.84                     | -1.13 | -2.60 | -2.16 |
| Operating Cost (Savings in TSLs) (\$Billions) | 11.37                     | 0.34  | 2.36  | 2.38  | 3.76  | 3.89  | 4.23  | 5.84   | 0.78                      | 1.23  | 3.69  | 3.26  |

<sup>a</sup> [http://www.eere.energy.gov/buildings/appliance\\_standards/commercial/distribution\\_transformers.html](http://www.eere.energy.gov/buildings/appliance_standards/commercial/distribution_transformers.html)

|                                                    |  |       |      |      |      |      |      |       |       |      |      |      |
|----------------------------------------------------|--|-------|------|------|------|------|------|-------|-------|------|------|------|
| Cumulative Source Savings 2044 (Quads)             |  | 0.09  | 0.47 | 0.47 | 0.75 | 0.80 | 0.90 | 1.37  | 0.18  | 0.27 | 0.75 | 0.65 |
| Net Present Value at 3% Discount Rate (\$Billions) |  | 0.13  | 3.87 | 3.93 | 6.64 | 6.28 | 5.51 | -4.64 | 0.94  | 1.78 | 6.44 | 5.86 |
| Net Present Value at 7% Discount Rate (\$Billions) |  | -0.19 | 0.58 | 0.60 | 1.15 | 0.85 | 0.19 | -6.27 | -0.06 | 0.10 | 1.09 | 1.10 |

**Table 8-B.2.3 Results for Notice of Public Meeting Equipment Class 1A**

|                                                    | Trial Standard Level |       |       |       |       |       |       |       | NOPM Trial Standard Level |       |       |       |
|----------------------------------------------------|----------------------|-------|-------|-------|-------|-------|-------|-------|---------------------------|-------|-------|-------|
|                                                    | Base                 | 1     | 2     | 3     | 4     | 5     | 6     | 7     | A                         | B     | C     | D     |
| Transformer Shipments 2015-2044 (Billion KVA)      | 0.24                 | 0.24  | 0.24  | 0.24  | 0.24  | 0.24  | 0.24  | 0.24  | 0.24                      | 0.24  | 0.24  | 0.24  |
| Equipment Cost (\$Billions)                        | 6.71                 | -0.16 | -0.53 | -0.54 | -0.78 | -0.91 | -1.21 | -3.63 | -0.25                     | -0.34 | -0.78 | -0.65 |
| Operating Cost (Savings in TSLs) (\$Billions)      | 3.41                 | 0.10  | 0.71  | 0.72  | 1.13  | 1.17  | 1.27  | 1.75  | 0.23                      | 0.37  | 1.11  | 0.98  |
| Cumulative Source Savings 2044 (Quads)             |                      | 0.03  | 0.14  | 0.14  | 0.23  | 0.24  | 0.27  | 0.41  | 0.05                      | 0.08  | 0.22  | 0.19  |
| Net Present Value at 3% Discount Rate (\$Billions) |                      | 0.04  | 1.16  | 1.18  | 1.99  | 1.88  | 1.65  | -1.39 | 0.28                      | 0.53  | 1.93  | 1.76  |
| Net Present Value at 7% Discount Rate (\$Billions) |                      | -0.06 | 0.17  | 0.18  | 0.34  | 0.26  | 0.06  | -1.88 | -0.02                     | 0.03  | 0.33  | 0.33  |

**Table 8-B.2.4 Results for Notice of Pubic Meeting Equipment Class 1B – Pole-mounted Distribution Transformer**

|                                                    | Trial Standard Level |       |       |       |       |       |       |       | NOPM Trial Standard Level |       |       |       |
|----------------------------------------------------|----------------------|-------|-------|-------|-------|-------|-------|-------|---------------------------|-------|-------|-------|
|                                                    | Base                 | 1     | 2     | 3     | 4     | 5     | 6     | 7     | A                         | B     | C     | D     |
| Transformer Shipments 2015-2044 (Billion KVA)      | 0.56                 | 0.56  | 0.56  | 0.56  | 0.56  | 0.56  | 0.56  | 0.55  | 0.56                      | 0.56  | 0.56  | 0.56  |
| Equipment Cost (\$Billions)                        | 15.65                | -0.37 | -1.25 | -1.25 | -1.83 | -2.12 | -2.83 | -8.48 | -0.59                     | -0.79 | -1.82 | -1.51 |
| Operating Cost (Savings in TSLs) (\$Billions)      | 7.96                 | 0.24  | 1.65  | 1.67  | 2.63  | 2.72  | 2.96  | 4.09  | 0.55                      | 0.86  | 2.58  | 2.28  |
| Cumulative Source Savings 2044 (Quads)             |                      | 0.07  | 0.33  | 0.33  | 0.53  | 0.56  | 0.63  | 0.96  | 0.13                      | 0.19  | 0.52  | 0.45  |
| Net Present Value at 3% Discount Rate (\$Billions) |                      | 0.09  | 2.71  | 2.75  | 4.65  | 4.40  | 3.85  | -3.25 | 0.66                      | 1.24  | 4.51  | 4.10  |
| Net Present Value at 7% Discount Rate (\$Billions) |                      | -0.13 | 0.41  | 0.42  | 0.80  | 0.60  | 0.13  | -4.39 | -0.04                     | 0.07  | 0.77  | 0.77  |

### 8-B.2.3 Summary National Impact Analysis Results for Three-phase Liquid-immersed Distribution Transformers

**Table 8-B.2.5 Results for Notice of Proposed Rulemaking Equipment Class 2**

|                                                    | NOPR Trial Standard Level |       |       |       |       |       | NOPM Trial Standard Level |       |       |       |       |       |
|----------------------------------------------------|---------------------------|-------|-------|-------|-------|-------|---------------------------|-------|-------|-------|-------|-------|
|                                                    | Base                      | 1     | 2     | 3     | 4     | 5     | 6                         | 7     | A     | B     | C     | D     |
| Transformer Shipments 2015-2044 (Billion KVA)      | 1.15                      | 1.15  | 1.15  | 1.15  | 1.15  | 1.15  | 1.14                      | 1.13  | 1.15  | 1.15  | 1.15  | 1.15  |
| Equipment Cost (\$Billions)                        | 9.92                      | -0.73 | -0.73 | -0.82 | -1.65 | -1.45 | -2.27                     | -7.78 | -0.73 | -0.87 | -1.12 | -1.12 |
| Operating Cost (Savings in TSLs) (\$Billions)      | 11.88                     | 1.67  | 1.67  | 1.95  | 3.46  | 3.25  | 3.84                      | 5.80  | 1.72  | 1.98  | 3.01  | 3.01  |
| Cumulative Source Savings 2044 (Quads)             |                           | 0.27  | 0.27  | 0.35  | 0.69  | 0.63  | 0.80                      | 1.33  | 0.27  | 0.33  | 0.55  | 0.55  |
| Net Present Value at 3% Discount Rate (\$Billions) |                           | 3.53  | 3.53  | 4.31  | 7.57  | 7.21  | 7.66                      | 3.53  | 3.71  | 4.26  | 7.07  | 7.07  |
| Net Present Value at 7% Discount Rate (\$Billions) |                           | 0.94  | 0.94  | 1.13  | 1.82  | 1.80  | 1.57                      | -1.98 | 0.99  | 1.11  | 1.90  | 1.90  |

**Table 8-B.2.6 Results for Notice of Public Meeting Equipment Class 2A**

|                                                    | Trial Standard Level |       |       |       |       |       | NOPM Trial Standard Level |       |       |       |       |       |
|----------------------------------------------------|----------------------|-------|-------|-------|-------|-------|---------------------------|-------|-------|-------|-------|-------|
|                                                    | Base                 | 1     | 2     | 3     | 4     | 5     | 6                         | 7     | A     | B     | C     | D     |
| Transformer Shipments 2015-2044 (Billion KVA)      | 1.10                 | 1.09  | 1.09  | 1.09  | 1.09  | 1.09  | 1.09                      | 1.07  | 1.09  | 1.09  | 1.09  | 1.09  |
| Equipment Cost (\$Billions)                        | 9.42                 | -0.70 | -0.70 | -0.78 | -1.57 | -1.38 | -2.16                     | -7.39 | -0.70 | -0.83 | -1.06 | -1.06 |
| Operating Cost (Savings in TSLs) (\$Billions)      | 11.29                | 1.58  | 1.58  | 1.85  | 3.29  | 3.08  | 3.65                      | 5.51  | 1.64  | 1.88  | 2.86  | 2.86  |
| Cumulative Source Savings 2044 (Quads)             |                      | 0.26  | 0.26  | 0.33  | 0.65  | 0.60  | 0.76                      | 1.26  | 0.26  | 0.31  | 0.53  | 0.53  |
| Net Present Value at 3% Discount Rate (\$Billions) |                      | 3.35  | 3.35  | 4.10  | 7.19  | 6.85  | 7.28                      | 3.35  | 3.53  | 4.05  | 6.72  | 6.72  |
| Net Present Value at 7% Discount Rate (\$Billions) |                      | 0.89  | 0.89  | 1.07  | 1.72  | 1.71  | 1.49                      | -1.88 | 0.94  | 1.05  | 1.80  | 1.80  |

**Table 8-B.2.7 Results for Notice of Public Meeting Equipment Class 2B – Pole-mounted Distribution Transformers**

|                                                    | Trial Standard Level |       |       |       |       |       |       |       | NOPM Trial Standard Level |       |       |       |
|----------------------------------------------------|----------------------|-------|-------|-------|-------|-------|-------|-------|---------------------------|-------|-------|-------|
|                                                    | Base                 | 1     | 2     | 3     | 4     | 5     | 6     | 7     | A                         | B     | C     | D     |
| Transformer Shipments 2015-2044 (Billion KVA)      | 0.06                 | 0.06  | 0.06  | 0.06  | 0.06  | 0.06  | 0.06  | 0.06  | 0.06                      | 0.06  | 0.06  | 0.06  |
| Equipment Cost (\$Billions)                        | 0.50                 | -0.04 | -0.04 | -0.04 | -0.08 | -0.07 | -0.11 | -0.39 | -0.04                     | -0.04 | -0.06 | -0.06 |
| Operating Cost (Savings in TSLs) (\$Billions)      | 0.59                 | 0.08  | 0.08  | 0.10  | 0.17  | 0.16  | 0.19  | 0.29  | 0.09                      | 0.10  | 0.15  | 0.15  |
| Cumulative Source Savings 2044 (Quads)             |                      | 0.01  | 0.01  | 0.02  | 0.03  | 0.03  | 0.04  | 0.07  | 0.01                      | 0.02  | 0.03  | 0.03  |
| Net Present Value at 3% Discount Rate (\$Billions) |                      | 0.18  | 0.18  | 0.22  | 0.38  | 0.36  | 0.38  | 0.18  | 0.19                      | 0.21  | 0.35  | 0.35  |
| Net Present Value at 7% Discount Rate (\$Billions) |                      | 0.05  | 0.05  | 0.06  | 0.09  | 0.09  | 0.08  | -0.10 | 0.05                      | 0.06  | 0.09  | 0.09  |