

**RÉPONSES DU TRANSPORTEUR
À LA DEMANDE DE RENSEIGNEMENTS NUMÉRO 2
DE LA RÉGIE DE L'ÉNERGIE
(« RÉGIE »)**

**RAPPORT 2007 DE PA CONSULTING
Réponse à la question 4.1**

(Déposé seulement en version électronique)

Polaris

2007 T&D Final Report - Transmission & Substations

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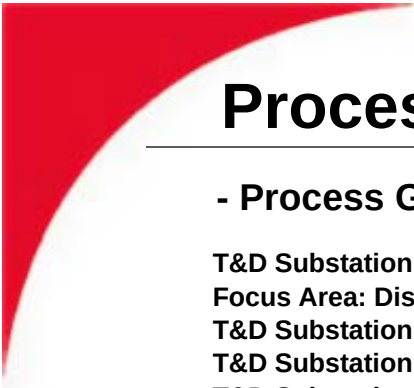
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Reporting Companies

- Companies -

B.C. Hydro, BC
Baltimore Gas & Electric Company, MD
CenterPoint Energy, TX
Consolidated Edison Co. of New York, NY
CPS Energy, TX
E.ON U.S.
El Paso Electric Company , TX
Entergy Arkansas, AR
Entergy GSU-LA, LA
Entergy Louisiana, LA
Entergy Mississippi, MS
Entergy Services, Inc., LA
Exelon - Commonwealth Edison Co, IL
Exelon - PECO Energy Co, PA
Florida Power & Light, FL
Hydro-Quebec, Canada
Omaha Public Power District, NE
Oncor Energy Delivery, TX
PPL Electric Utilities Corp.
Public Service Company Of New Mexico, NM
Public Service Electric & Gas Company, NJ
Texas-New Mexico Power Company
We Energies, WI



Process Group Sections

- Process Group Sections -

T&D Substation Statistics

Focus Area: Distribution Substation Cost Detail

T&D Substation Engineering & Design

T&D Substation Field Construction

T&D Substation Field Maintenance/Operations

Focus Area: T&D Substation Refurbishment

Focus Area: T&D Substation Automation

Focus Area: On-line Monitoring of T&D Substation Components

T&D Substation Transformer Shops

Focus Area: T&D Substation Work Management Processes

Focus Area: T&D Substation Contracting

Transmission Line Statistics

Transmission Line Engineering & Design

Focus Area: Transmission Line Refurbishment

Transmission Line Field Maintenance/Operations

Transmission Vegetation Management

Transmission Operations: Control Center

Focus Area: Transmission Line Support

Focus Area: Energy Management System

Focus Area: Transmission Line Work Management Process

Focus Area: Transmission Line Contracting

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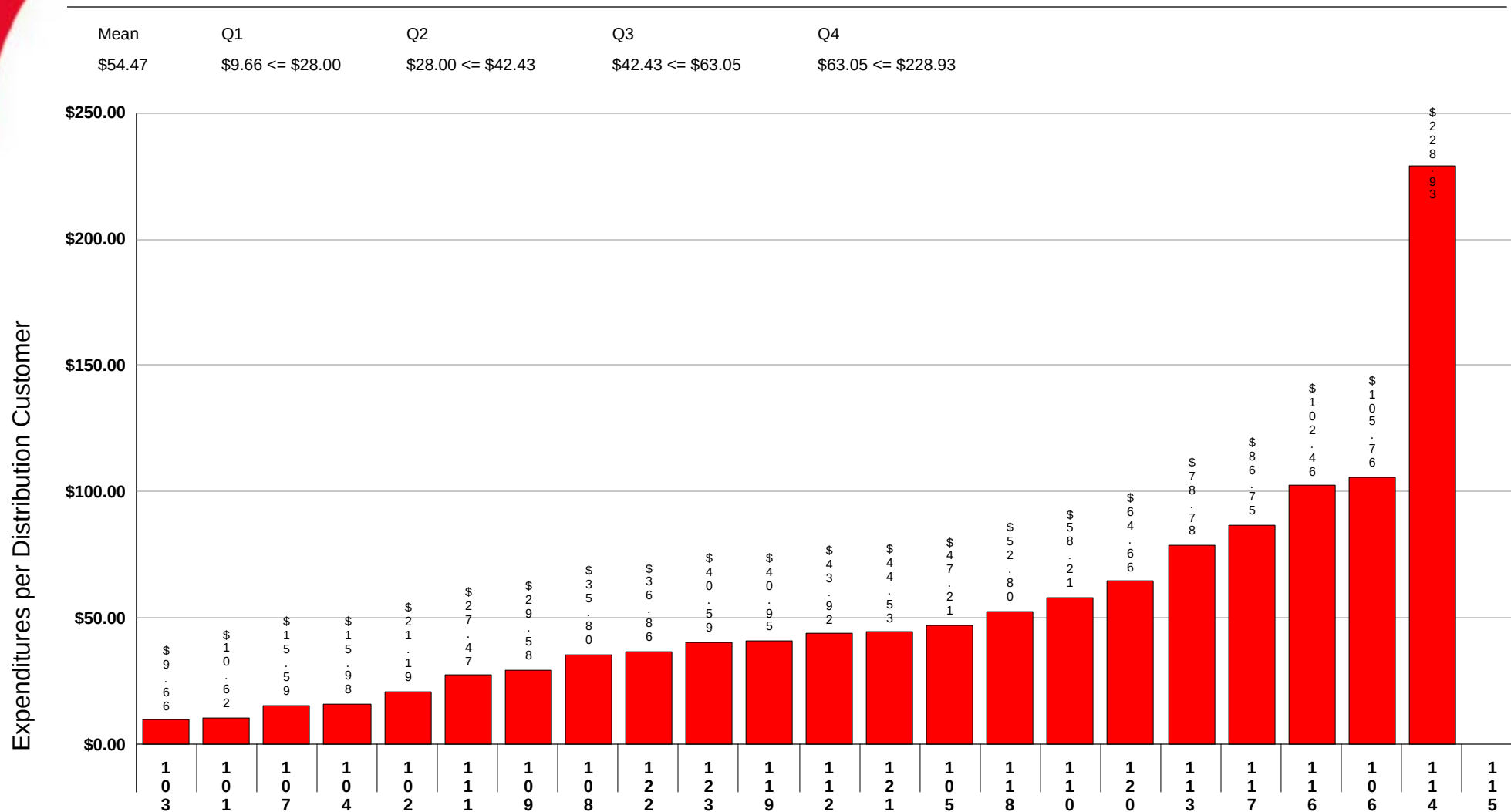
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T&D Substation Expenditures

Per Distribution Customer



Source/Calculation: (SUM{B.3}+SUM{B.6}+SUM{B.25}+SUM{B.27}+SUM{B.21}+SUM{B.23})/A.2.2

Volume: T&D Substation Statistics, Final Report, 2006

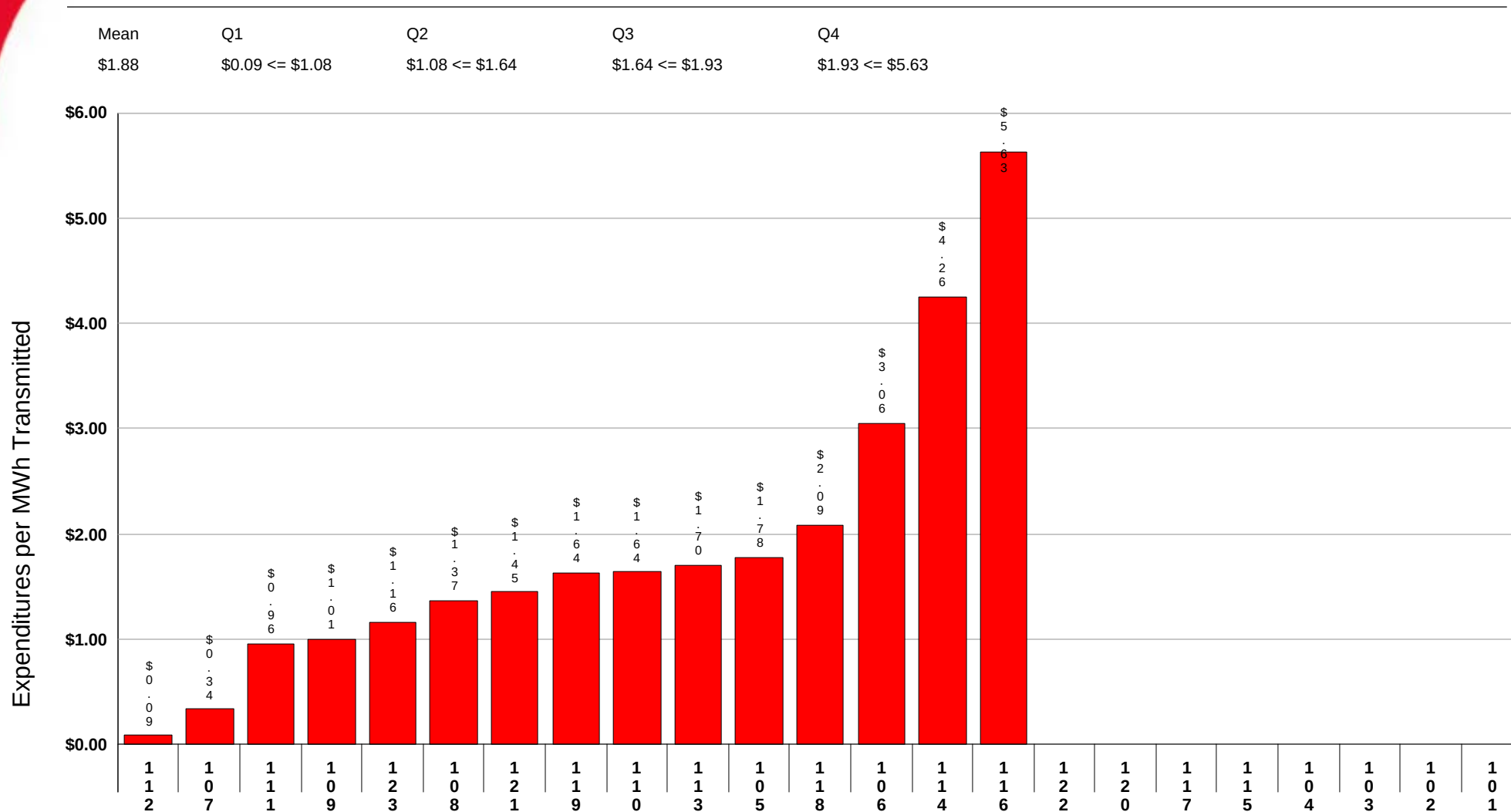
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Only companies with all the data are shown.

T&D Substation Expenditures

Per MWh Transmitted



Source/Calculation: (SUM{B.3}+SUM{B.21}+SUM{B.23}+SUM{B.6}+SUM{B.25}+SUM{B.27})/A.2.5

Volume: T&D Substation Statistics, Final Report, 2006

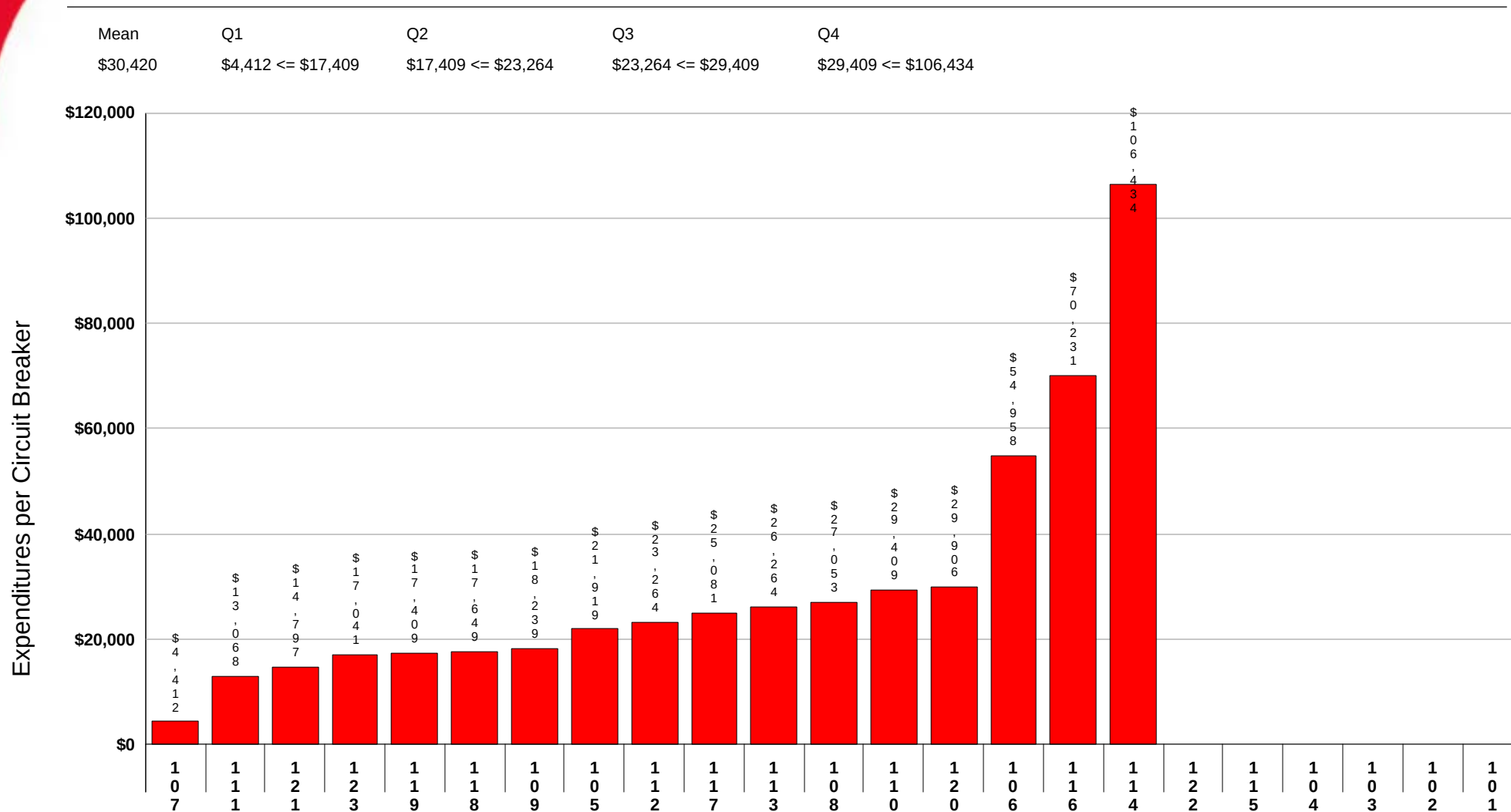
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Only companies with all the data are shown.

T&D Substation Expenditures

Per Circuit Breaker



Source/Calculation: (SUM{B.3}+SUM{B.6}+SUM{B.21}+SUM{B.23}+SUM{B.25}+SUM{B.27})/SUM{AQ.4}

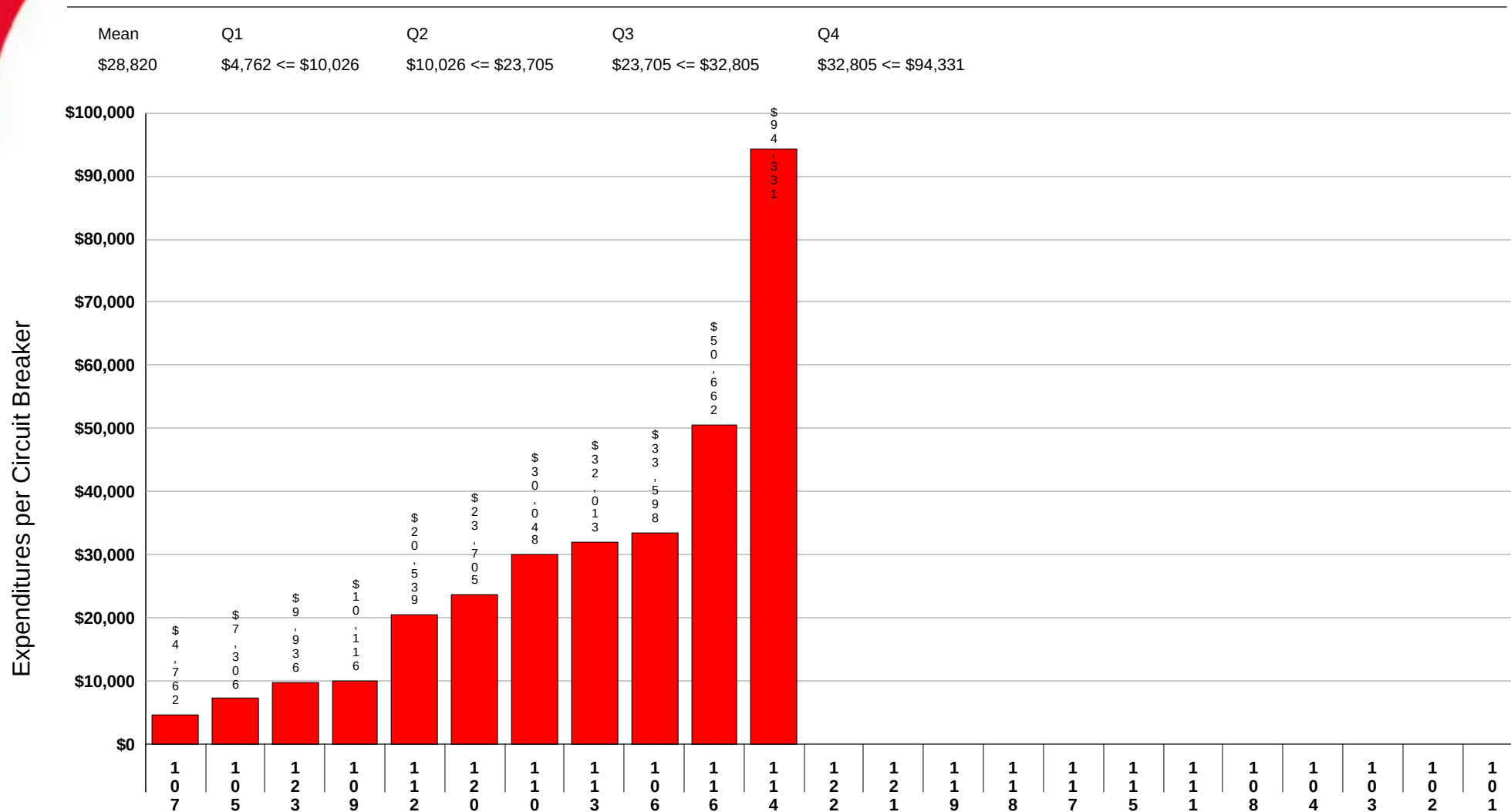
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Only companies with all the data are shown.

3-Year Average T&D Substation Expenditures Per Circuit Breaker



$$((\text{SUM}\{B.3\}+\text{SUM}\{B.6\}+\text{SUM}\{B.21\}+\text{SUM}\{B.23\}+\text{SUM}\{B.25\}+\text{SUM}\{B.27\})/\text{SUM}\{AQ.4\}+(\text{B.9.1}+\text{B.9.3}+\text{B.29.1}+\text{B.29.3})/AQ.5.1+(\text{B.9.4}+\text{B.9.2}+\text{B.29.4}+\text{B.29.2})/AQ.5.2)/3$$

Source/Calculation:

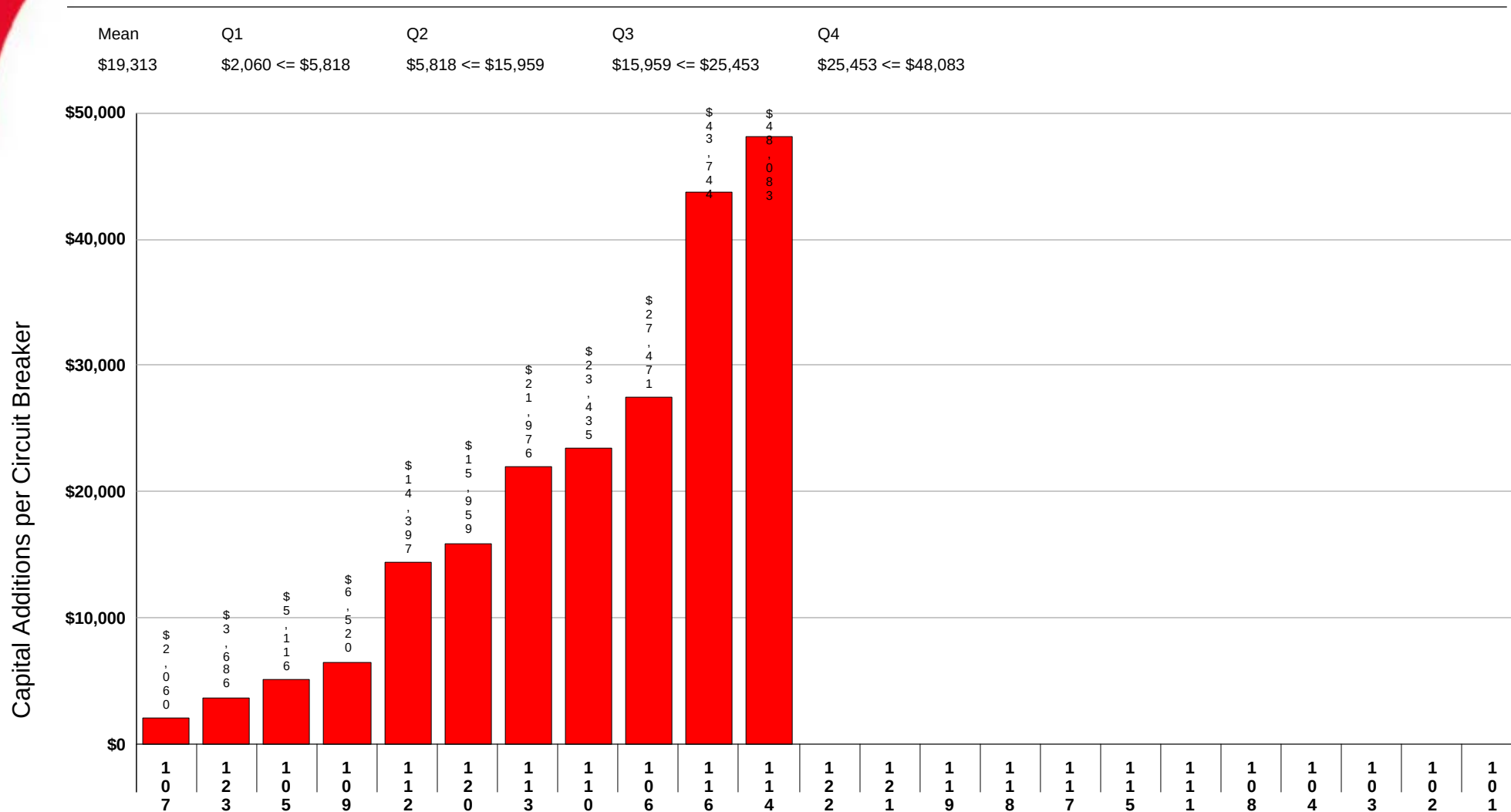
Volume: T&D Substation Statistics, Final Report, 2006

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Only companies with all the data are shown.

3-Year Average T&D Substation Capital Additions Per Circuit Breaker



Source/Calculation: $((\text{SUM}\{B.3\} + \text{SUM}\{B.6\}) / \text{SUM}\{AQ.4\} + (B.9.1 + B.9.3) / AQ.5.1 + (B.9.2 + B.9.4) / AQ.5.2) / 3$

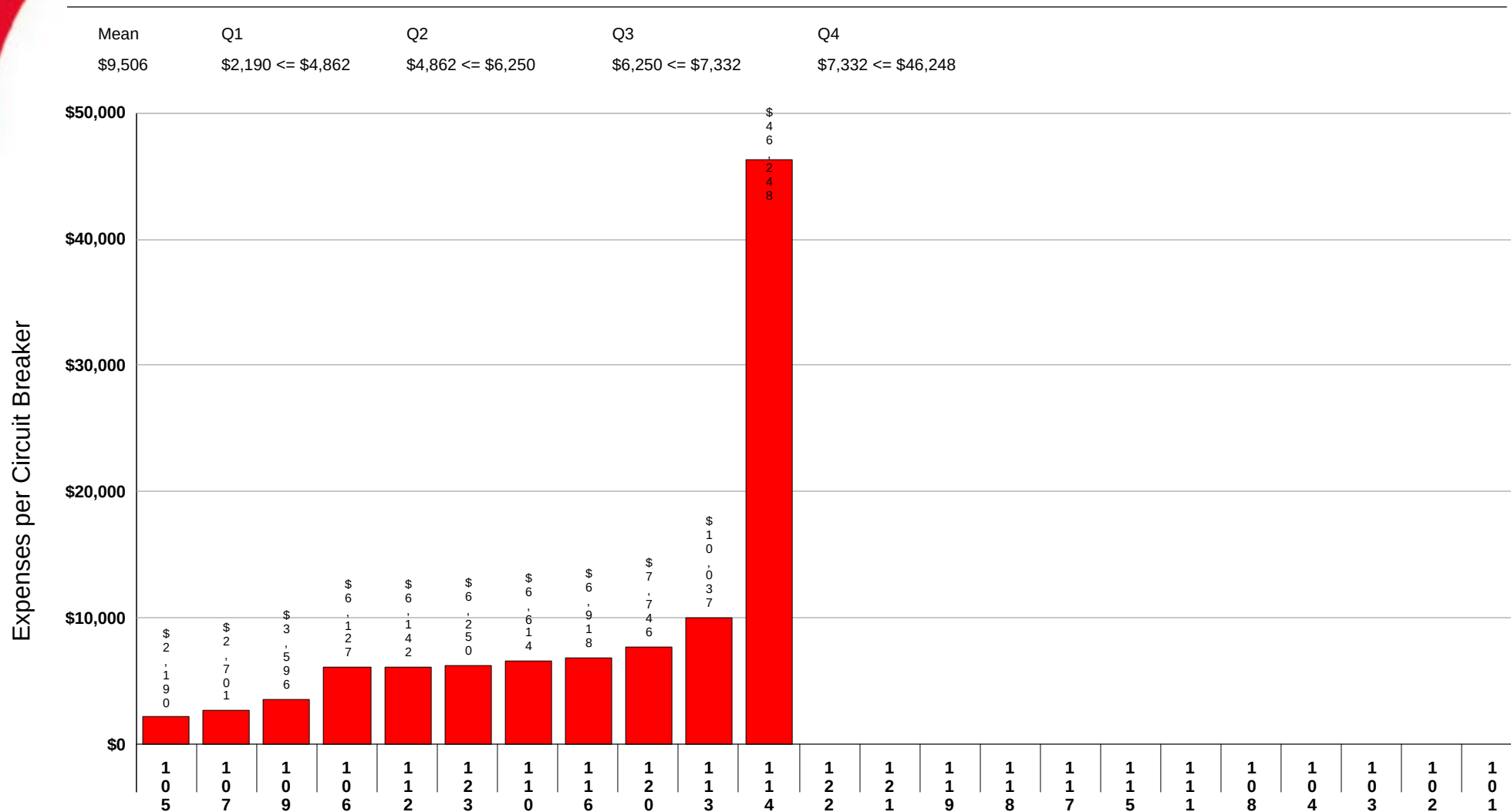
Volume: T&D Substation Statistics, Final Report, 2006

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Only companies with all the data are shown.

3-Year Average T&D Substation O&M Expenses Per Circuit Breaker



Source/Calculation: $((\text{SUM}\{B.21\} + \text{SUM}\{B.23\} + \text{SUM}\{B.25\} + \text{SUM}\{B.27\}) / \text{SUM}\{AQ.4\} + (B.29.1 + B.29.3) / AQ.5.1 + (B.29.4 + B.29.2) / AQ.5.2) / 3$

Volume: T&D Substation Statistics, Final Report, 2006

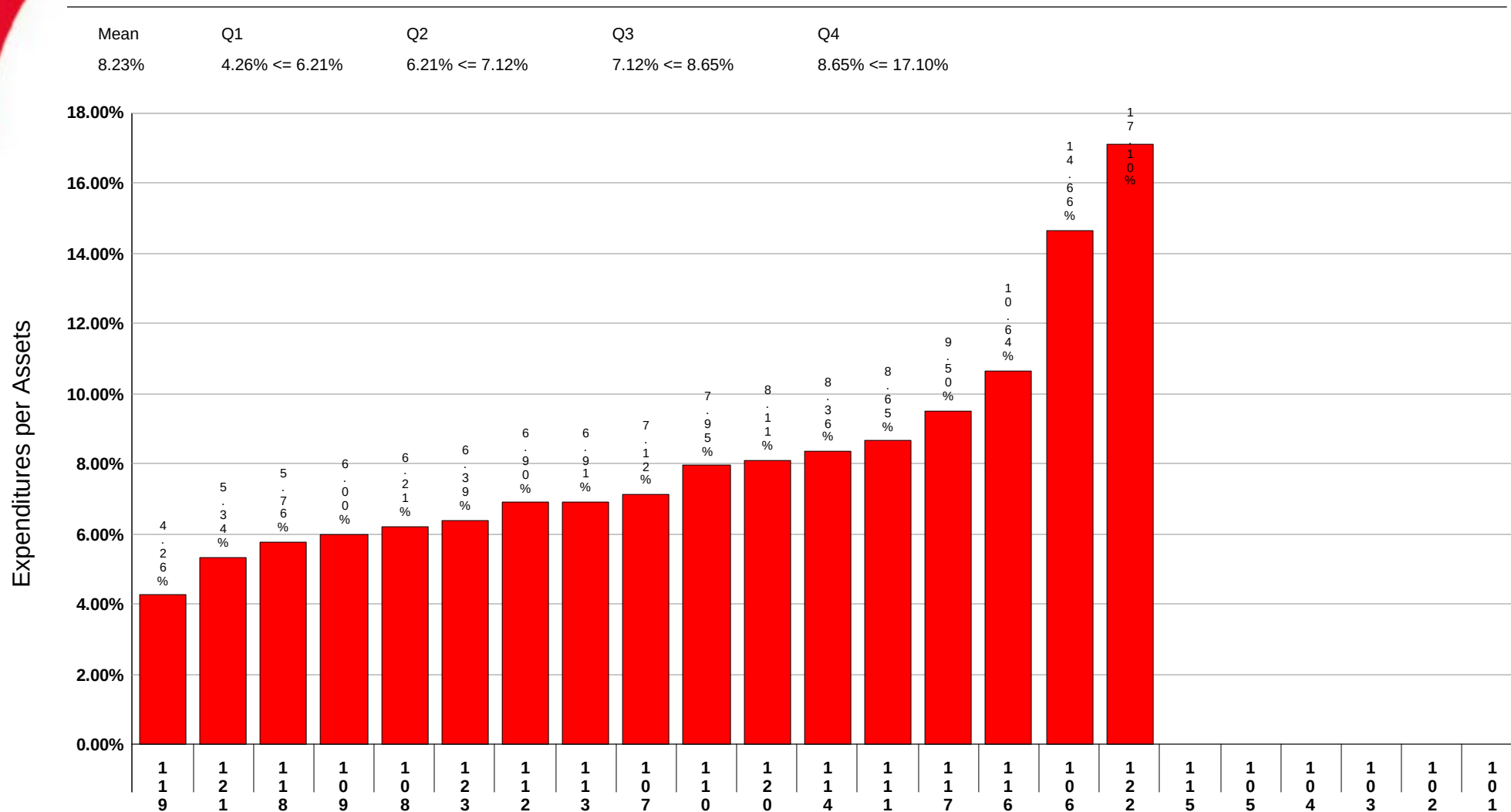
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Only companies with all the data are shown.

T&D Substation Expenditures

Per Assets



Source/Calculation: $(\text{SUM}\{B.3\} + \text{SUM}\{B.21\} + \text{SUM}\{B.23\} + \text{SUM}\{B.6\} + \text{SUM}\{B.25\} + \text{SUM}\{B.27\}) / \text{SUM}\{B.11\}$

Volume: T&D Substation Statistics, Final Report, 2006

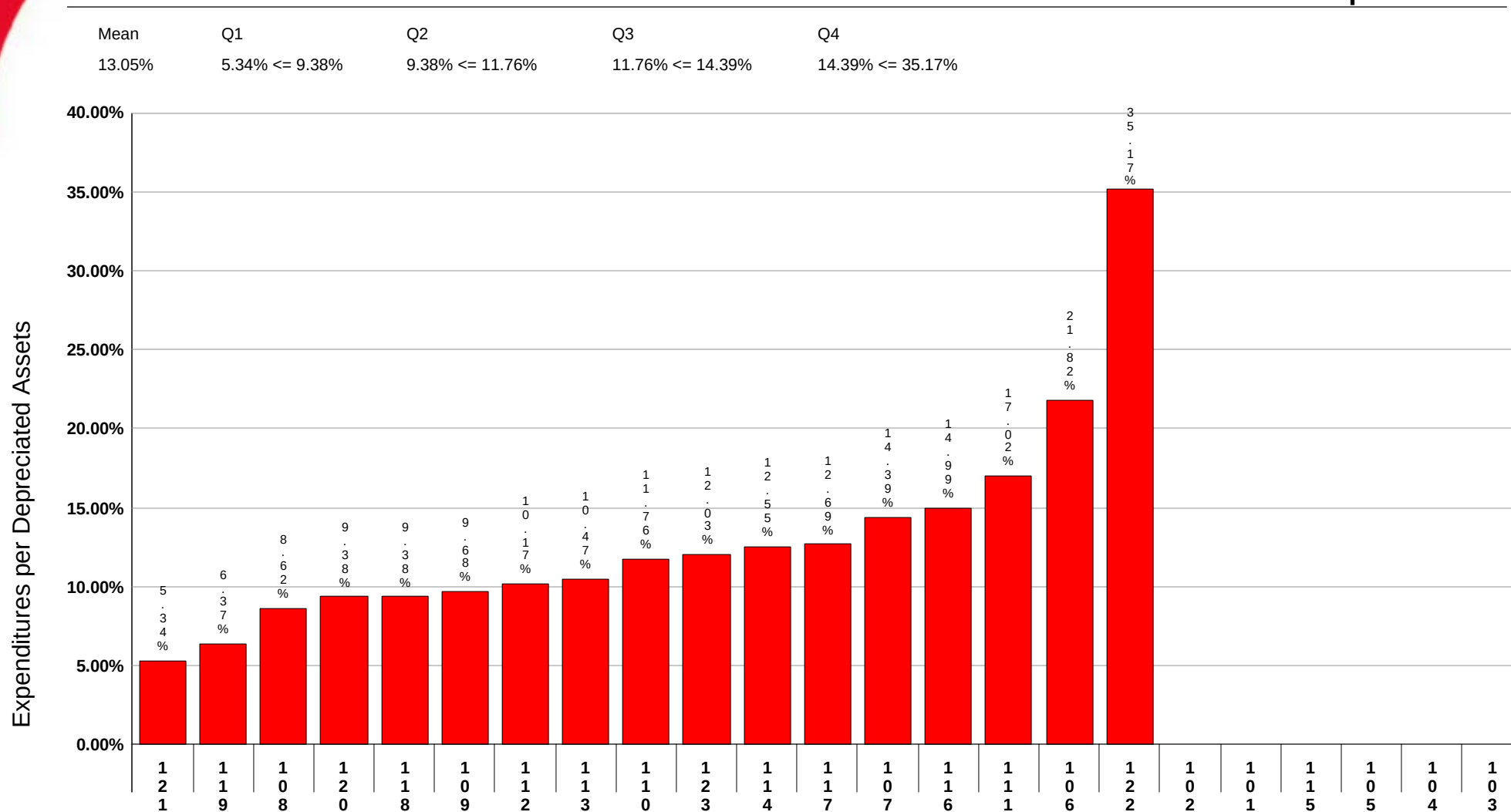
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Only companies with all the data are shown.

T&D Substation Expenditures

Per Assets Less Depreciation



Source/Calculation: $(\text{SUM}\{B.3\} + \text{SUM}\{B.6\} + \text{SUM}\{B.21\} + \text{SUM}\{B.23\} + \text{SUM}\{B.25\} + \text{SUM}\{B.27\}) / (\text{SUM}\{B.11\} - \text{SUM}\{B.15\})$

Volume: T&D Substation Statistics, Final Report, 2006

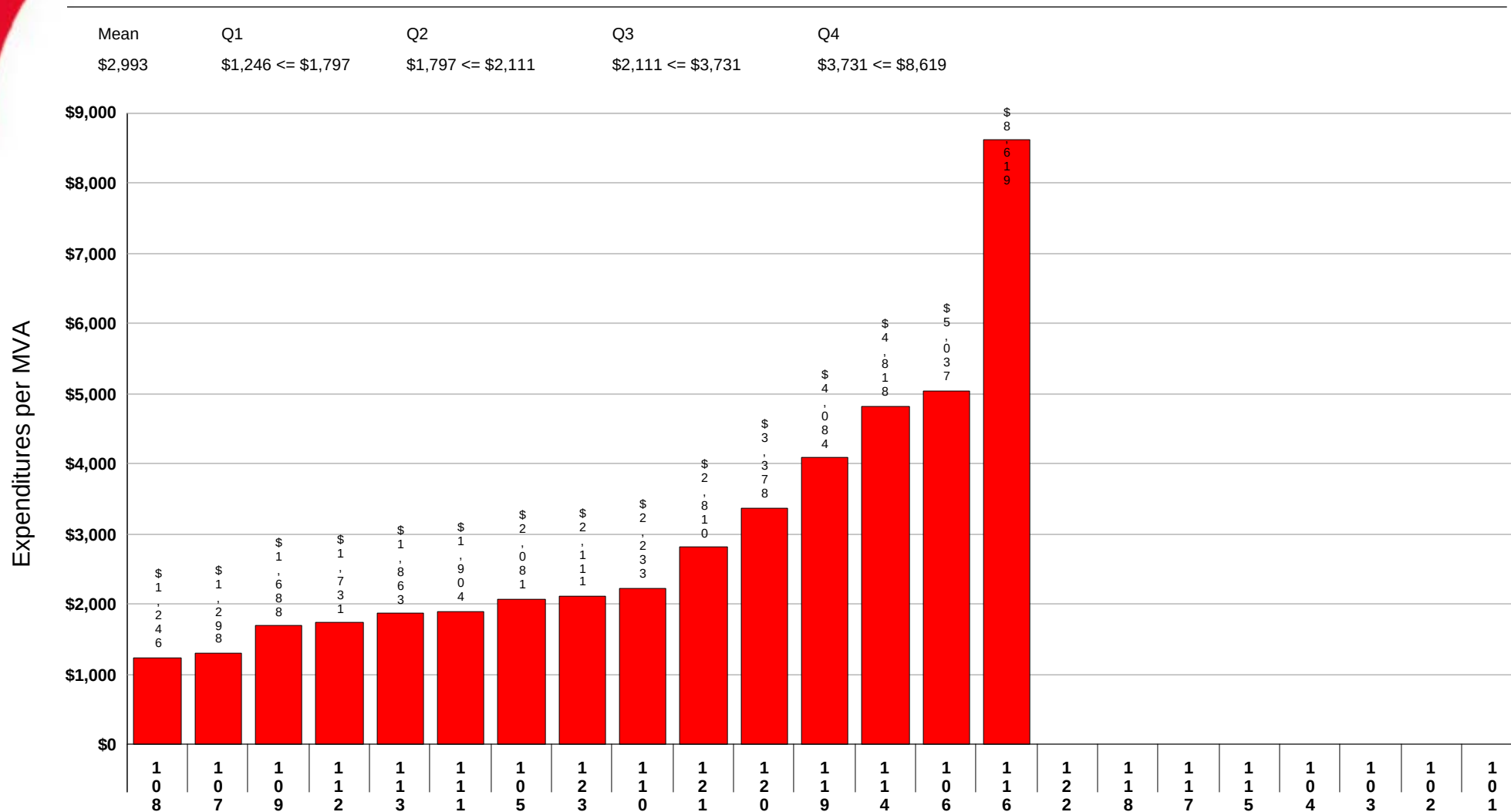
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Only companies with all the data are shown.

T&D Substation Expenditures

Per T&D Substation MVA



Source/Calculation: $(\text{SUM}\{B.3\} + \text{SUM}\{B.21\} + \text{SUM}\{B.23\} + \text{SUM}\{B.6\} + \text{SUM}\{B.25\} + \text{SUM}\{B.27\}) / (\text{SUM}\{AQ.12\} + \text{SUM}\{AQ.13\})$

Volume: T&D Substation Statistics, Final Report, 2006

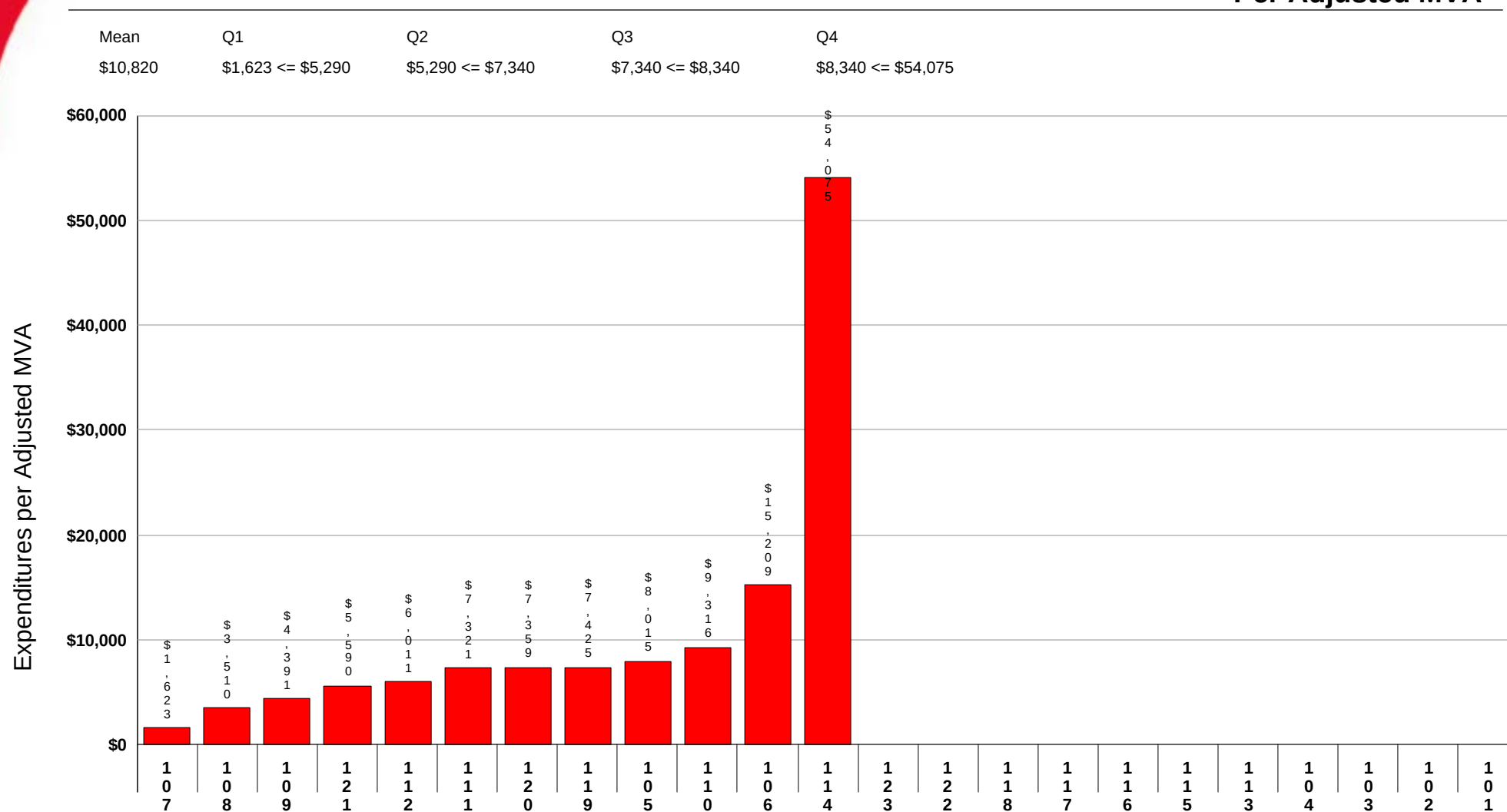
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Only companies with all the data are shown.

T&D Substation Expenditures

Per Adjusted MVA



Source/Calculation: $(\text{SUM}\{B.25\} + \text{SUM}\{B.6\} + \text{SUM}\{B.27\} + \text{SUM}\{B.3\} + \text{SUM}\{B.21\} + \text{SUM}\{B.23\}) / ((\text{SUM}\{AQ.12\} * AQ.14.2) + (\text{SUM}\{AQ.13\} * AQ.14.1))$

Volume: T&D Substation Statistics, Final Report, 2006

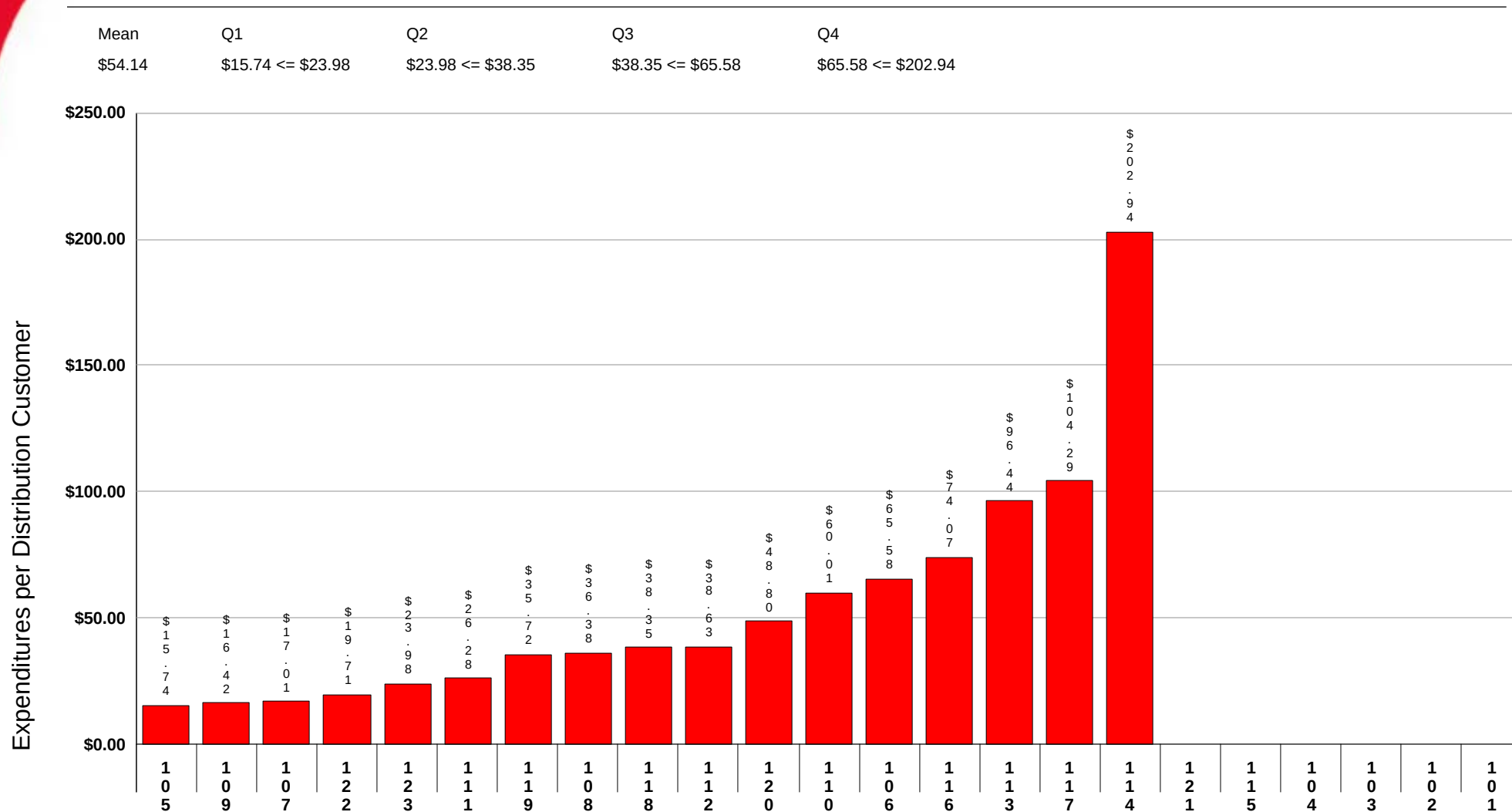
ID Code: 2110

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Only companies with all the data are shown.

3-Year Average T&D Substation Expenditures

Per Distribution Customer



Source/Calculation: ((SUM{B.3}+SUM{B.6}+SUM{B.25}+SUM{B.27}+SUM{B.21}+SUM{B.23}))/A.2.2+(B.9.1+B.9.3+B.29.1+B.29.3)/A.3.1+(B.9.4+B.9.2+B.29.4+B.29.2)/A.3

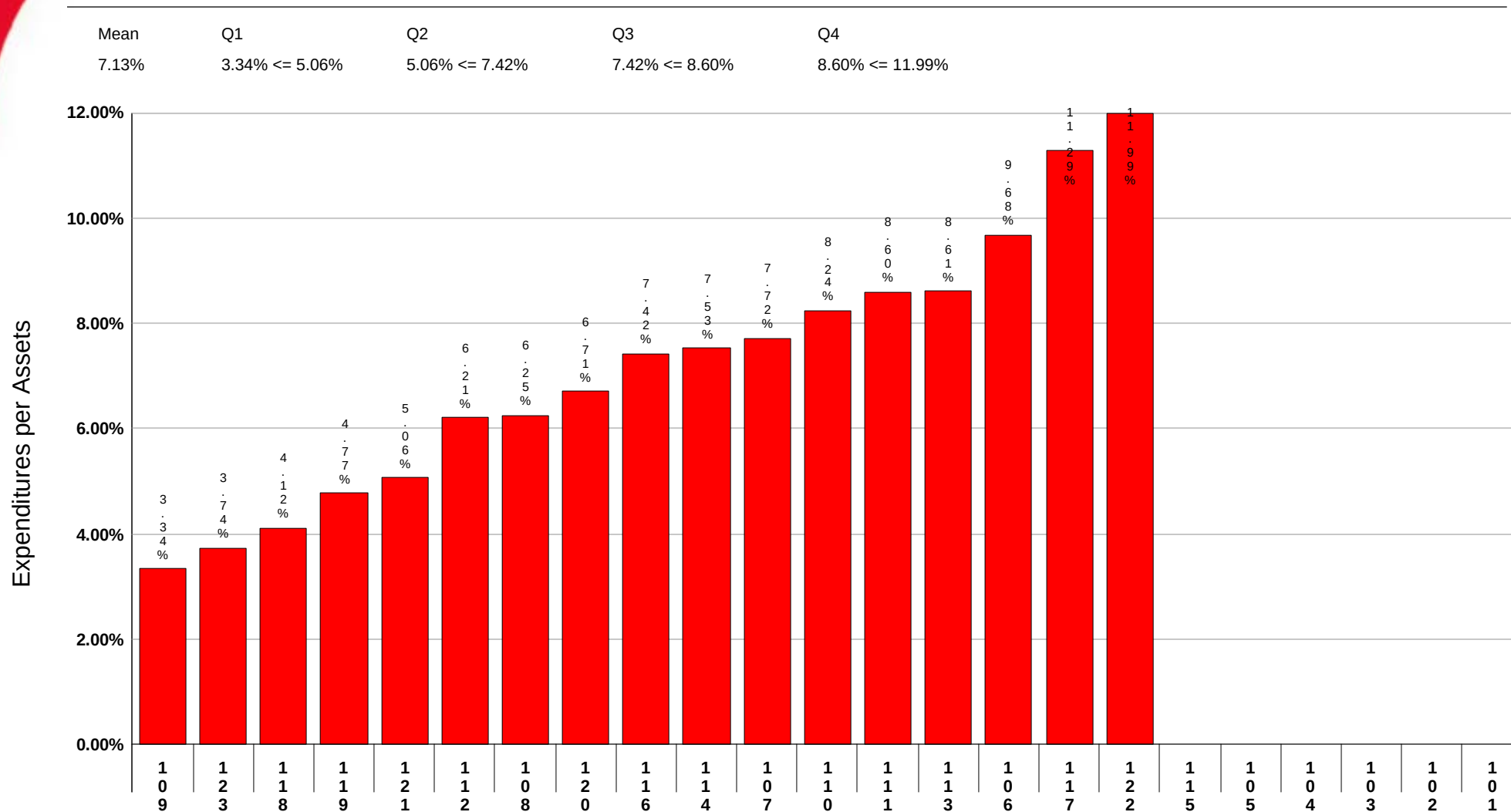
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Only companies with all the data are shown.

3-Year Average T&D Substation Expenditures Per Assets



((SUM{B.3}+SUM{B.6}+SUM{B.21}+SUM{B.23}+SUM{B.25}+SUM{B.27})/SUM{B.11}+(B.9.1+B.9.3+B.29.1+B.29.3)/(B.13.1+B.13.3)+(B.9.2+B.9.4+B.29.2+B.29.4)/(B.13.2+B.13.4))/

Source/Calculation:³

Volume: T&D Substation Statistics, Final Report, 2006

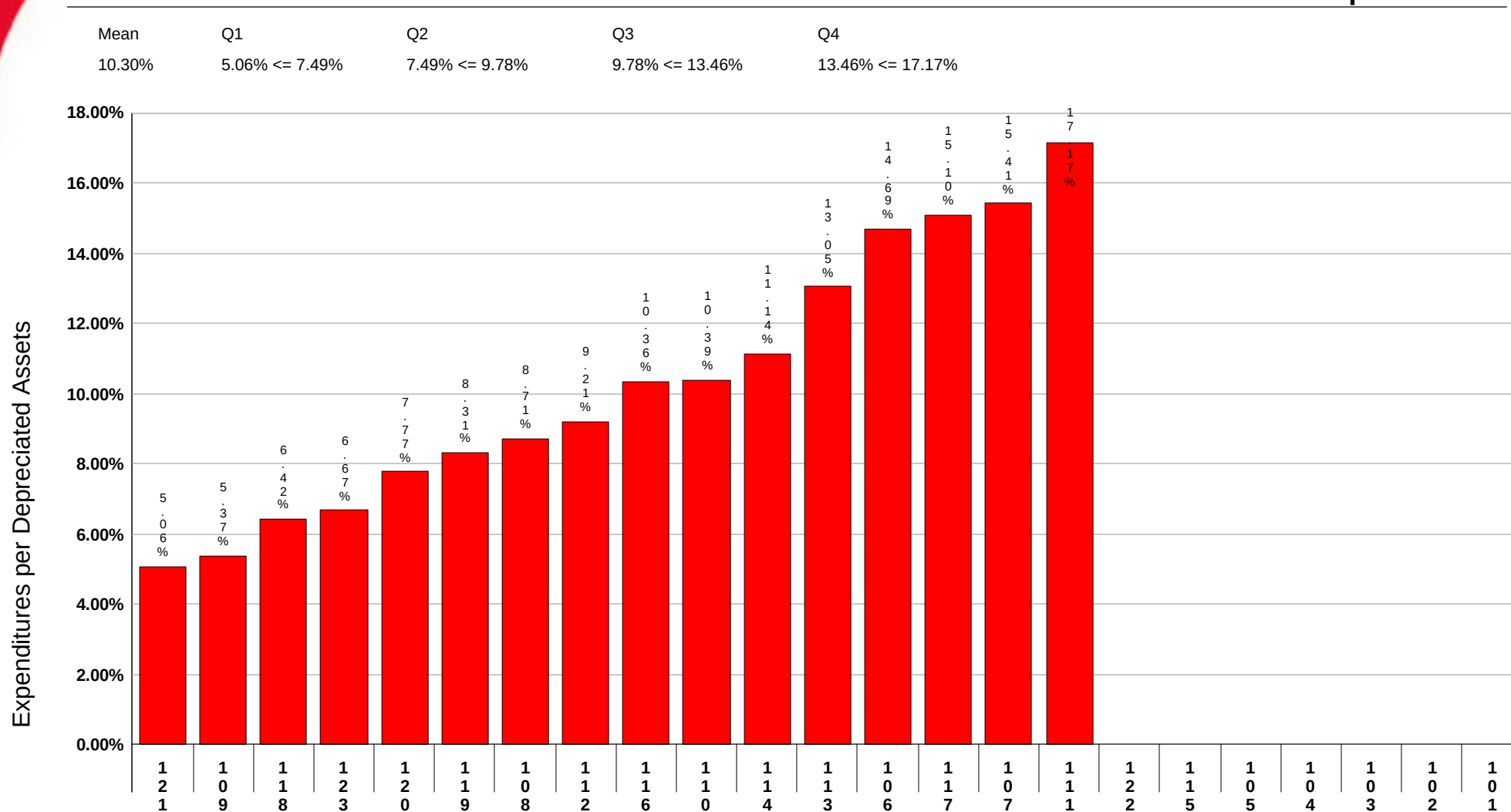
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Only companies with all the data are shown.

3-Year Average T&D Substation Expenditures

Per Assets Less Depreciation



(((SUM{B.3}+SUM{B.6}+SUM{B.21}+SUM{B.23}+SUM{B.25}+SUM{B.27}))/((SUM{B.11}-SUM{B.15}))+((B.9.1+B.9.3+B.29.1+B.29.3))/((B.13.1+B.13.3)-(B.17.3+B.17.1)))+((B.9.2+B.9.4+B.29.2+B.29.4))/((B.13.2+B.13.4)-(B.17.4+B.17.2))))/3

Source/Calculation:

Volume: T&D Substation Statistics, Final Report, 2006

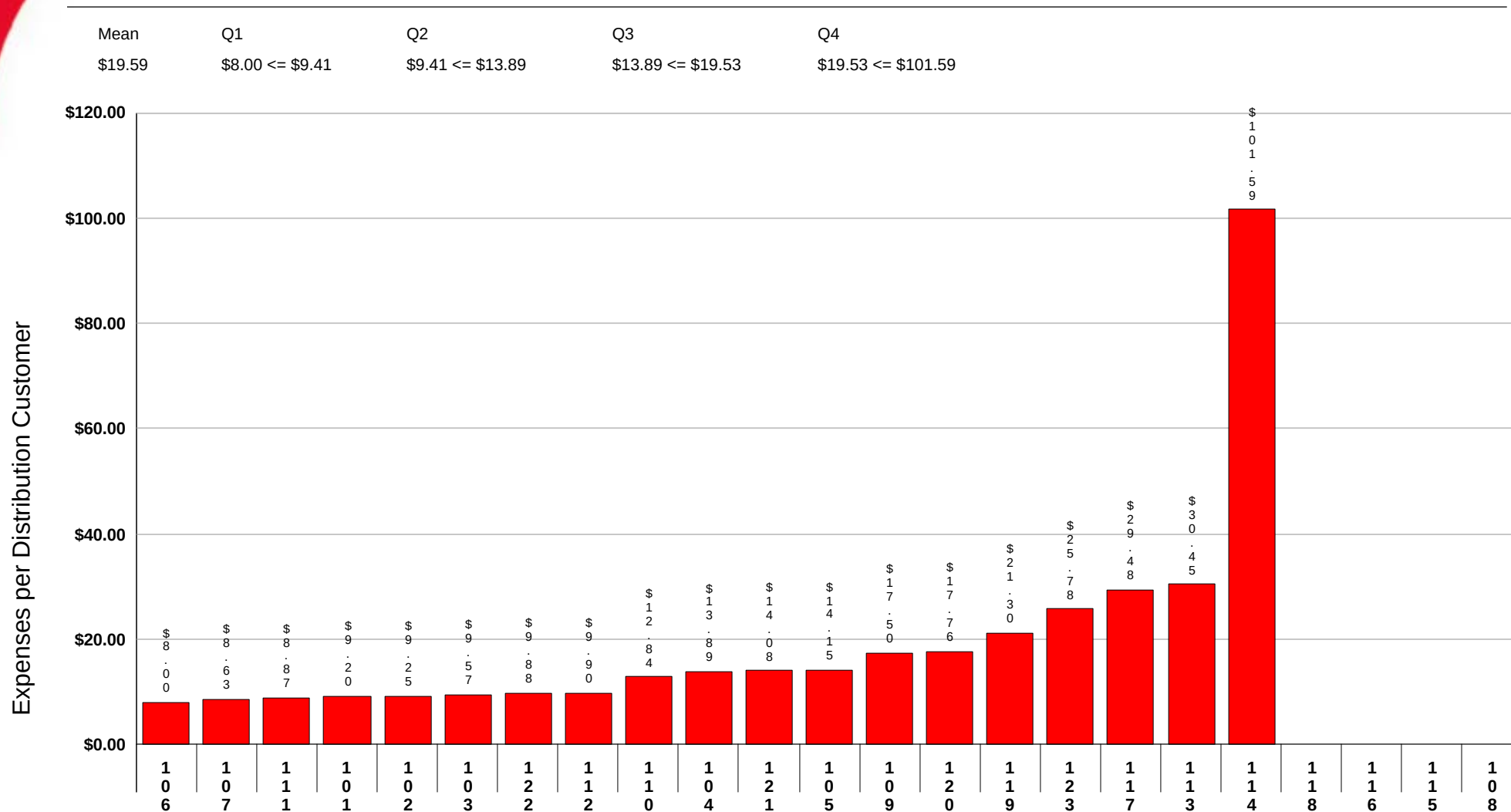
ID Code:27113

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Only companies with all the data are shown.

T&D Substation O&M Expenses

Per Distribution Customer



Source/Calculation: (SUM{B.21}+SUM{B.23}+SUM{B.25}+SUM{B.27})/A.2.2

Volume: T&D Substation Statistics, Final Report, 2006

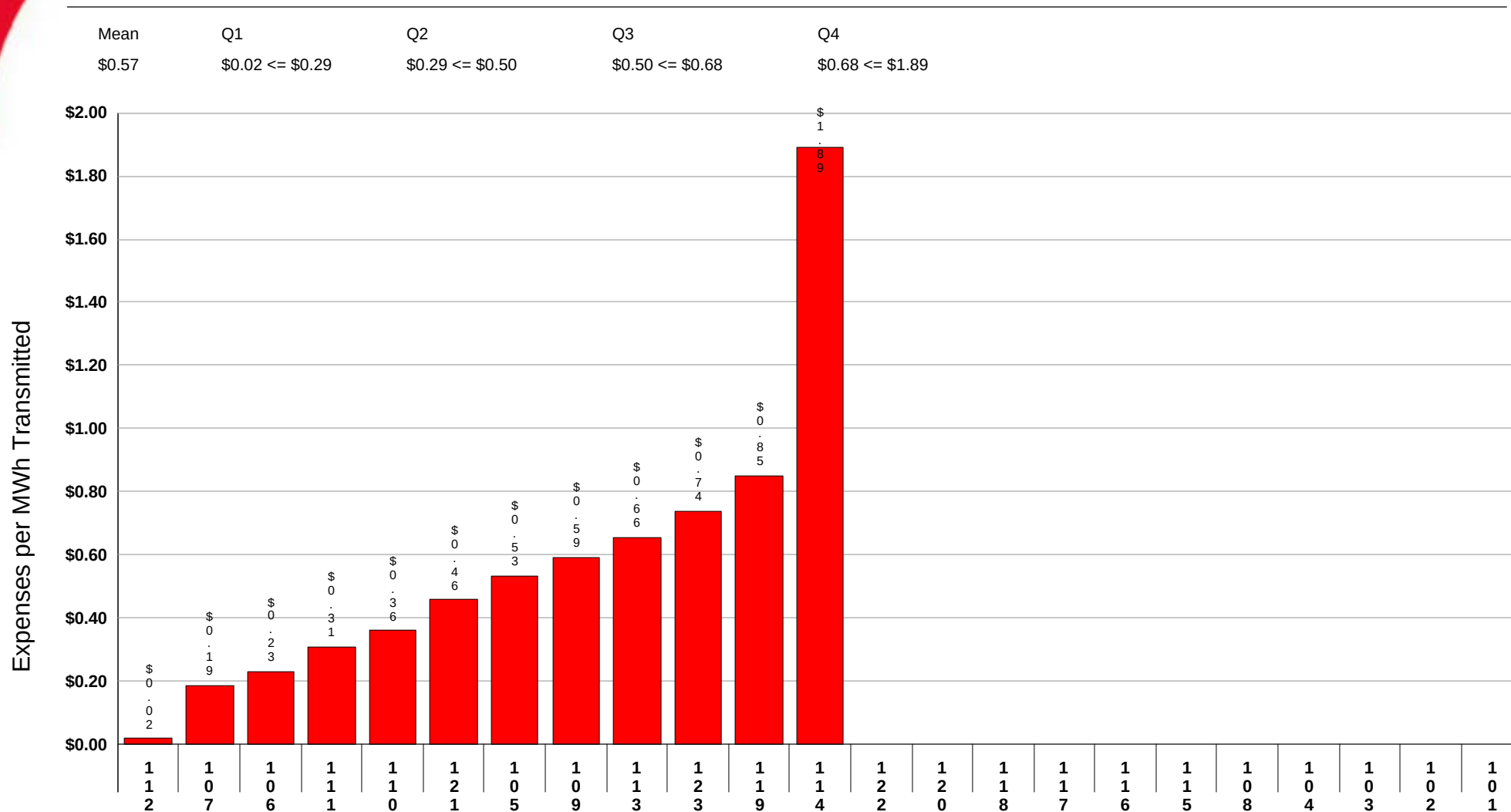
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Only companies with all the data are shown.

T&D Substation O&M Expenses

Per MWh Transmitted



Source/Calculation: (SUM{B.21}+SUM{B.23}+SUM{B.25}+SUM{B.27})/A.2.5

Volume: T&D Substation Statistics, Final Report, 2006

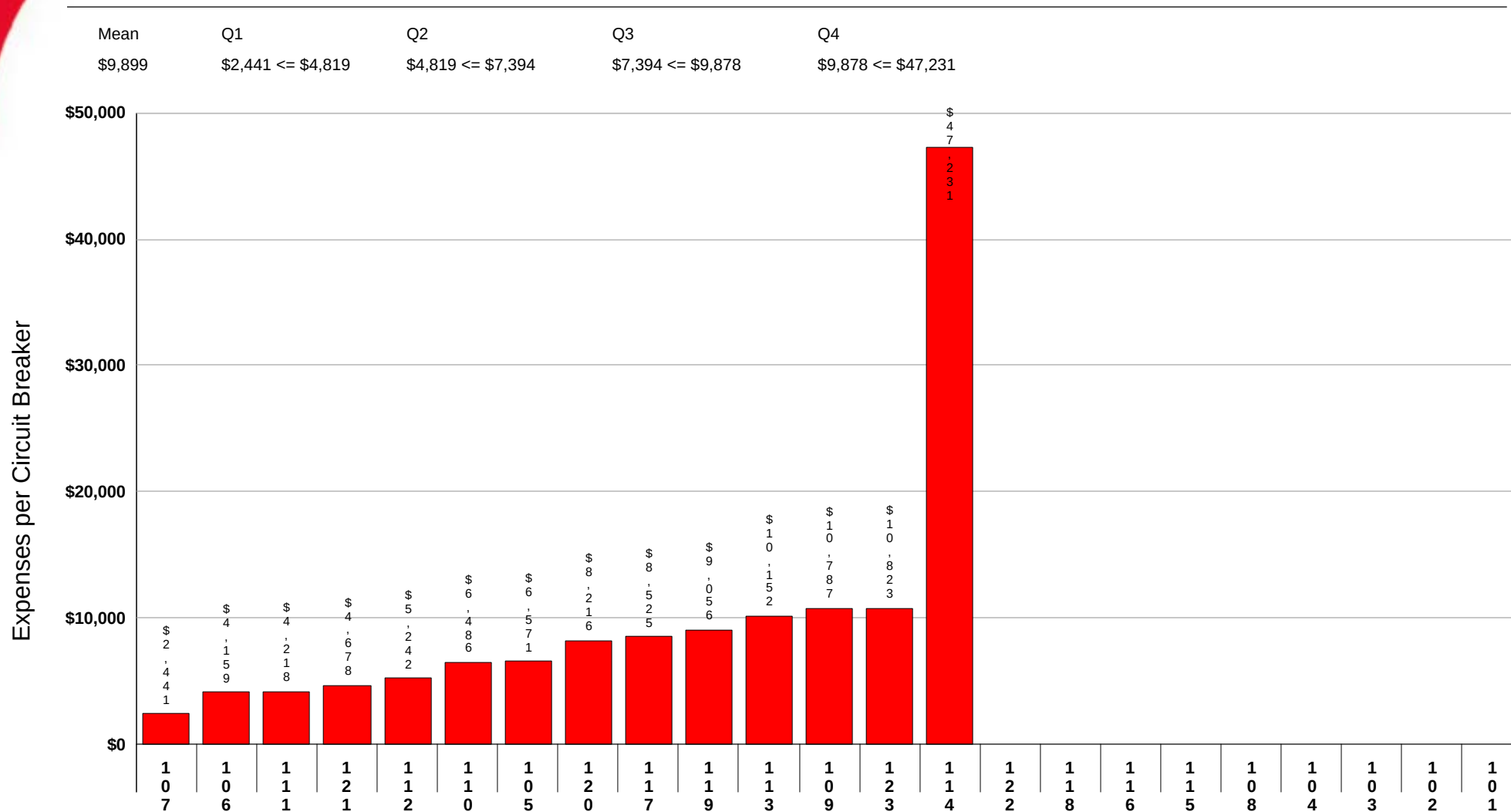
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Only companies with all the data are shown.

T&D Substation O&M Expenses

Per Circuit Breaker



Source/Calculation: (SUM{B.25}+SUM{B.27}+SUM{B.21}+SUM{B.23})/SUM{AQ.4}

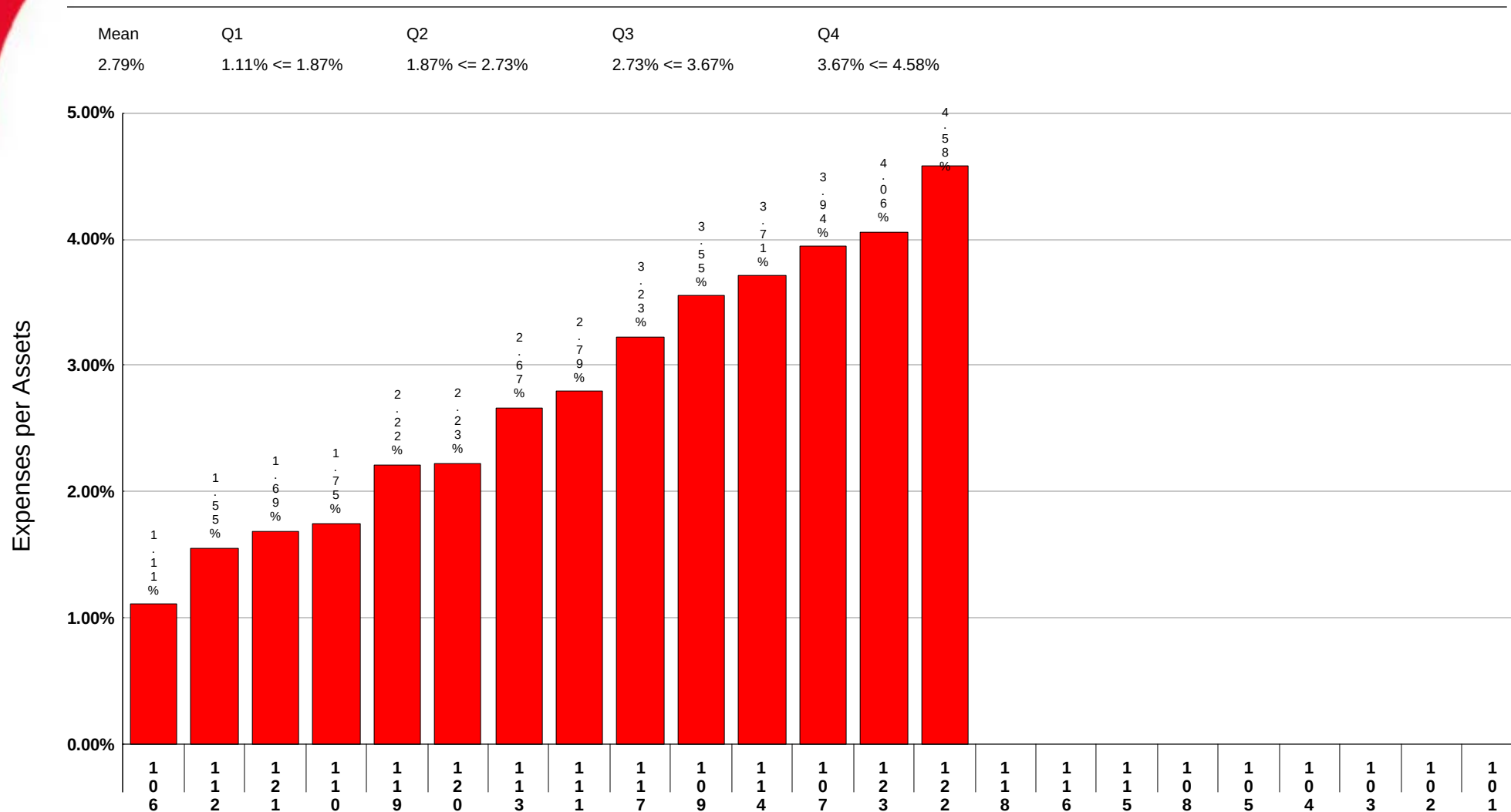
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Only companies with all the data are shown.

T&D Substation O&M Expenses Per Assets



Source/Calculation: (SUM{B.21}+SUM{B.23}+SUM{B.25}+SUM{B.27})/SUM{B.11}

Volume: T&D Substation Statistics, Final Report, 2006

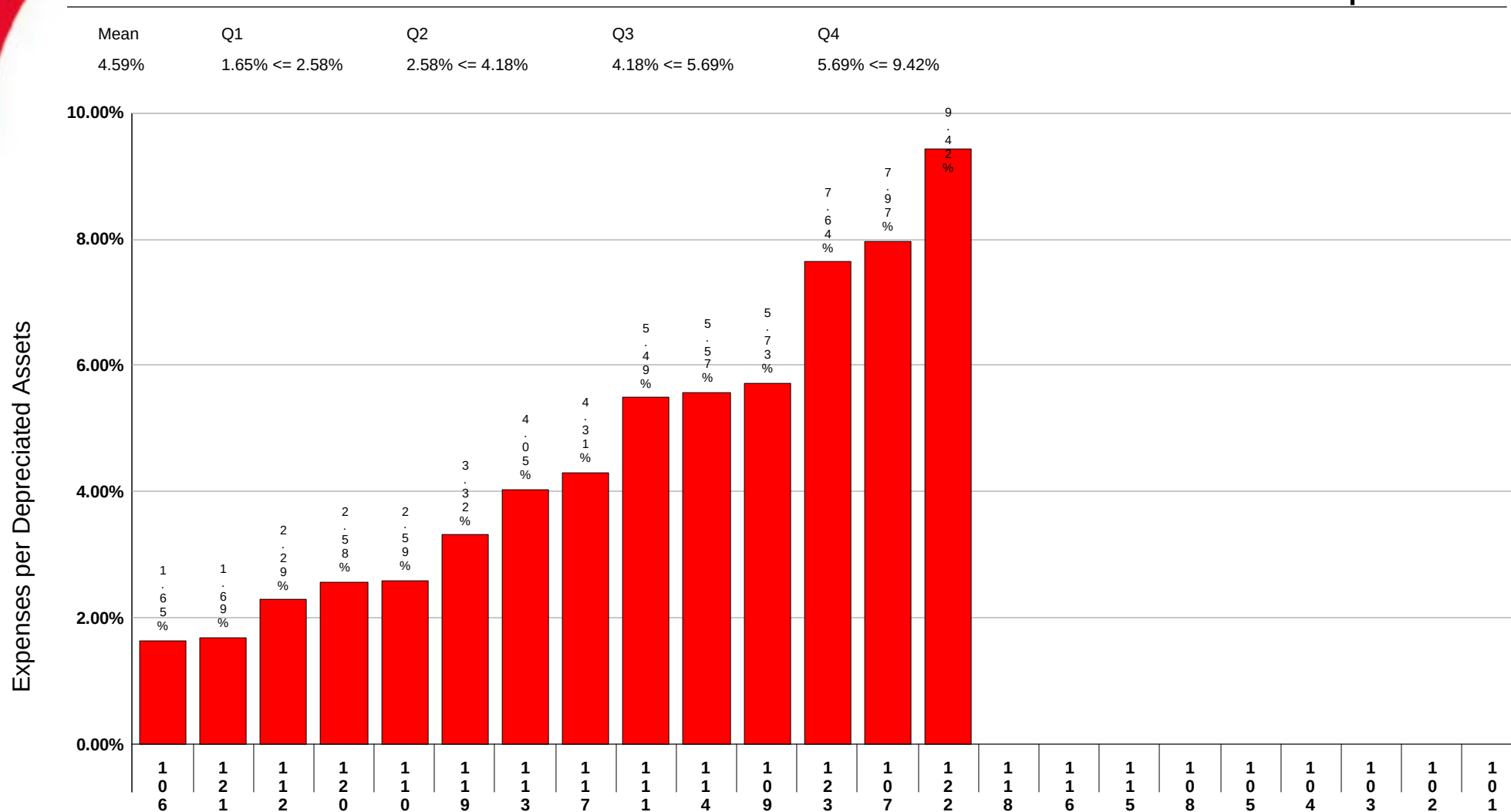
ID Code: 2107

Page: 1264

Only companies with all the data are shown.

T&D Substation O&M Expenses

Per Assets Less Depreciation



Source/Calculation: (SUM{B.21}+SUM{B.23}+SUM{B.25}+SUM{B.27})/(SUM{B.11}-SUM{B.15})

Volume: T&D Substation Statistics, Final Report, 2006

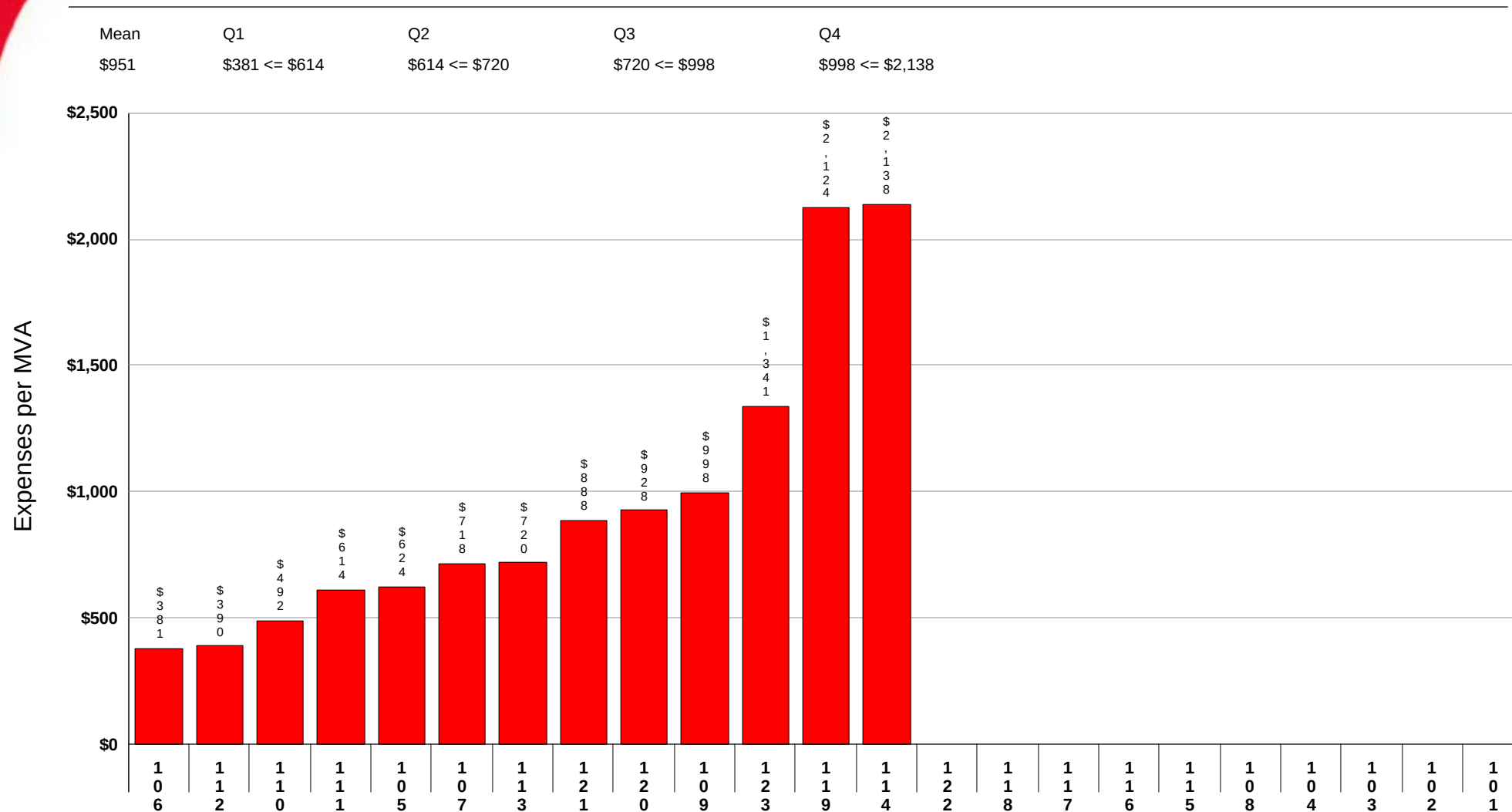
ID Code:7007

Page:1265

Only companies with all the data are shown.

T&D Substation O&M Expenses

Per T&D Substation MVA



Source/Calculation: (SUM{B.21}+SUM{B.23}+SUM{B.25}+SUM{B.27})/(SUM{AQ.12}+SUM{AQ.13})

Volume: T&D Substation Statistics, Final Report, 2006

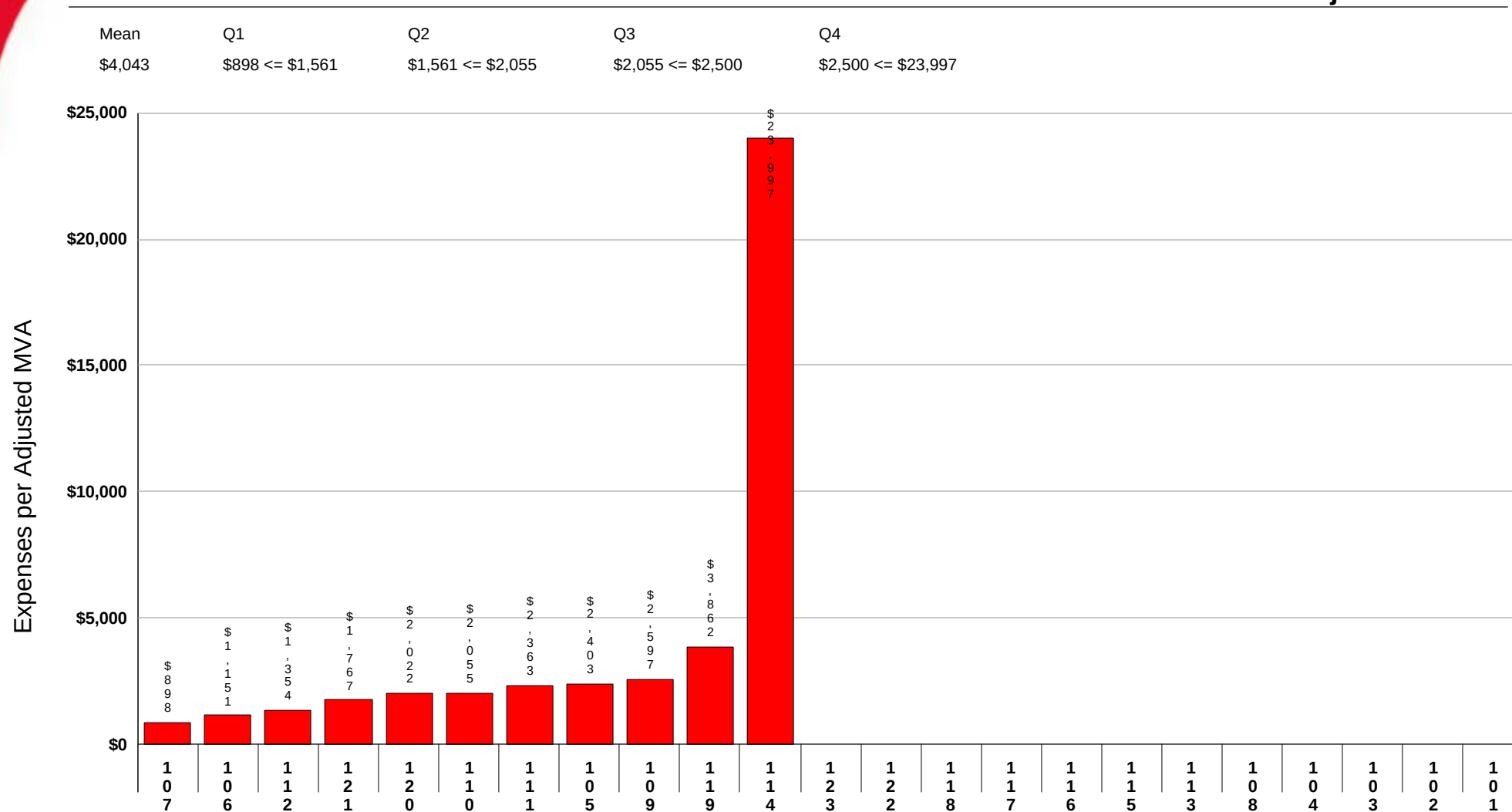
ID Code: 621

Page: 1266

Only companies with all the data are shown.

T&D Substation O&M Expenses

Per Adjusted MVA



Source/Calculation: $(\text{SUM}\{B.21\} + \text{SUM}\{B.23\} + \text{SUM}\{B.25\} + \text{SUM}\{B.27\}) / ((\text{SUM}\{AQ.12\} * AQ.14.2) + (\text{SUM}\{AQ.13\} * AQ.14.1))$

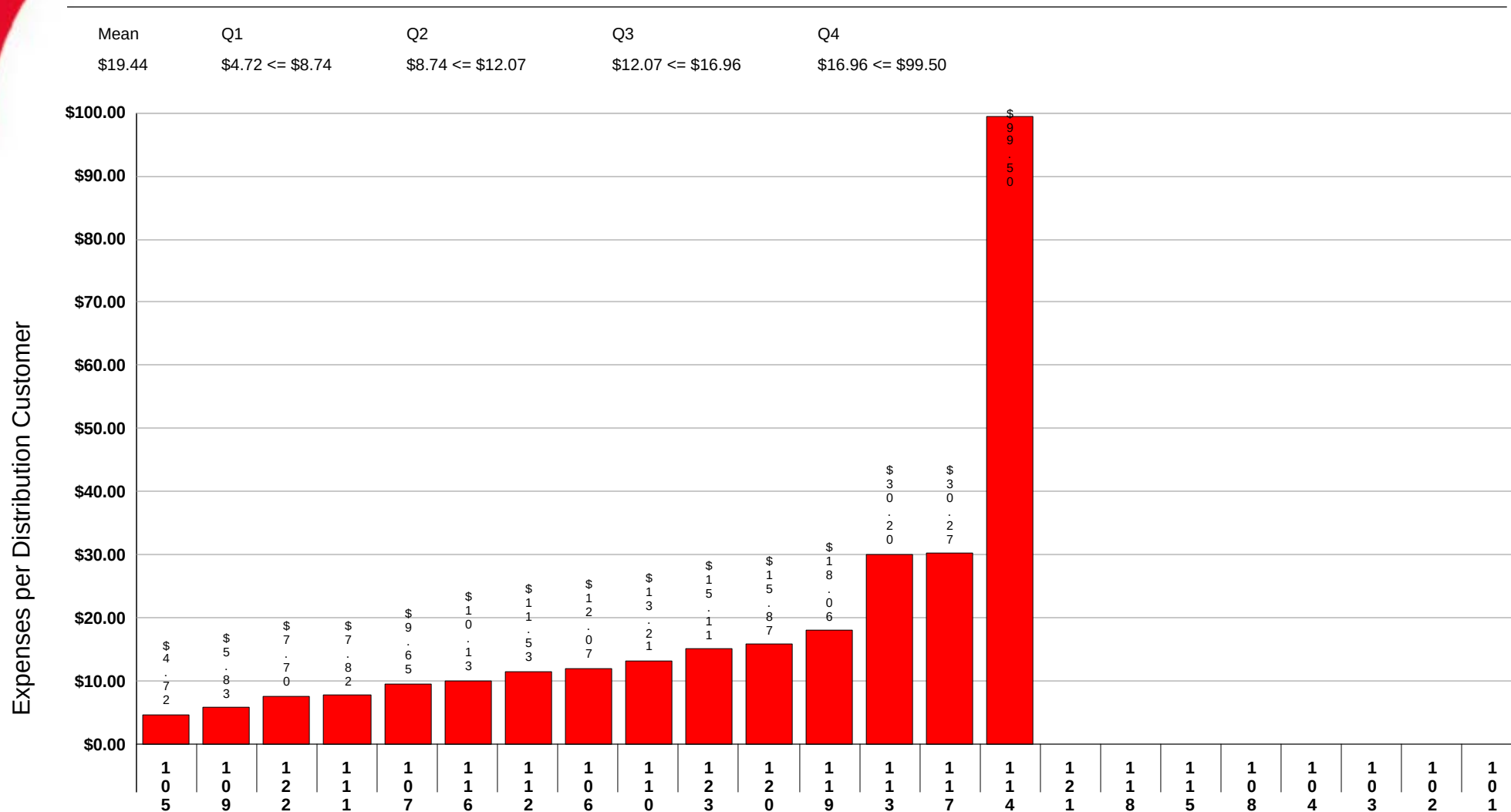
Volume: T&D Substation Statistics, Final Report, 2006

ID Code: 2112

Page: 1267

Only companies with all the data are shown.

3-Year Average T&D Substation O&M Expenses Per Distribution Customer



Source/Calculation: ((SUM{B.25}+SUM{B.27}+SUM{B.21}+SUM{B.23})/A.2.2+(B.29.1+B.29.3)/A.3.1+(B.29.4+B.29.2)/A.3.2)/3

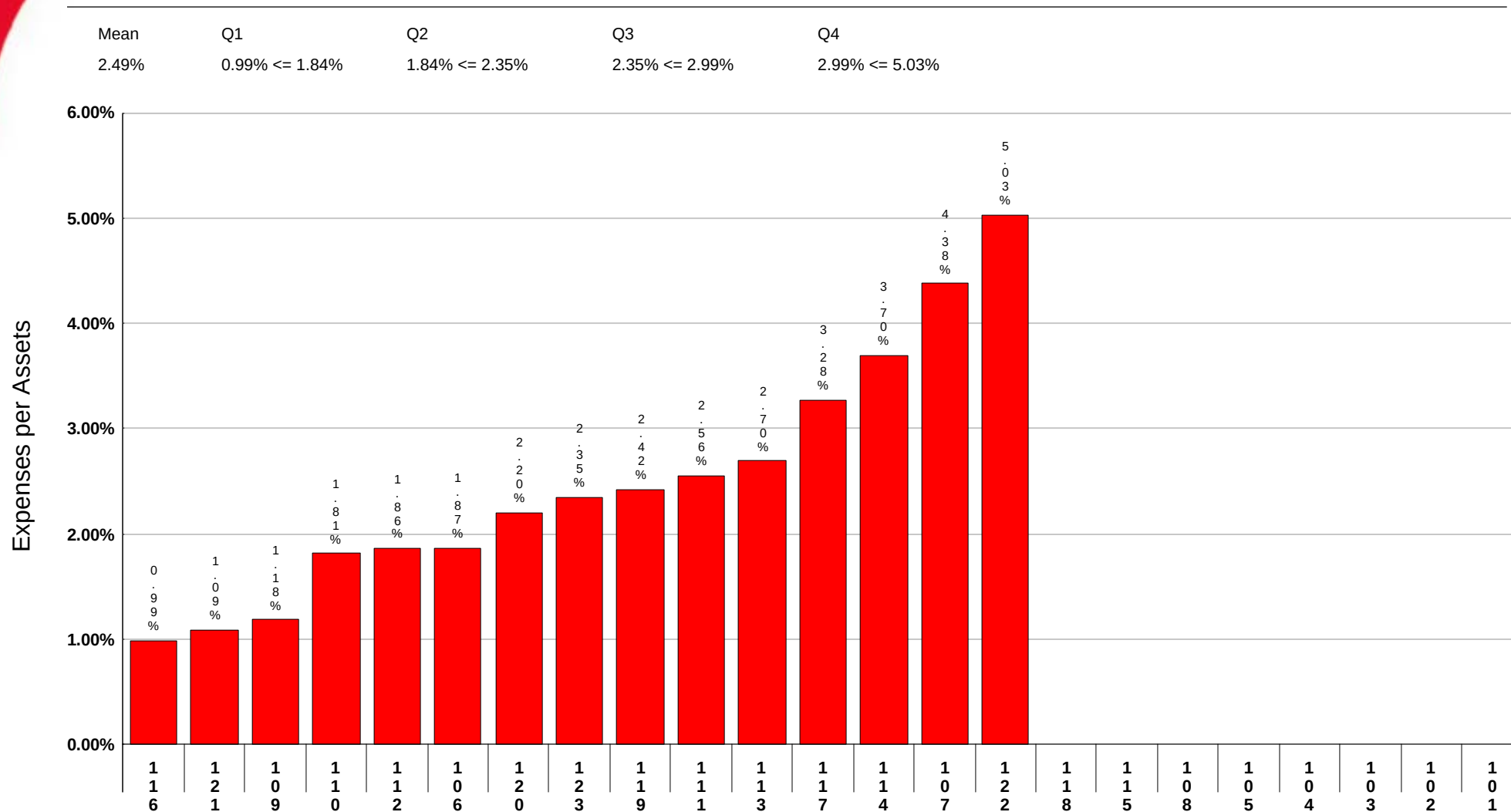
Volume: T&D Substation Statistics, Final Report, 2006

ID Code: 27380

Page: 1269

Only companies with all the data are shown.

3-Year Average T&D Substation O&M Expenses Per Assets



Source/Calculation: $((SUM\{B.21\}+SUM\{B.23\}+SUM\{B.25\}+SUM\{B.27\})/SUM\{B.11\}+(B.29.1+B.29.3)/(B.13.1+B.13.3)+(B.29.2+B.29.4)/(B.13.2+B.13.4))/3$

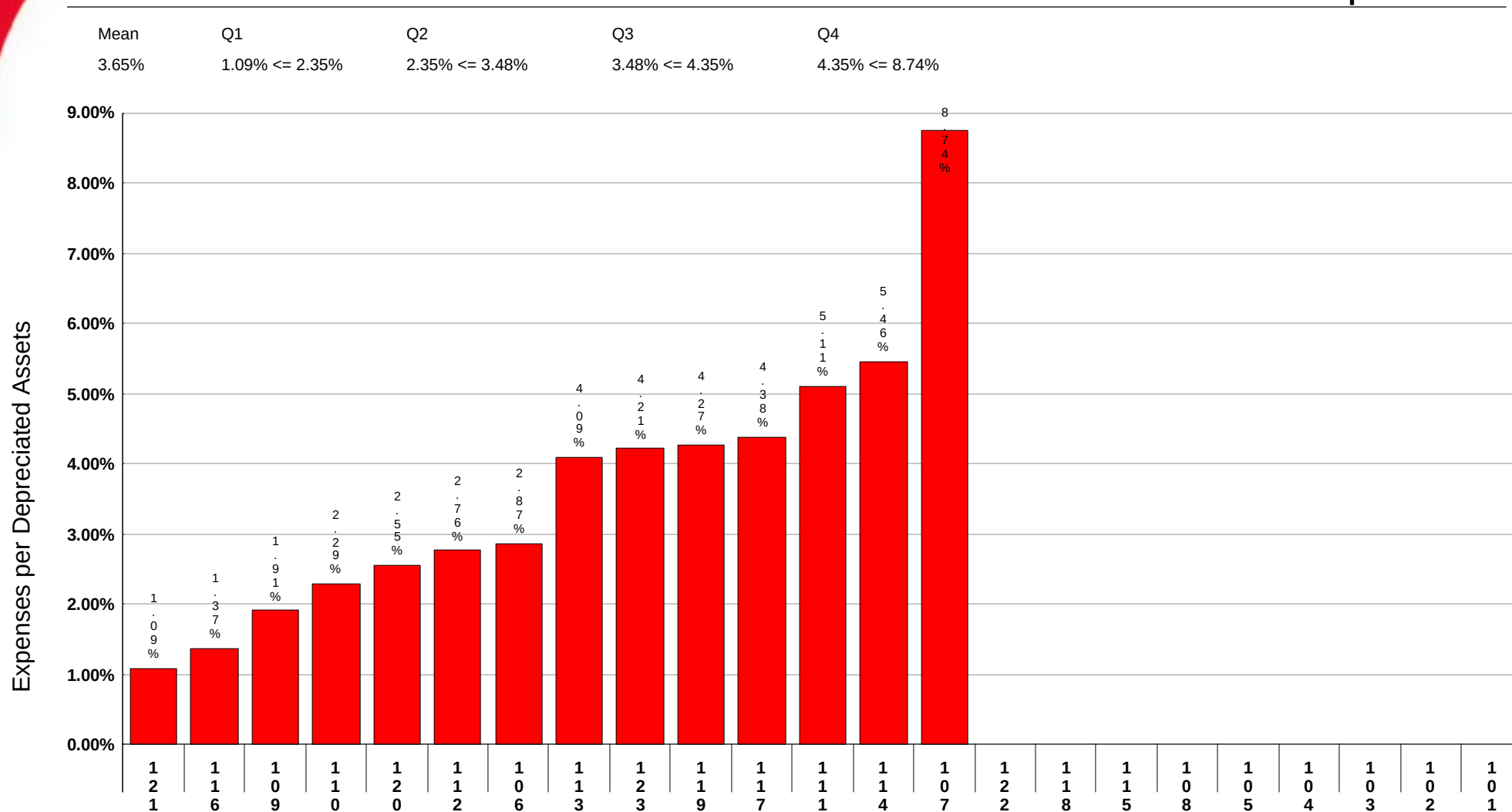
Volume: T&D Substation Statistics, Final Report, 2006

ID Code: 27447

Page: 1271

Only companies with all the data are shown.

3-Year Average T&D Substation O&M Expenses Per Assets Less Depreciation



$$((\text{SUM}\{B.21\}+\text{SUM}\{B.23\}+\text{SUM}\{B.25\}+\text{SUM}\{B.27\})/(\text{SUM}\{B.11\}-\text{SUM}\{B.15\})+(B.29.1+B.29.3)/((B.13.1+B.13.3)-(B.17.3+B.17.1)))+(B.29.2+B.29.4)/((B.13.2+B.13.4)-(B.17.4+B.17.2)))/3$$

Source/Calculation:

Volume: T&D Substation Statistics, Final Report, 2006

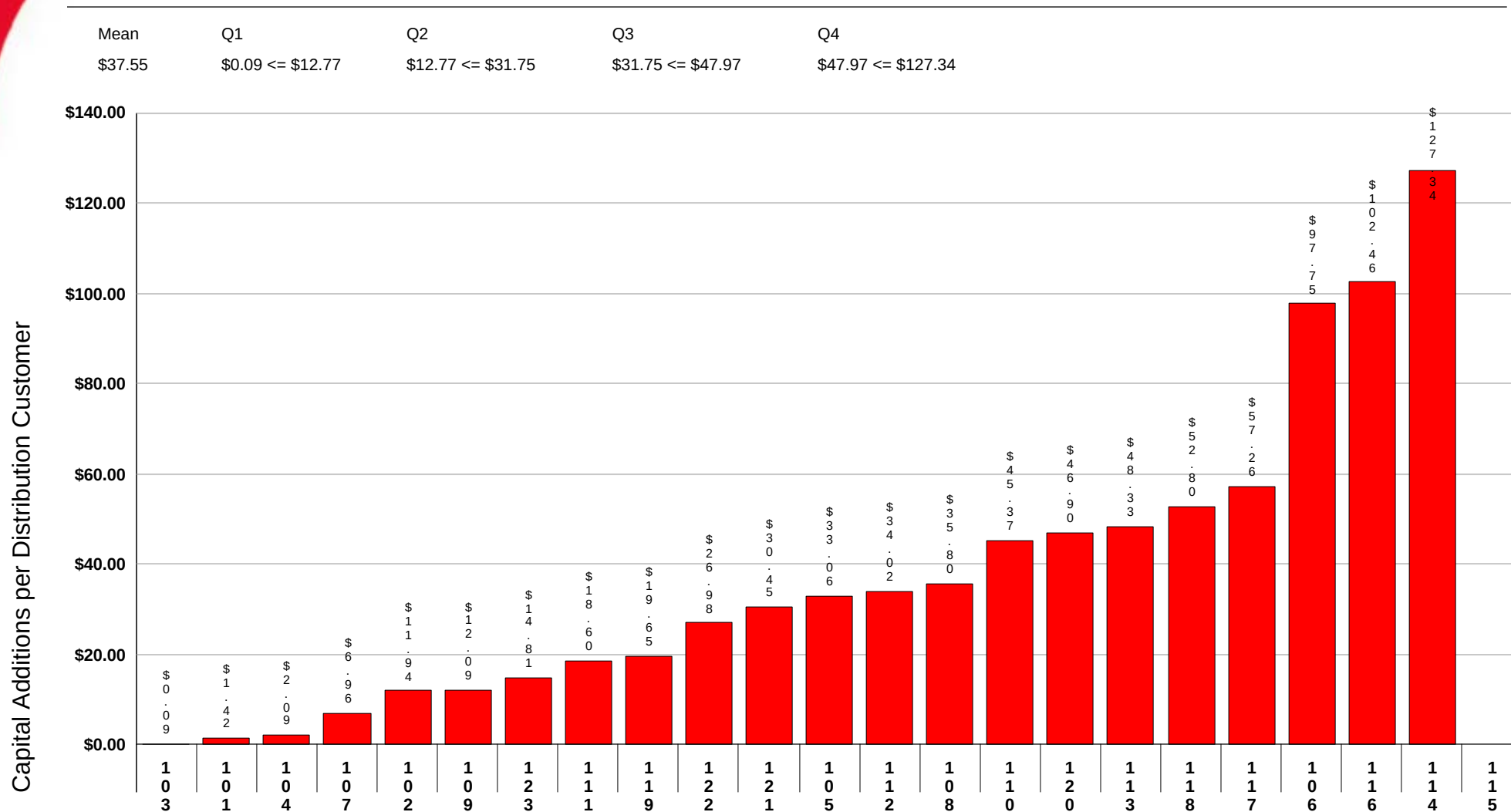
ID Code:27116

Page:1272

Only companies with all the data are shown.

T&D Substation Capital Additions

Per Distribution Customer



Source/Calculation: (SUM{B.3}+SUM{B.6})/A.2.2

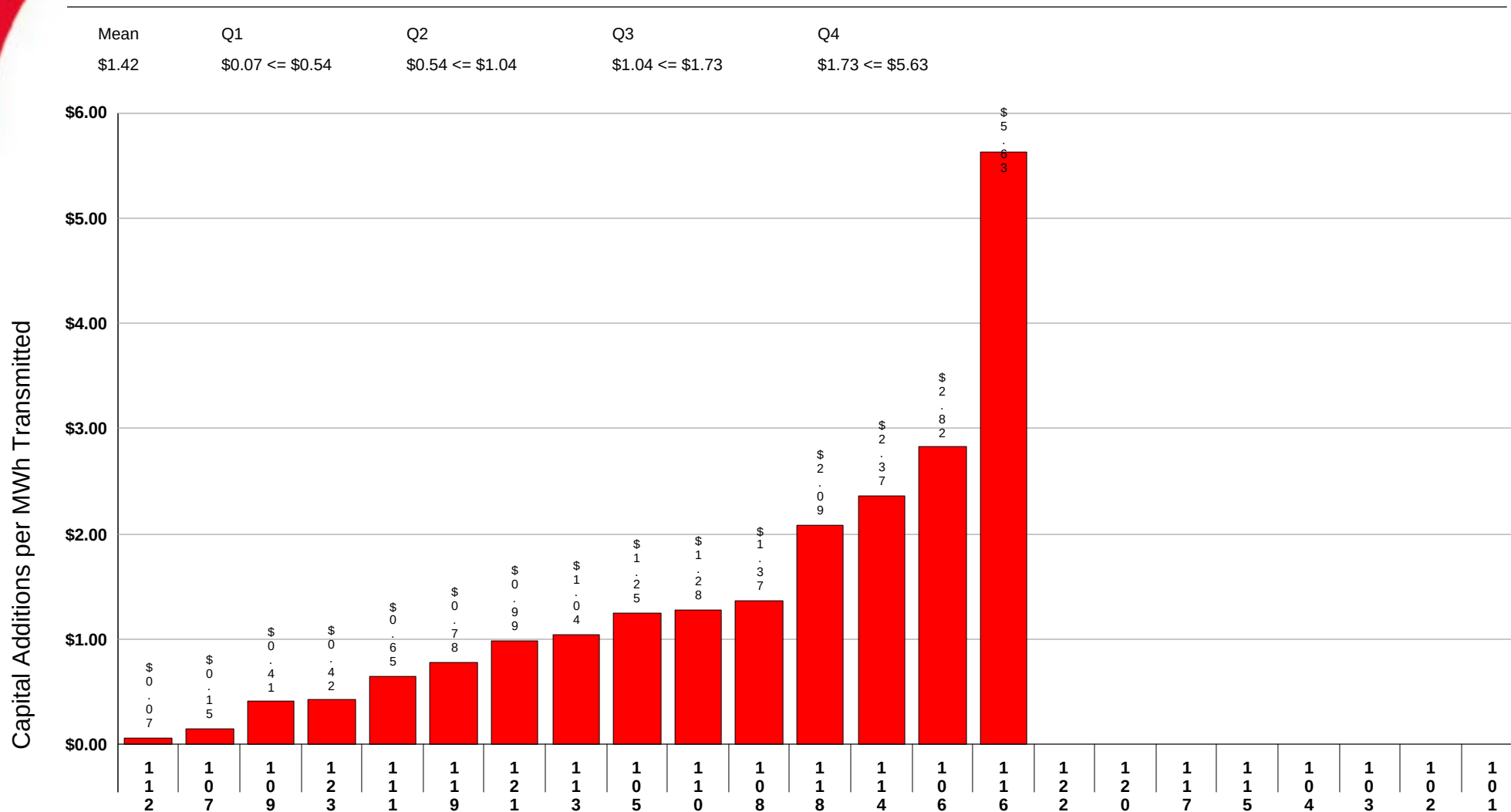
Volume: T&D Substation Statistics, Final Report, 2006

ID Code:623

Page:1273

Only companies with all the data are shown.

T&D Substation Capital Additions Per MWh Transmitted



Source/Calculation: (SUM{B.3}+SUM{B.6})/A.2.5

Volume: T&D Substation Statistics, Final Report, 2006

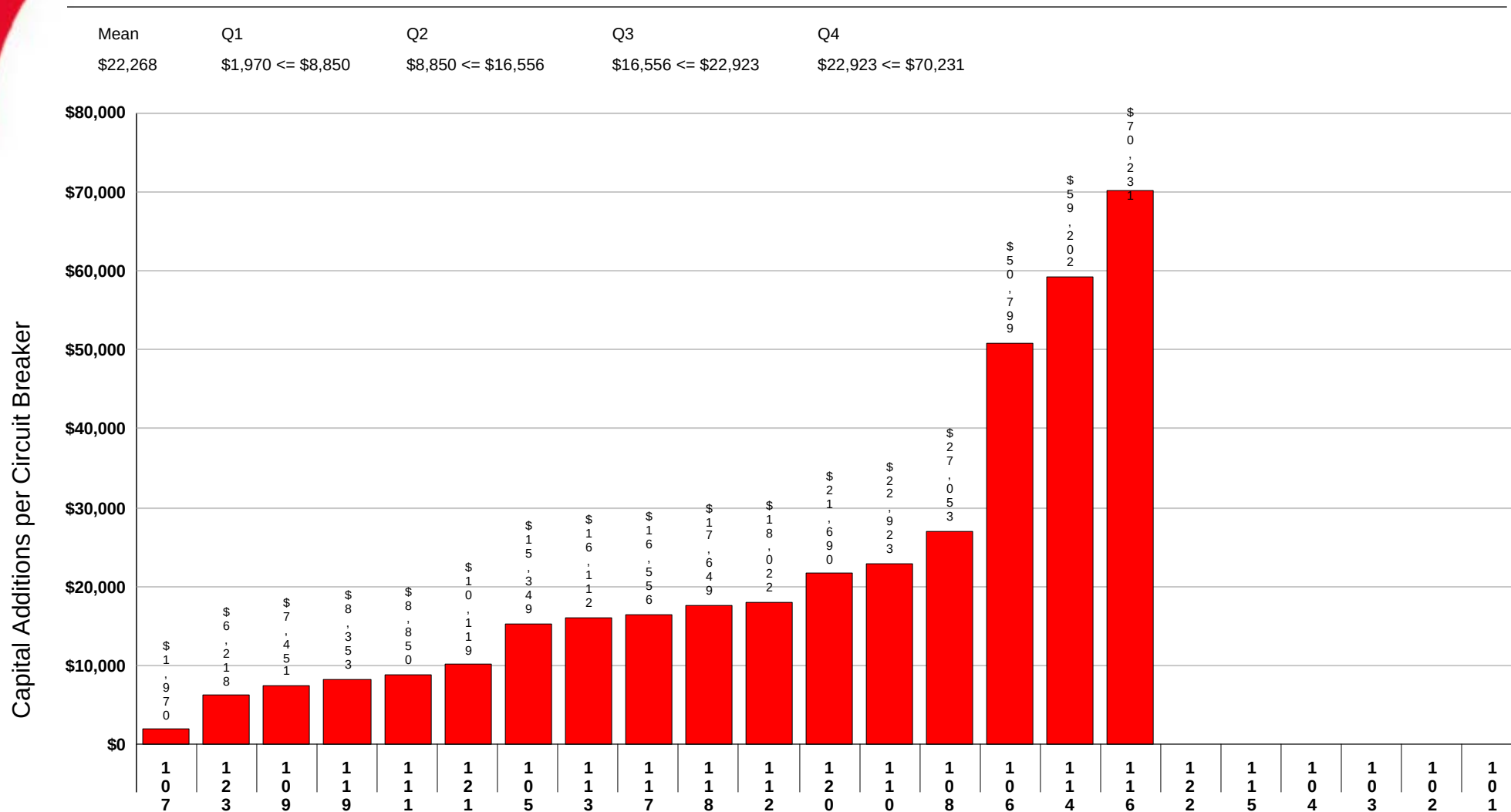
ID Code:1906

Only companies with all the data are shown.

Page:1276

T&D Substation Capital Additions

Per Circuit Breaker



Source/Calculation: (SUM{B.3}+SUM{B.6})/SUM{AQ.4}

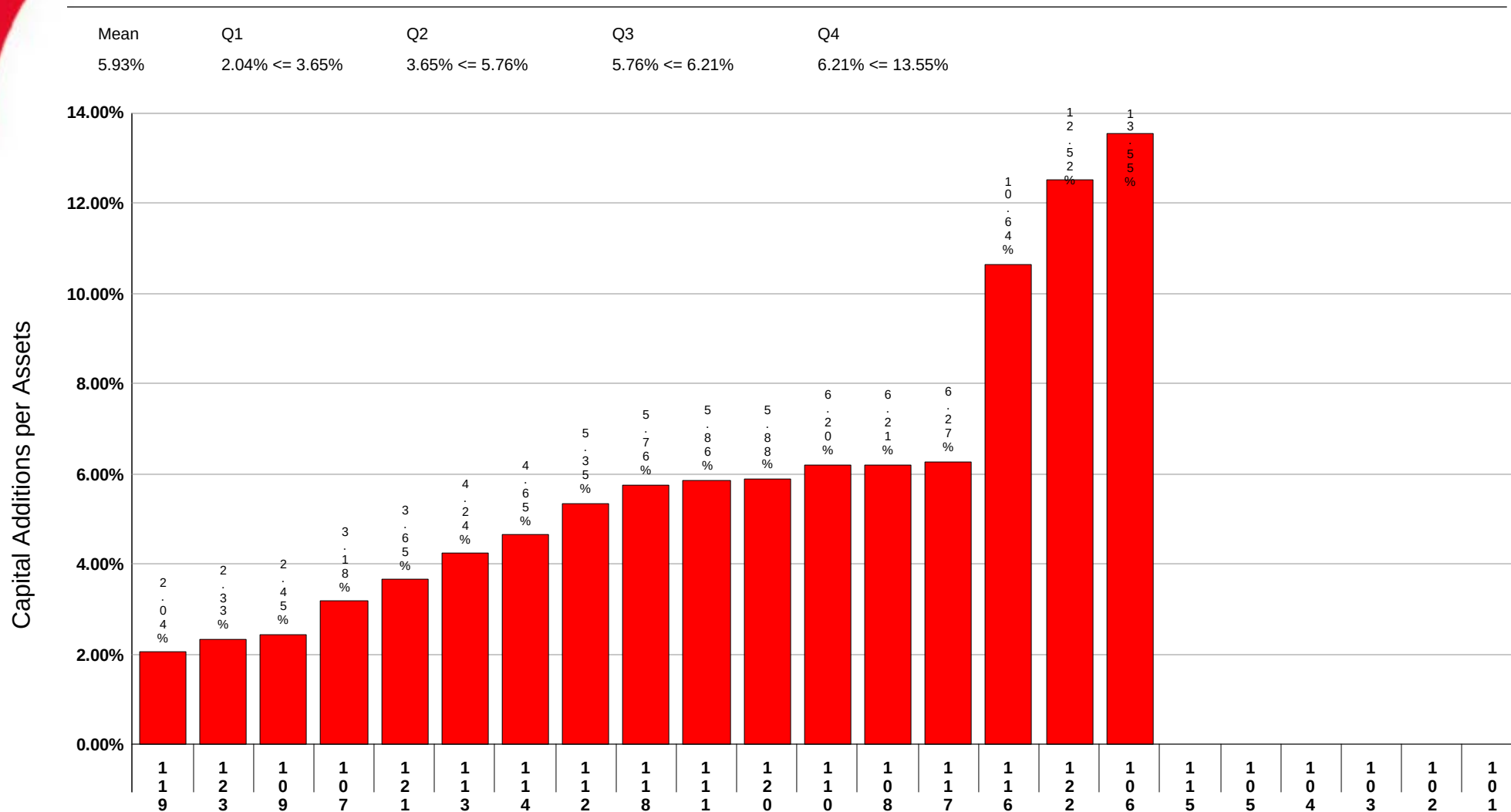
Volume: T&D Substation Statistics, Final Report, 2006

ID Code: 7002

Page: 1277

Only companies with all the data are shown.

T&D Substation Capital Additions Per Assets



Source/Calculation: $(\text{SUM}\{B.3\} + \text{SUM}\{B.6\}) / \text{SUM}\{B.11\}$

Volume: T&D Substation Statistics, Final Report, 2006

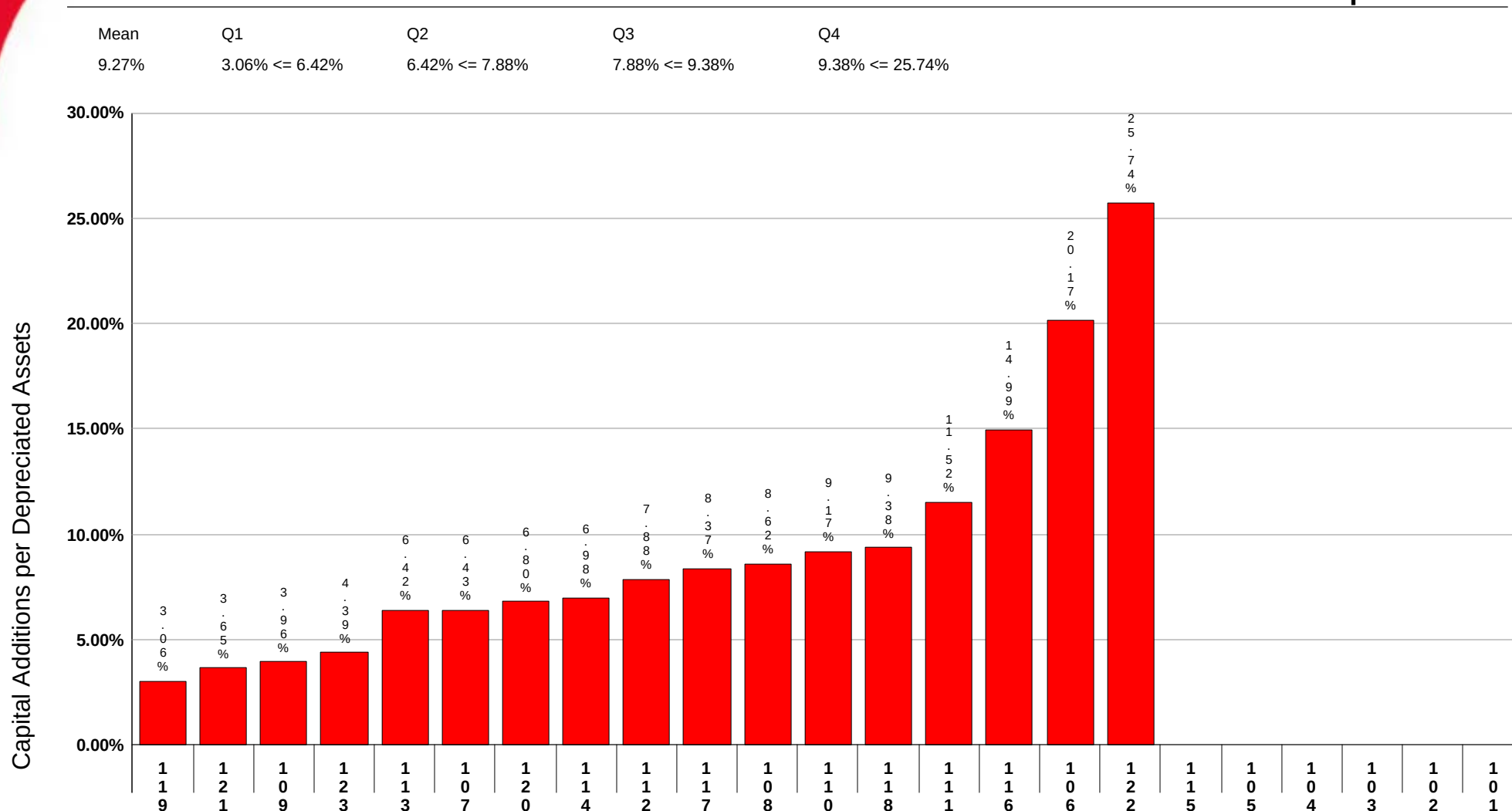
ID Code: 2104

Page: 1279

Only companies with all the data are shown.

T&D Substation Capital Additions

Per Assets Less Depreciation



Source/Calculation: $(\text{SUM}\{B.3\} + \text{SUM}\{B.6\}) / (\text{SUM}\{B.11\} - \text{SUM}\{B.15\})$

Volume: T&D Substation Statistics, Final Report, 2006

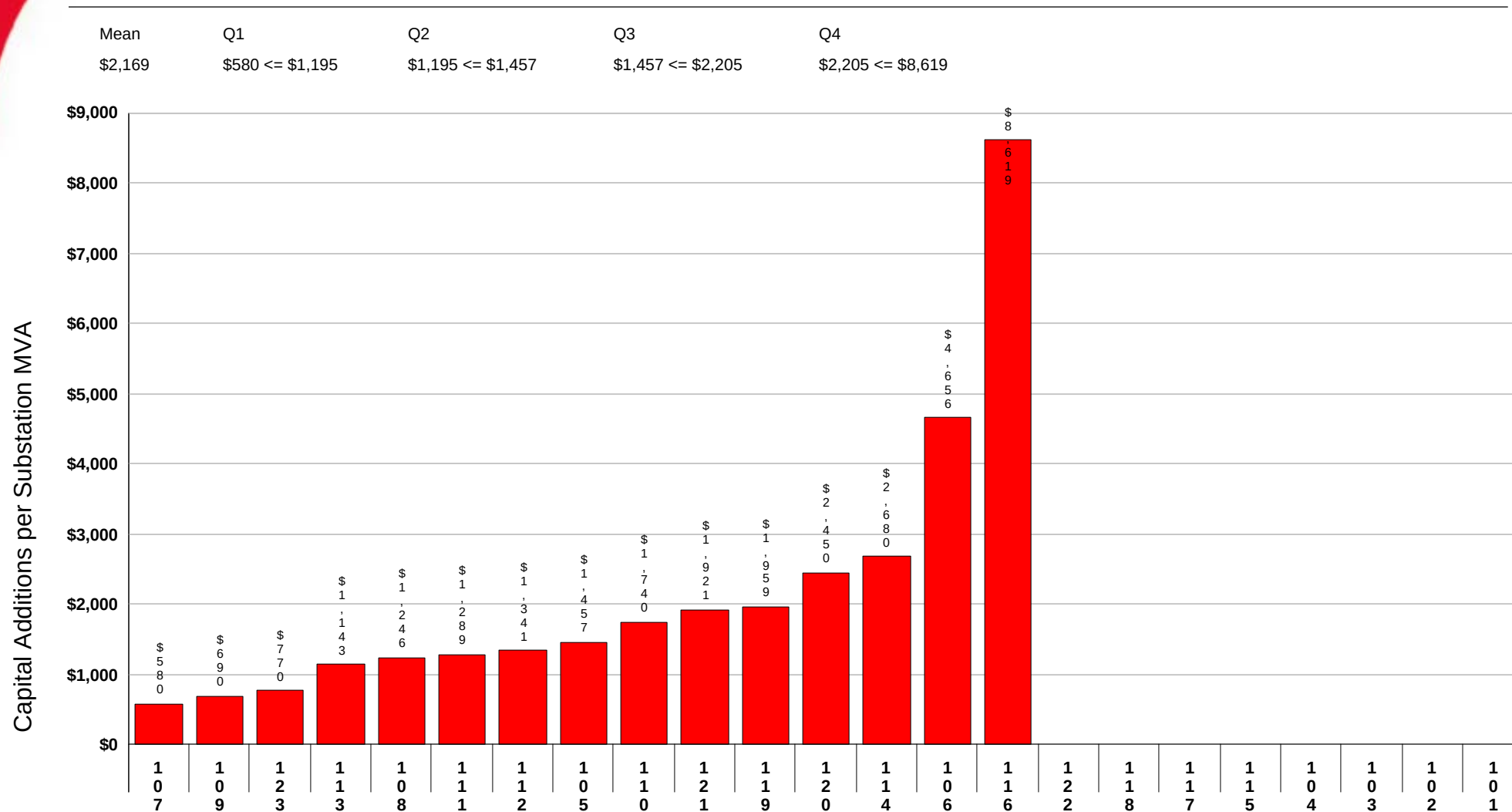
ID Code: 7005

Page: 1280

Only companies with all the data are shown.

T&D Substation Capital Additions

Per T&D Substation MVA



Source/Calculation: (SUM{B.3}+SUM{B.6})/(SUM{AQ.12}+SUM{AQ.13})

Volume: T&D Substation Statistics, Final Report, 2006

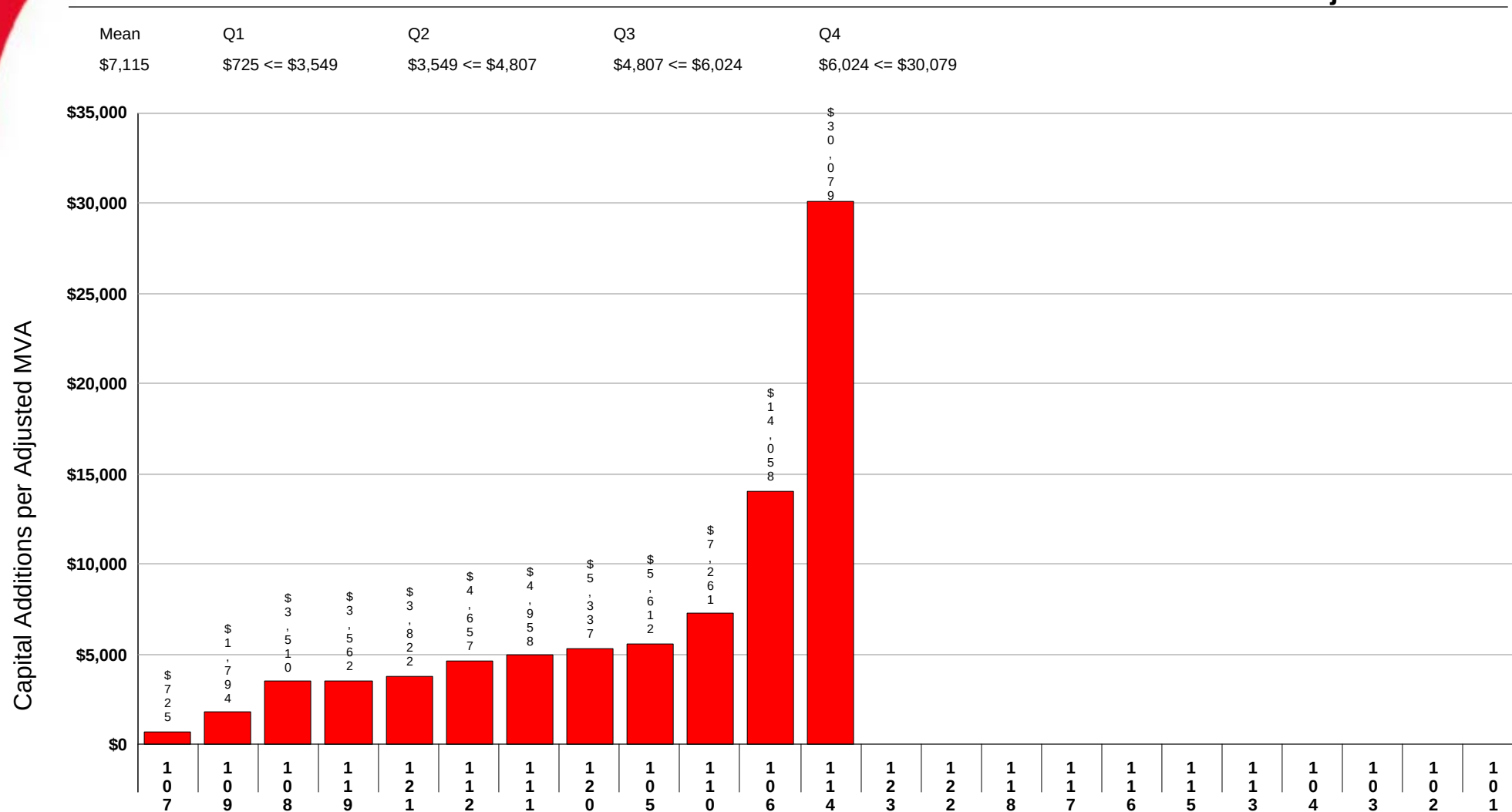
ID Code:624

Page:1281

Only companies with all the data are shown.

T&D Substation Capital Additions

Per Adjusted MVA



Source/Calculation: $(\text{SUM}\{B.3\} + \text{SUM}\{B.6\}) / ((\text{SUM}\{AQ.12\} * AQ.14.2) + (\text{SUM}\{AQ.13\} * AQ.14.1))$

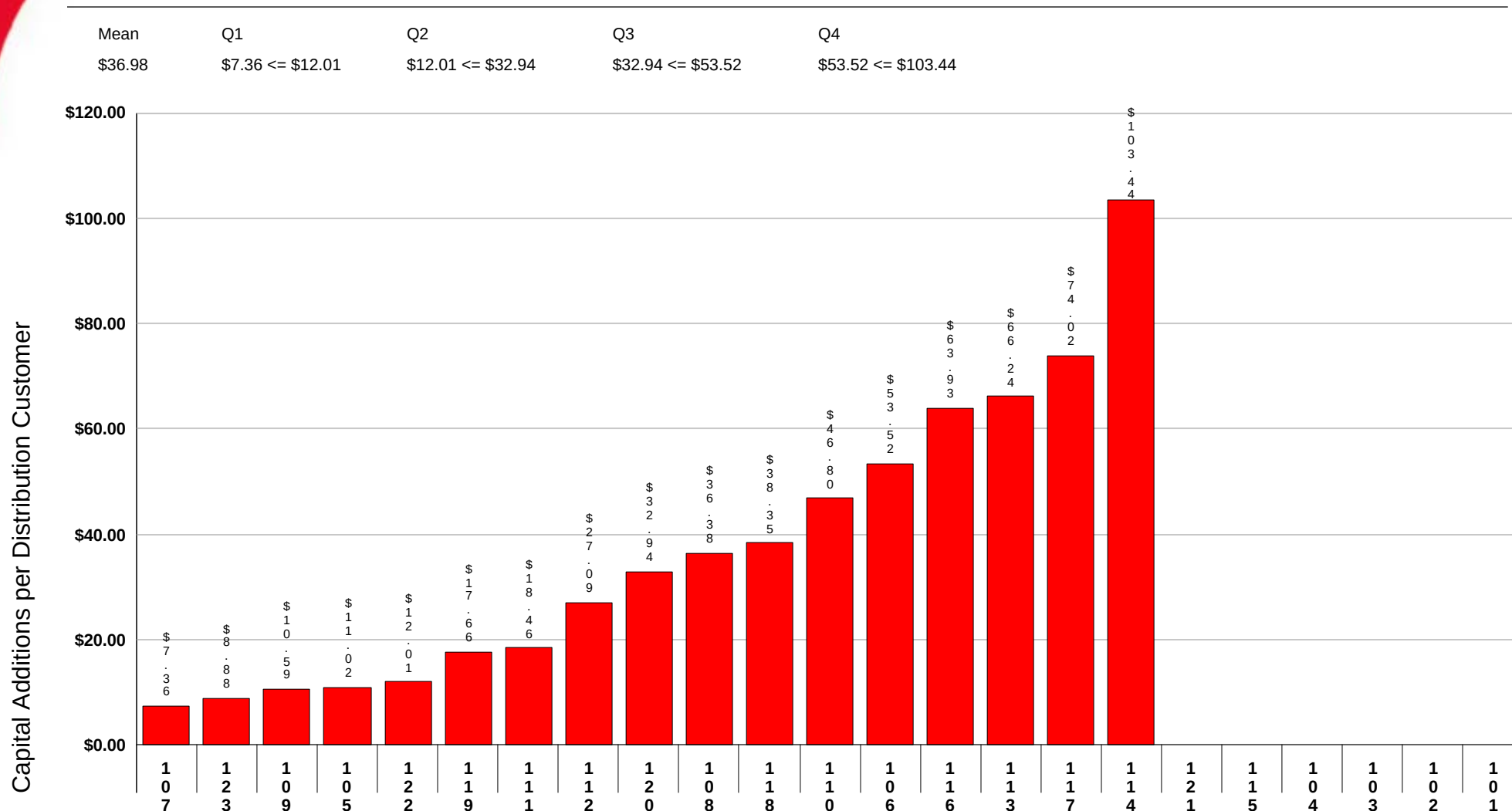
Volume: T&D Substation Statistics, Final Report, 2006

ID Code: 2109

Page: 1282

Only companies with all the data are shown.

3-Year Average T&D Substation Capital Additions Per Distribution Customer



Source/Calculation: $((\text{SUM}\{B.3\} + \text{SUM}\{B.6\}) / A.2.2 + (B.9.1 + B.9.3) / A.3.1 + (B.9.2 + B.9.4) / A.3.2) / 3$

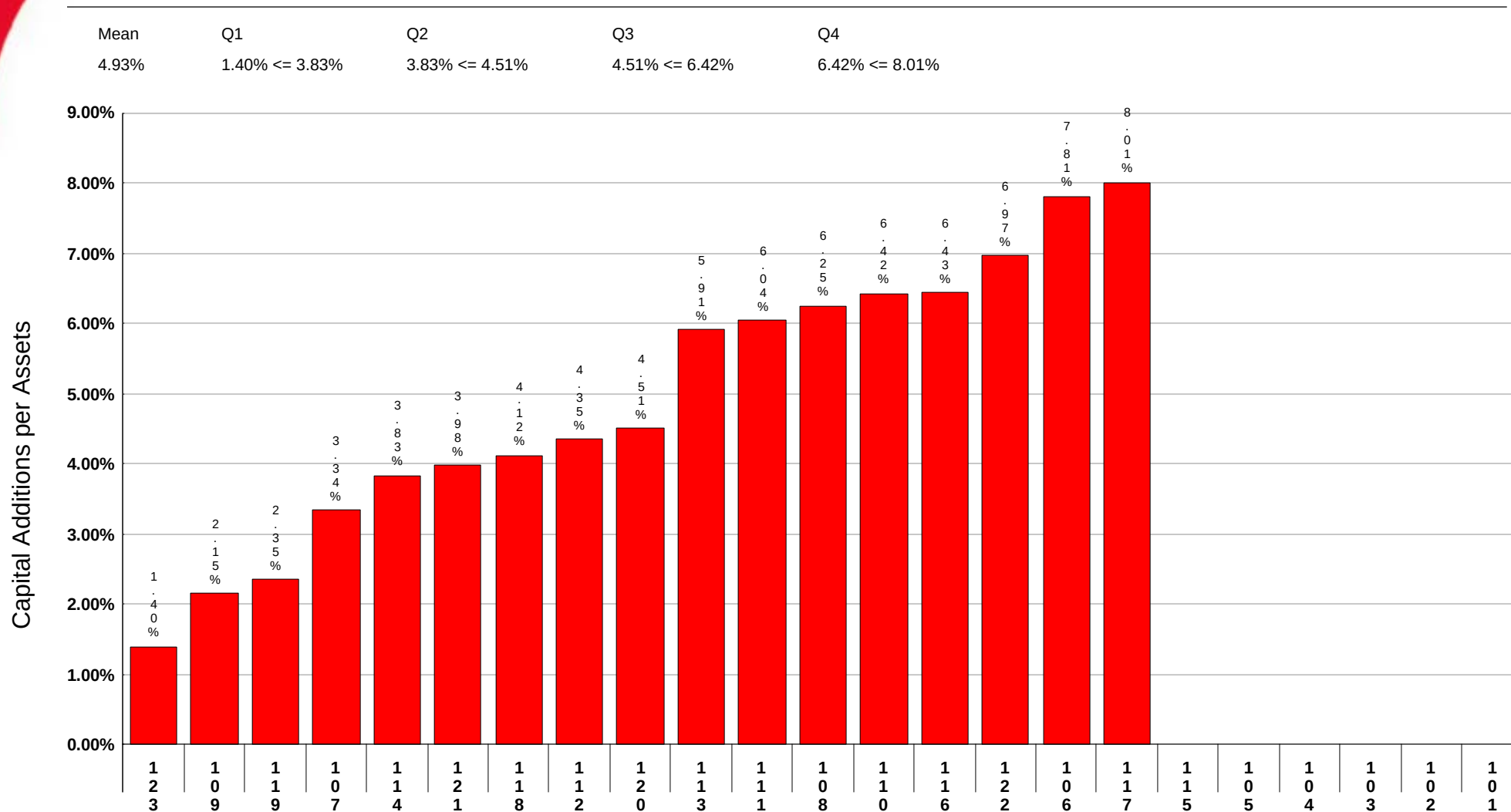
Volume: T&D Substation Statistics, Final Report, 2006

ID Code: 27379

Page: 1283

Only companies with all the data are shown.

3-Year Average T&D Substation Capital Additions Per Assets



Source/Calculation: $((\text{SUM}\{B.3\} + \text{SUM}\{B.6\}) / \text{SUM}\{B.11\} + (B.9.1 + B.9.3) / (B.13.1 + B.13.3) + (B.9.2 + B.9.4) / (B.13.2 + B.13.4)) / 3$

Volume: T&D Substation Statistics, Final Report, 2006

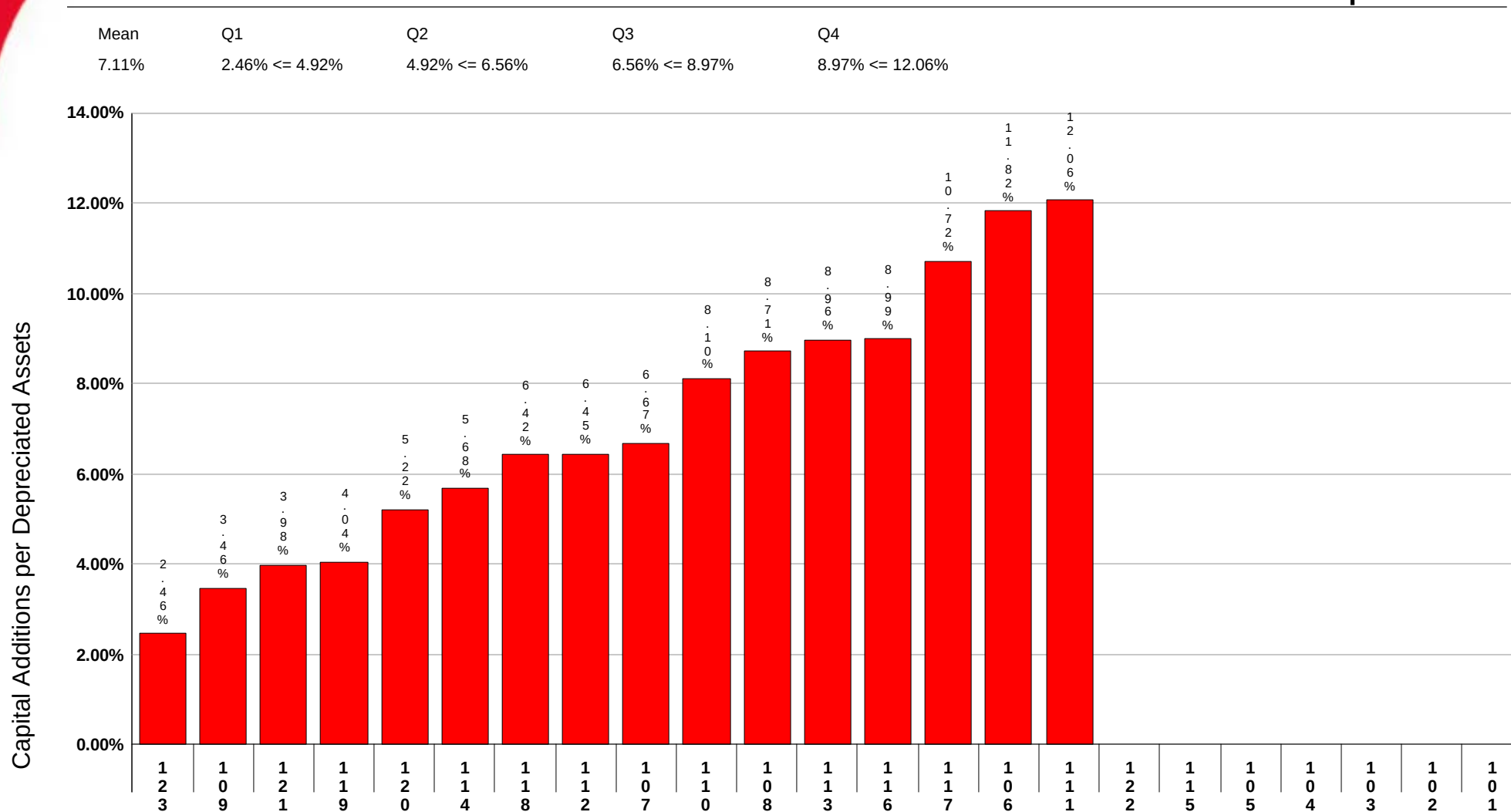
ID Code: 27446

Page: 1285

Only companies with all the data are shown.

3-Year Average T&D Substation Capital Additions

Per Assets Less Depreciation



Source/Calculation: $((\text{SUM}\{B.3\} + \text{SUM}\{B.6\}) / (\text{SUM}\{B.11\} - \text{SUM}\{B.15\}) + (B.9.1 + B.9.3) / (B.13.1 + B.13.3 - B.17.3 - B.17.1) + (B.9.2 + B.9.4) / (B.13.2 + B.13.4 - B.17.4 - B.17.2)) / 3$

Volume: T&D Substation Statistics, Final Report, 2006

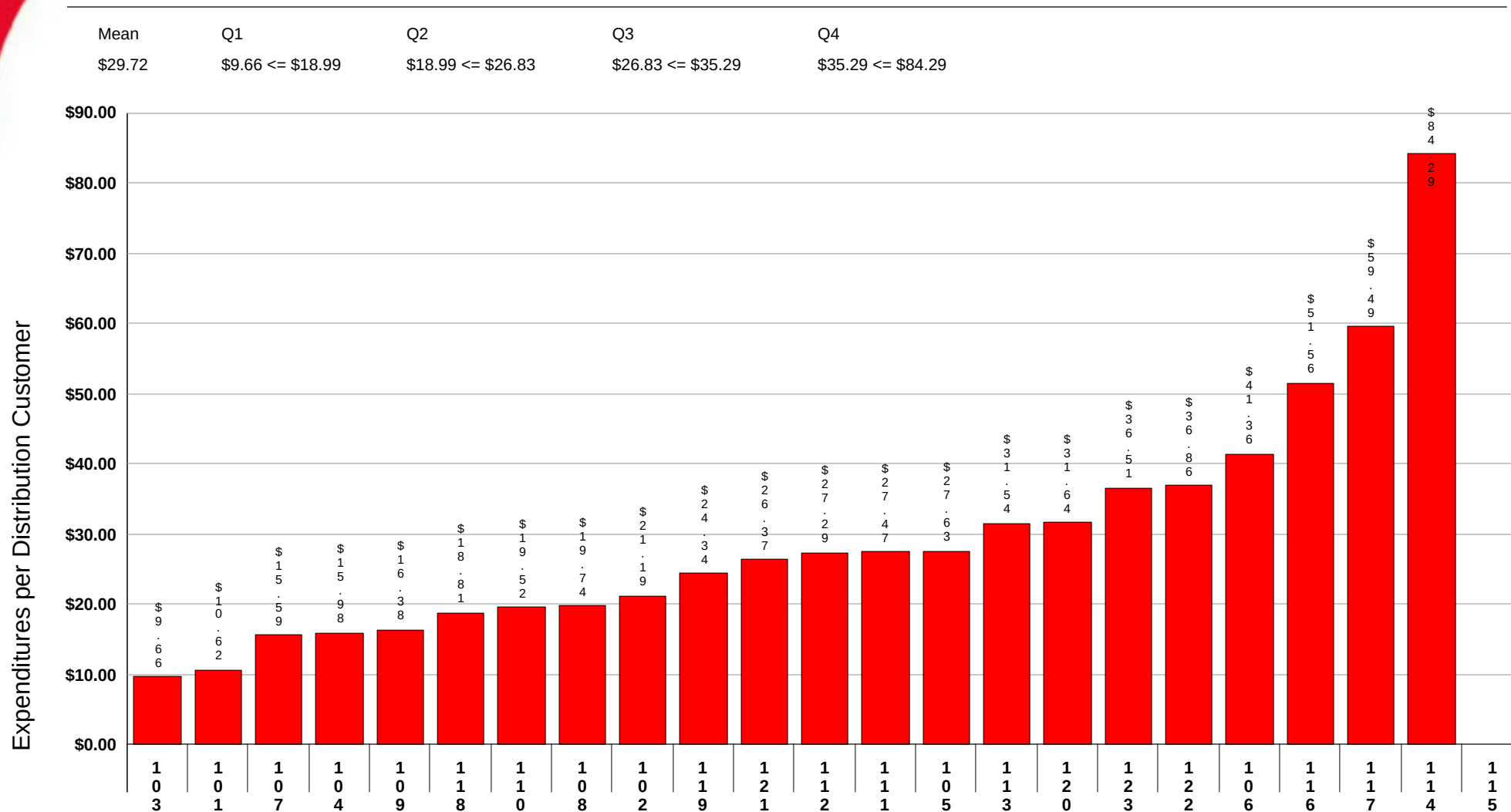
ID Code: 9509

Page: 1286

Only companies with all the data are shown.

Distribution Substation Expenditures

Per Distribution Customer



Source/Calculation: (SUM{B.6}+SUM{B.25}+SUM{B.27})/A.2.2

Volume: T&D Substation Statistics, Final Report, 2006

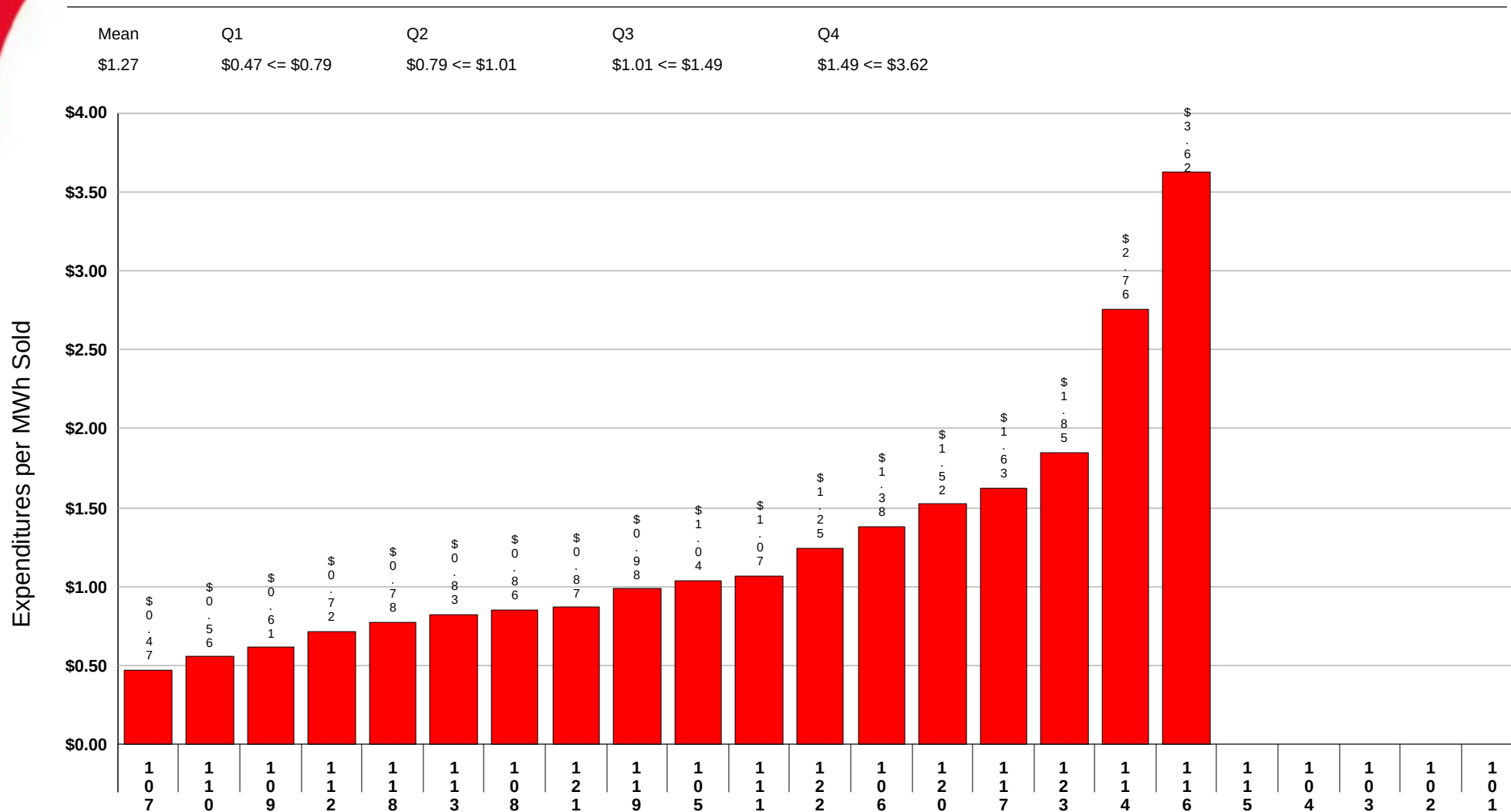
ID Code: 2235

Page: 1287

Only companies with all the data are shown.

Distribution Substation Expenditures

Per MWh Sold



Source/Calculation: (SUM{B.6}+SUM{B.25}+SUM{B.27})/A.2.4

Volume: T&D Substation Statistics, Final Report, 2006

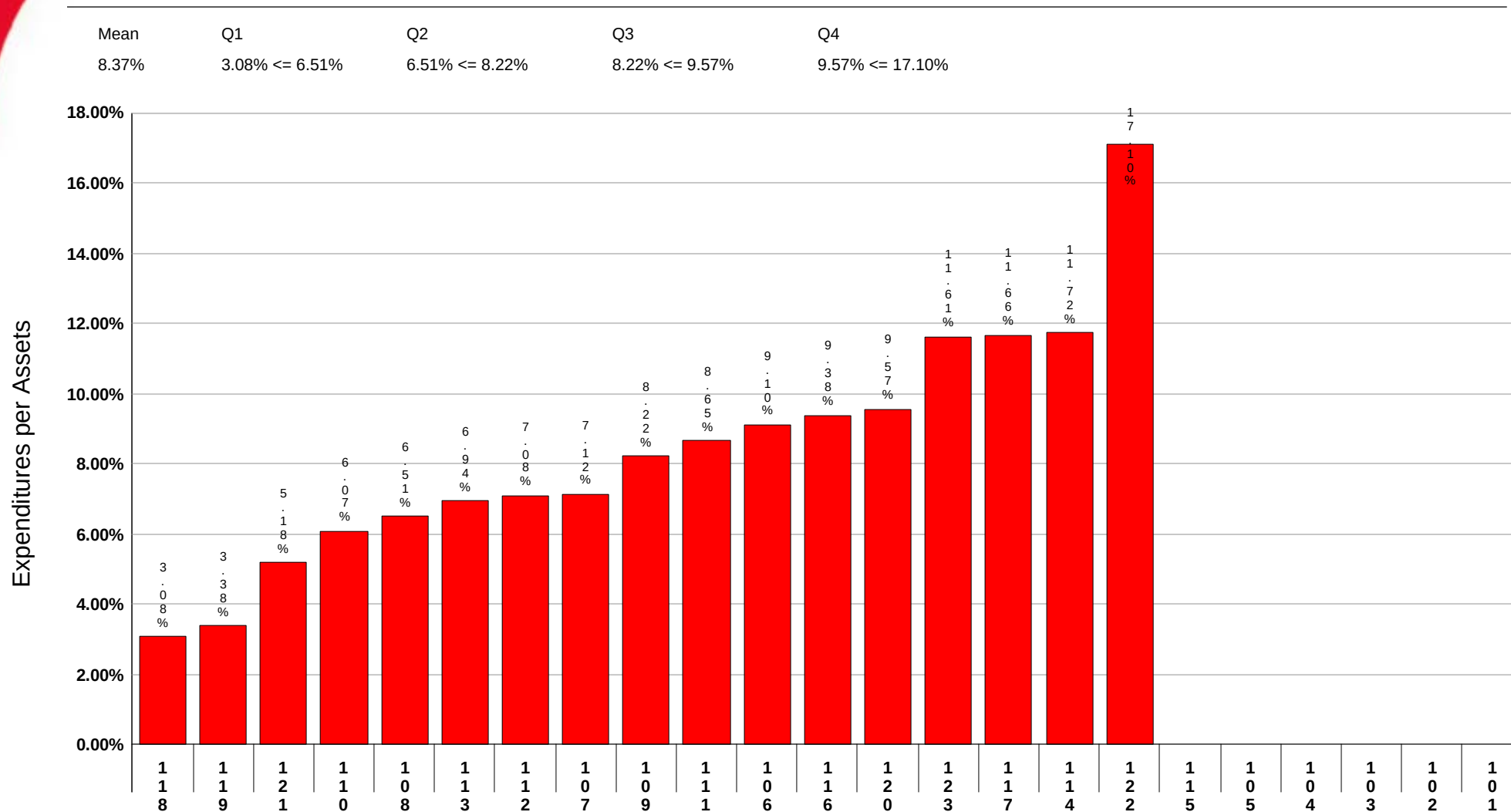
ID Code: 2160

Page: 1288

Only companies with all the data are shown.

Distribution Substation Expenditures

Per Assets



Source/Calculation: (SUM{B.6}+SUM{B.25}+SUM{B.27})/B.11.2

Volume: T&D Substation Statistics, Final Report, 2006

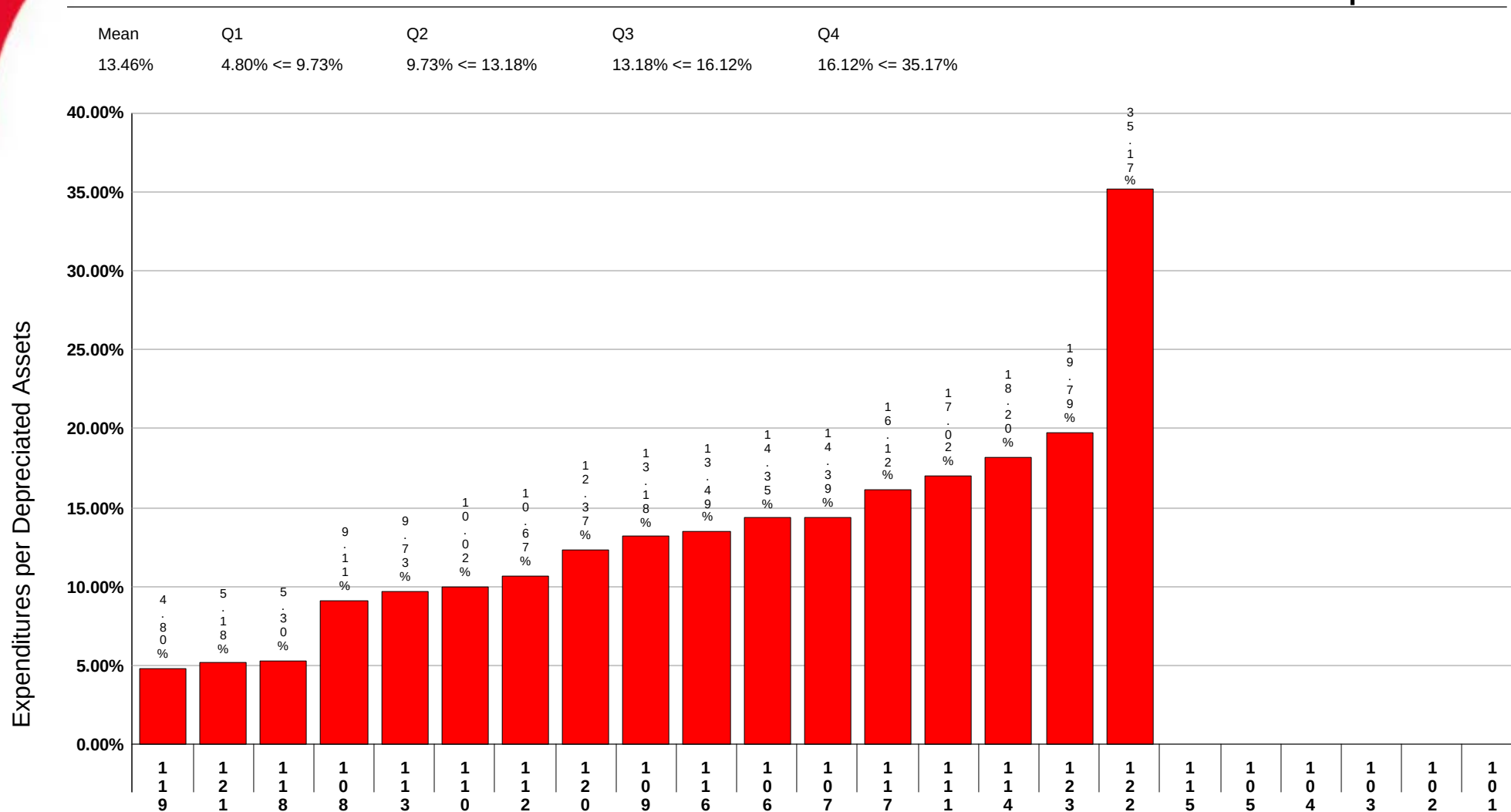
ID Code: 6384

Page: 1289

Only companies with all the data are shown.

Distribution Substation Expenditures

Per Assets Less Depreciation



Source/Calculation: $(\text{SUM}\{B.6\} + \text{SUM}\{B.25\} + \text{SUM}\{B.27\}) / (B.11.2 - B.15.1)$

Volume: T&D Substation Statistics, Final Report, 2006

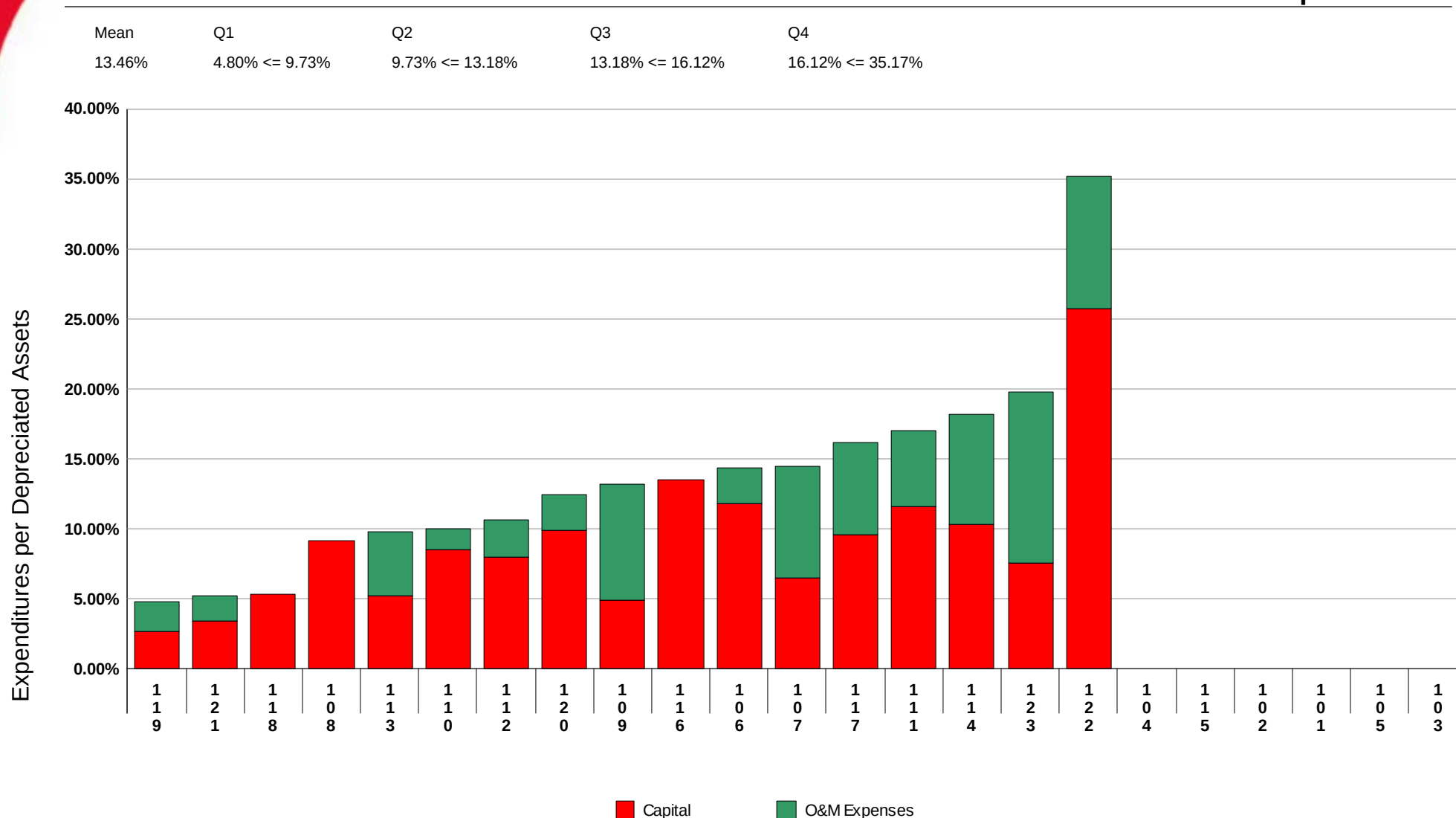
ID Code: 6483

Page: 1290

Only companies with all the data are shown.

Distribution Substation Expenditures

Per Assets Less Depreciation



Source/Calculation: SUM{B.6}/(B.11.2-B.15.1)

Volume: T&D Substation Statistics, Final Report, 2006

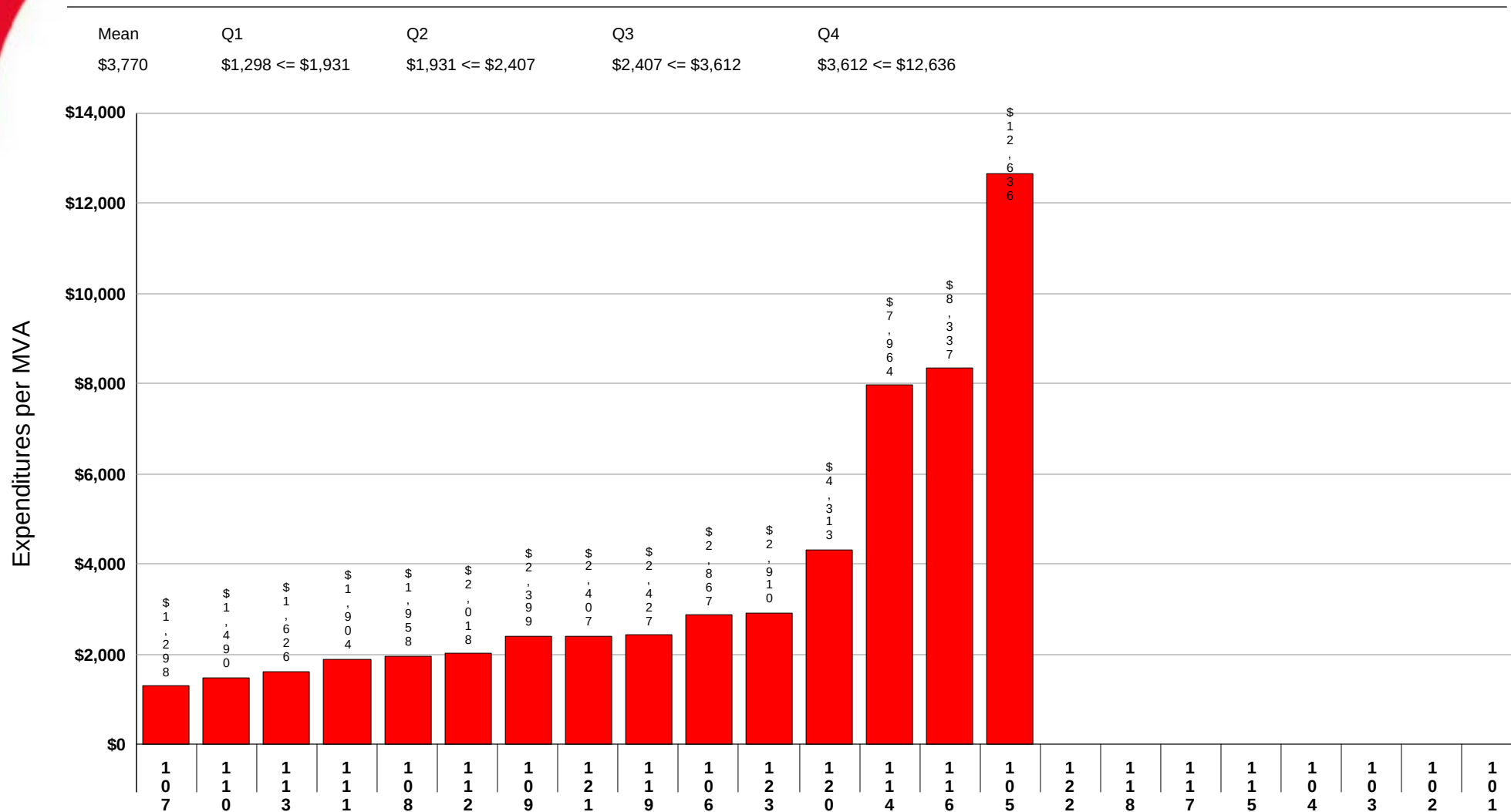
ID Code: 2300528

Page: 1291

Calculation shown is for the first piece of the stacked bar only.

Distribution Substation Expenditures

Per Distribution MVA



Source/Calculation: (SUM{B.6}+SUM{B.25}+SUM{B.27})/(SUM{AQ.13})

Volume: T&D Substation Statistics, Final Report, 2006

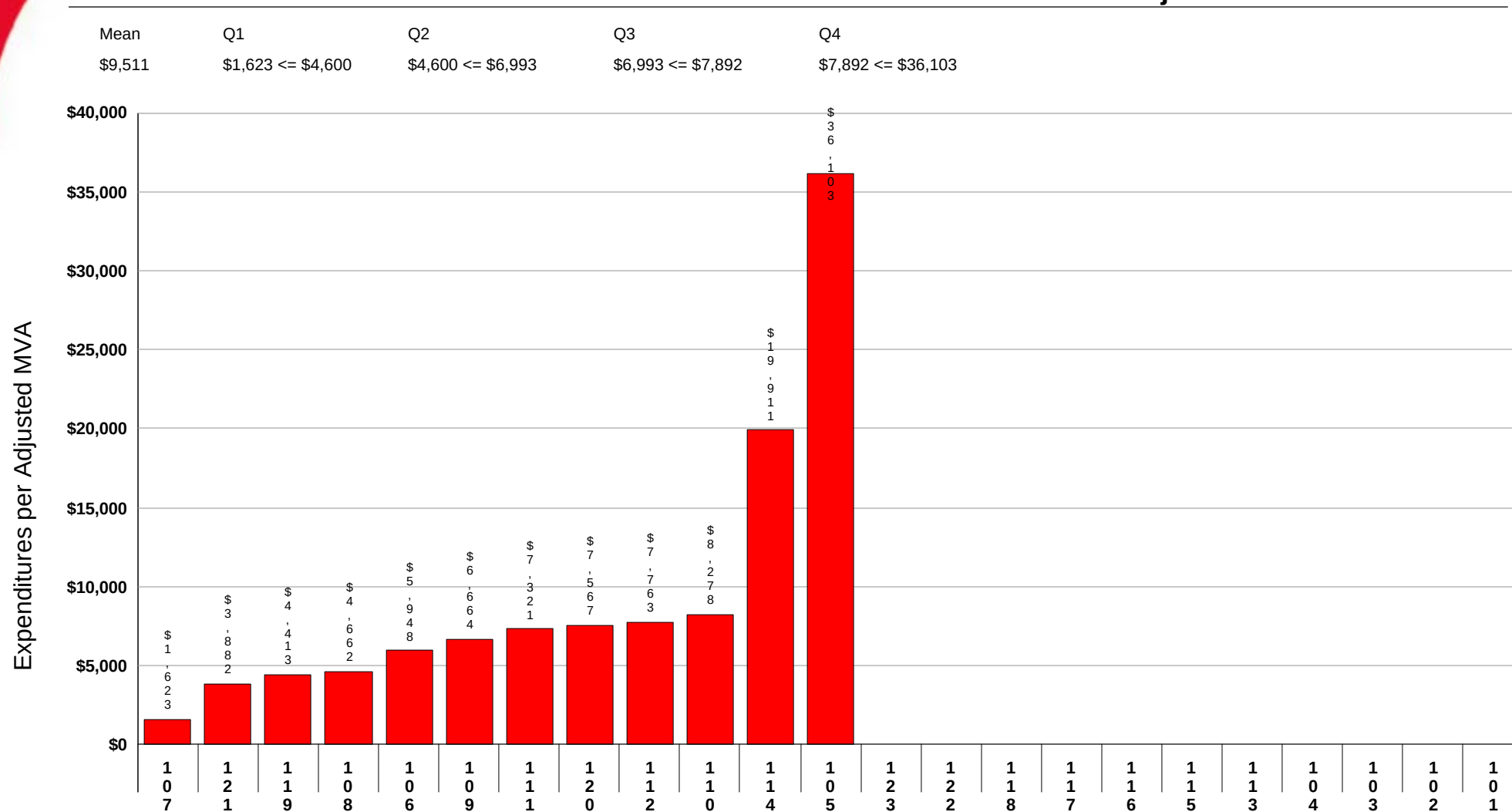
ID Code:6383

Only companies with all the data are shown.

Page: 1292

Distribution Substation Expenditures

Per Adjusted Distribution MVA



Source/Calculation: $(\text{SUM}\{B.6\} + \text{SUM}\{B.25\} + \text{SUM}\{B.27\}) / (\text{SUM}\{AQ.13\} * AQ.14.1)$

Volume: T&D Substation Statistics, Final Report, 2006

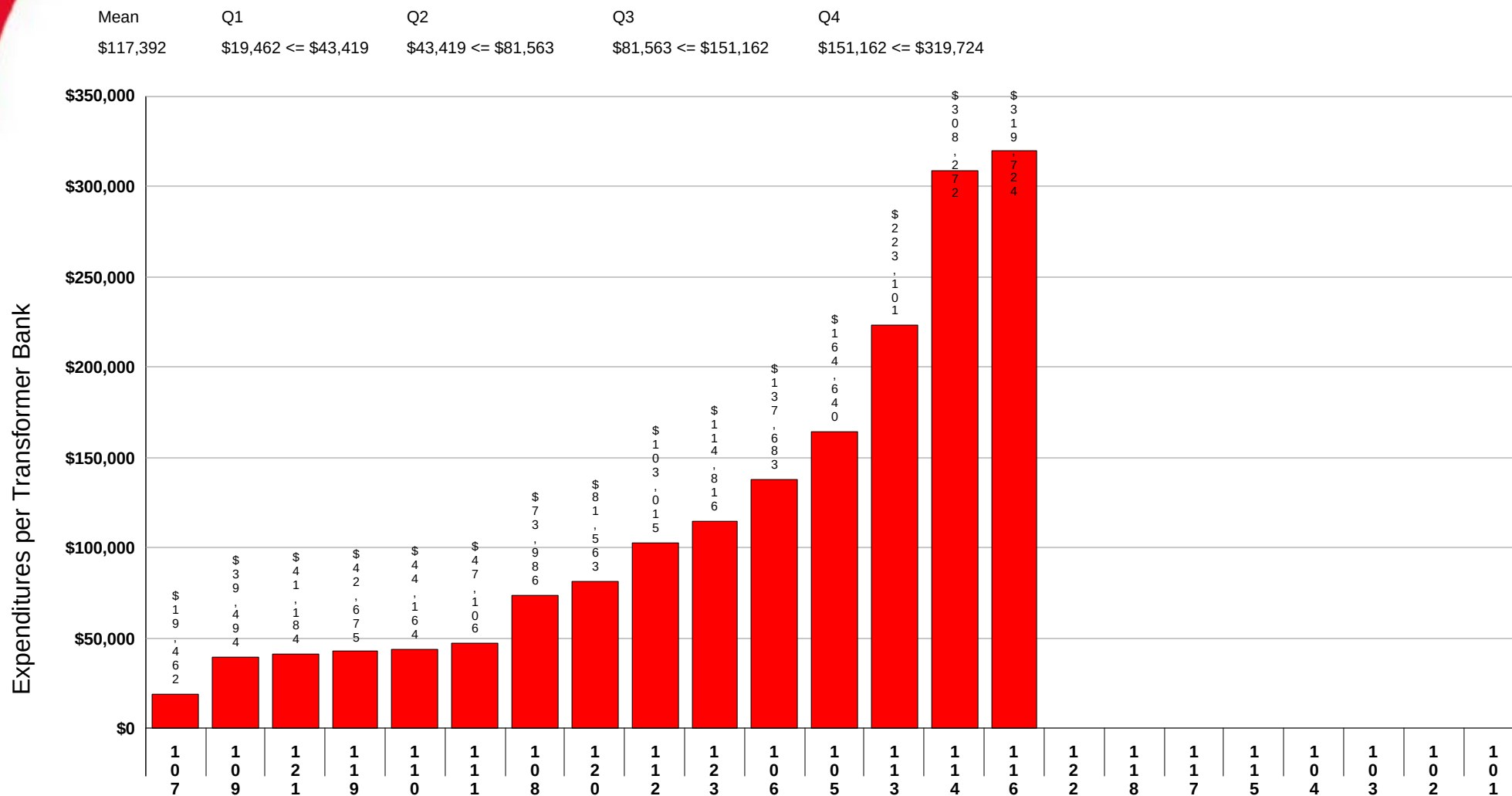
ID Code: 2214

Page: 1293

Only companies with all the data are shown.

Distribution Substation Expenditures

Per Distribution Transformer Bank



Source/Calculation: (SUM{B.6}+SUM{B.25}+SUM{B.27})/SUM{AQ.3}

Volume: T&D Substation Statistics, Final Report, 2006

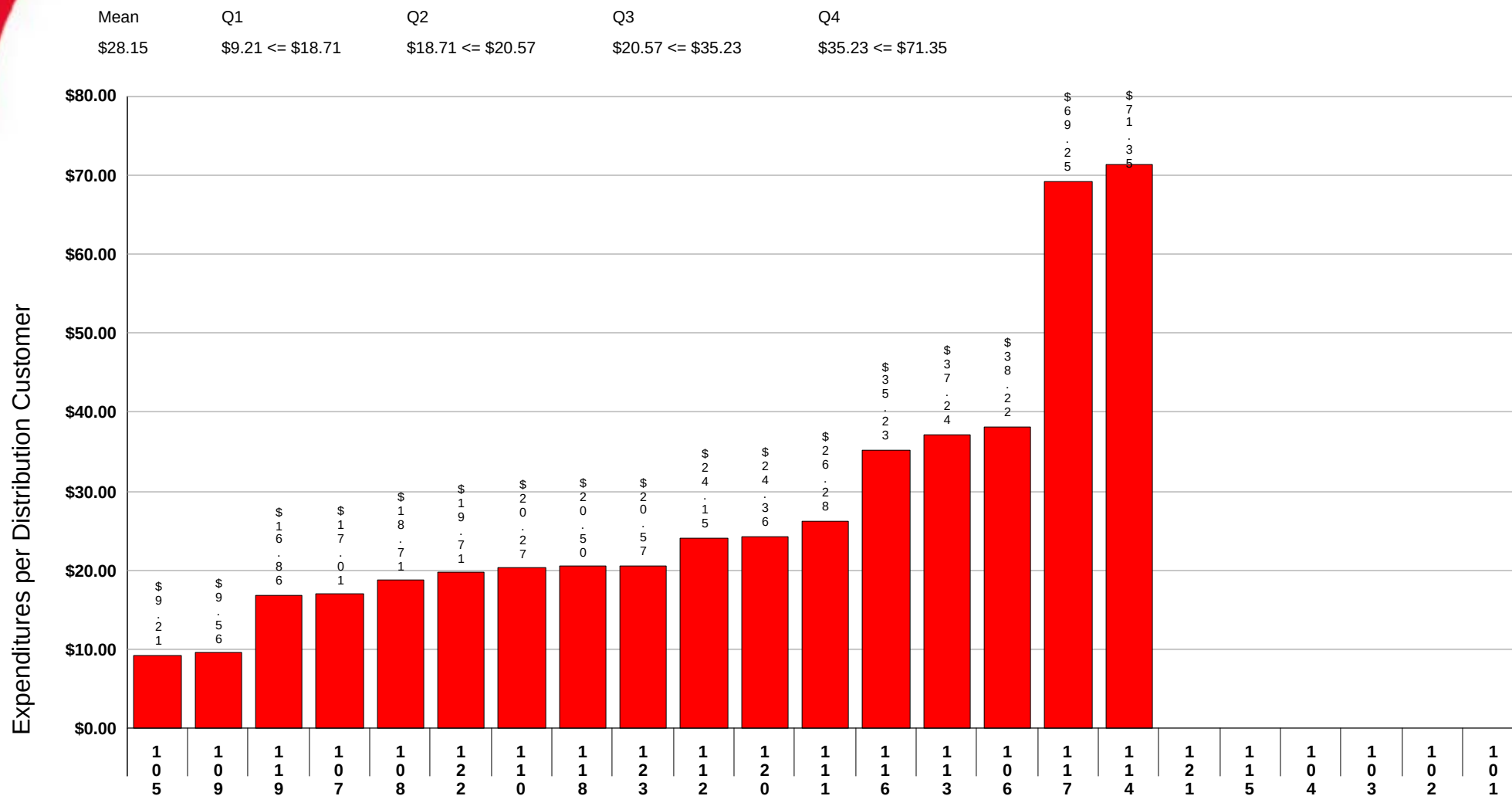
ID Code: 27337

Page: 1294

Only companies with all the data are shown.

3-Year Average Distribution Substation Expenditures

Per Distribution Customer



Source/Calculation: $((\text{SUM}\{B.6\} + \text{SUM}\{B.25\} + \text{SUM}\{B.27\}) / A.2.2 + (B.9.3 + B.29.3) / A.3.1 + (B.9.4 + B.29.4) / A.3.2) / 3$

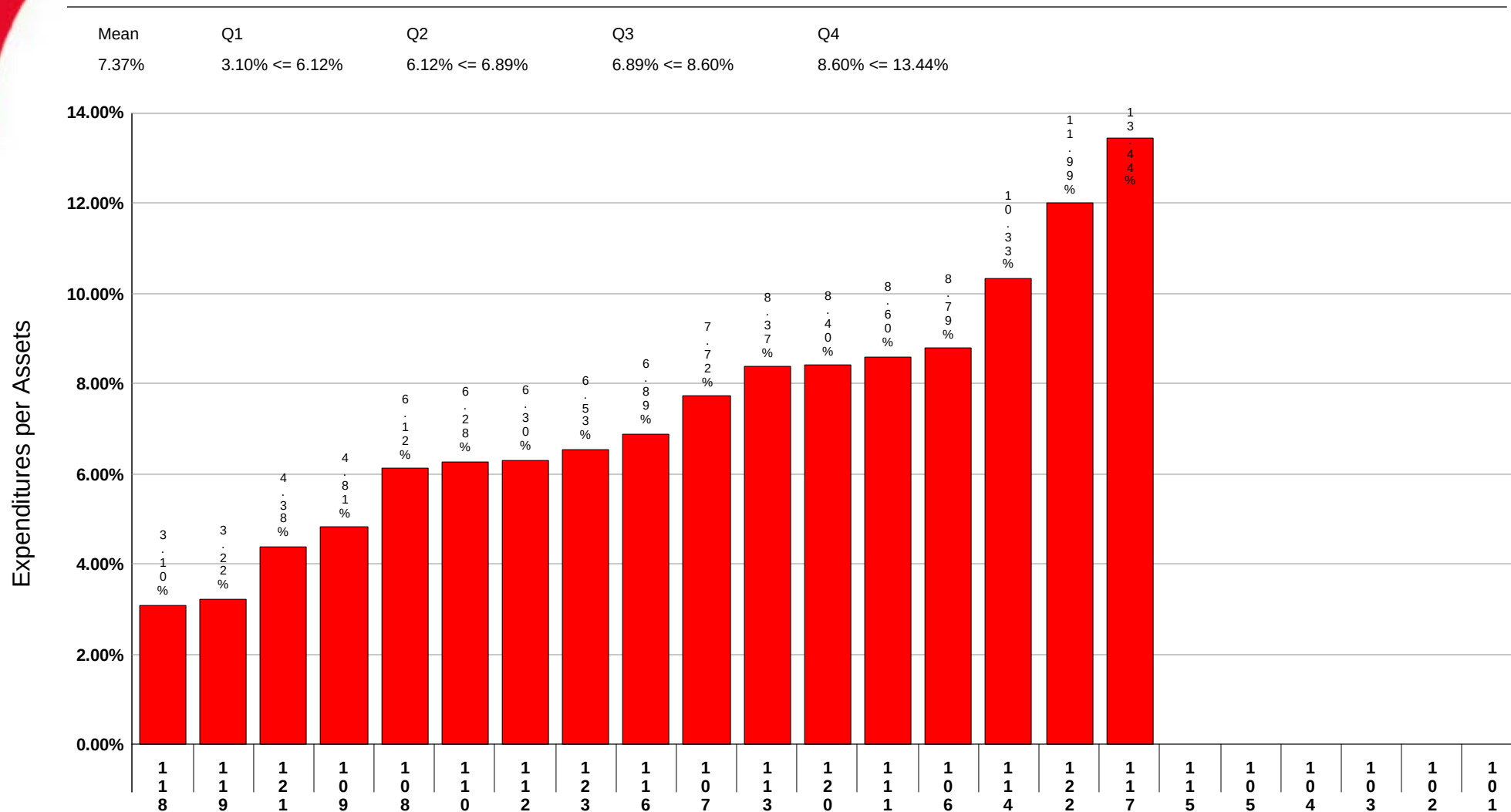
Volume: T&D Substation Statistics, Final Report, 2006

ID Code: 27098

Only companies with all the data are shown.

Page: 1295

3-Year Average Distribution Substation Expenditures Per Assets



Source/Calculation: $((\text{SUM}\{B.6\} + \text{SUM}\{B.25\} + \text{SUM}\{B.27\}) / (B.11.2) + (B.9.3 + B.29.3) / (B.13.3) + (B.9.4 + B.29.4) / (B.13.4)) / 3$

Volume: T&D Substation Statistics, Final Report, 2006

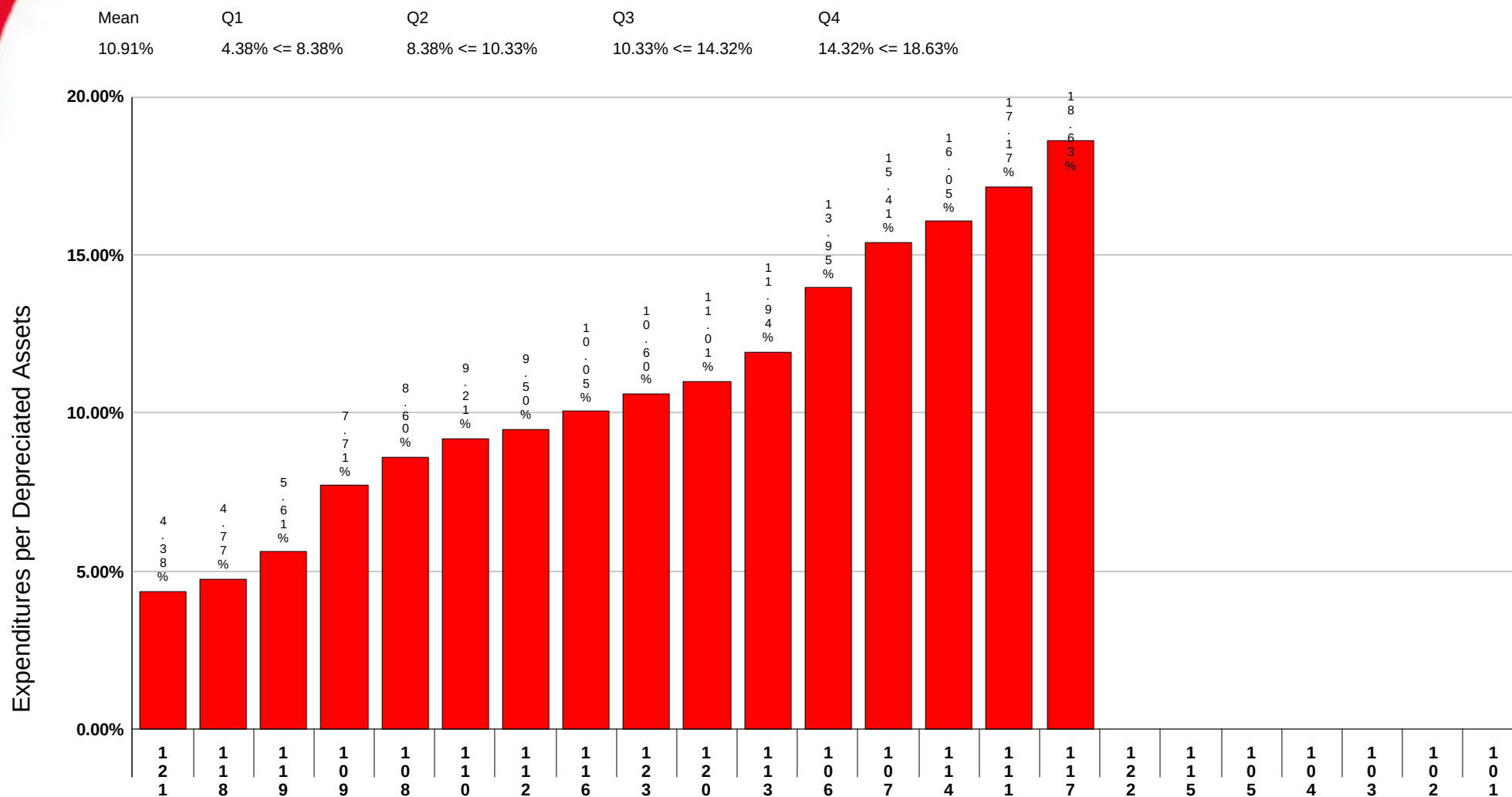
ID Code: 27114

Page: 1296

Only companies with all the data are shown.

3-Year Average Distribution Substation Expenditures

Per Assets Less Depreciation



Source/Calculation: $((\text{SUM}\{B.6\} + \text{SUM}\{B.25\} + \text{SUM}\{B.27\}) / (B.11.2 - B.15.1) + (B.9.3 + B.29.3) / (B.13.3 - B.17.1) + (B.9.4 + B.29.4) / (B.13.4 - B.17.2)) / 3$

Volume: T&D Substation Statistics, Final Report, 2006

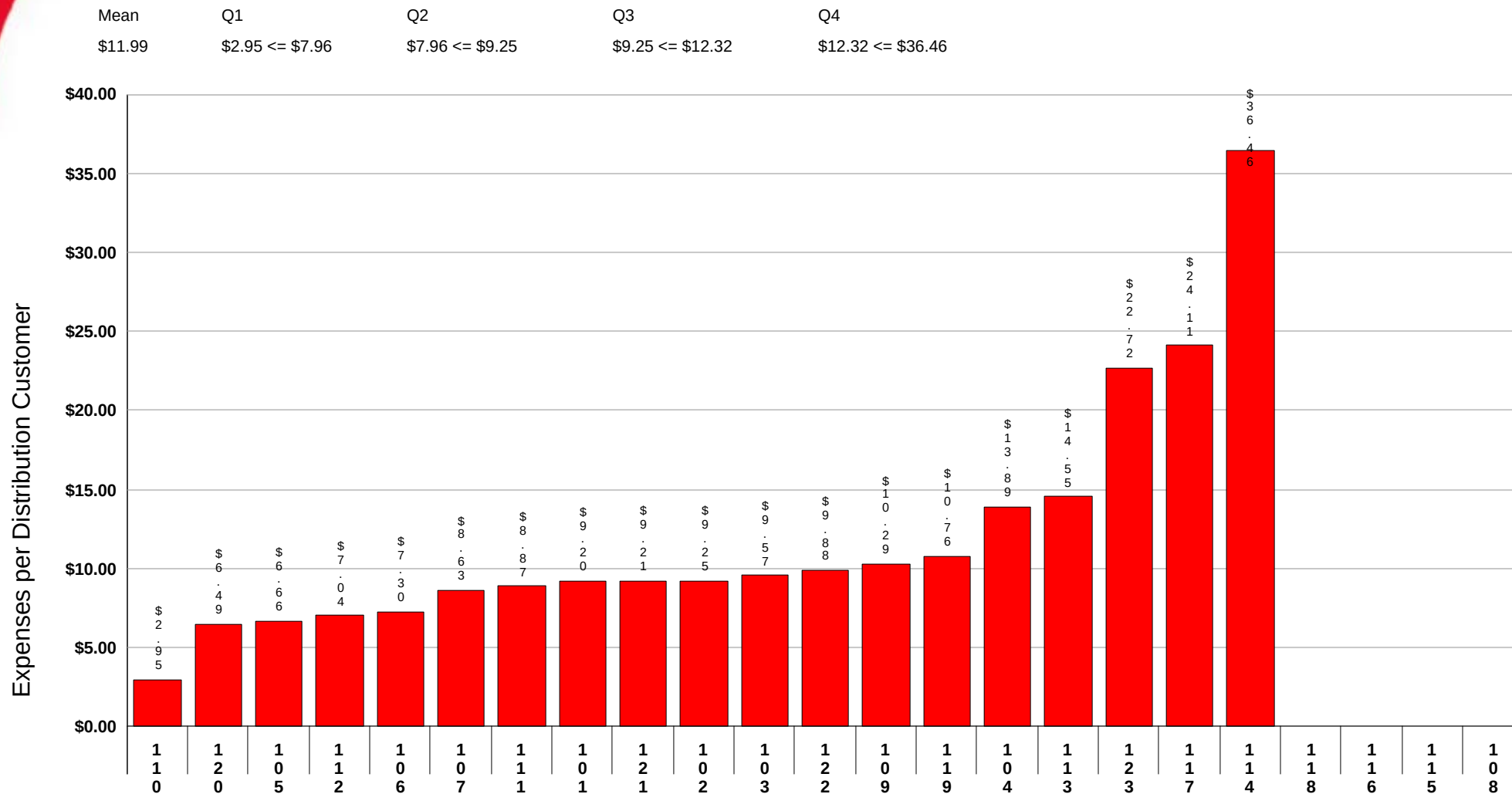
ID Code: 1600242

Page: 1296.1

Only companies with all the data are shown.

Distribution Substation O&M Expenses

Per Distribution Customer



Source/Calculation: (SUM{B.25}+SUM{B.27})/A.2.2

Volume: T&D Substation Statistics, Final Report, 2006

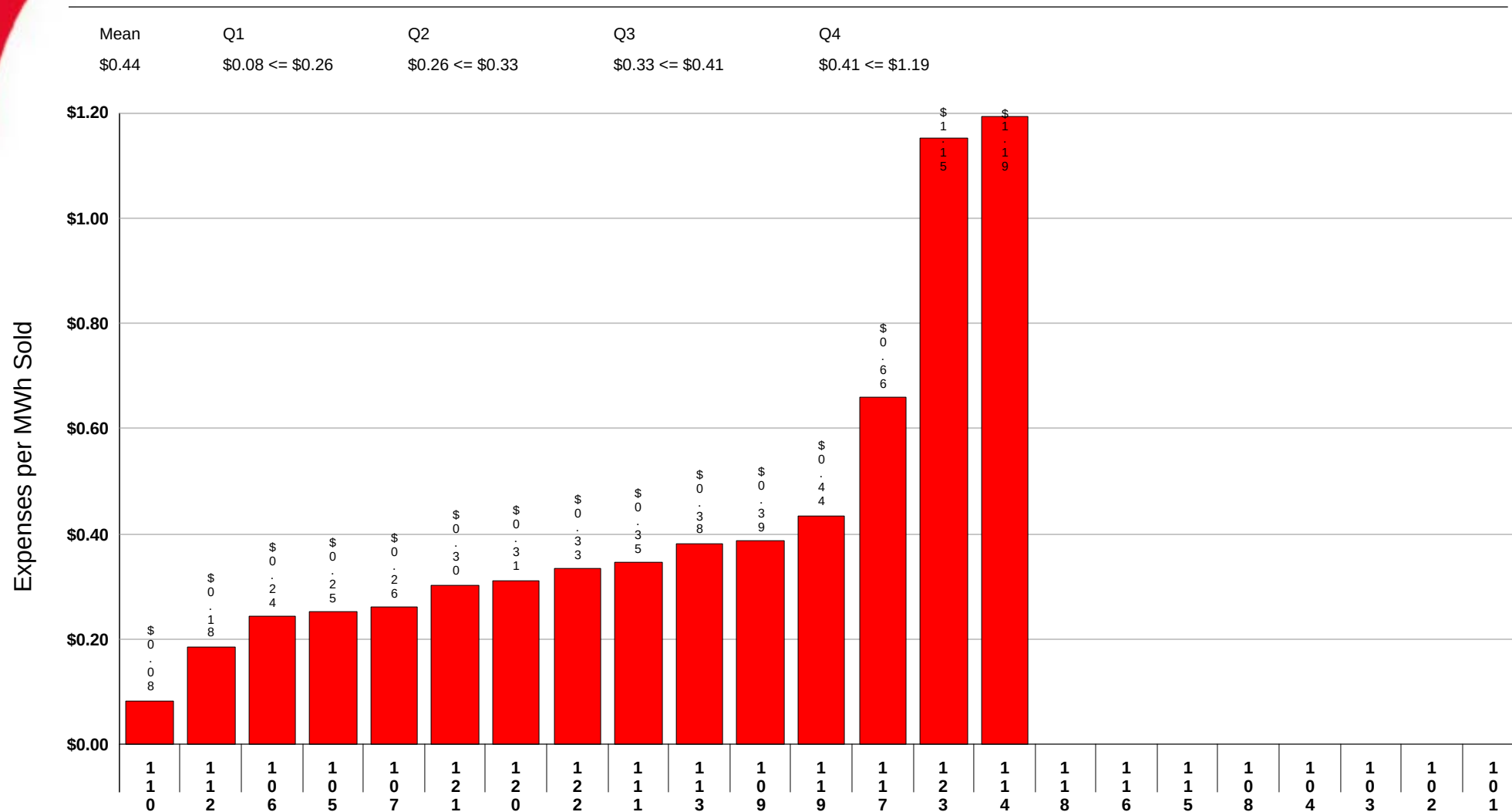
ID Code: 2236

Page: 1297

Only companies with all the data are shown.

Distribution Substation O&M Expenses

Per MWh Sold



Source/Calculation: (SUM{B.25}+SUM{B.27})/A.2.4

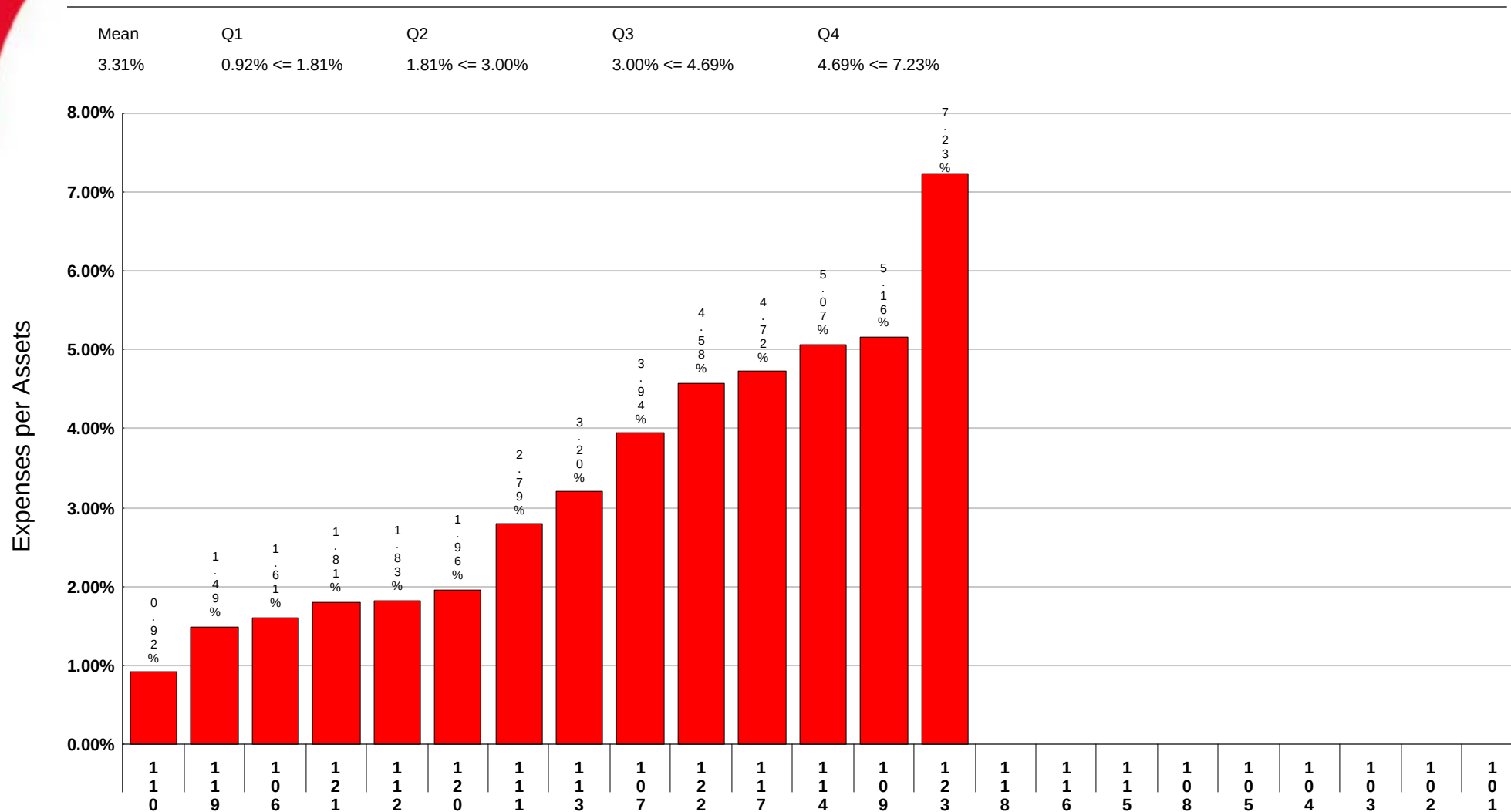
Volume: T&D Substation Statistics, Final Report, 2006

ID Code: 2165

Page: 1298

Only companies with all the data are shown.

Distribution Substation O&M Expenses Per Assets



Source/Calculation: (SUM{B.25}+SUM{B.27})/B.11.2

Volume: T&D Substation Statistics, Final Report, 2006

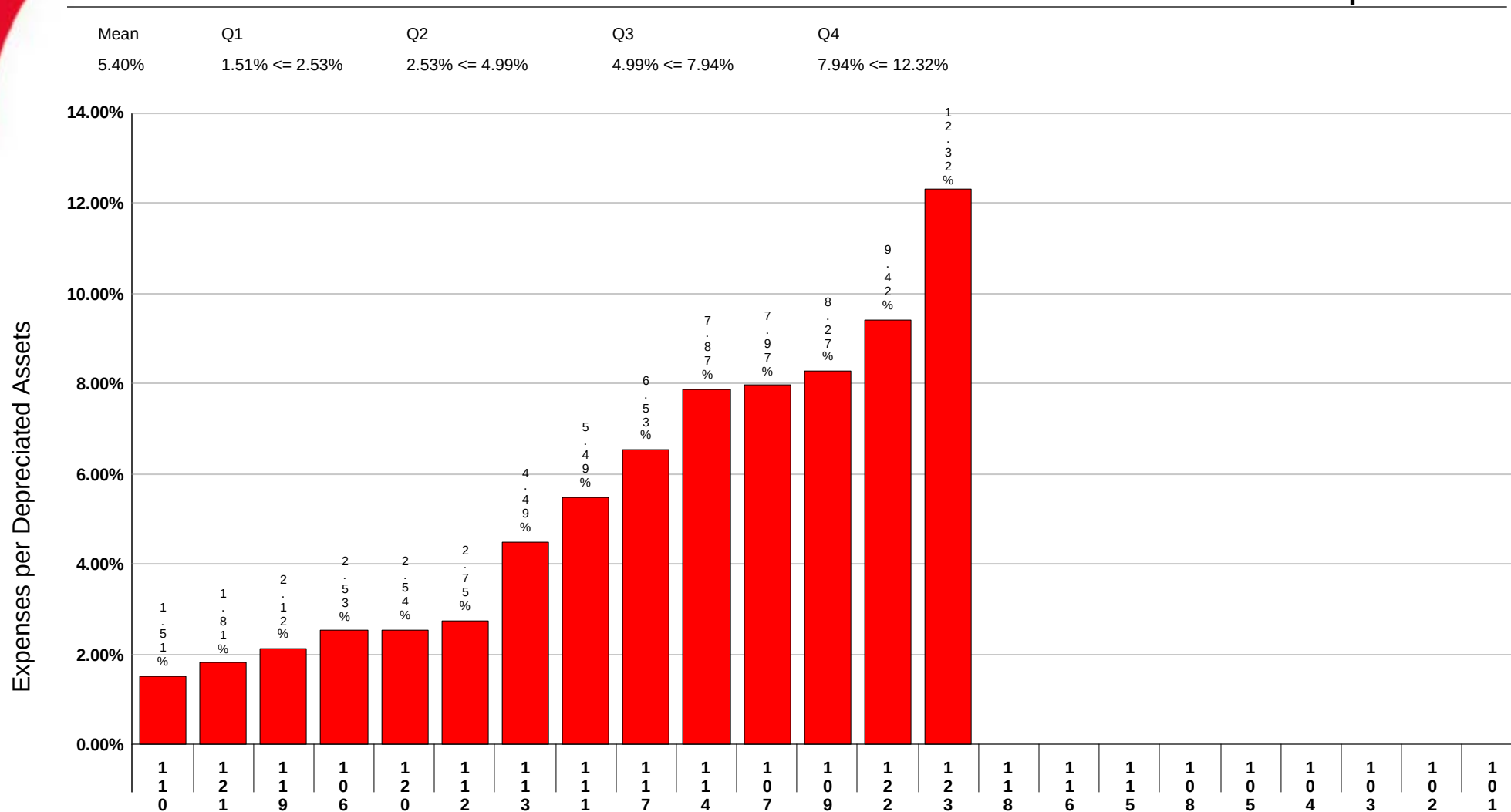
ID Code: 6385

Page: 1299

Only companies with all the data are shown.

Distribution Substation O&M Expenses

Per Assets Less Depreciation



Source/Calculation: (SUM{B.25}+SUM{B.27})/(B.11.2-B.15.1)

Volume: T&D Substation Statistics, Final Report, 2006

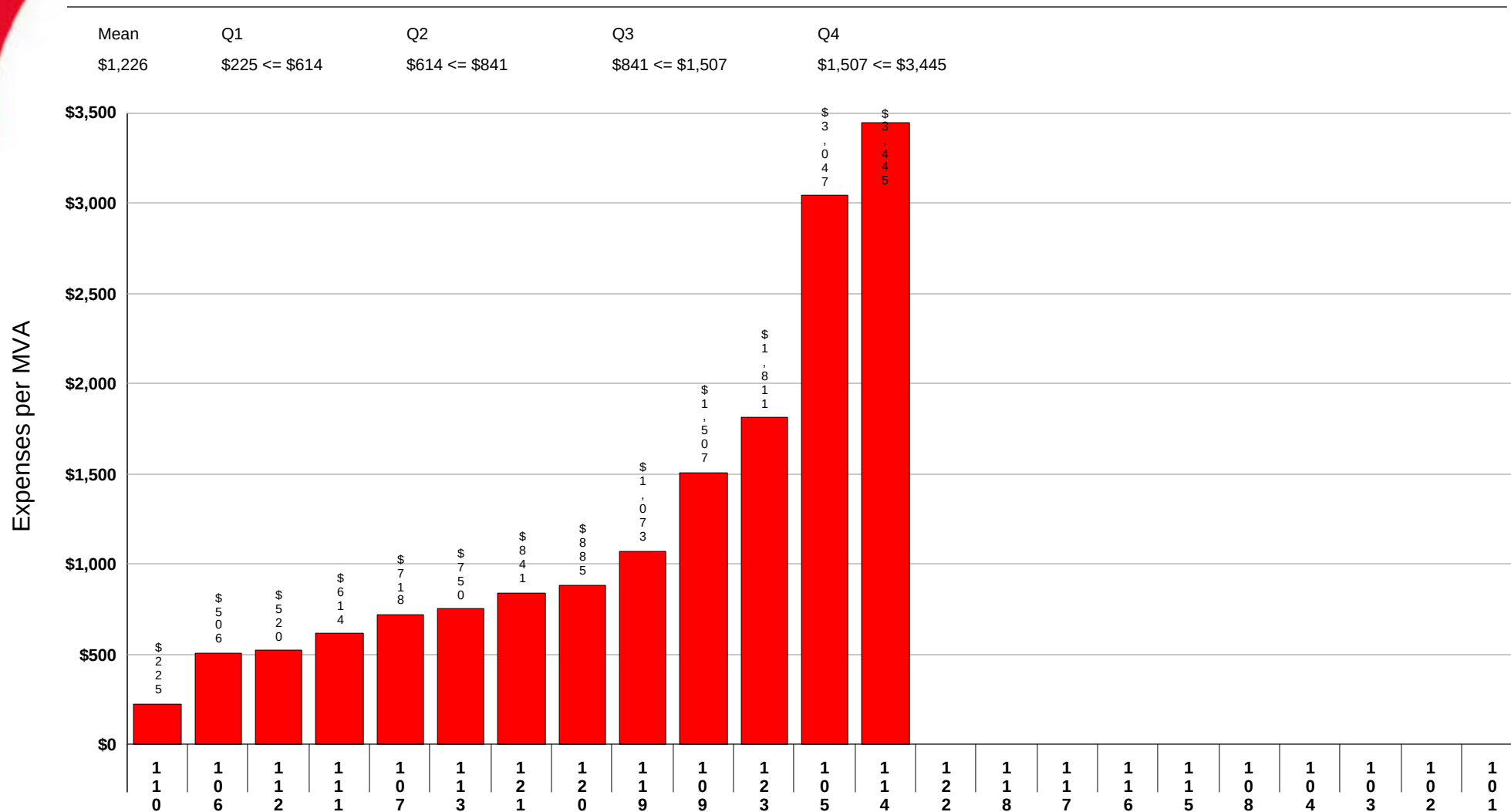
ID Code: 6485

Page: 1300

Only companies with all the data are shown.

Distribution Substation O&M Expenses

Per Distribution MVA



Source/Calculation: (SUM{B.25}+SUM{B.27})/SUM{AQ.13}

Volume: T&D Substation Statistics, Final Report, 2006

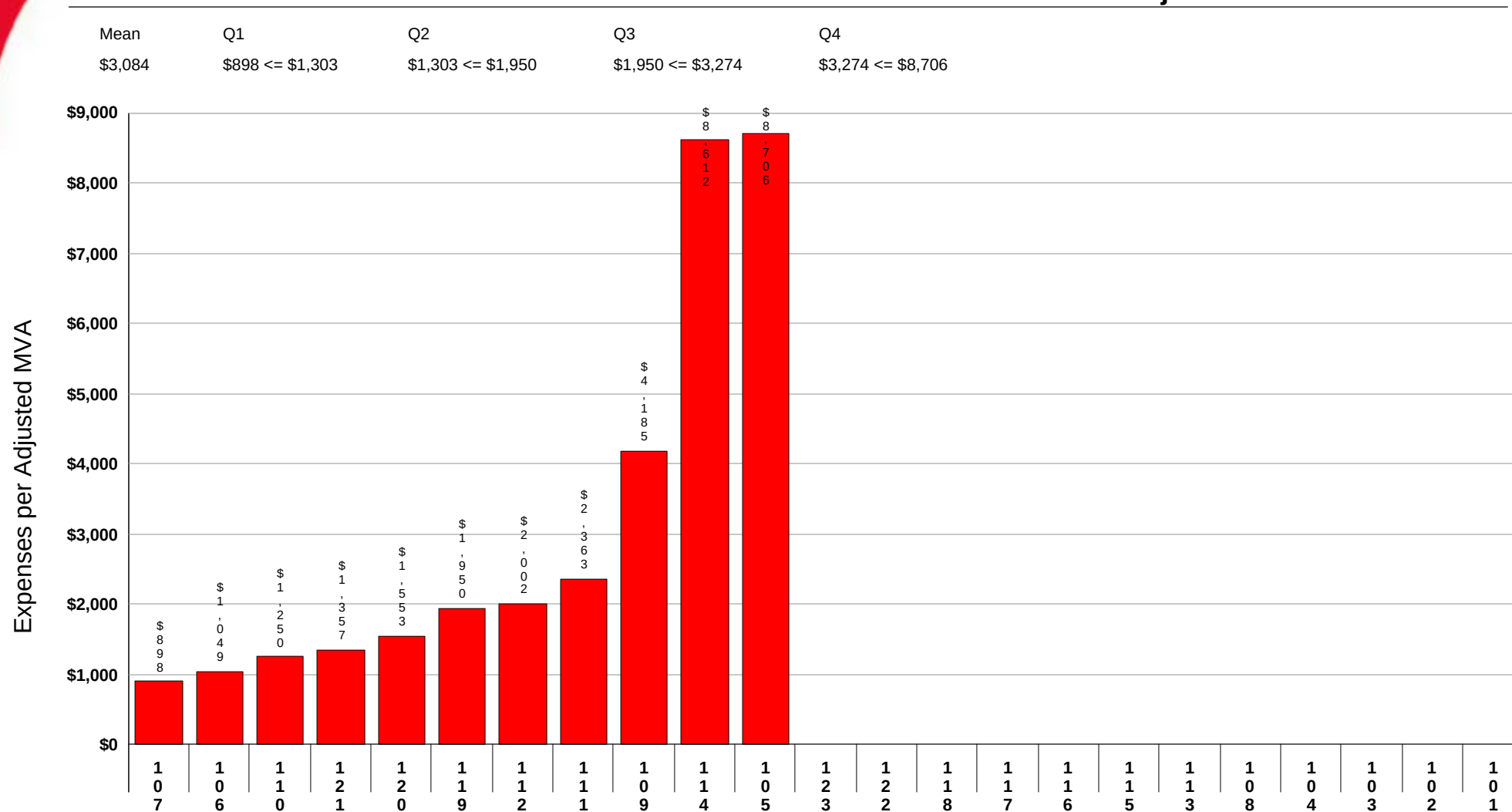
ID Code: 6386

Page: 1301

Only companies with all the data are shown.

Distribution Substation O&M Expenses

Per Adjusted Distribution MVA



Source/Calculation: $(\text{SUM}\{B.25\} + \text{SUM}\{B.27\}) / (\text{SUM}\{AQ.13\} * AQ.14.1)$

Volume: T&D Substation Statistics, Final Report, 2006

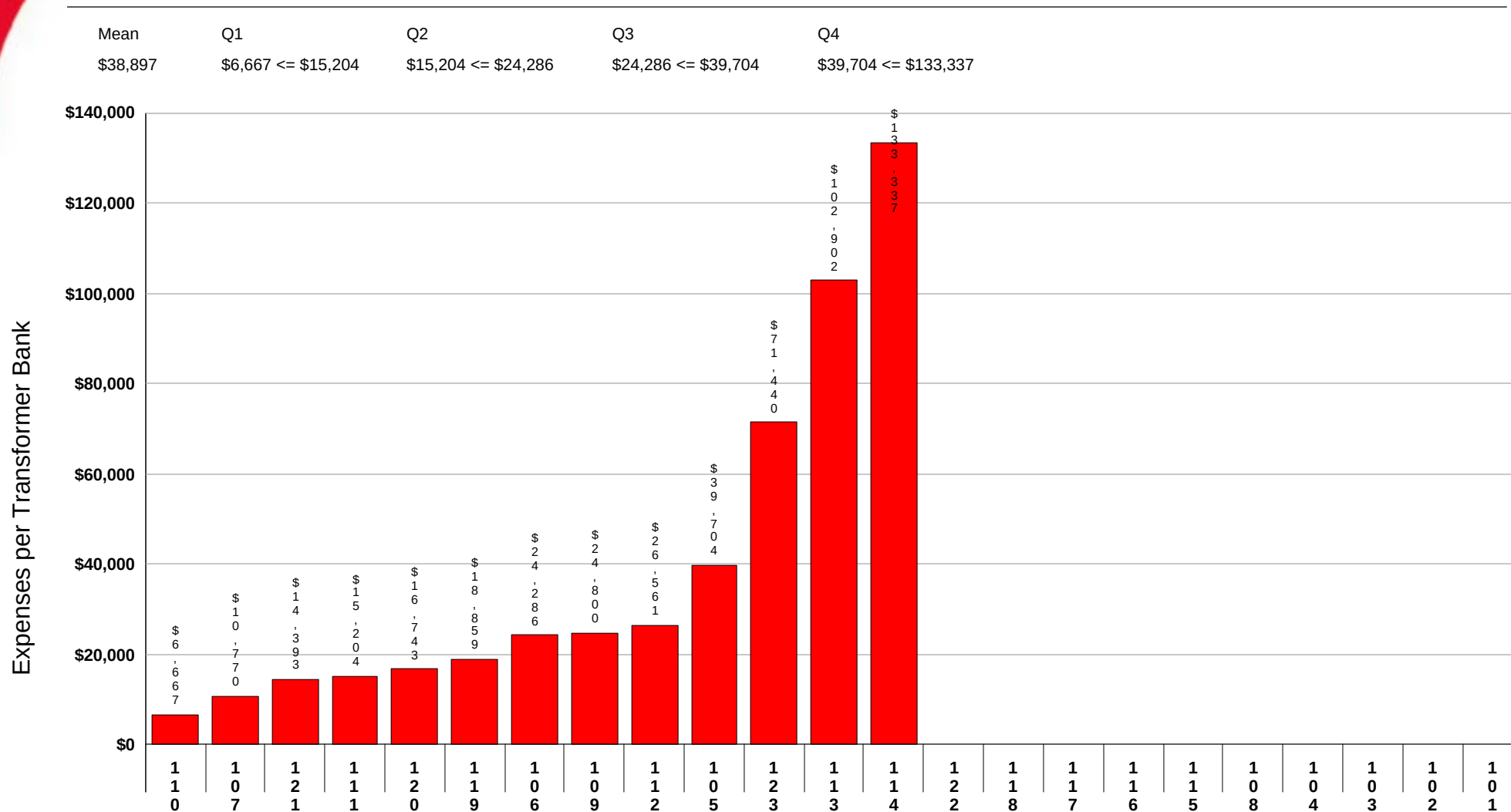
ID Code: 2220

Page: 1302

Only companies with all the data are shown.

Distribution Substation O&M Expenses

Per Distribution Transformer Bank



Source/Calculation: (SUM{B.25}+SUM{B.27})/SUM{AQ.3}

Volume: T&D Substation Statistics, Final Report, 2006

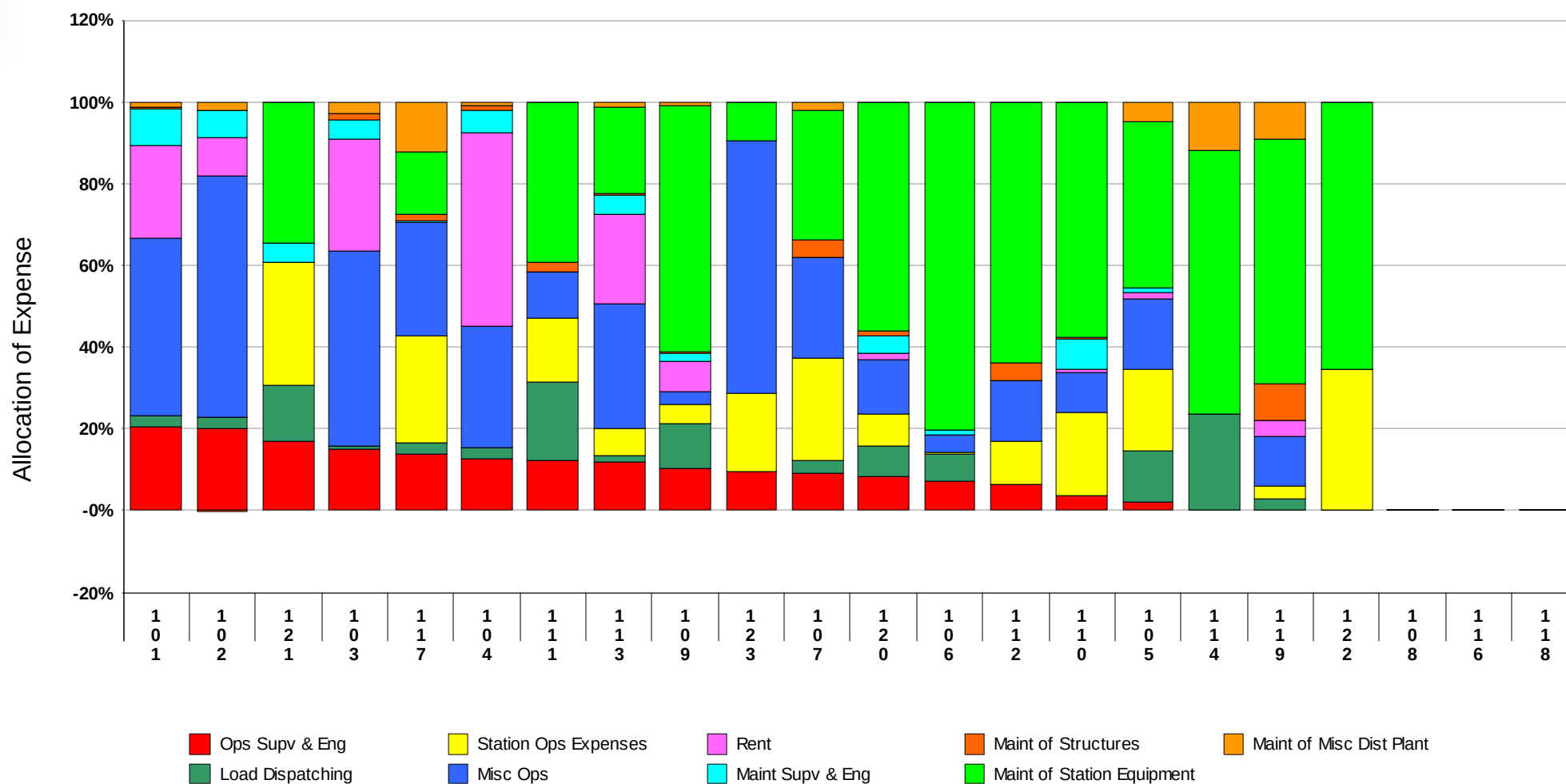
ID Code: 27338

Page: 1303

Only companies with all the data are shown.

Distribution Substation O&M Expenses (FERC)

Percent of Total



Source/Calculation: (B.25.1)/(SUM{B.25}+SUM{B.27}-B.27.100-B.25.100)

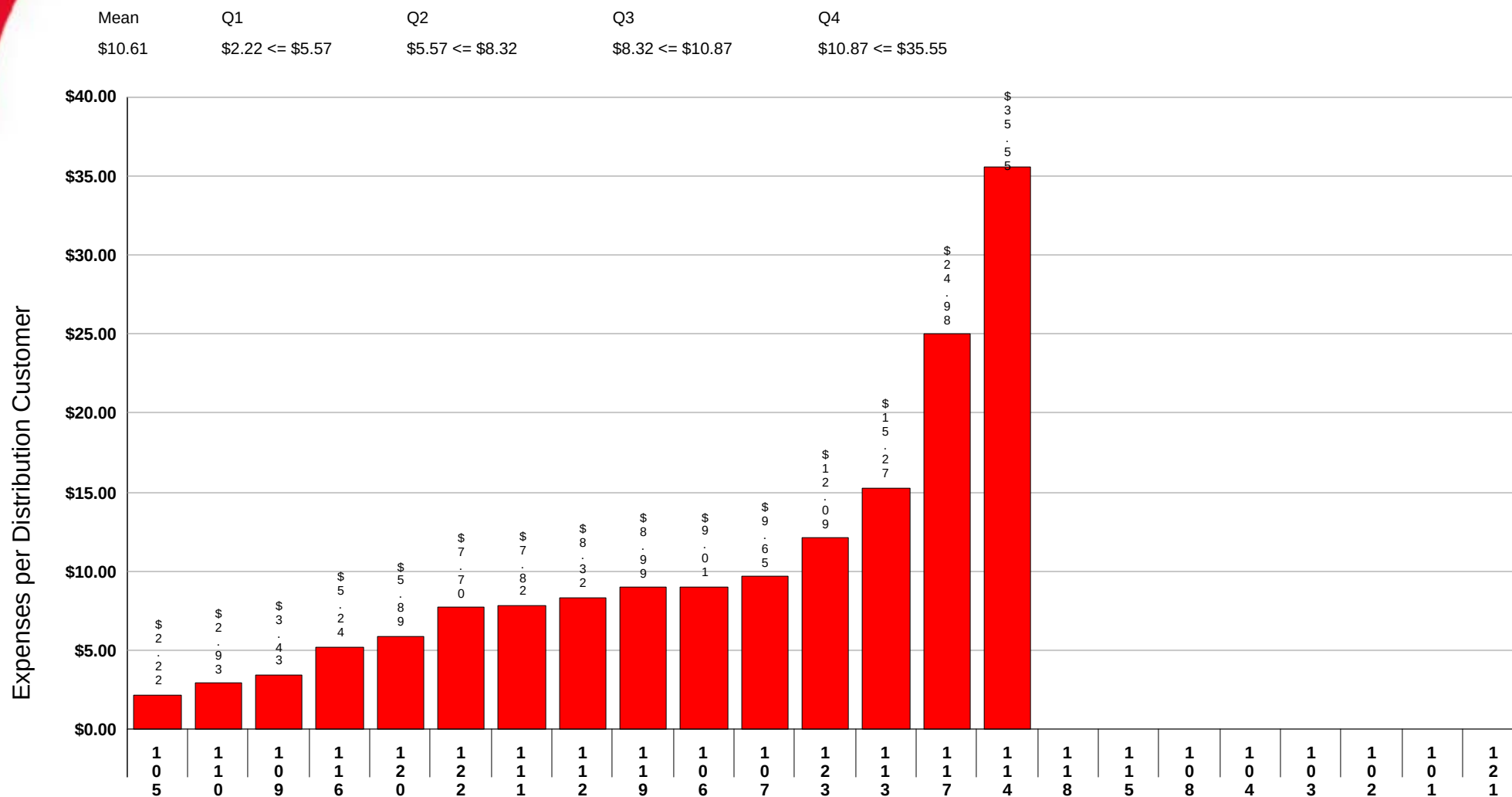
Volume: T&D Substation Statistics, Final Report, 2006

ID Code: 8724

Page: 1304

Calculation shown is for the first piece of the stacked bar only.

3-Year Average Distribution Substation O&M Expenses Per Distribution Customer



Source/Calculation: ((SUM{B.25}+SUM{B.27}))/A.2.2+B.29.3/A.3.1+B.29.4/A.3.2)/3

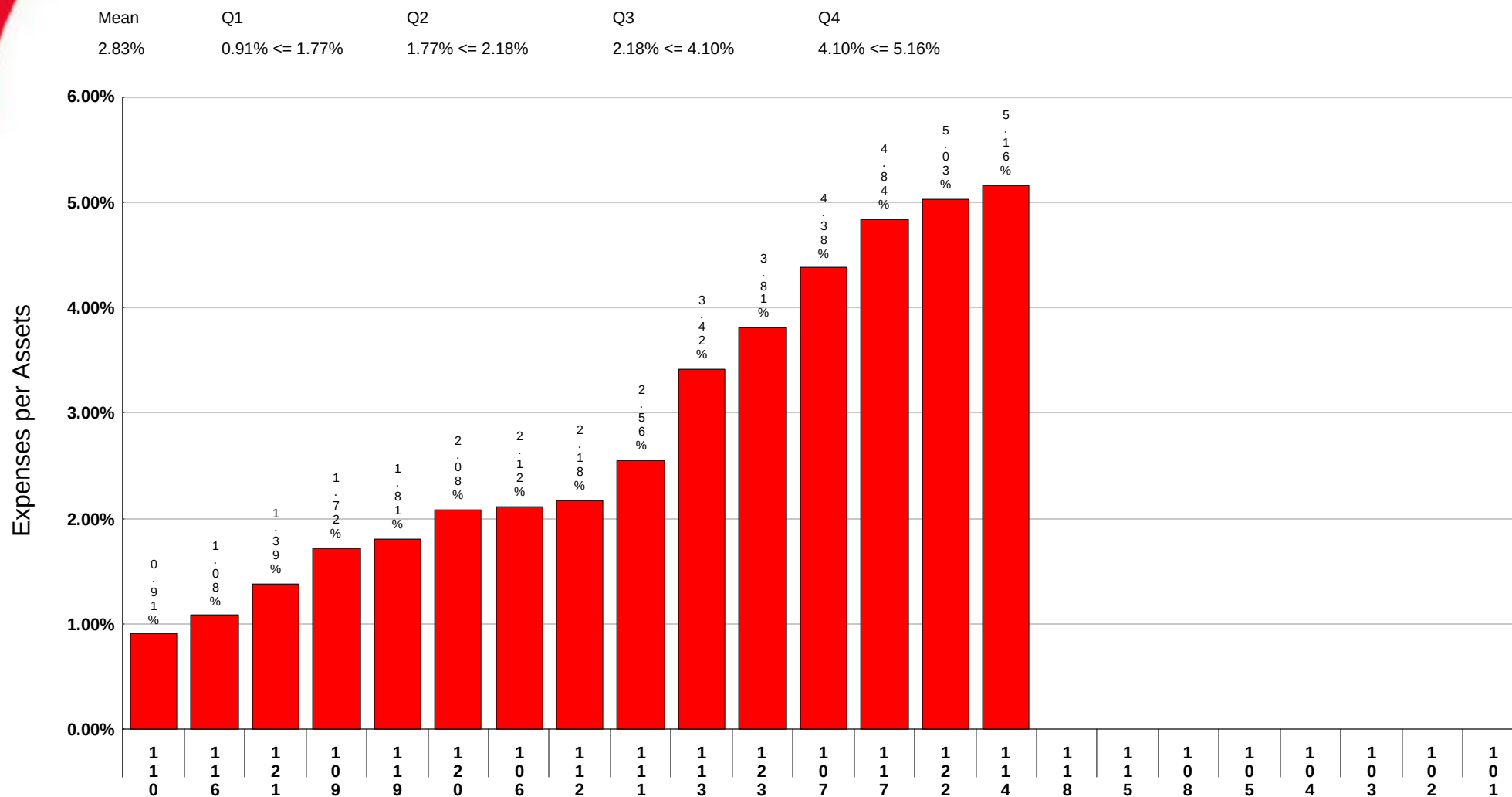
Volume: T&D Substation Statistics, Final Report, 2006

ID Code: 27099

Page: 1305

Only companies with all the data are shown.

3-Year Average Distribution Substation O&M Expenses Per Assets



Source/Calculation:(((SUM{B.25}+SUM{B.27})/(B.11.2))+((B.29.3)/((B.13.3)))+(B.29.4)/((B.13.4)))/3

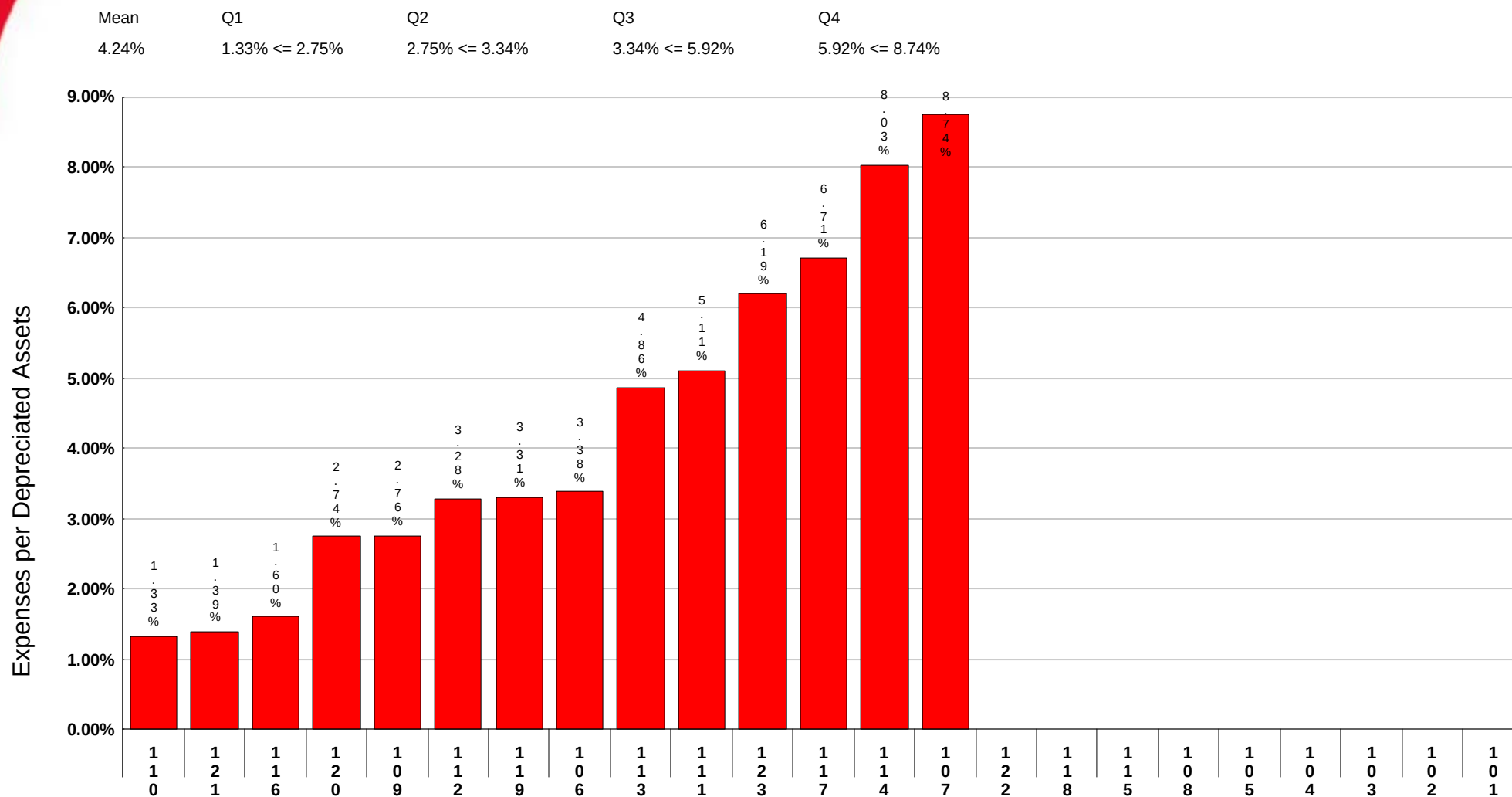
Volume: T&D Substation Statistics, Final Report, 2006

ID Code:27117

Page:1306

Only companies with all the data are shown.

3-Year Average Distribution Substation O&M Expenses Per Assets Less Depreciation



Source/Calculation:(((SUM{B.25}+SUM{B.27})/(B.11.2-B.15.1))+((B.29.3)/((B.13.3)-(B.17.1)))+((B.29.4)/((B.13.4)-(B.17.2))))/3

Volume: T&D Substation Statistics, Final Report, 2006

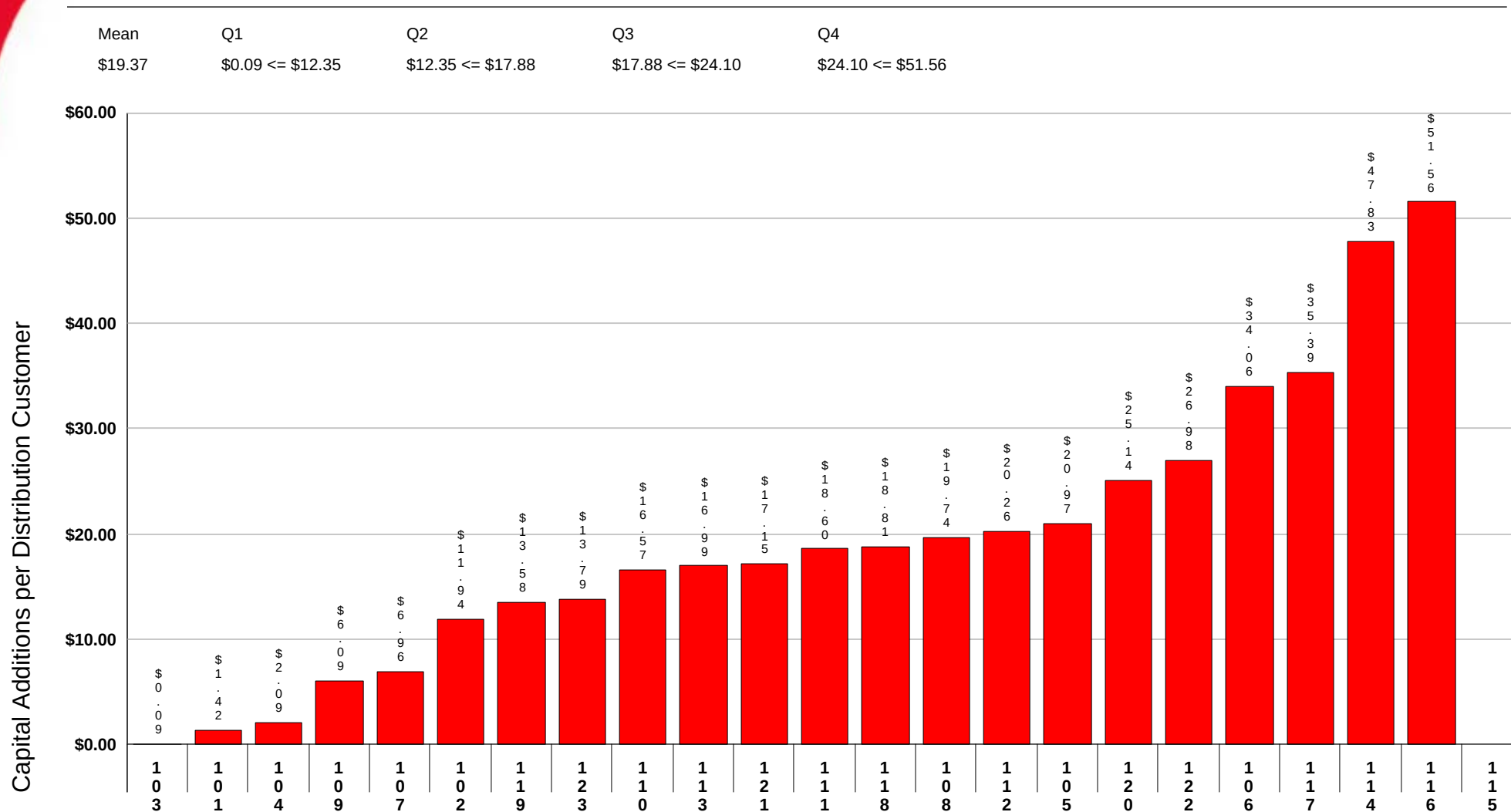
ID Code:1600243

Page:1306.1

Only companies with all the data are shown.

Distribution Substation Capital Additions

Per Distribution Customer



Source/Calculation: SUM{B.6}/A.2.2

Volume: T&D Substation Statistics, Final Report, 2006

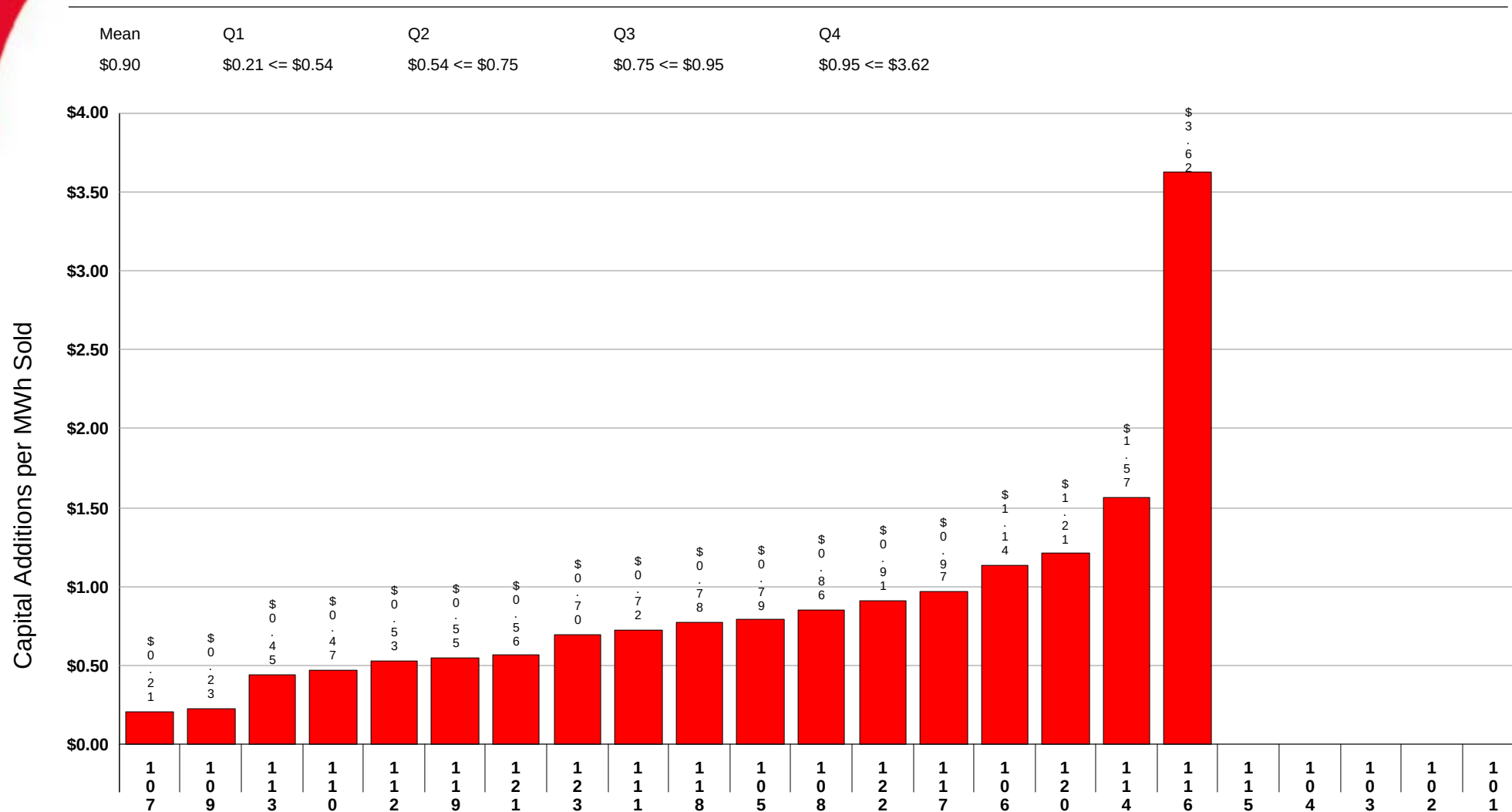
ID Code:2211

Page: 1307

Only companies with all the data are shown.

Distribution Substation Capital Additions

Per MWh Sold



Source/Calculation: SUM{B.6}/A.2.4

Volume: T&D Substation Statistics, Final Report, 2006

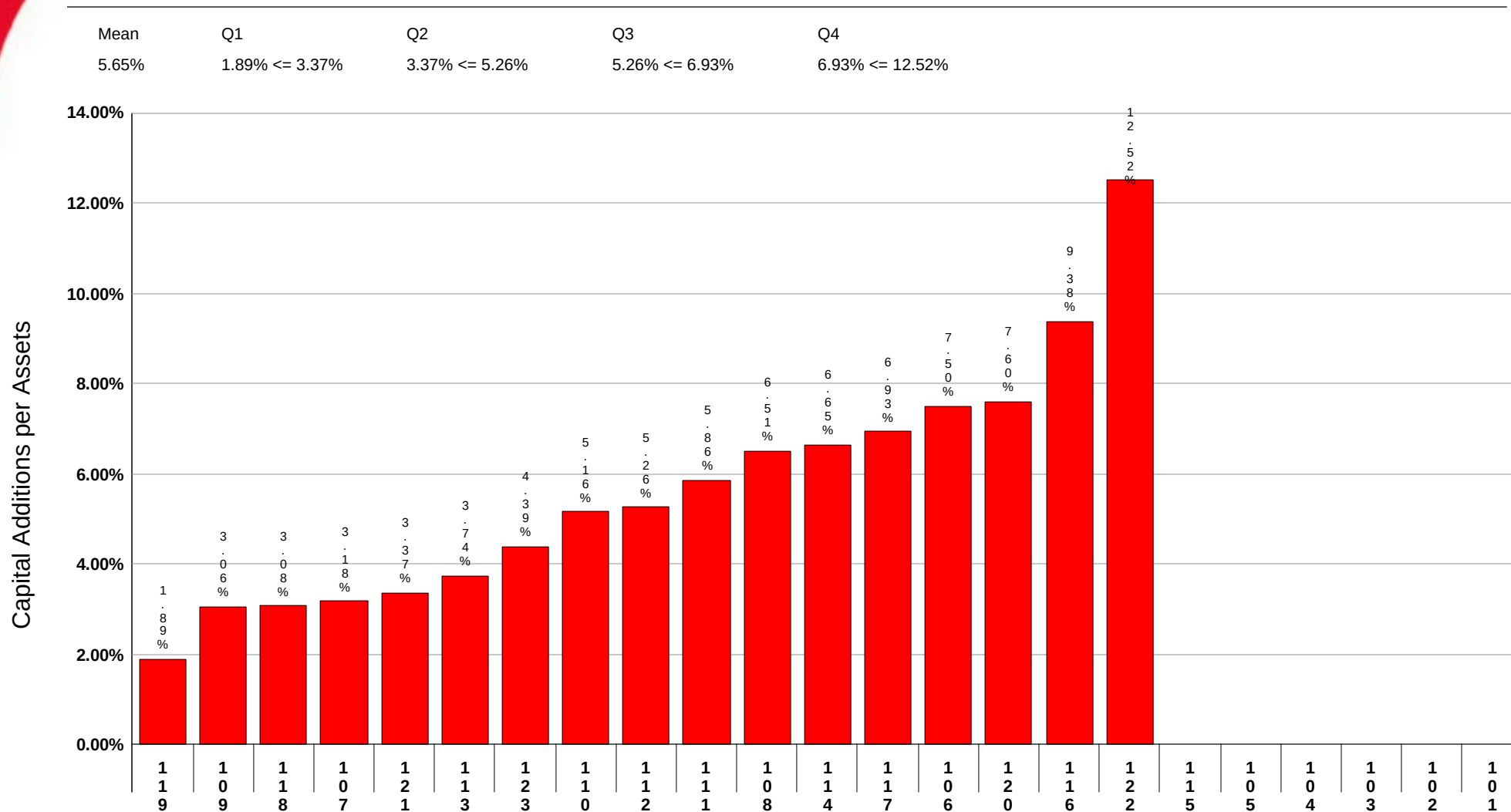
ID Code: 2170

Page: 1308

Only companies with all the data are shown.

Distribution Substation Capital Additions

Per Assets



Source/Calculation: SUM{B.6}/B.11.2

Volume: T&D Substation Statistics, Final Report, 2006

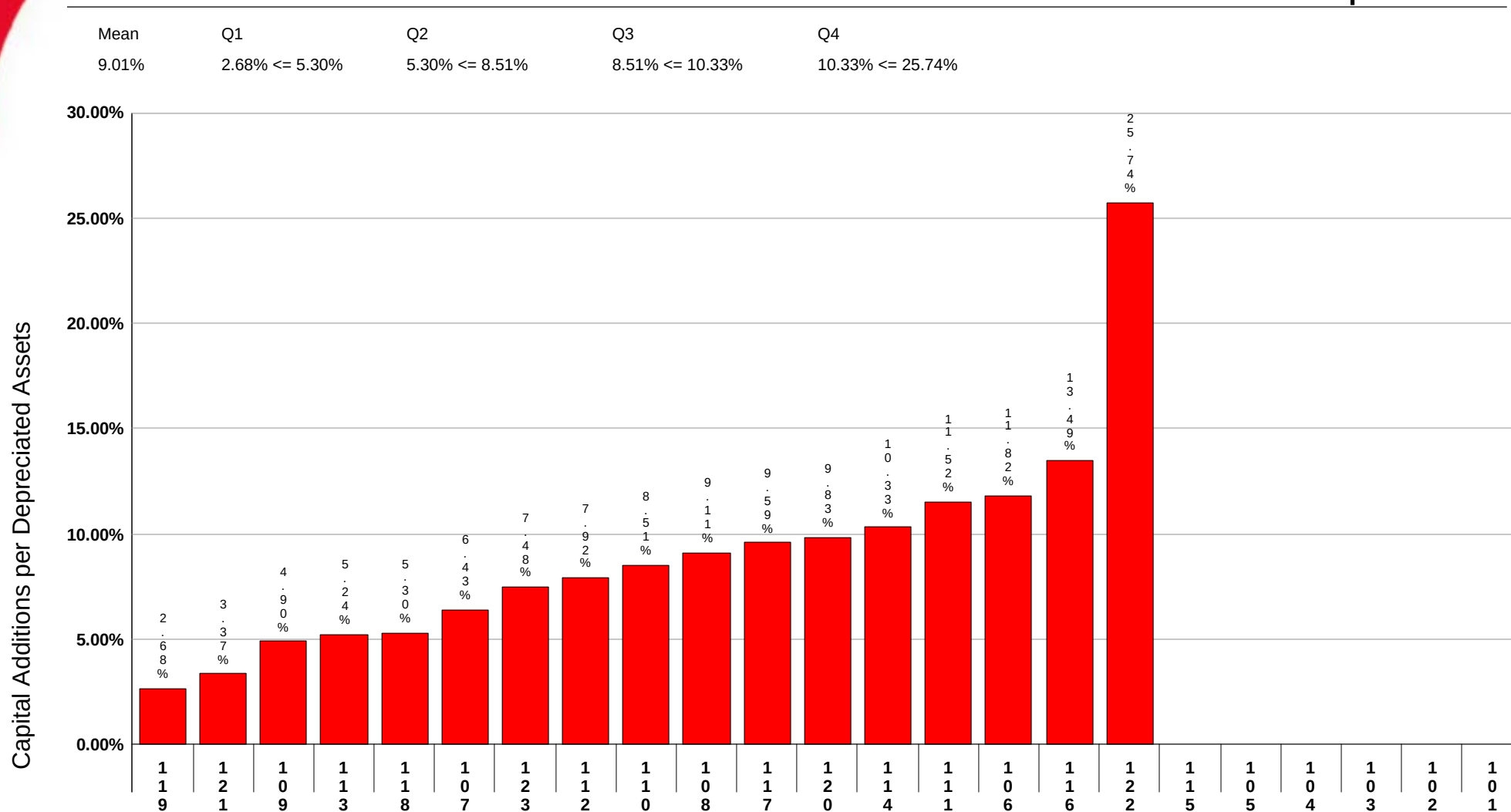
ID Code: 6387

Page: 1309

Only companies with all the data are shown.

Distribution Substation Capital Additions

Per Assets Less Depreciation



Source/Calculation: (SUM{B.6})/(B.11.2-B.15.1)

Volume: T&D Substation Statistics, Final Report, 2006

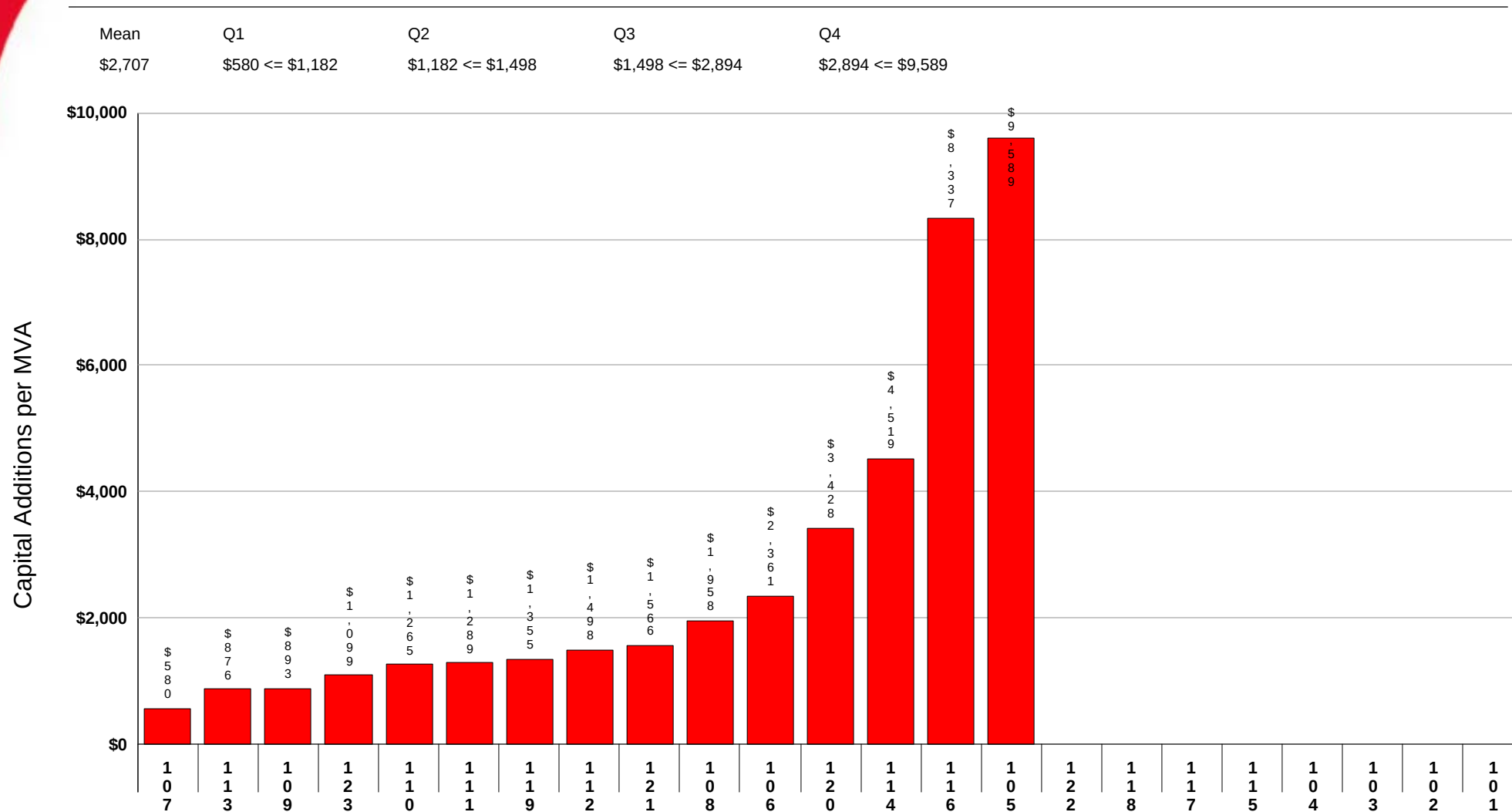
ID Code: 7004

Page: 1310

Only companies with all the data are shown.

Distribution Substation Capital Additions

Per Distribution MVA



Source/Calculation: SUM{B.6}/SUM{AQ.13}

Volume: T&D Substation Statistics, Final Report, 2006

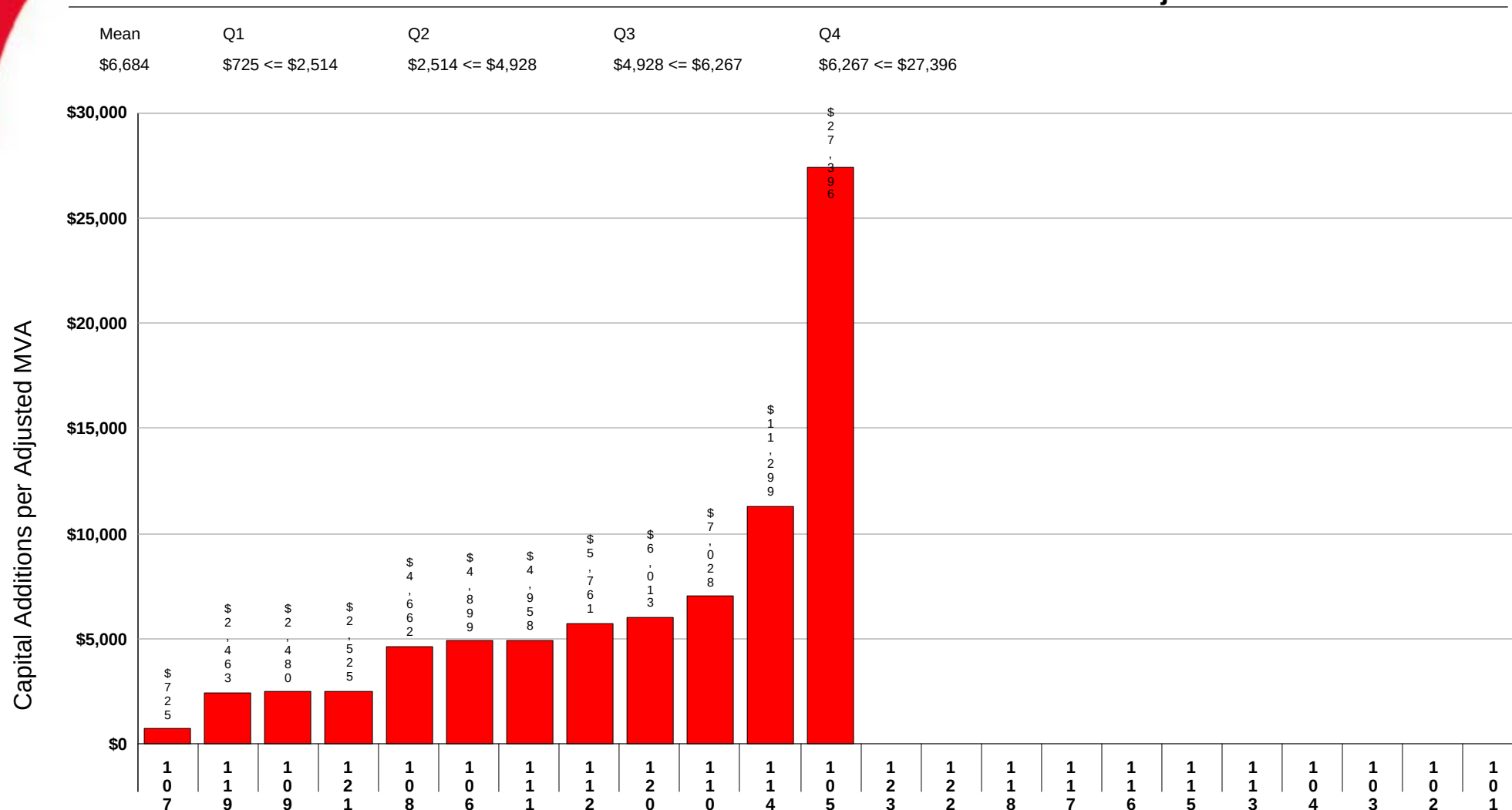
ID Code:6113

Page:1311

Only companies with all the data are shown.

Distribution Substation Capital Additions

Per Adjusted Distribution MVA



Source/Calculation: $\text{SUM}\{B.6\} / (\text{SUM}\{AQ.13\} * AQ.14.1)$

Volume: T&D Substation Statistics, Final Report, 2006

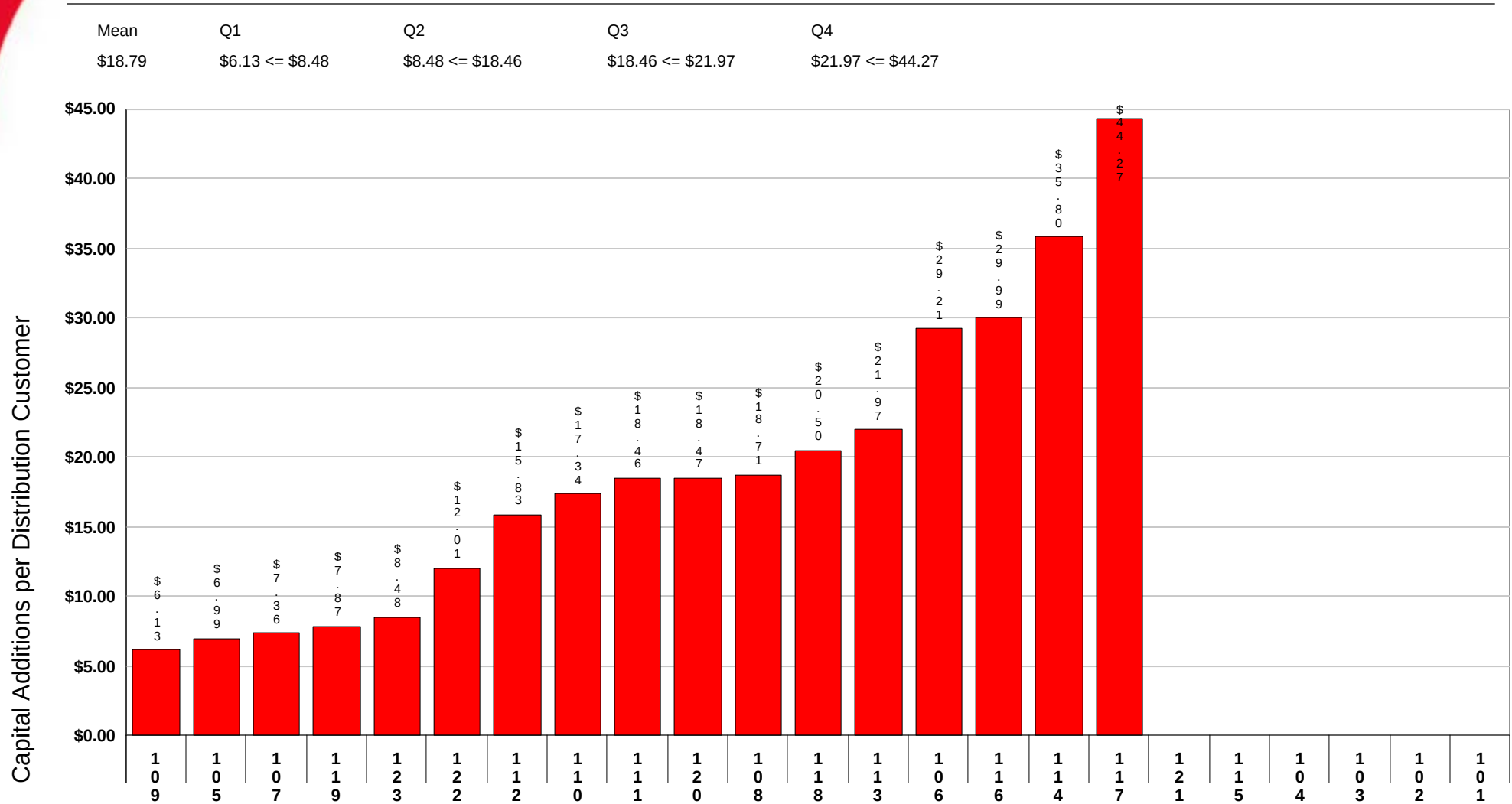
ID Code: 2209

Page: 1312

Only companies with all the data are shown.

3-Year Average Distribution Substation Capital Additions

Per Distribution Customer



Source/Calculation: (SUM{B.6}/A.2.2+B.9.3/A.3.1+B.9.4/A.3.2)/3

Volume: T&D Substation Statistics, Final Report, 2006

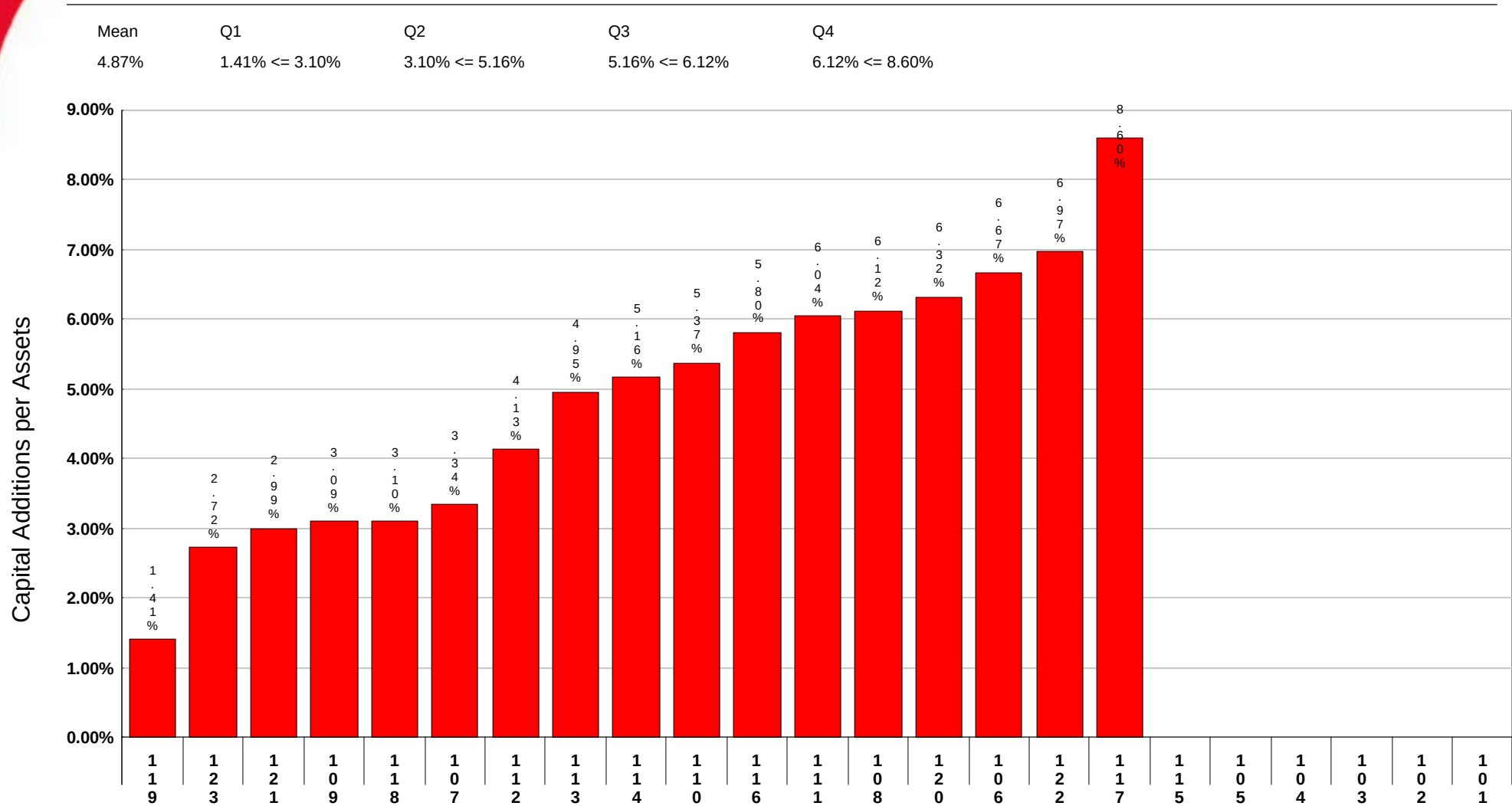
ID Code:6481

Page: 1313

Only companies with all the data are shown.



3-Year Average Distribution Substation Capital Additions Per Assets



Source/Calculation: ((SUM{B.6}):(B.11.2)+(B.9.3)/(B.13.3)+(B.9.4)/(B.13.4))/3

Volume: T&D Substation Statistics, Final Report, 2006

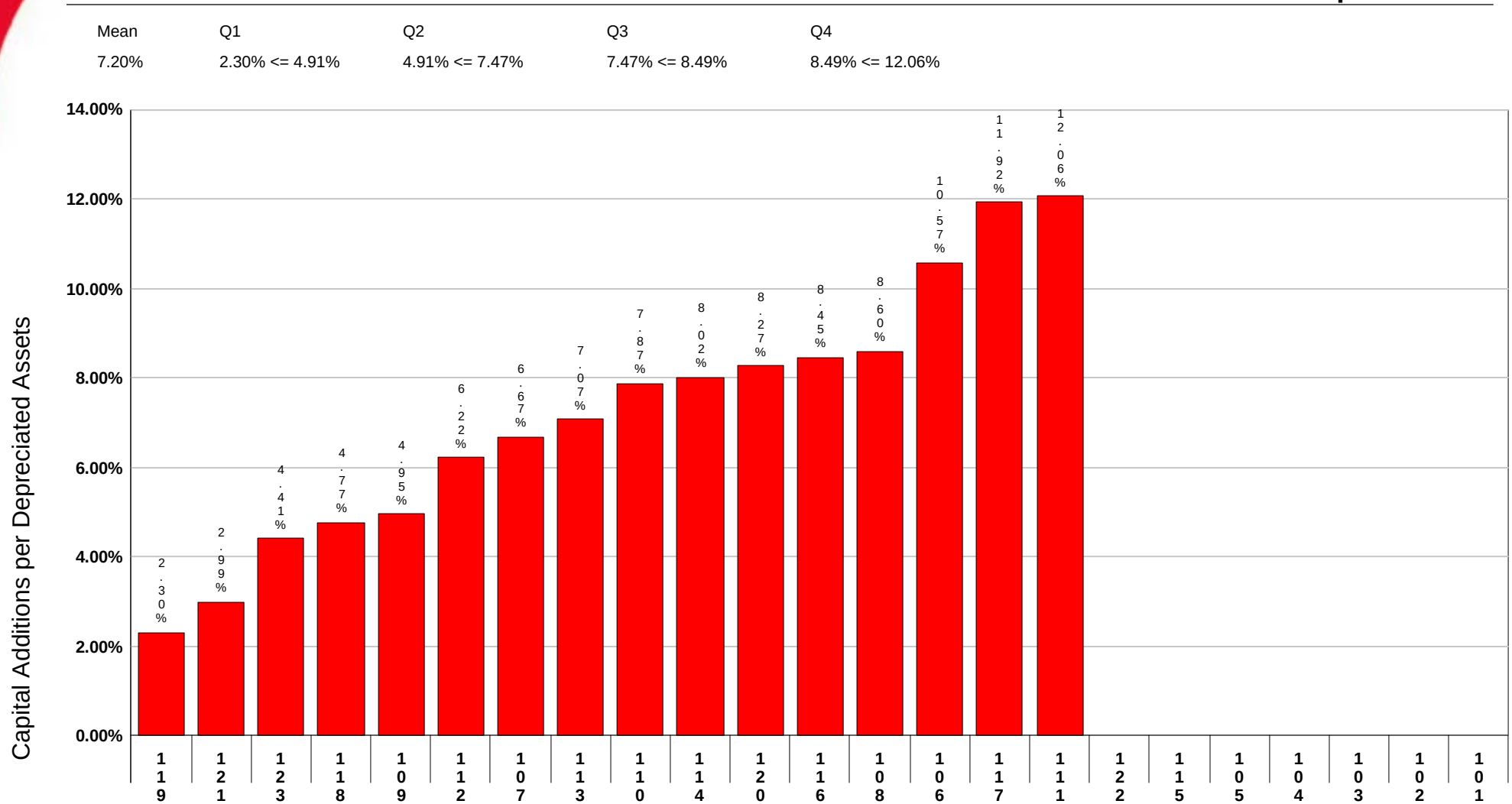
ID Code:6484

Page:1314

Only companies with all the data are shown.

3-Year Average Distribution Substation Capital Additions

Per Assets Less Depreciation



Source/Calculation: ((SUM{B.6})*(B.11.2-B.15.1)+(B.9.3)/(B.13.3-B.17.1)+(B.9.4)/(B.13.4-B.17.2))/3

Volume: T&D Substation Statistics, Final Report, 2006

ID Code:1600244

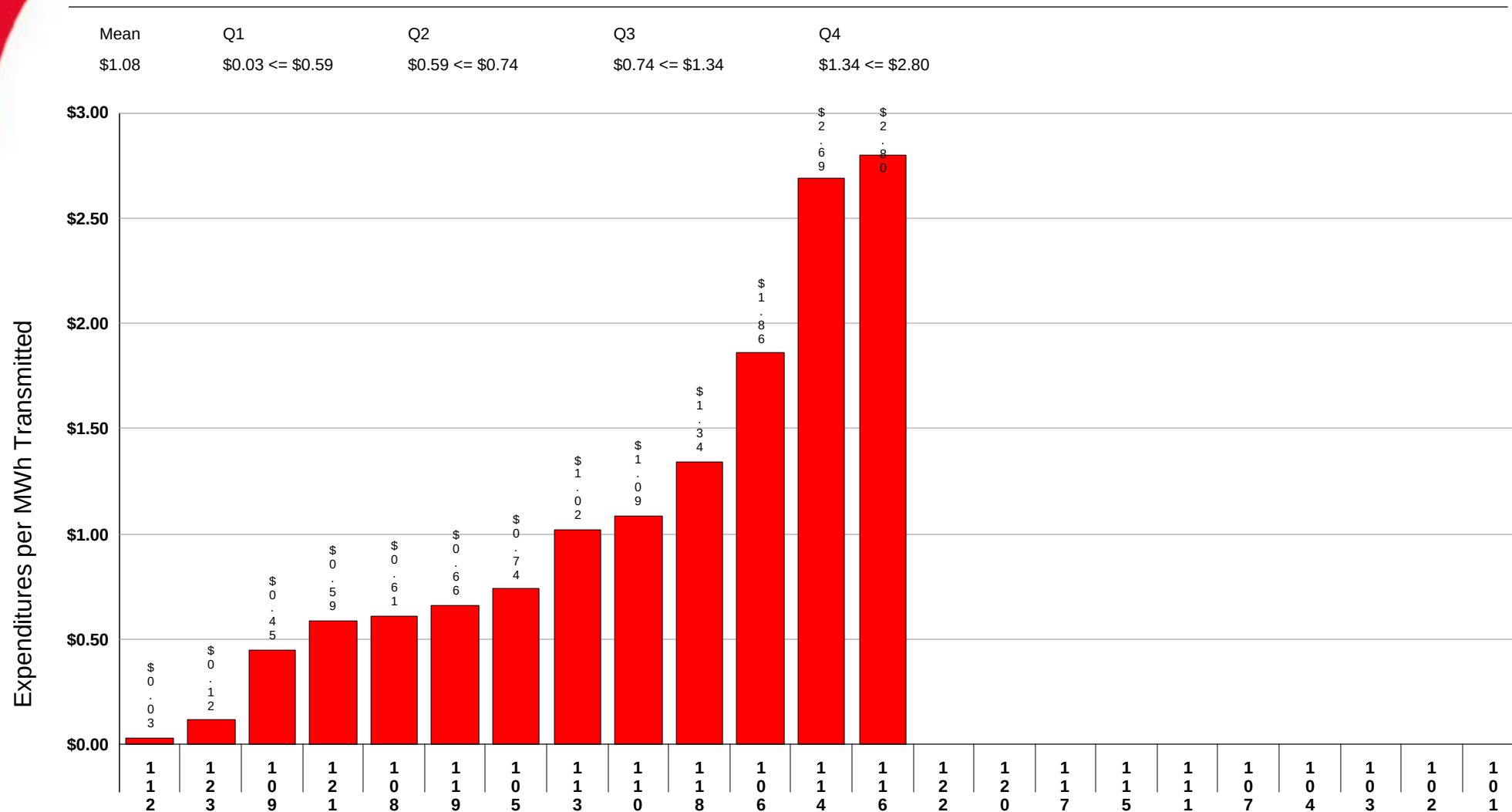
Page:1314.1

Only companies with all the data are shown.



Transmission Substation Expenditures

Per MWh Transmitted



Source/Calculation: (SUM{B.3}+SUM{B.21}+SUM{B.23})/A.2.5

Volume: T&D Substation Statistics, Final Report, 2006

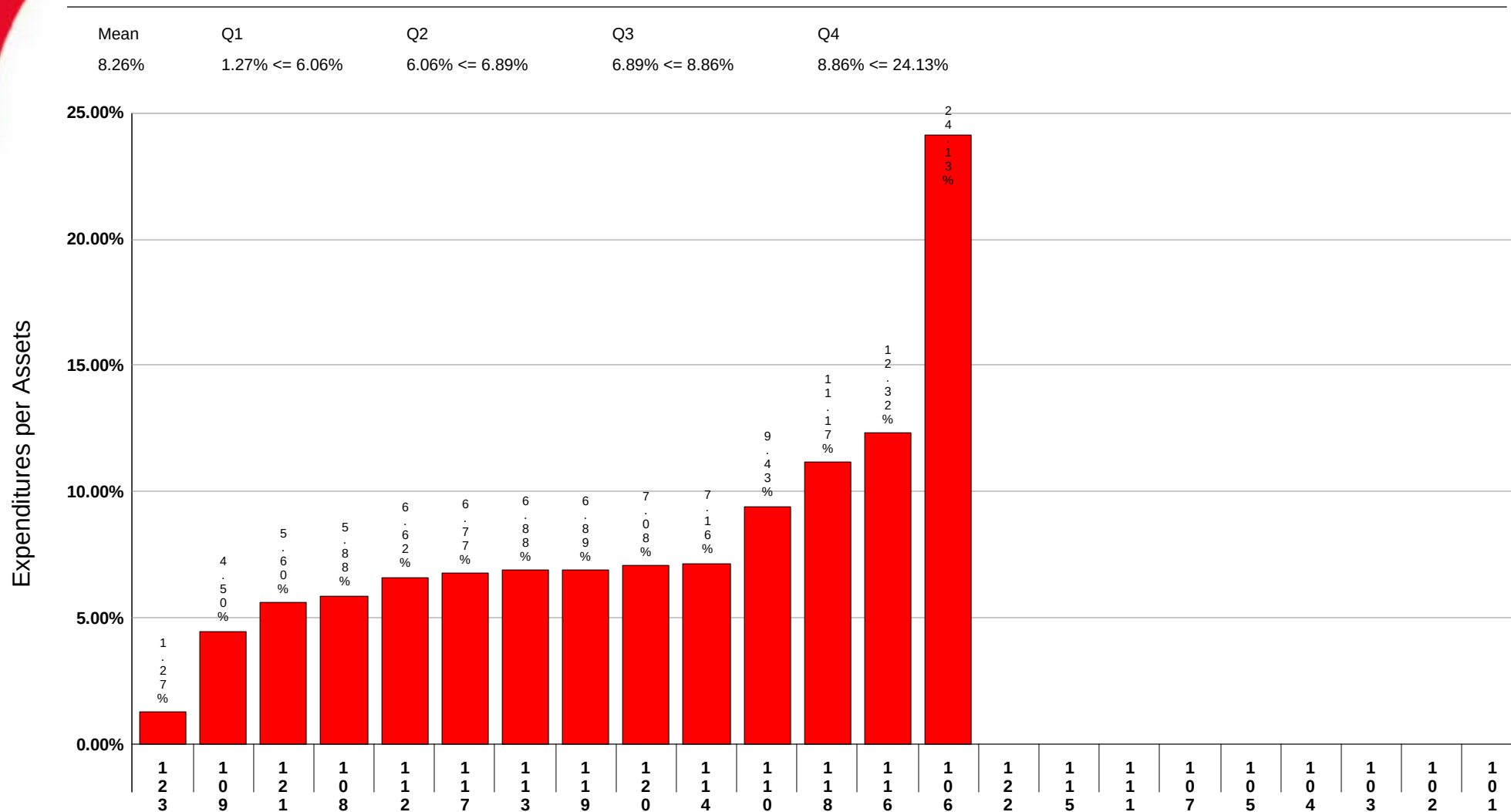
ID Code: 2145

Page: 1316

Only companies with all the data are shown.

Transmission Substation Expenditures

Per Transmission Substation Assets



Source/Calculation: (SUM{B.3}+SUM{B.21}+SUM{B.23})/B.11.1

Volume: T&D Substation Statistics, Final Report, 2006

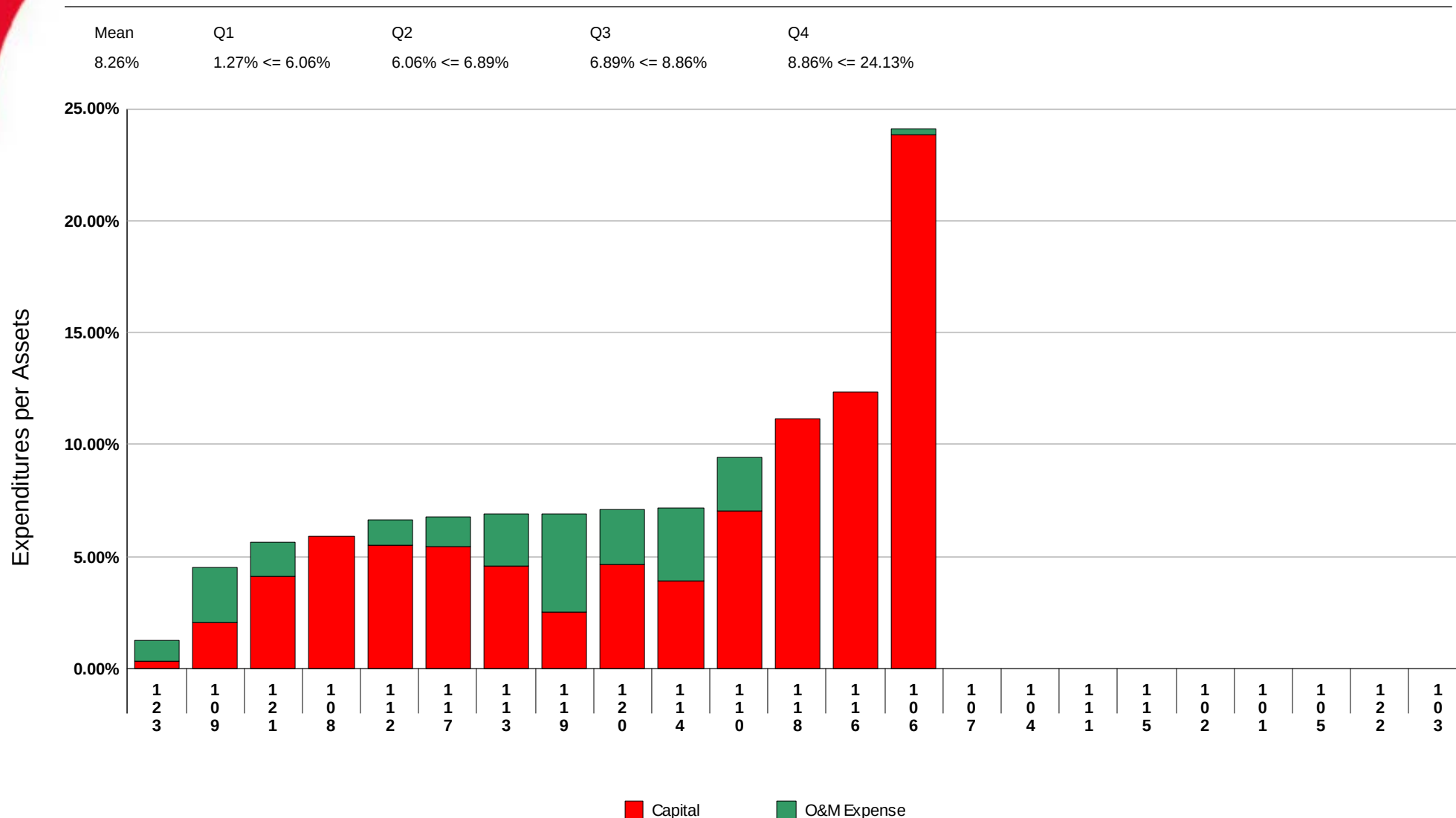
ID Code:6391

Page:1317

Only companies with all the data are shown.

Transmission Substation Expenditures

Per Transmission Substation Assets



Source/Calculation: (SUM{B.3})/B.11.1

Volume: T&D Substation Statistics, Final Report, 2006

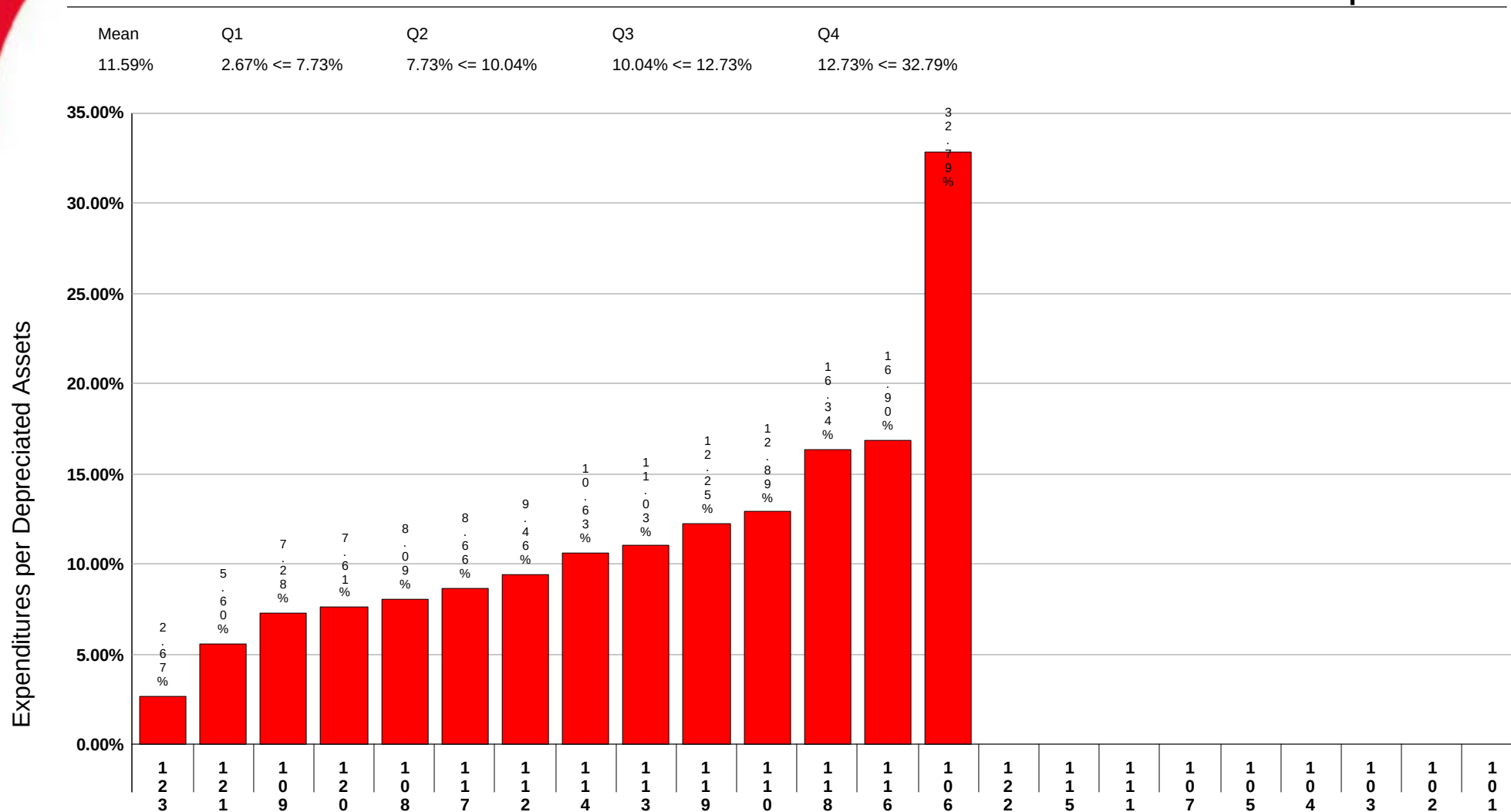
ID Code: 2300526

Page: 1318

Calculation shown is for the first piece of the stacked bar only.

Transmission Substation Expenditures

Per Assets Less Depreciation



Source/Calculation: (SUM{B.3}+SUM{B.21}+SUM{B.23})/(B.11.1-B.15.2)

Volume: T&D Substation Statistics, Final Report, 2006

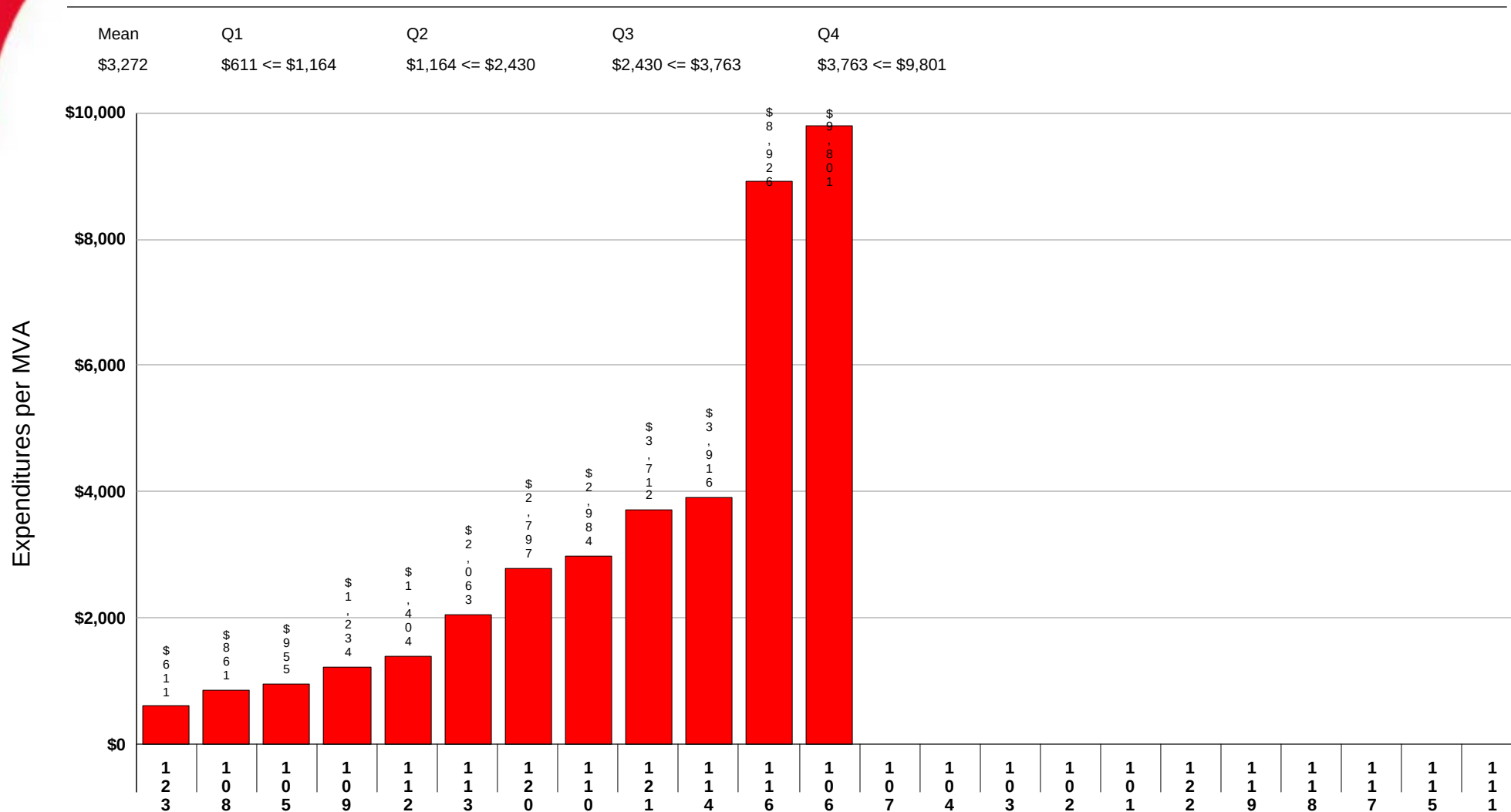
ID Code: 7010

Page: 1319

Only companies with all the data are shown.

Transmission Substation Expenditures

Per Transmission MVA



Source/Calculation: $(\text{SUM}\{B.3\} + \text{SUM}\{B.21\} + \text{SUM}\{B.23\}) / \text{SUM}\{AQ.12\}$

Volume: T&D Substation Statistics, Final Report, 2006

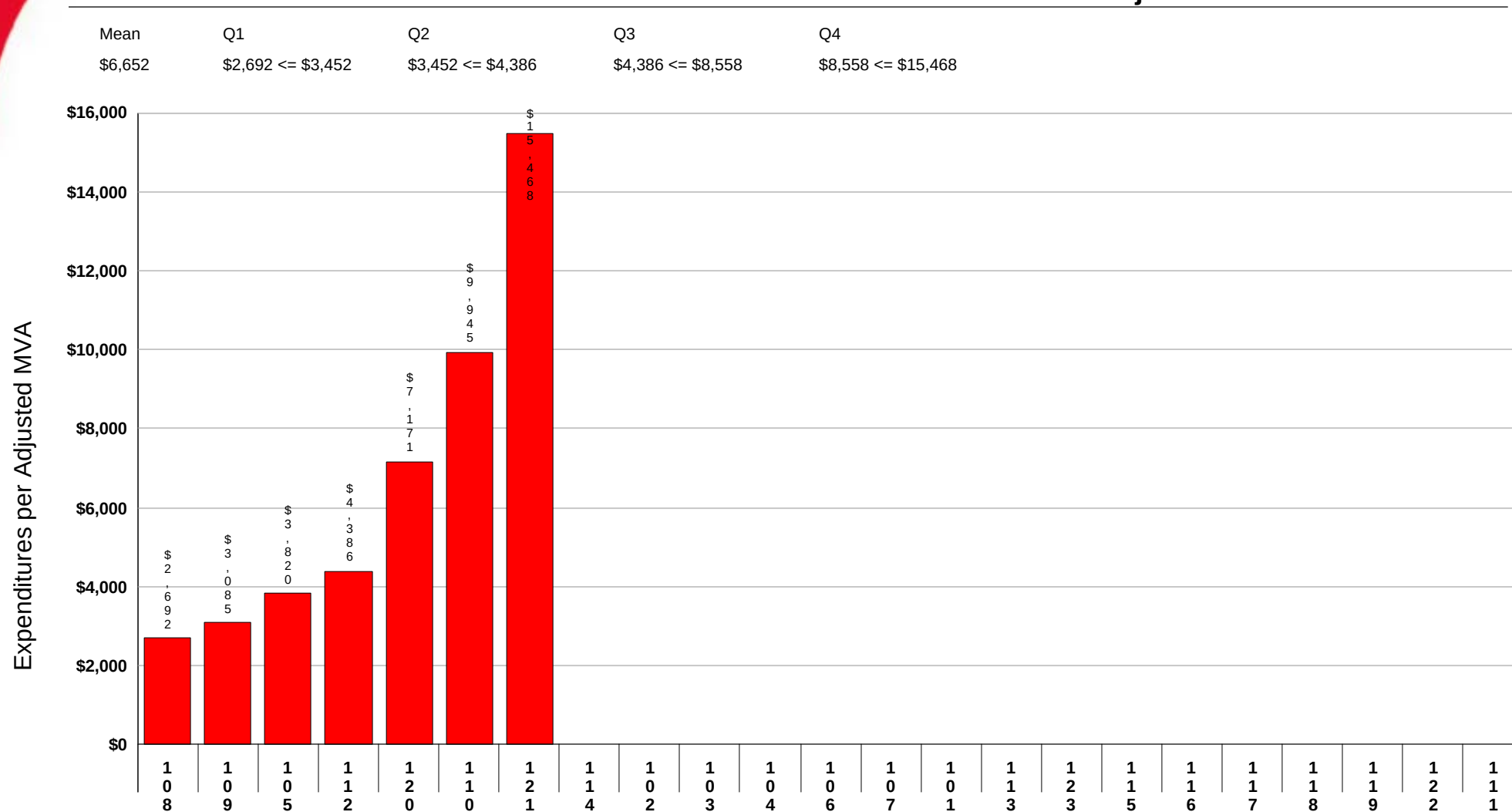
ID Code: 6390

Only companies with all the data are shown.

Page: 1320

Transmission Substation Expenditures

Per Adjusted Transmission MVA



Source/Calculation: $(\text{SUM}\{B.3\} + \text{SUM}\{B.21\} + \text{SUM}\{B.23\}) / (\text{SUM}\{AQ.12\} * AQ.14.2)$

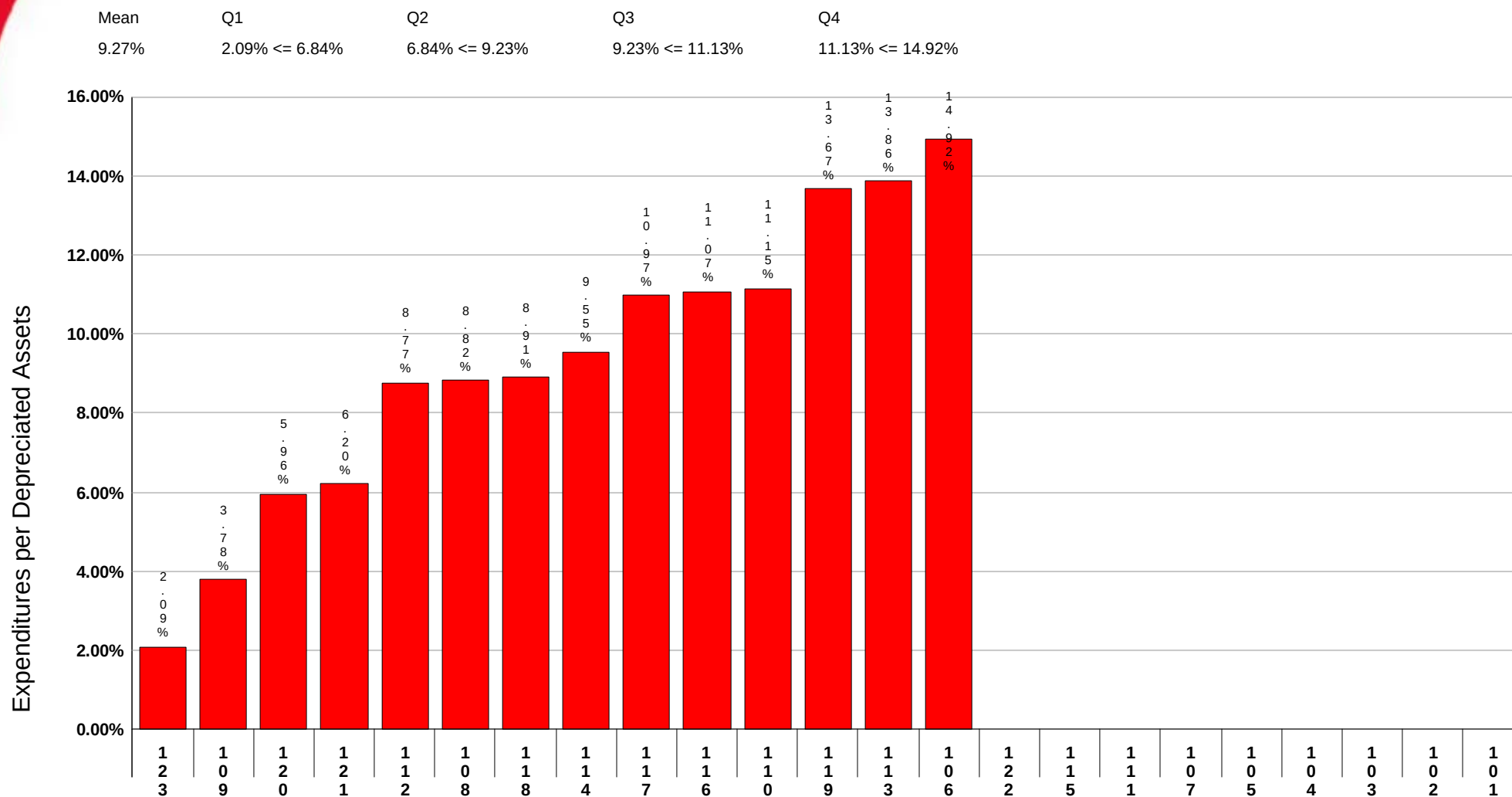
Volume: T&D Substation Statistics, Final Report, 2006

ID Code: 2218

Page: 1321

Only companies with all the data are shown.

3-Year Average Transmission Substation Expenditures Per Assets Less Depreciation



Source/Calculation:(((SUM{B.3}+SUM{B.21}+SUM{B.23}))/((B.11.1-B.15.2)))+((B.9.1+B.29.1)/(B.13.1-B.17.3))+((B.9.2+B.29.2)/(B.13.2-B.17.4)))/3

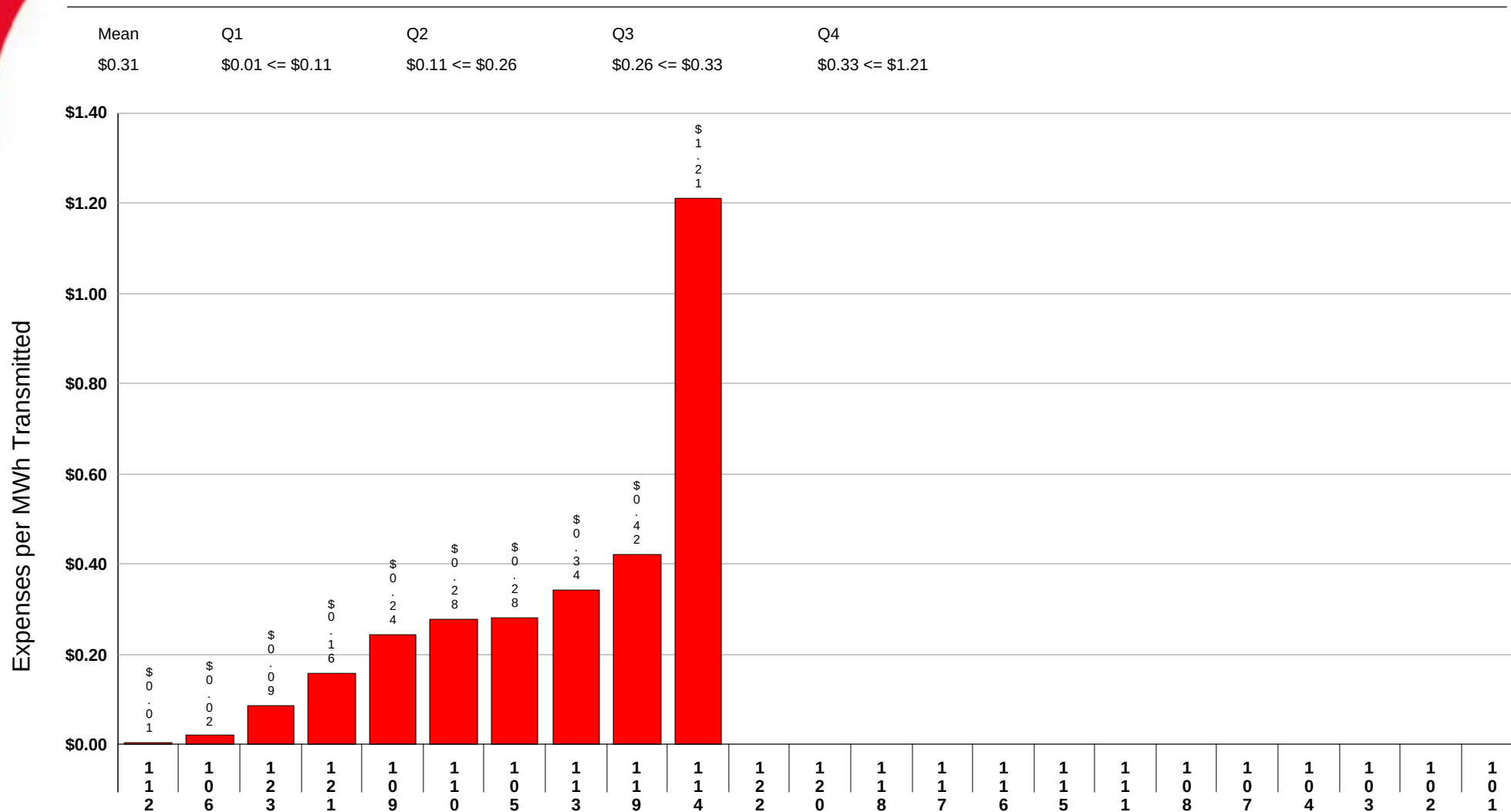
Volume: T&D Substation Statistics, Final Report, 2006

ID Code:27115

Page:1325

Only companies with all the data are shown.

Transmission Substation O&M Expenses Per MWh Transmitted



Source/Calculation: (SUM{B.21}+SUM{B.23})/A.2.5

Volume: T&D Substation Statistics, Final Report, 2006

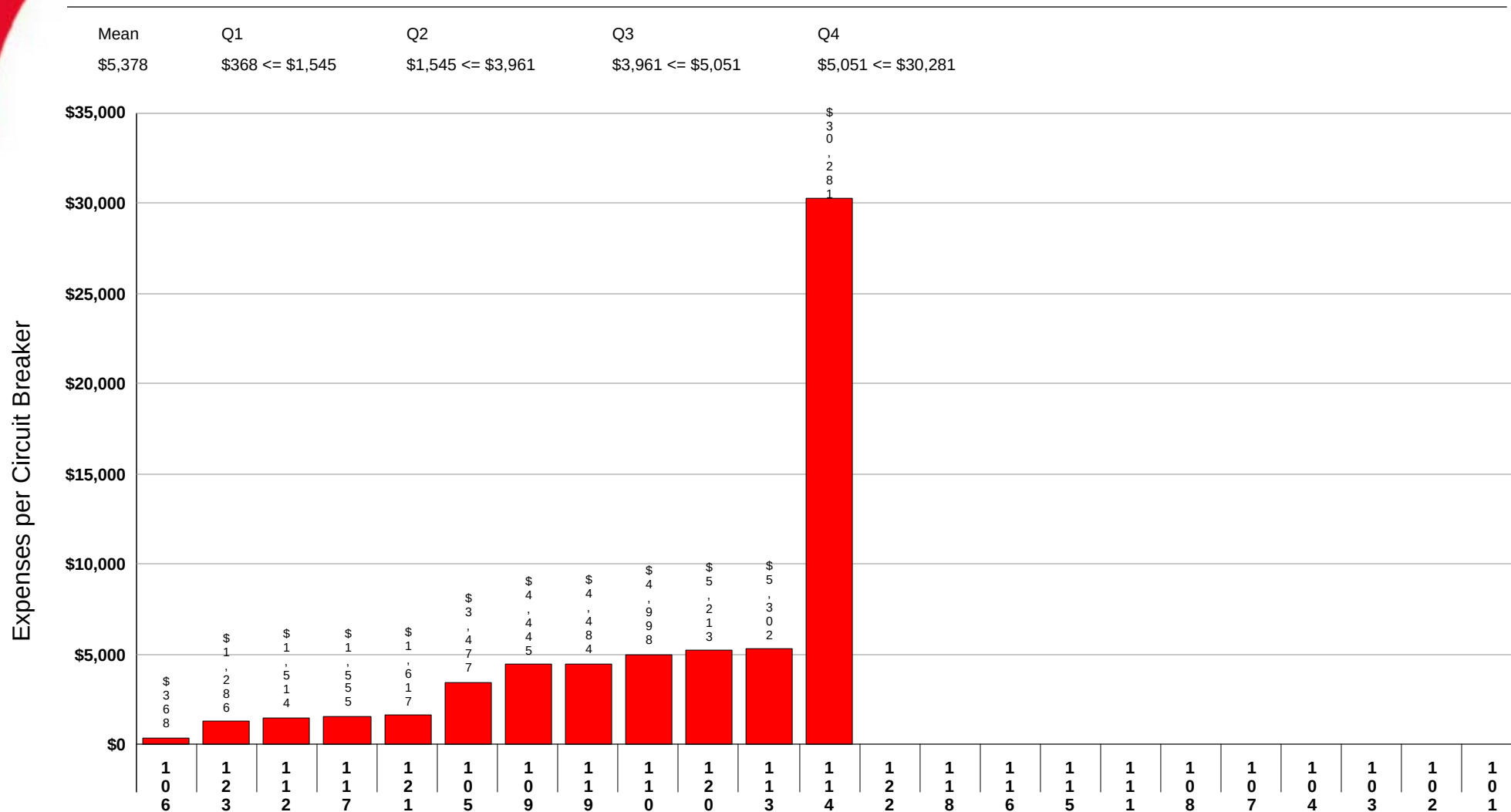
ID Code: 2150

Page: 1327

Only companies with all the data are shown.

Transmission Substation O&M Expenses

Per Circuit Breaker



Source/Calculation: (SUM{B.21}+SUM{B.23})/SUM{AQ.4}

Volume: T&D Substation Statistics, Final Report, 2006

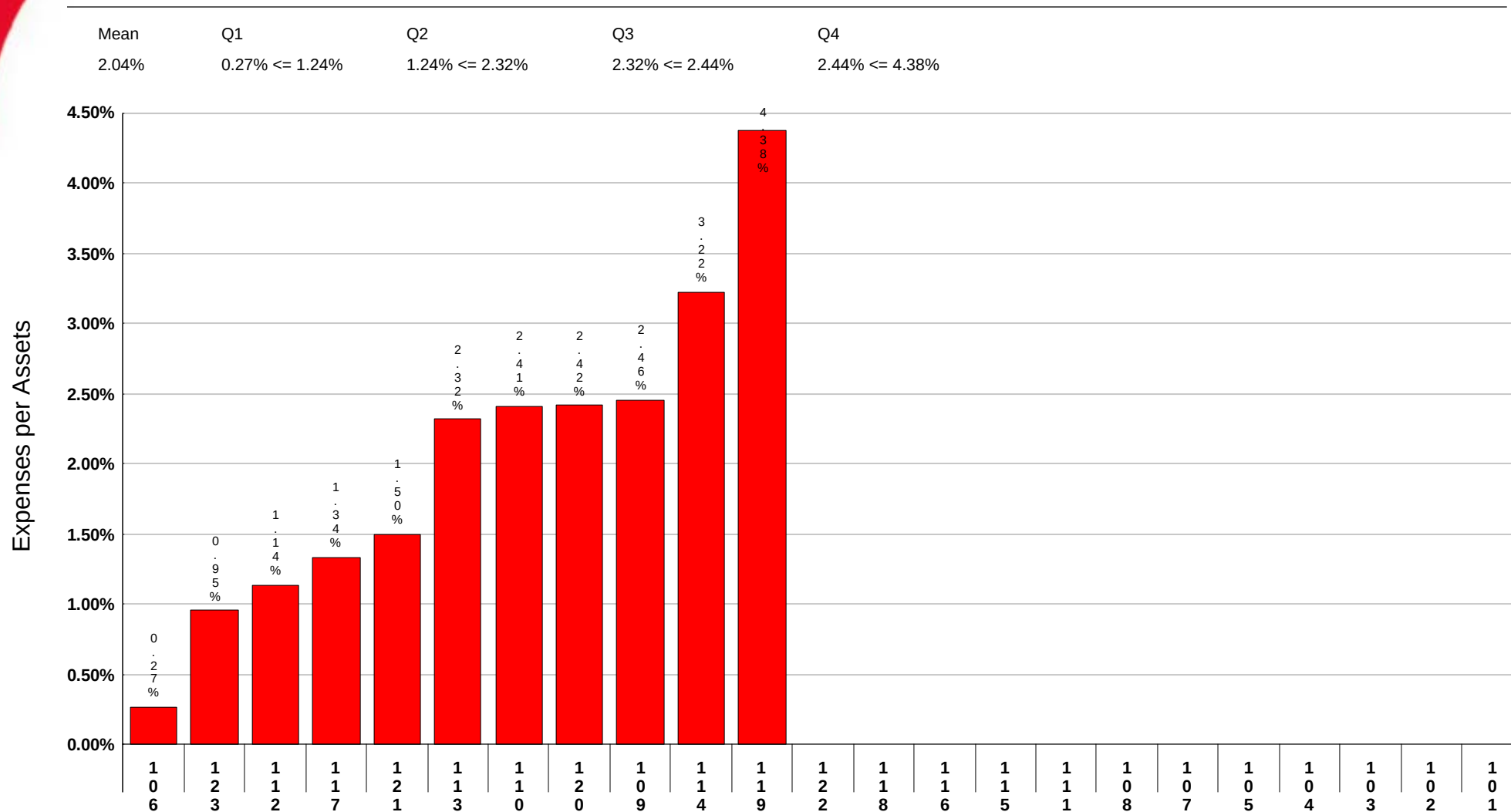
ID Code: 6496

Page: 1328

Only companies with all the data are shown.

Transmission Substation O&M Expenses

Per Transmission Substation Assets



Source/Calculation: (SUM{B.21}+SUM{B.23})/B.11.1

Volume: T&D Substation Statistics, Final Report, 2006

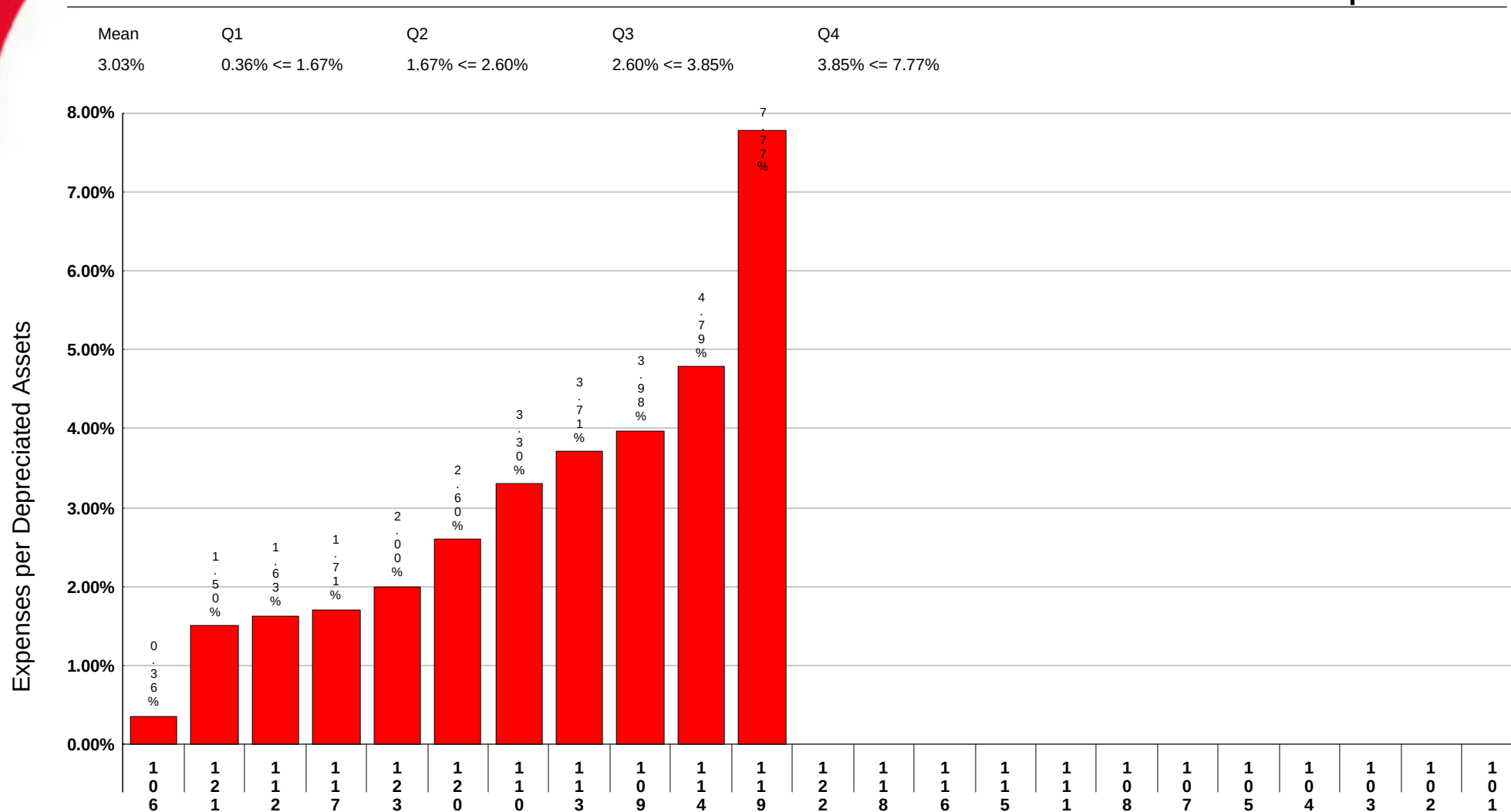
ID Code: 6393

Page: 1329

Only companies with all the data are shown.

Transmission Substation O&M Expenses

Per Assets Less Depreciation



Source/Calculation: (SUM{B.21}+SUM{B.23})/(B.11.1-B.15.2)

Volume: T&D Substation Statistics, Final Report, 2006

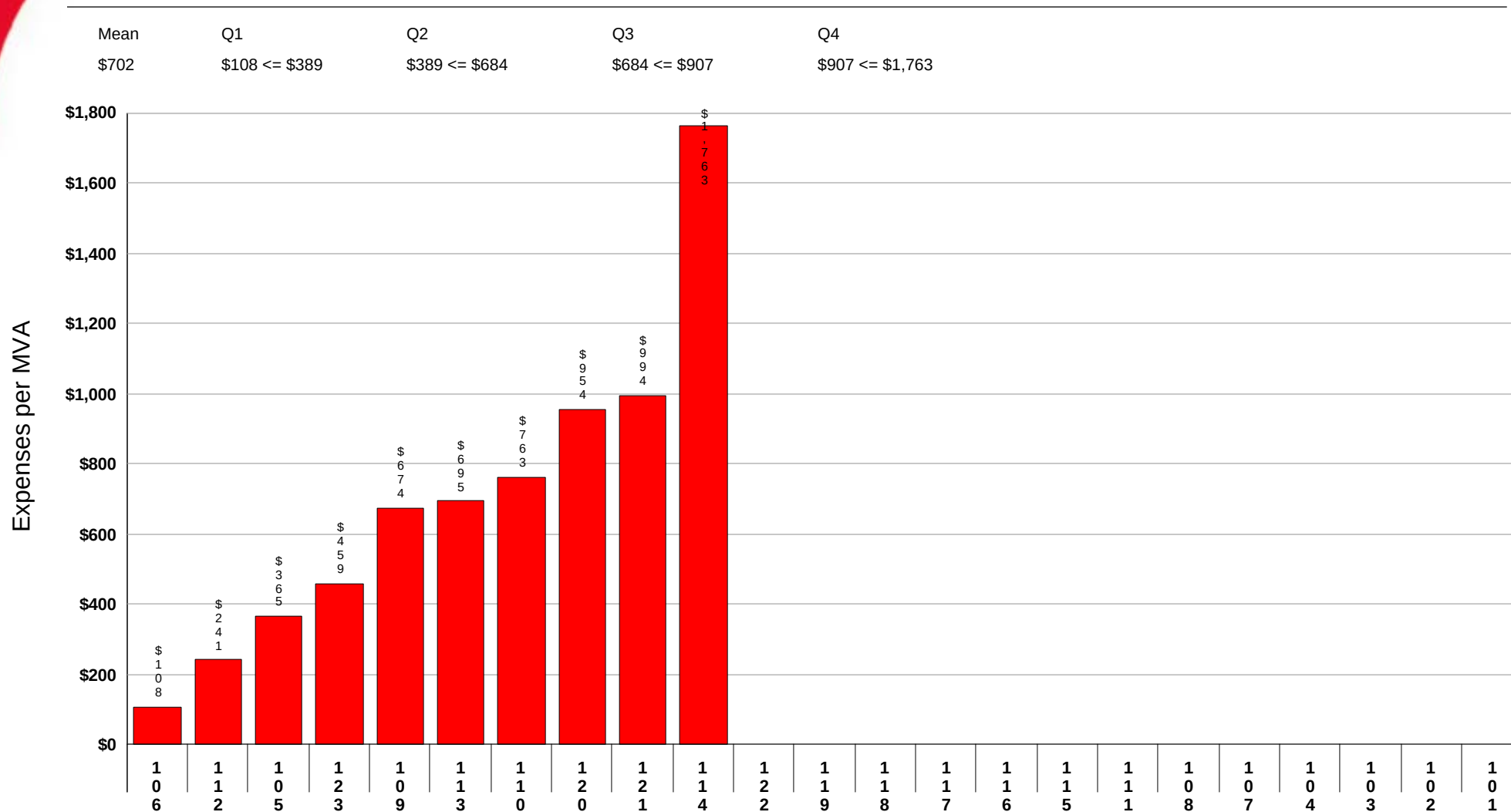
ID Code: 6493

Page: 1330

Only companies with all the data are shown.

Transmission Substation O&M Expenses

Per Transmission MVA



Source/Calculation: (SUM{B.21}+SUM{B.23})/SUM{AQ.12}

Volume: T&D Substation Statistics, Final Report, 2006

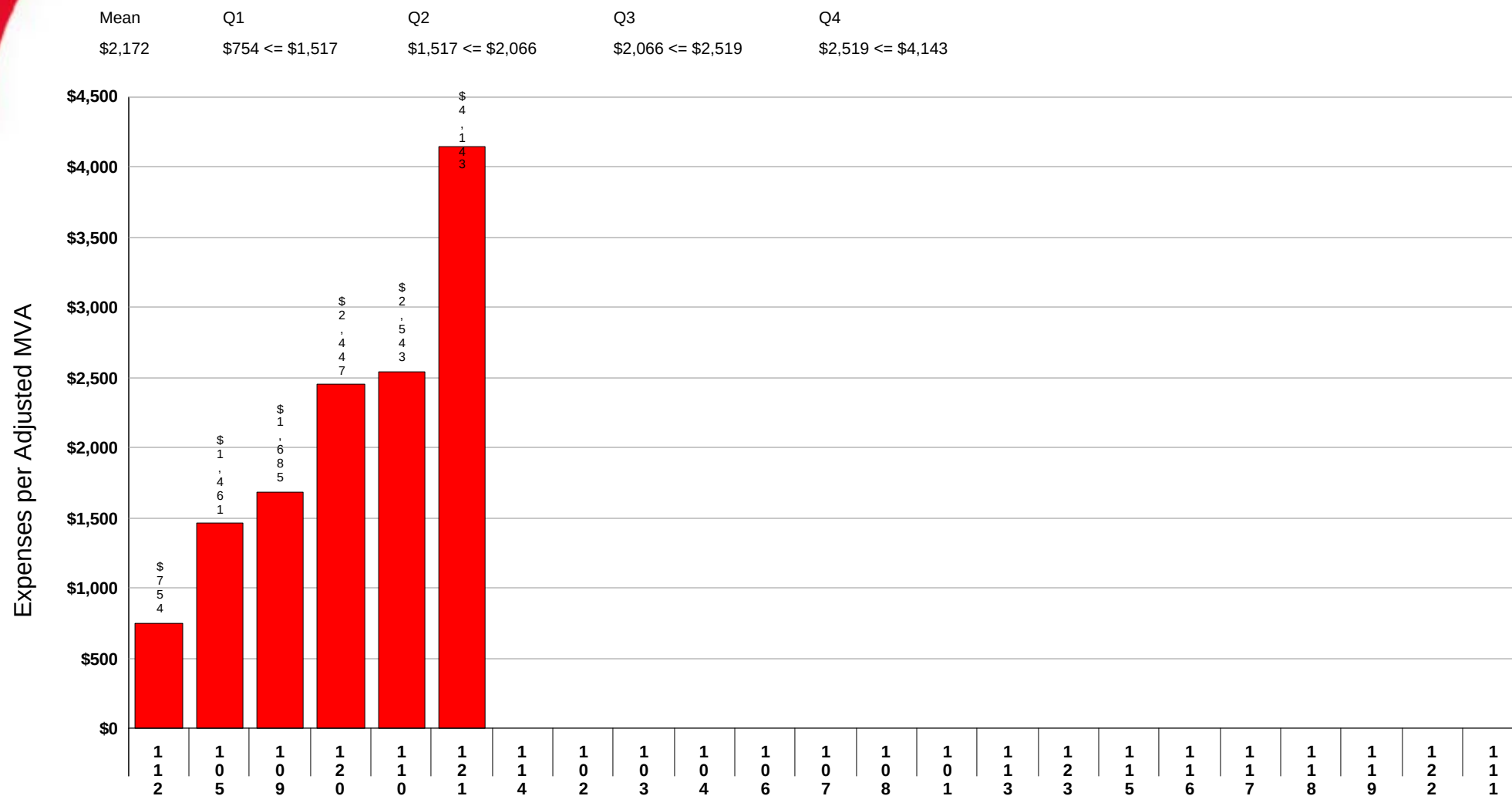
ID Code: 6392

Page: 1331

Only companies with all the data are shown.

Transmission Substation O&M Expenses

Per Adjusted Transmission MVA



Source/Calculation: $(\text{SUM}\{B.21\} + \text{SUM}\{B.23\}) / (\text{SUM}\{AQ.12\} * AQ.14.2)$

Volume: T&D Substation Statistics, Final Report, 2006

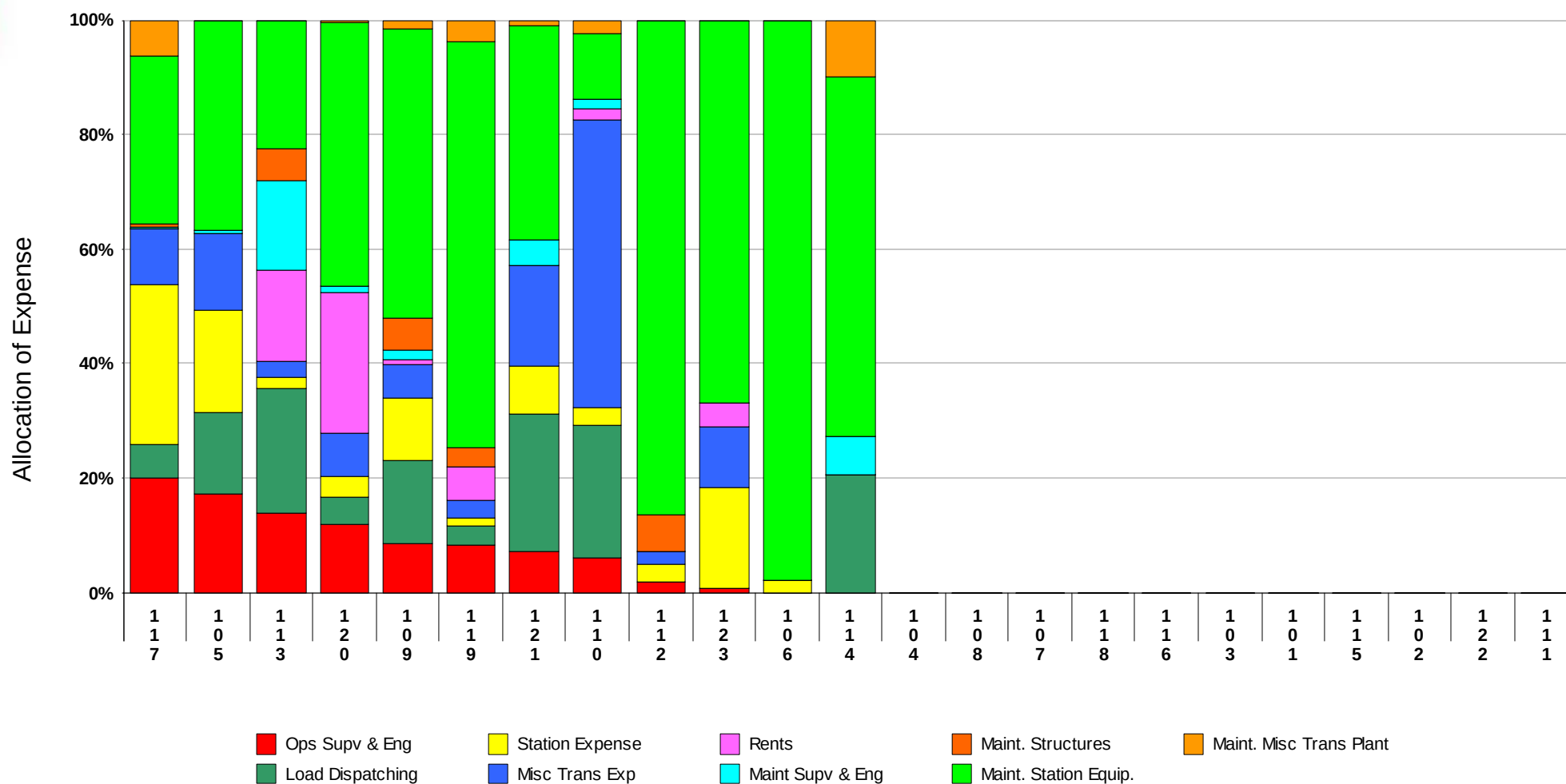
ID Code: 2223

Page: 1332

Only companies with all the data are shown.

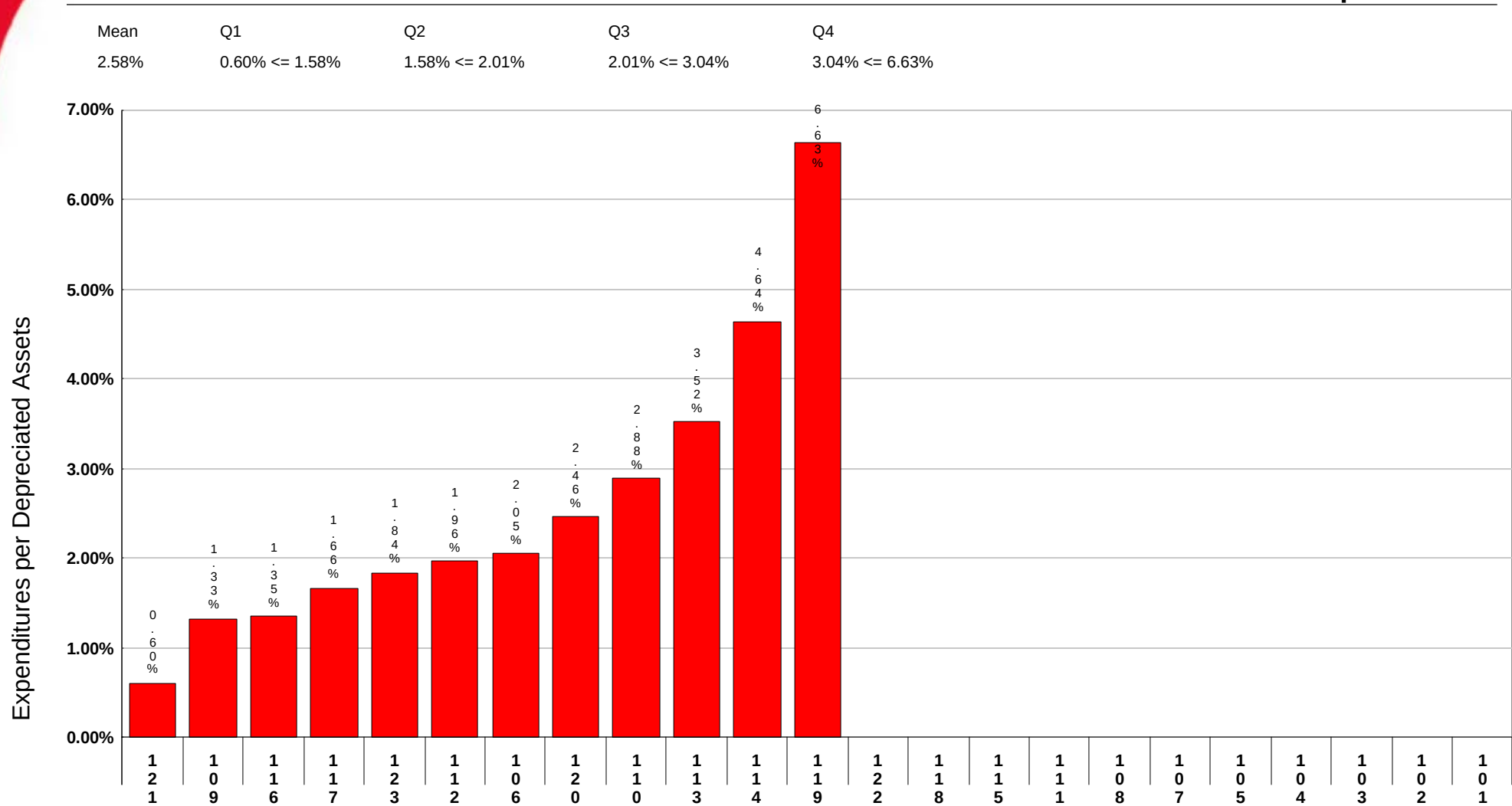
Transmission Substation O&M Expenses (FERC)

As a Percent of Total



3-Year Average Transmission Substation O&M Expenses

Per Assets Less Depreciation



Source/Calculation:(((SUM{B.21}+SUM{B.23}))/((B.11.1-B.15.2)))+(B.29.1/(B.13.1-B.17.3)))+(B.29.2/(B.13.2-B.17.4)))/3

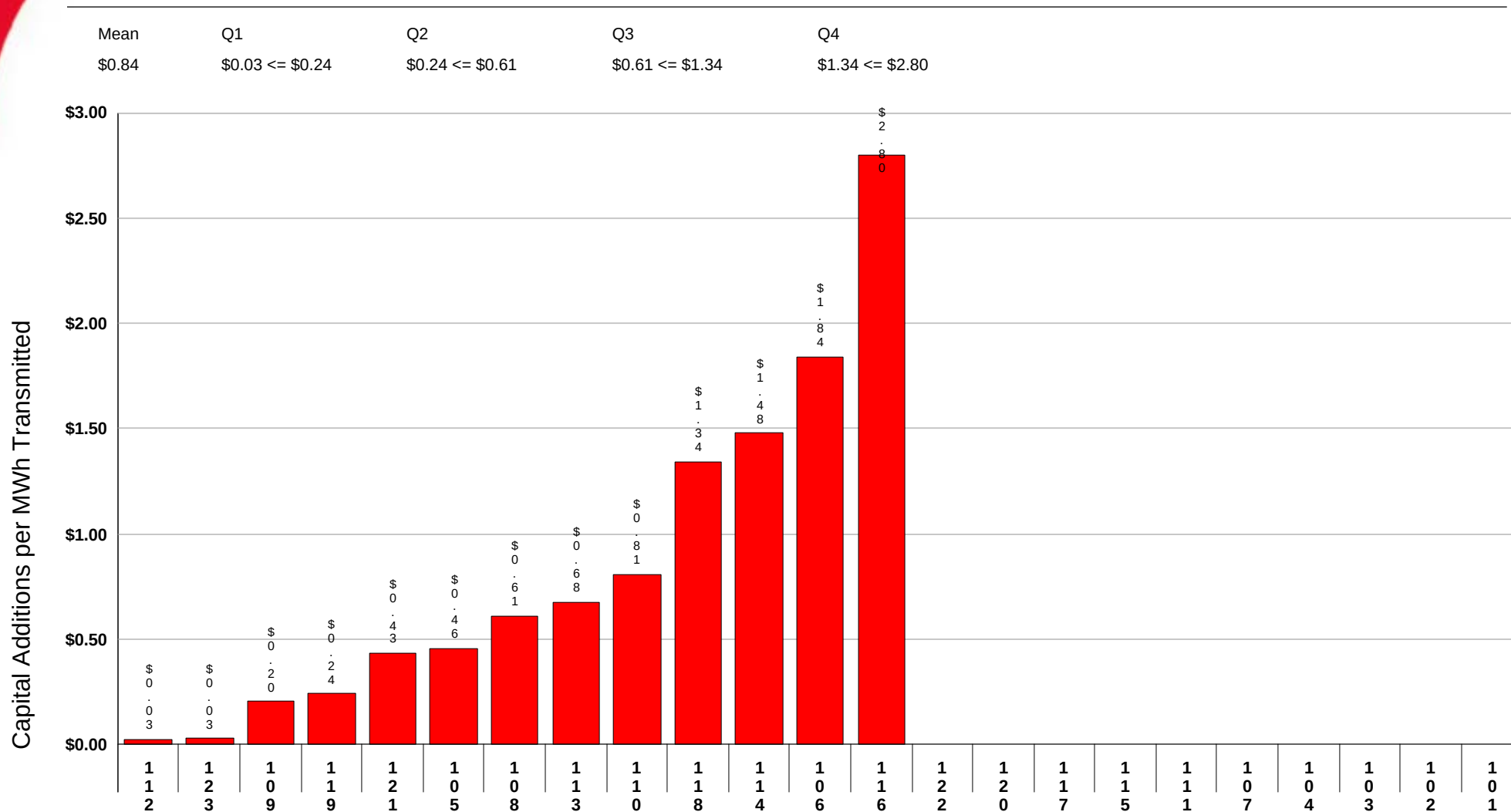
Volume: T&D Substation Statistics, Final Report, 2006

ID Code:27118

Page:1336

Only companies with all the data are shown.

Transmission Substation Capital Additions Per MWh Transmitted



Source/Calculation: (SUM{B.3})/A.2.5

Volume: T&D Substation Statistics, Final Report, 2006

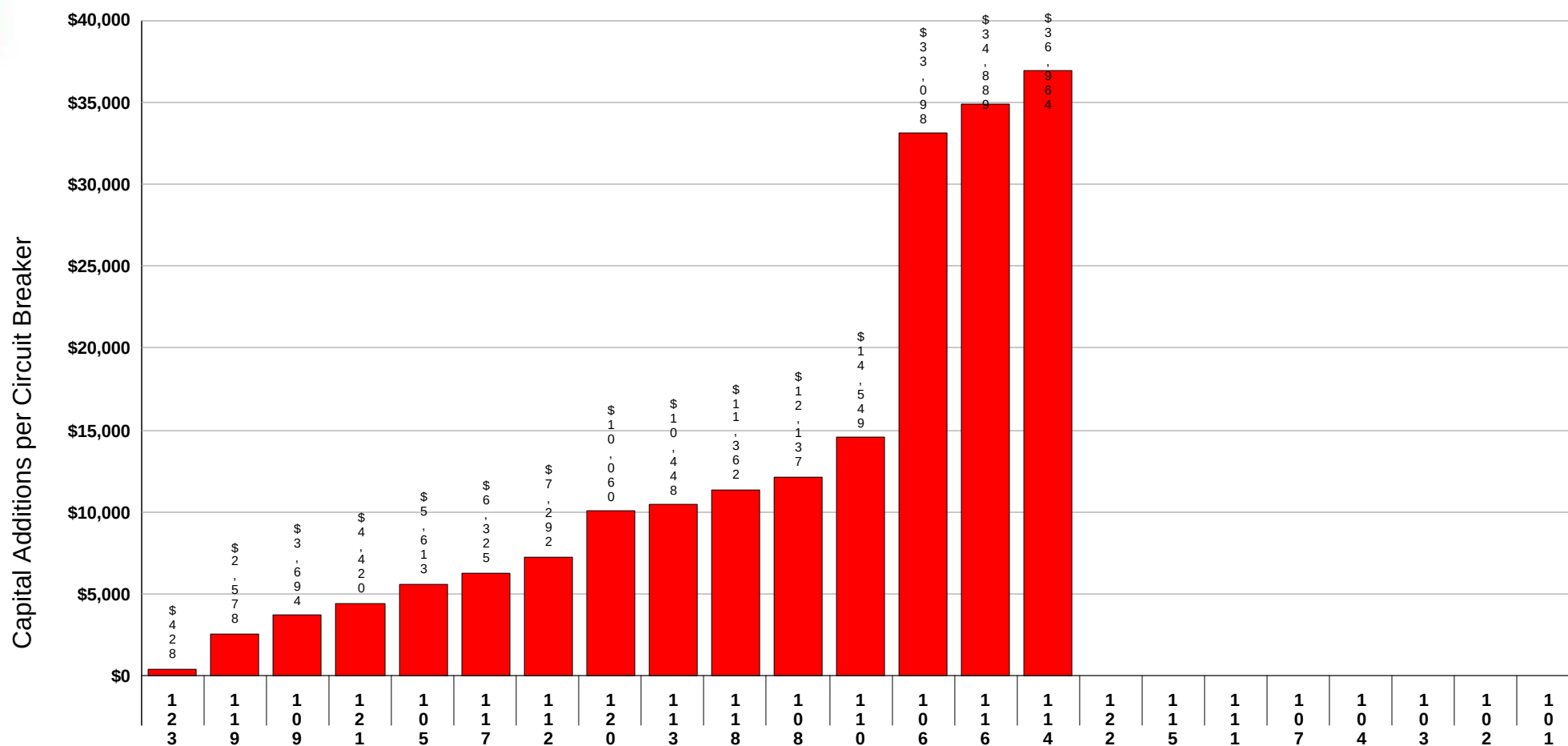
ID Code: 2155

Page: 1338

Only companies with all the data are shown.

Per Circuit Breaker

Mean	Q1	Q2	Q3	Q4
\$12.924	\$428 <= \$5,016	\$5,016 <= \$10,060	\$10,060 <= \$13,343	\$13,343 <= \$36,964



Source/Calculation: $\text{SUM}\{\text{B.3}\}/\text{SUM}\{\text{AQ.4}\}$

Volume: T&D Substation Statistics, Final Report, 2006

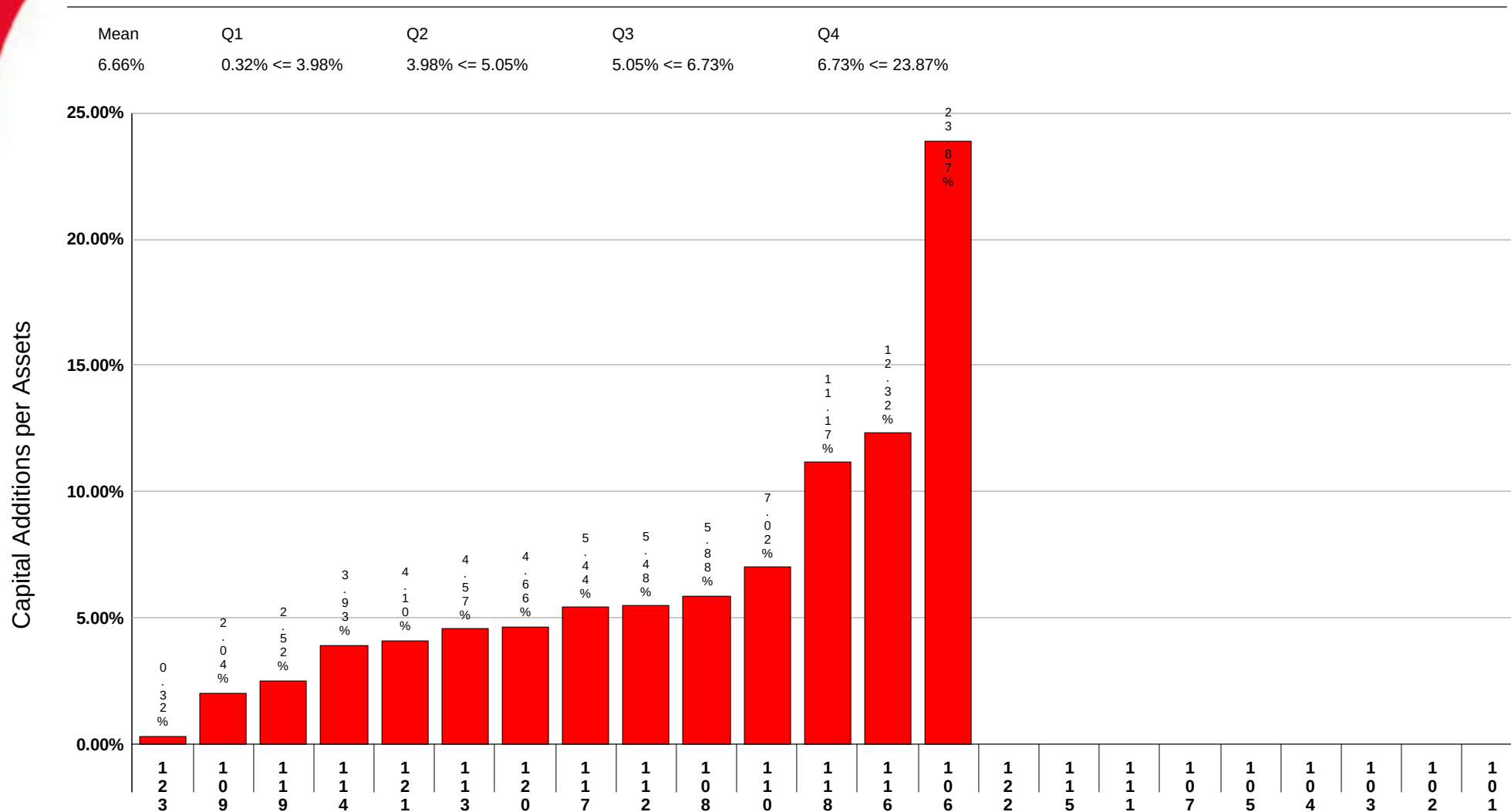
ID Code:7009

Page: 1339

Only companies with all the data are shown.

Transmission Substation Capital Additions

Per Transmission Substation Assets



Source/Calculation: (SUM{B.3})/B.11.1

Volume: T&D Substation Statistics, Final Report, 2006

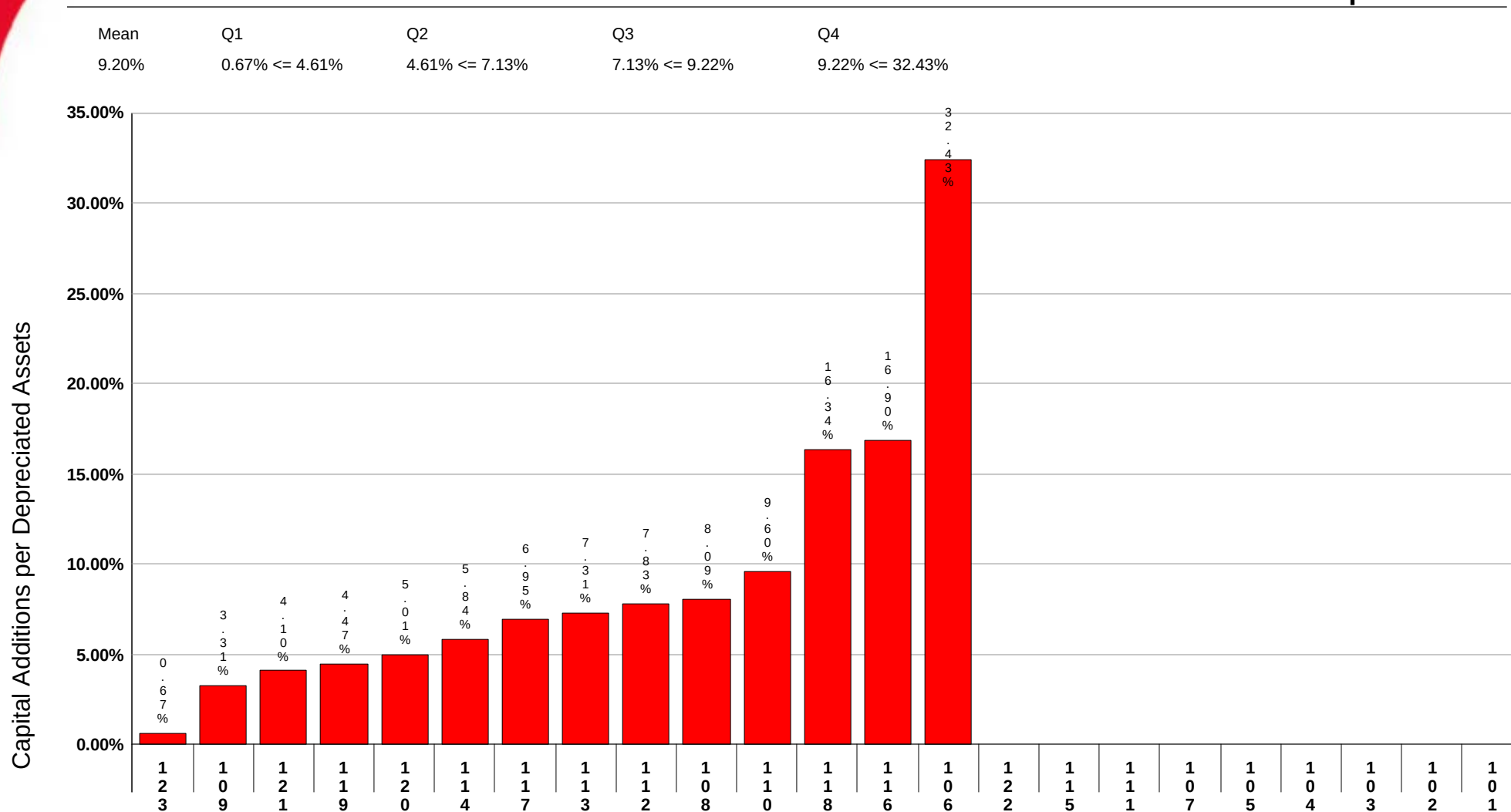
ID Code: 6389

Page: 1340

Only companies with all the data are shown.

Transmission Substation Capital Additions

Per Assets Less Depreciation



Source/Calculation: SUM{B.3}/(B.11.1-B.15.2)

Volume: T&D Substation Statistics, Final Report, 2006

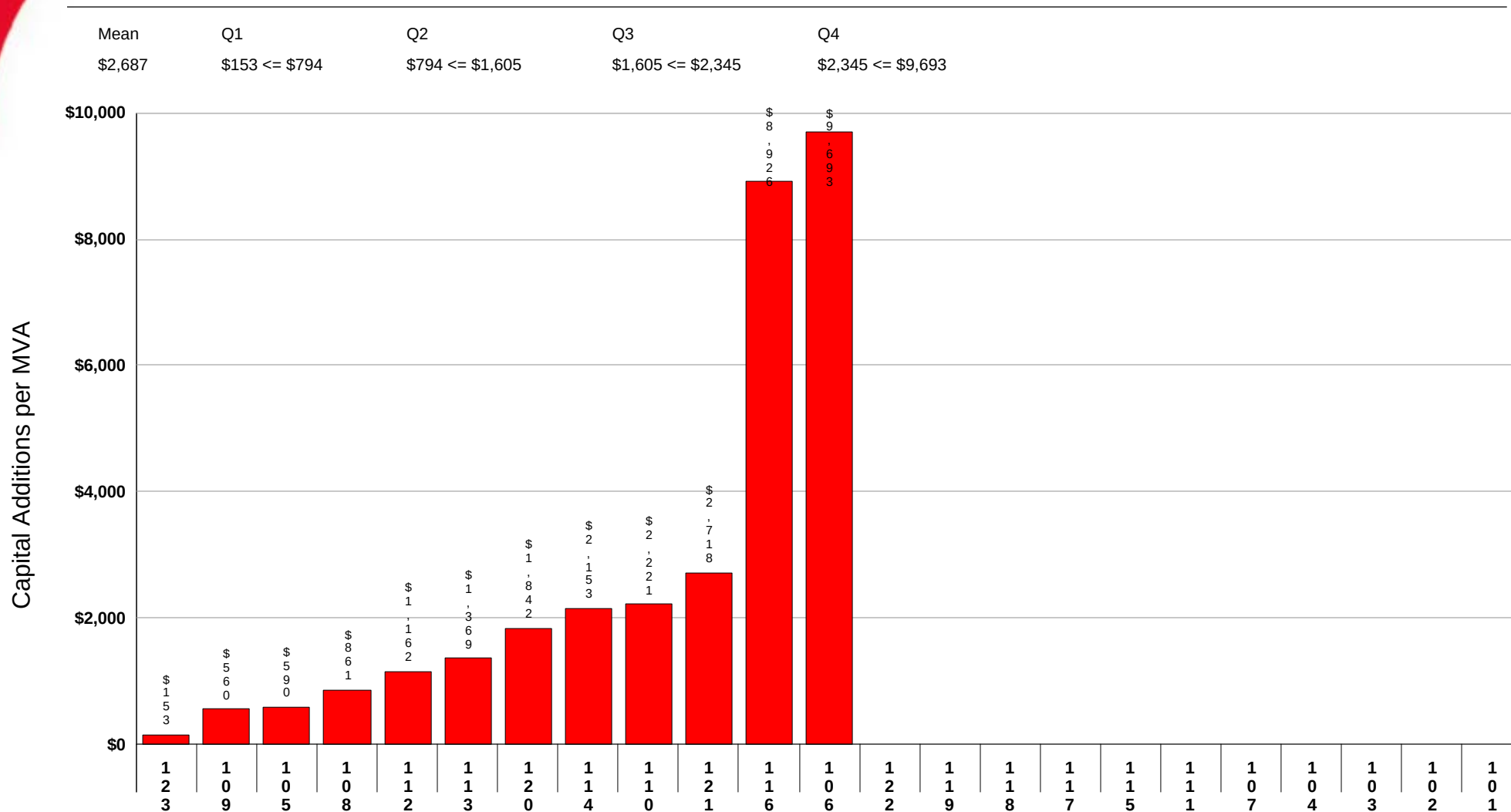
ID Code: 7008

Page: 1341

Only companies with all the data are shown.

Transmission Substation Capital Additions

Per Transmission MVA



Source/Calculation: SUM{B.3}/SUM{AQ.12}

Volume: T&D Substation Statistics, Final Report, 2006

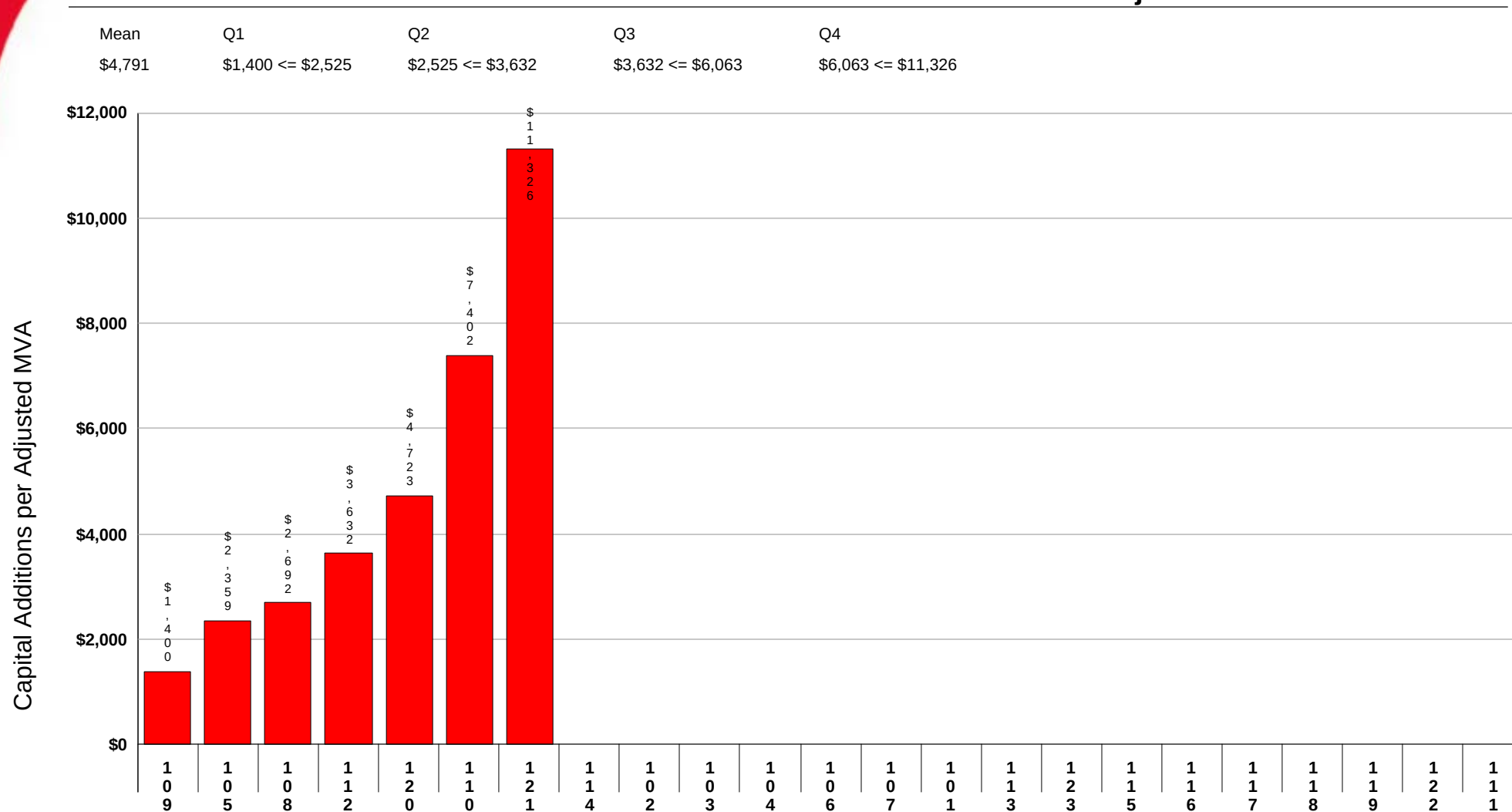
ID Code: 27160

Page: 1342

Only companies with all the data are shown.

Transmission Substation Capital Additions

Per Adjusted Transmission MVA



Source/Calculation: SUM{B.3}/(SUM{AQ.12}*AQ.14.2)

Volume: T&D Substation Statistics, Final Report, 2006

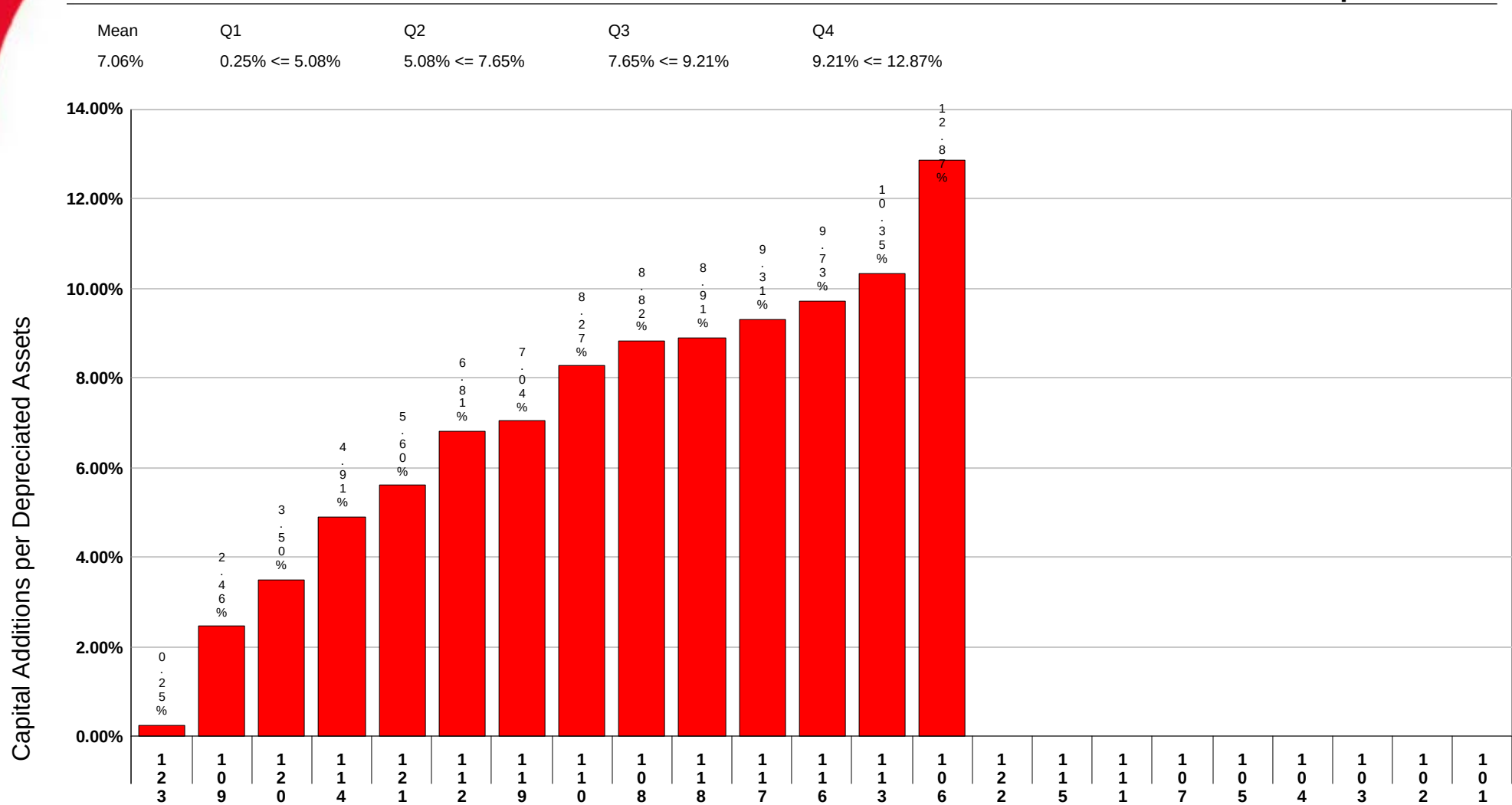
ID Code:2213

Page: 1343

Only companies with all the data are shown.

3-Year Average Transmission Substation Capital Additions

Per Assets Less Depreciation



Source/Calculation: ((SUM{B.3})*(B.11.1-B.15.2)+(B.9.1)/(B.13.1-B.17.3)+(B.9.2)/(B.13.2-B.17.4))/3

Volume: T&D Substation Statistics, Final Report, 2006

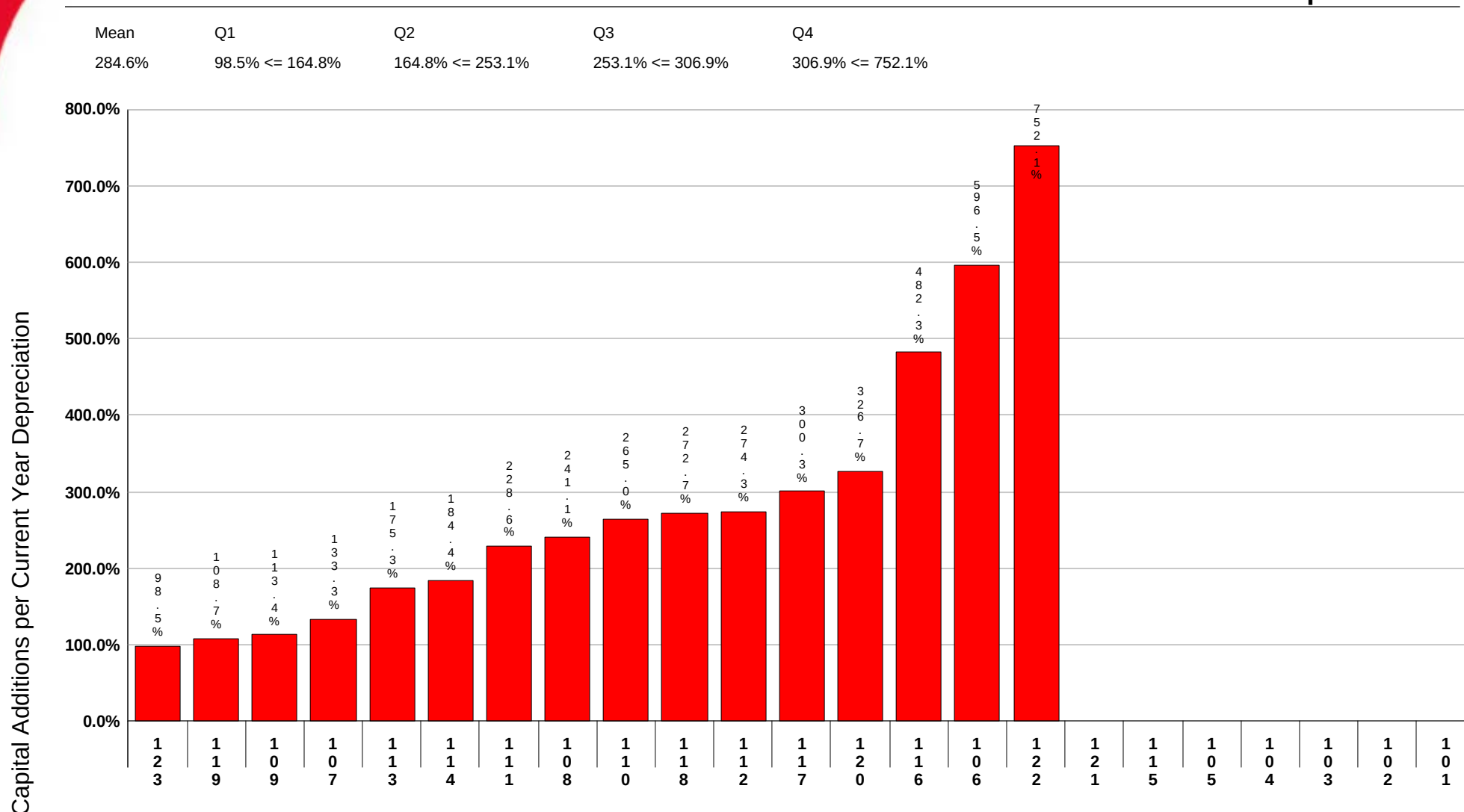
ID Code:6492

Page: 1345

Only companies with all the data are shown.

Substation Capital Additions

Per Current Year Depreciation



Source/Calculation: (SUM{B.3}+SUM{B.6})/SUM{B.19}

Volume: T&D Substation Statistics, Final Report, 2006

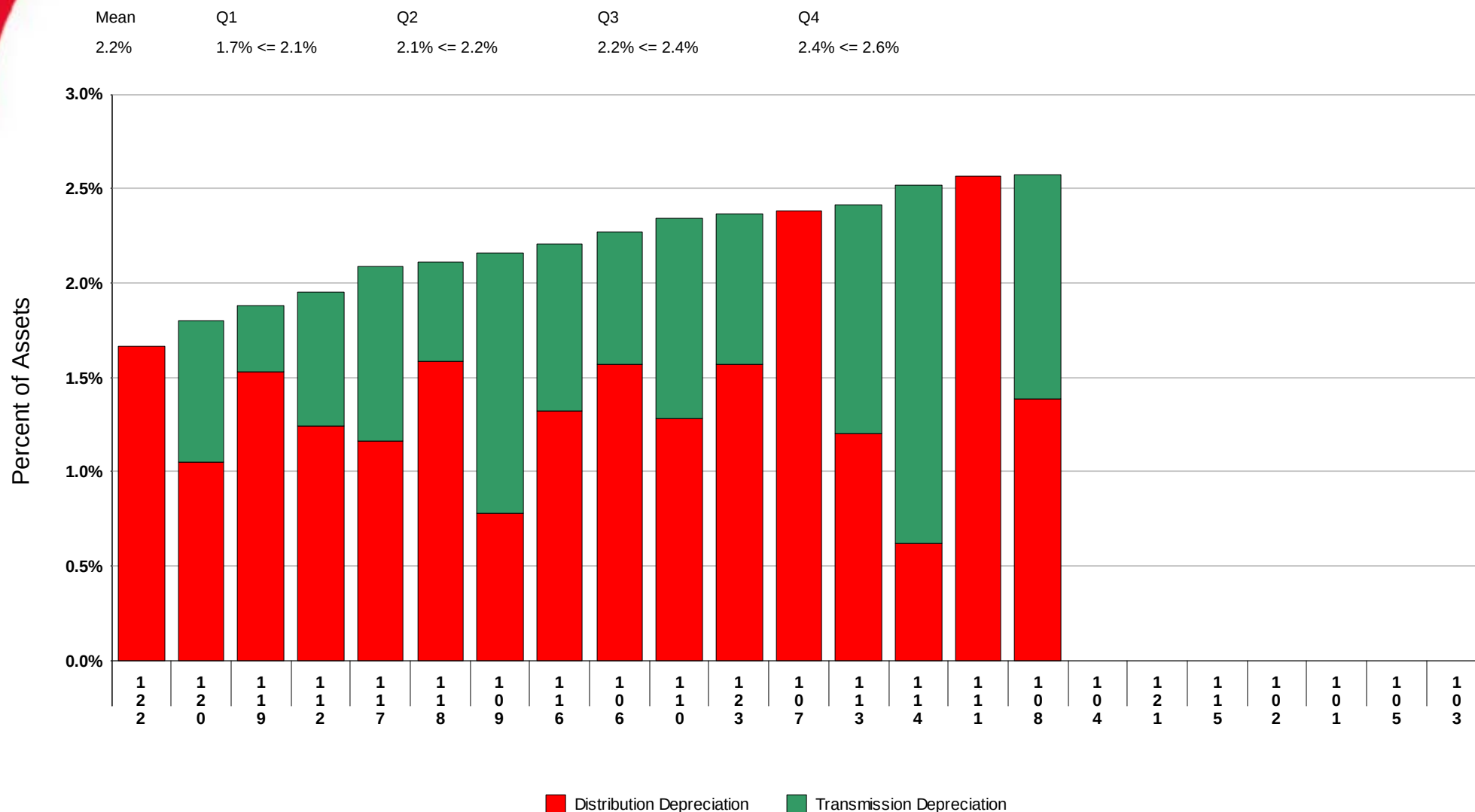
ID Code: 27417

Page: 1346

Only companies with all the data are shown.

Current Year T&D Substation Depreciation Charges

As a Percent of Assets



Source/Calculation: B.19.1/SUM{B.11}

Volume: T&D Substation Statistics, Final Report, 2006

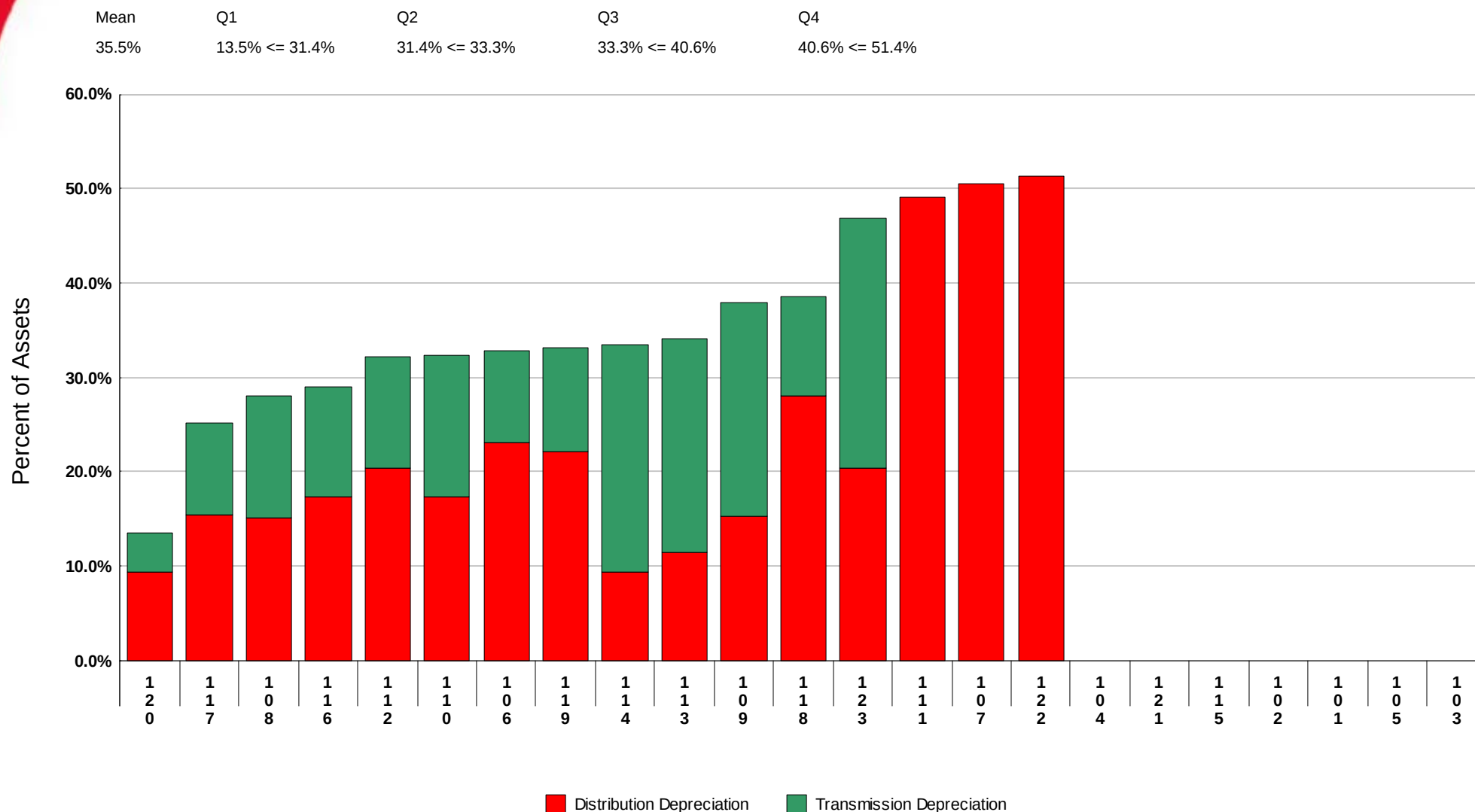
ID Code: 9590

Page: 1349

Calculation shown is for the first piece of the stacked bar only.

Accumulated T&D Substation Depreciation Charges

As a Percent of T&D Substation Assets



Source/Calculation: B.15.1/SUM{B.11}

Volume: T&D Substation Statistics, Final Report, 2006

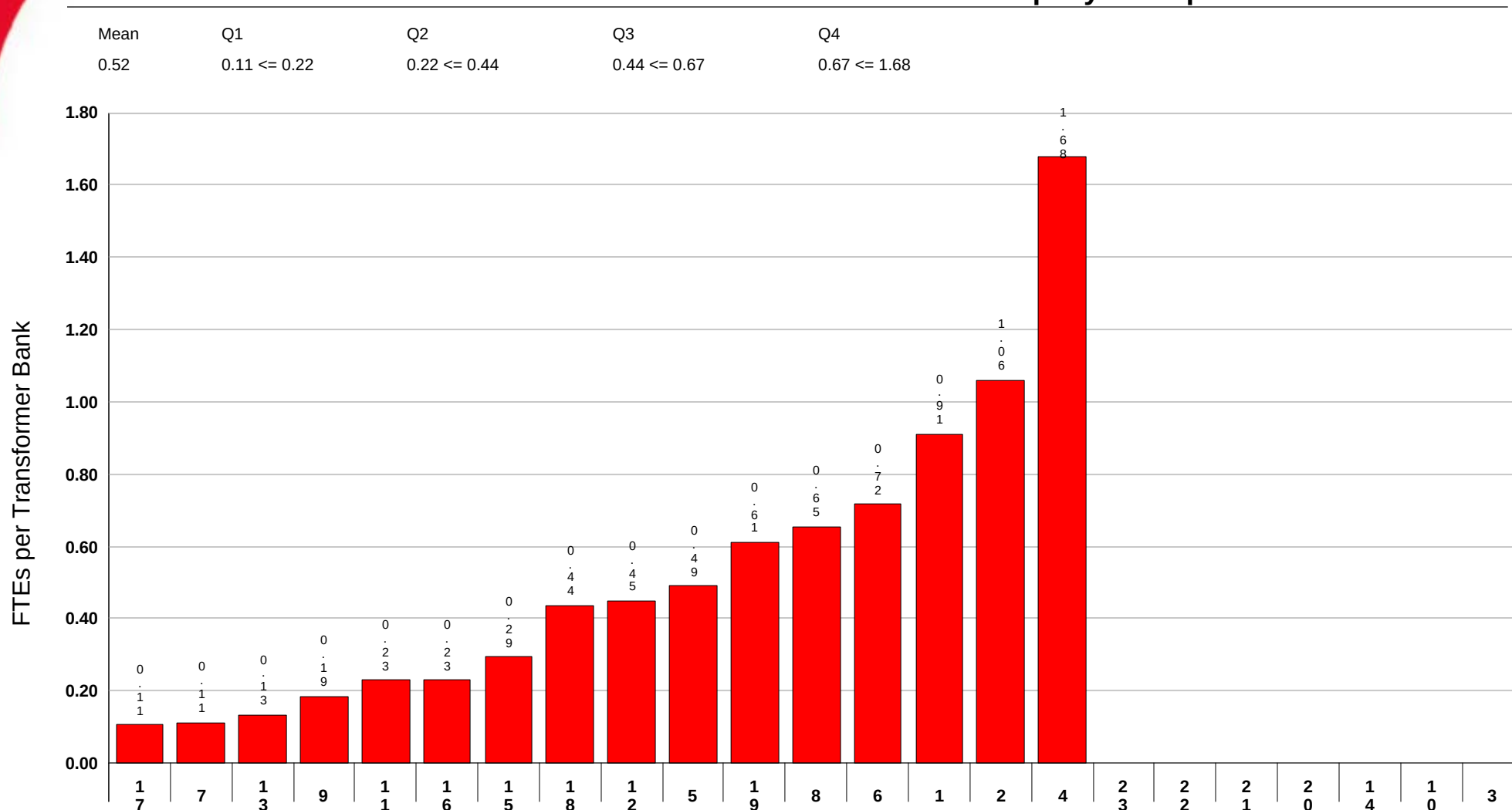
ID Code: 2300130

Page: 1350

Calculation shown is for the first piece of the stacked bar only.

Substation Staffing Level

Company FTEs per Transformer Bank



Source/Calculation: (SUM{P.3})/(SUM{AQ.2}+SUM{AQ.3})

Volume: T&D Substation Statistics, Final Report, 2006

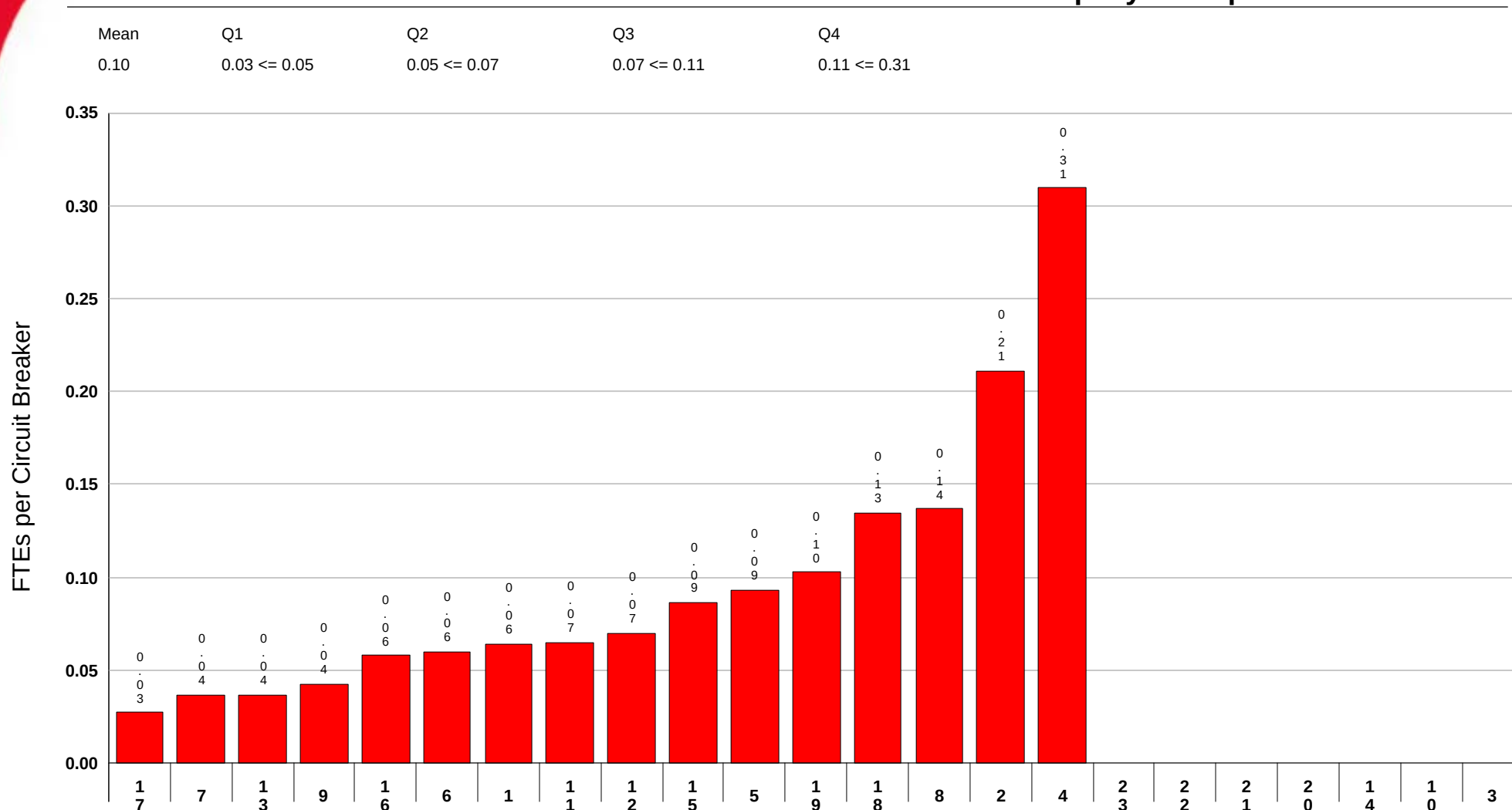
ID Code: 27344

Page: 1351

Only companies with all the data are shown.

Substation Staffing Level

Company FTEs per Circuit Breaker



Source/Calculation: SUM{P.3}/SUM{AQ.4}

Volume: T&D Substation Statistics, Final Report, 2006

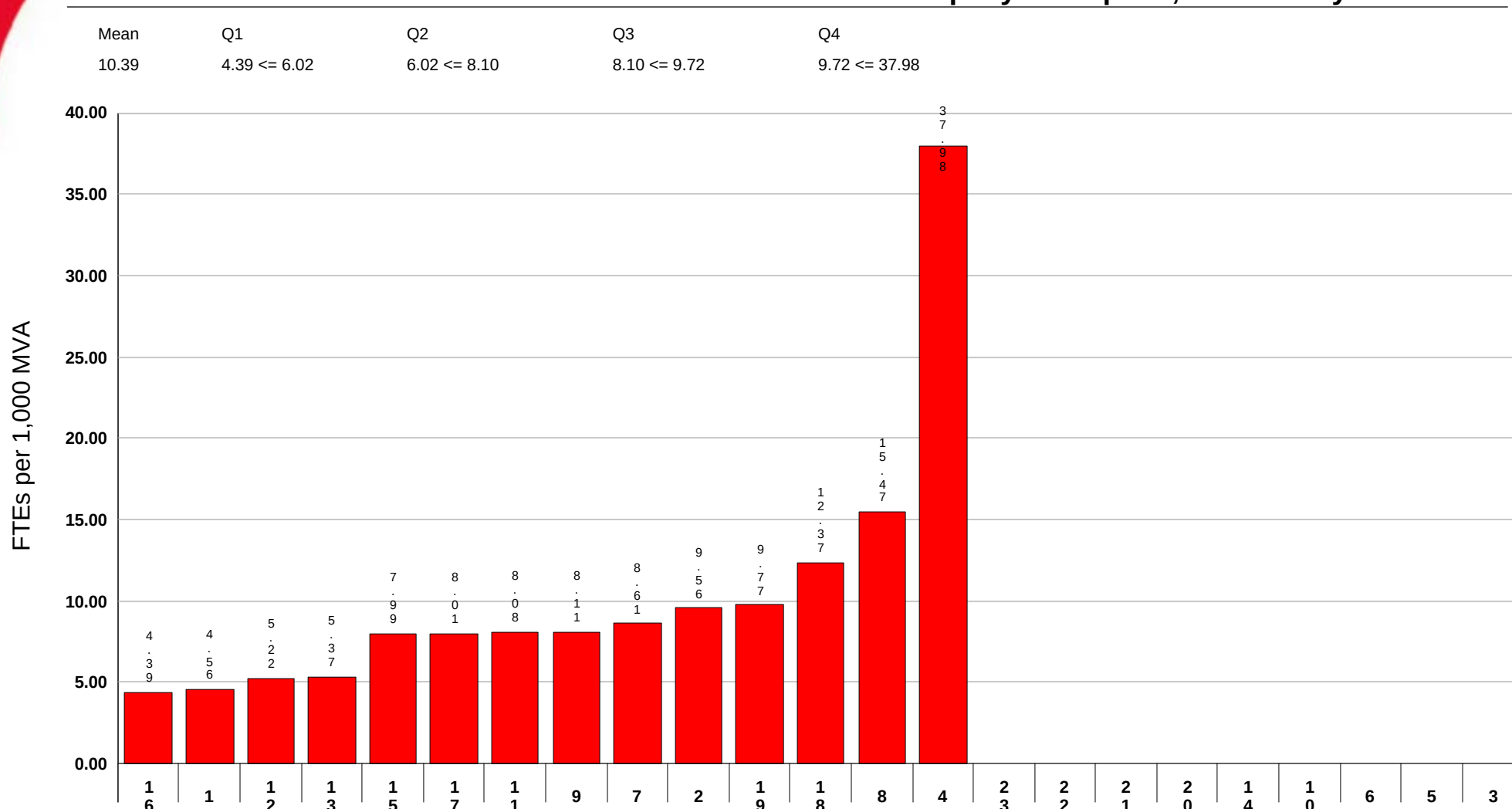
ID Code: 27343

Page: 1352

Only companies with all the data are shown.

Substation Staffing Level

Company FTEs per 1,000 Total System MVA



Source/Calculation: $(\text{SUM}\{P.3\}) / ((\text{SUM}\{AQ.12\} + \text{SUM}\{AQ.13\}) / 1000)$

Volume: T&D Substation Statistics, Final Report, 2006

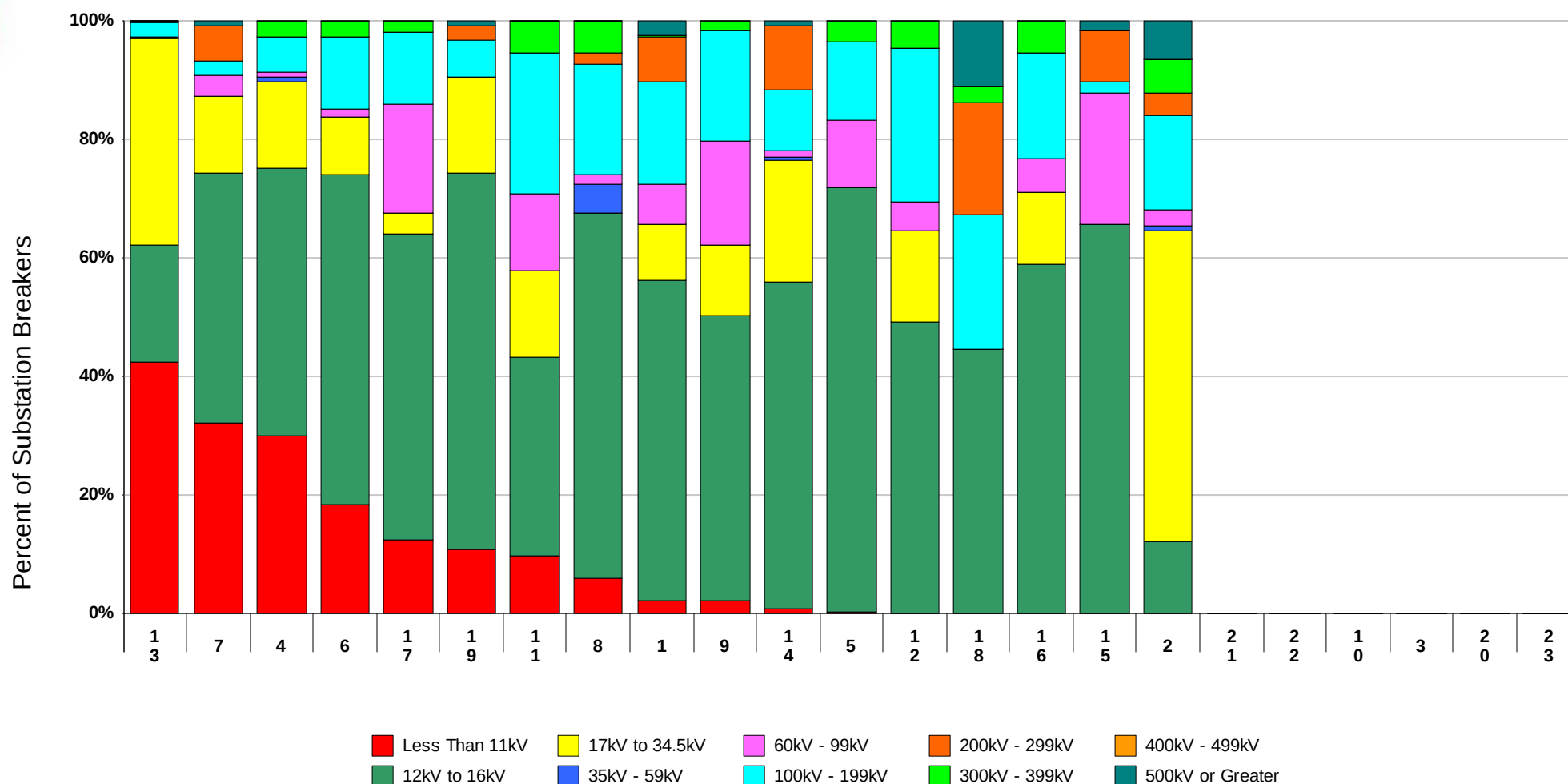
ID Code: 2016

Page: 1353

Only companies with all the data are shown.

Company-Owned Transmission Substation Breakers

By Voltage Class



Source/Calculation: AQ.4.10/SUM{AQ.4}

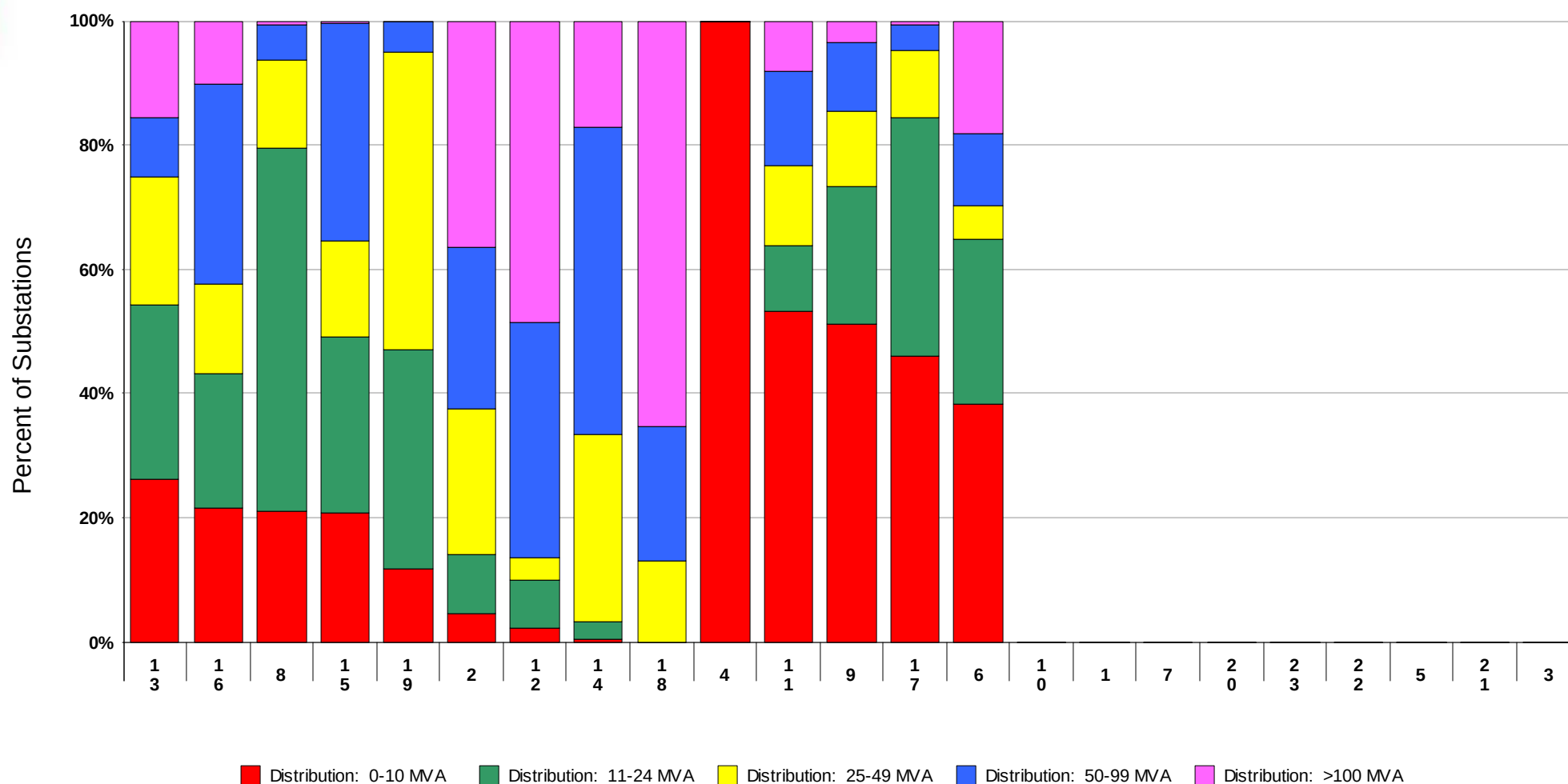
Volume: T&D Substation Statistics, Final Report, 2006

ID Code: 27403

Page: 1355

Calculation shown is for the first piece of the stacked bar only.

Company-Owned Substations - Distribution By Size



Source/Calculation: AQ.6.1/(AQ.6.1+AQ.6.2+AQ.6.3+AQ.6.4+AQ.6.5)

Volume: T&D Substation Statistics, Final Report, 2006

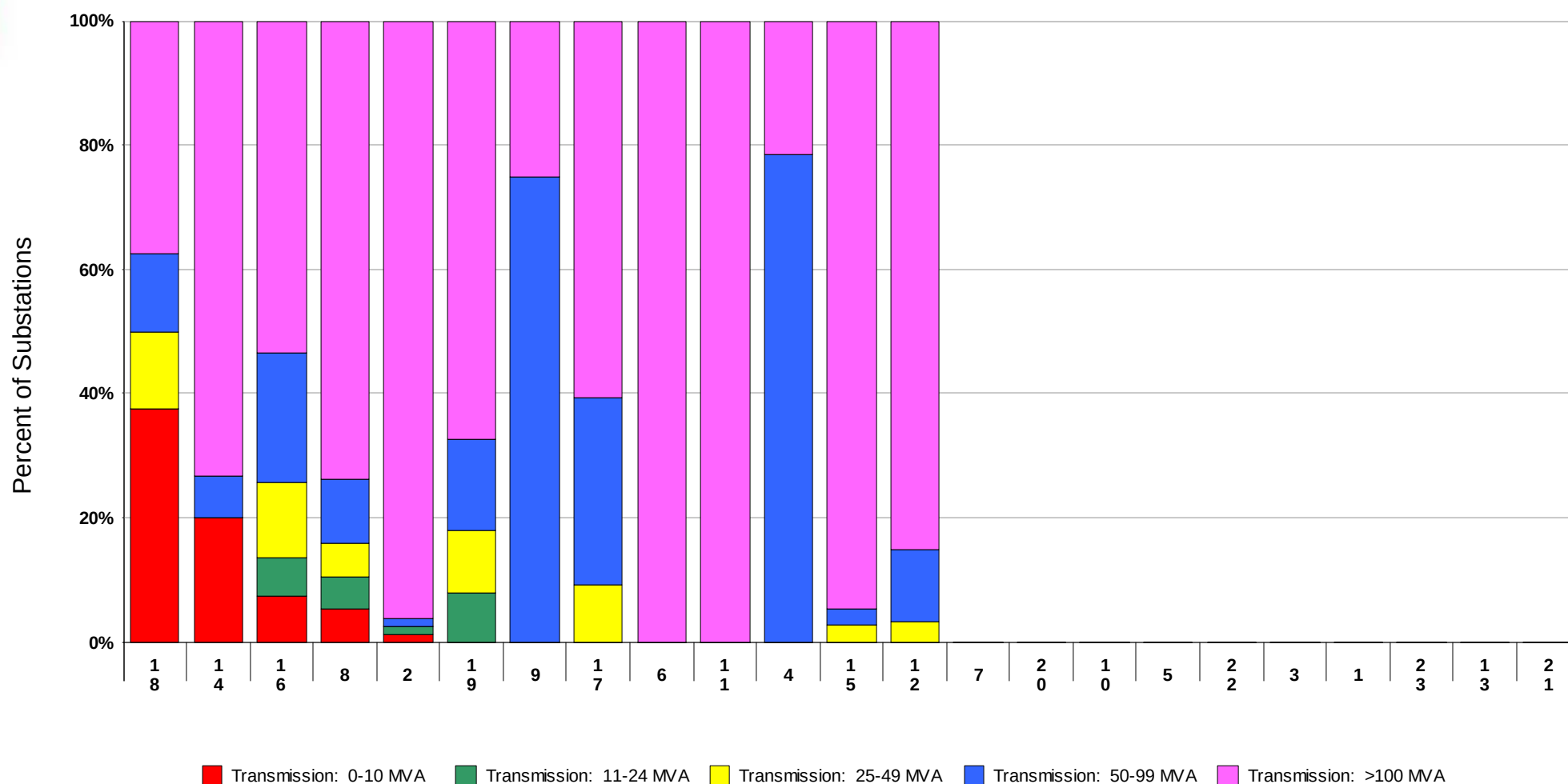
ID Code:1596

Page:1356

Calculation shown is for the first piece of the stacked bar only.

Company-Owned Substations - Transmission

By Size



Source/Calculation: AQ.6.6/(AQ.6.6+AQ.6.7+AQ.6.8+AQ.6.9+AQ.6.10)

Volume: T&D Substation Statistics, Final Report, 2006

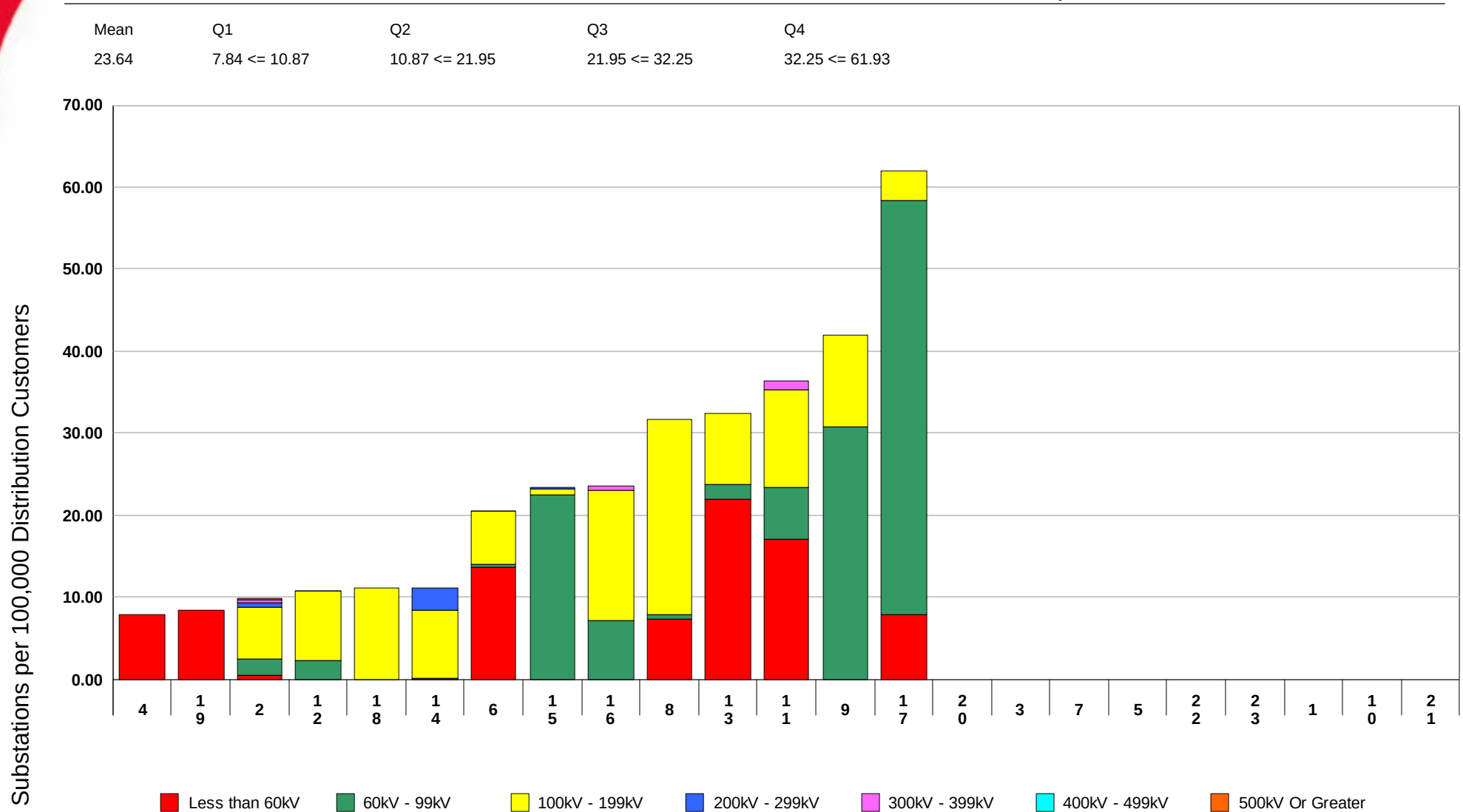
ID Code:1668

Page:1357

Calculation shown is for the first piece of the stacked bar only.

Company-Owned Substations by High-Side Voltage - Distribution

Per 100,000 Distribution Customers



Source/Calculation: AQ.7.14/(A.2.2/100000)

Volume: T&D Substation Statistics, Final Report, 2006

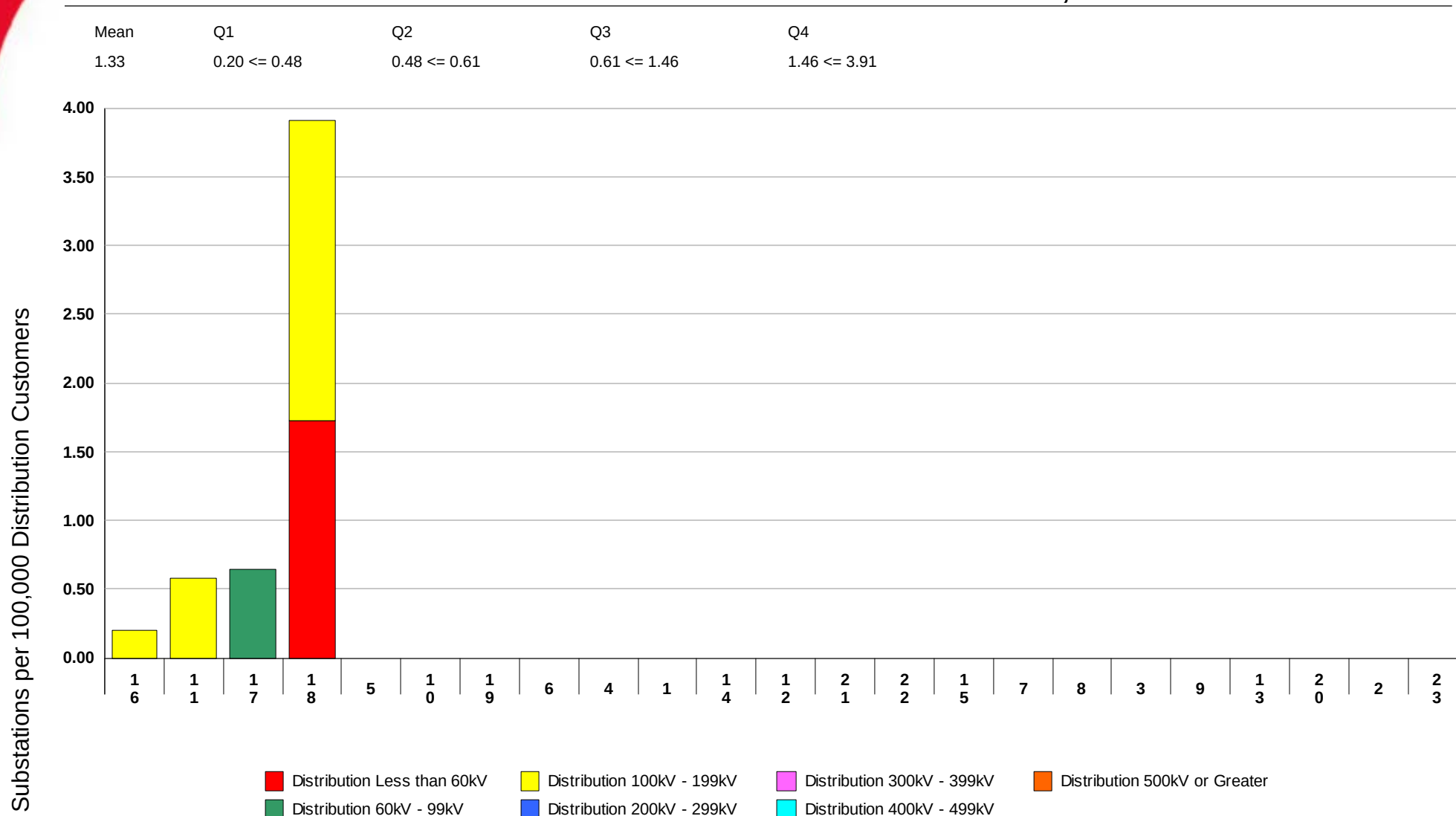
ID Code:8127

Page:1358

Calculation shown is for the first piece of the stacked bar only.

Customer-Owned Substations, Company Maintained

Per 100,000 Distribution Customers



Source/Calculation: AQ.9.14/(A.2.2/100000)

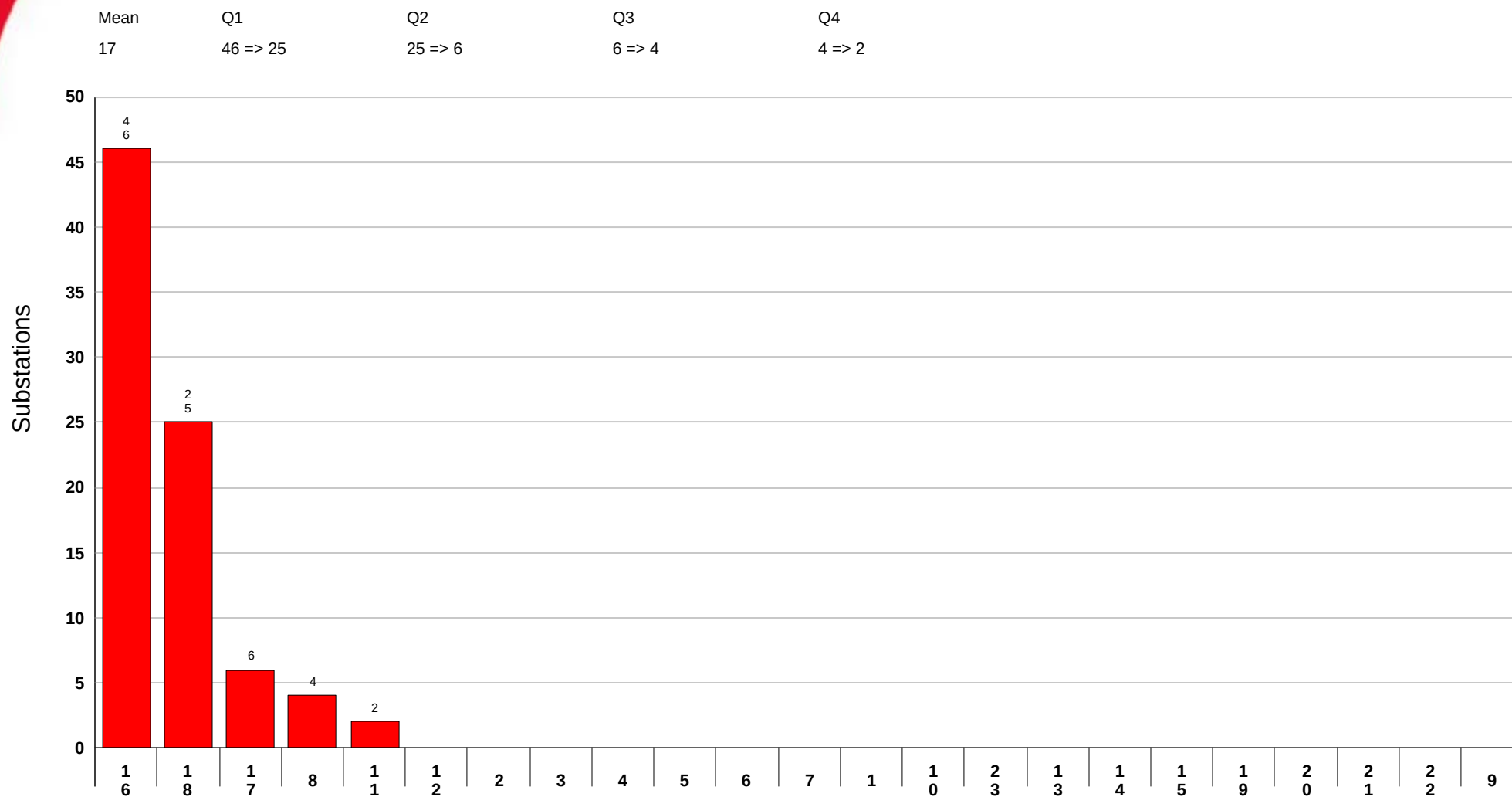
Volume: T&D Substation Statistics, Final Report, 2006

ID Code: 27486

Page: 1360

Calculation shown is for the first piece of the stacked bar only.

Substations Owned By Customers But Maintained By Utility



Source/Calculation: SUM{AQ.9}

Volume: T&D Substation Statistics, Final Report, 2006

ID Code: 6292

Page: 1362

Only companies with all the data are shown.

Distribution Substation Types

Company Owned

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:
1. Wholesale (Muni/Coops):	-	9	-	-	-	-	-	4		-	-	-	-	-		264	3	5		-	-	-	-	35.6
2. Large Industrial:	-	99	-	-	-	-	-	6	2	-	-	-	6	-		-		24	90	-	-	-	-	28.4
3. Independent Power Producers:	-	78	-	-	-	-	-	3	1	-	-	-	-	-		26				-	-	-	-	13.5
4. Company Generation:	-	-	-	-	-	16	-	5		-	-	-	-	-		19				-	-	-	-	5.0
5. Interconnects:	-	15	-	-	-	-	-	7	2	-	-	-	-	-		104				-	-	-	-	16.0
99. Other:	-	1	-	-	-	1794	-	-		-	-	-	-	-		-				-	-	-	-	299.2

Source/Calculation:AQ.10.1

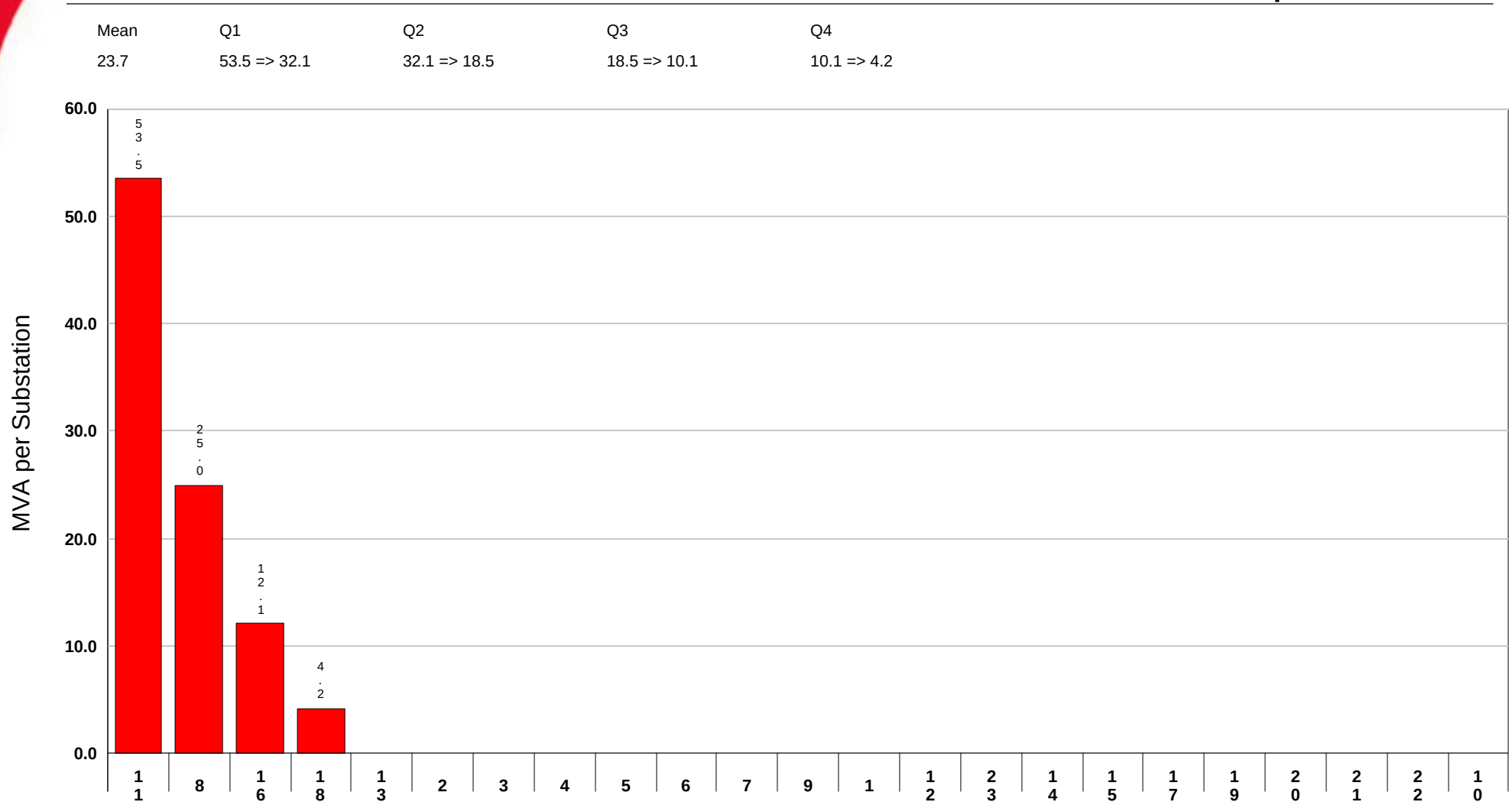
Volume: T&D Substation Statistics, Final Report, 2006

ID Code:10556

Page:1363

MVA for Customer-Owned Utility Maintained Substations

MVA per Substation



Source/Calculation: AQ.11.1/SUM{AQ.9}

Volume: T&D Substation Statistics, Final Report, 2006

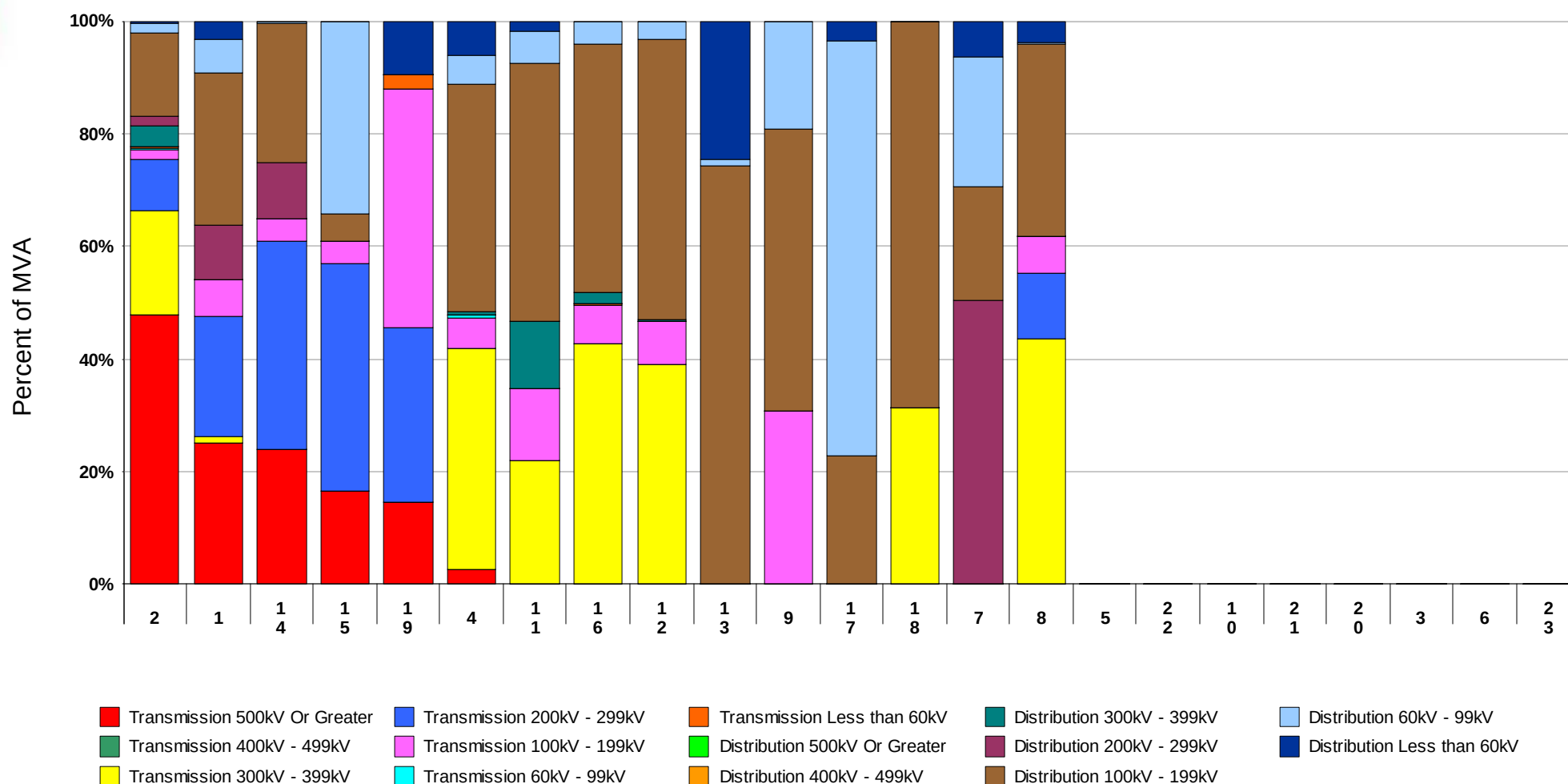
ID Code: 3131

Page: 1364

Only companies with all the data are shown.

Total Substation MVA Installed

By Voltage



Source/Calculation: AQ.12.1/(SUM{AQ.12}+SUM{AQ.13})

Volume: T&D Substation Statistics, Final Report, 2006

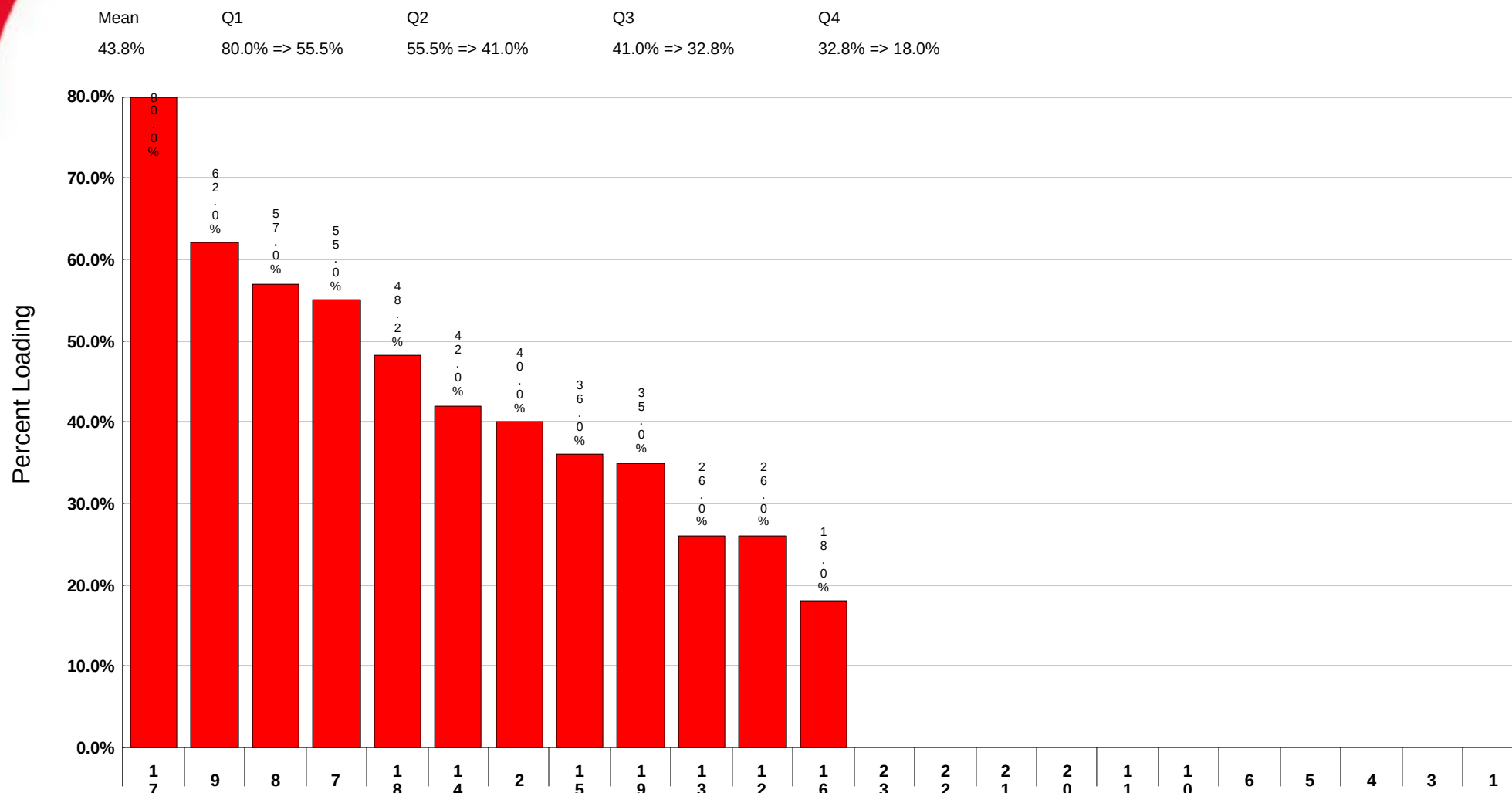
ID Code:8774

Page:1365

Calculation shown is for the first piece of the stacked bar only.

Average Percent Loading of Substation Transformers

Load Serving Substations



Source/Calculation:AQ.14.1

Volume: T&D Substation Statistics, Final Report, 2006

ID Code:1608

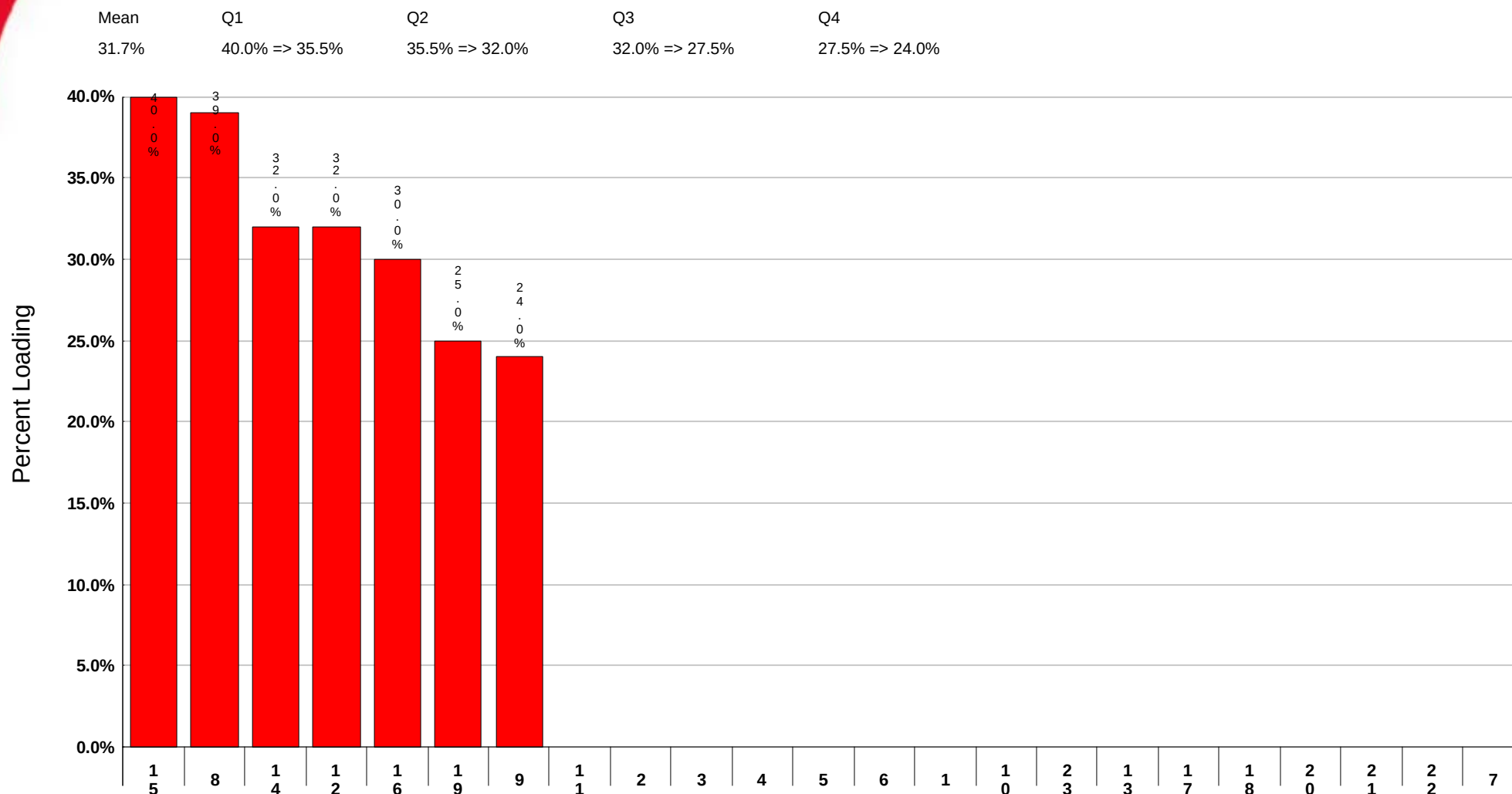
Page: 1366

Only companies with all the data are shown.



Average Percent Loading of Substation Transformers

Auto-Transformation Substations



Source/Calculation:AQ.14.2

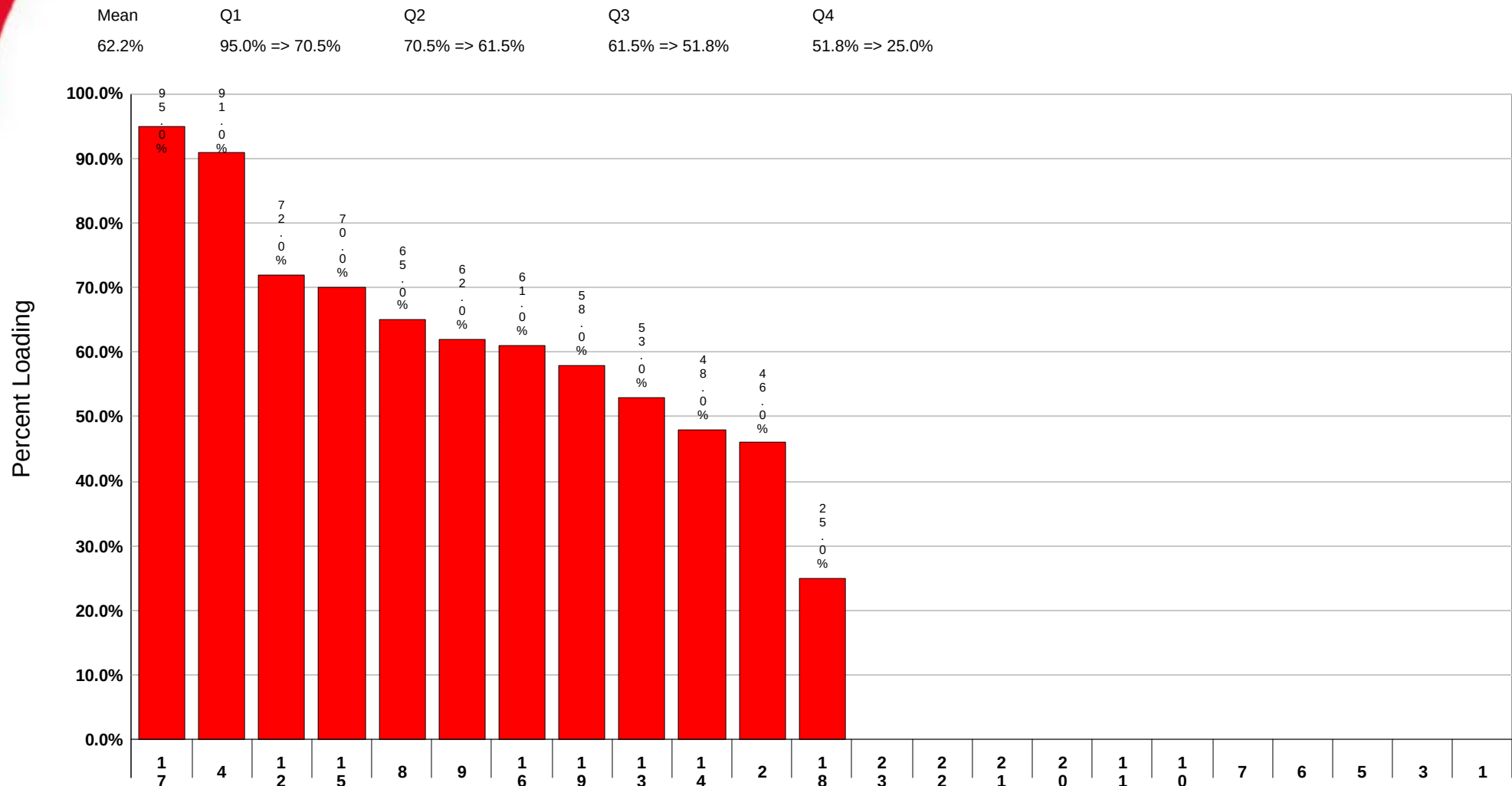
Volume: T&D Substation Statistics, Final Report, 2006

ID Code:1692

Page: 1367

Only companies with all the data are shown.

Average Percent Loading of Substation Transformers (Non-Coincident Peak) Load Serving Substations



Source/Calculation:AQ.15.1

Volume: T&D Substation Statistics, Final Report, 2006

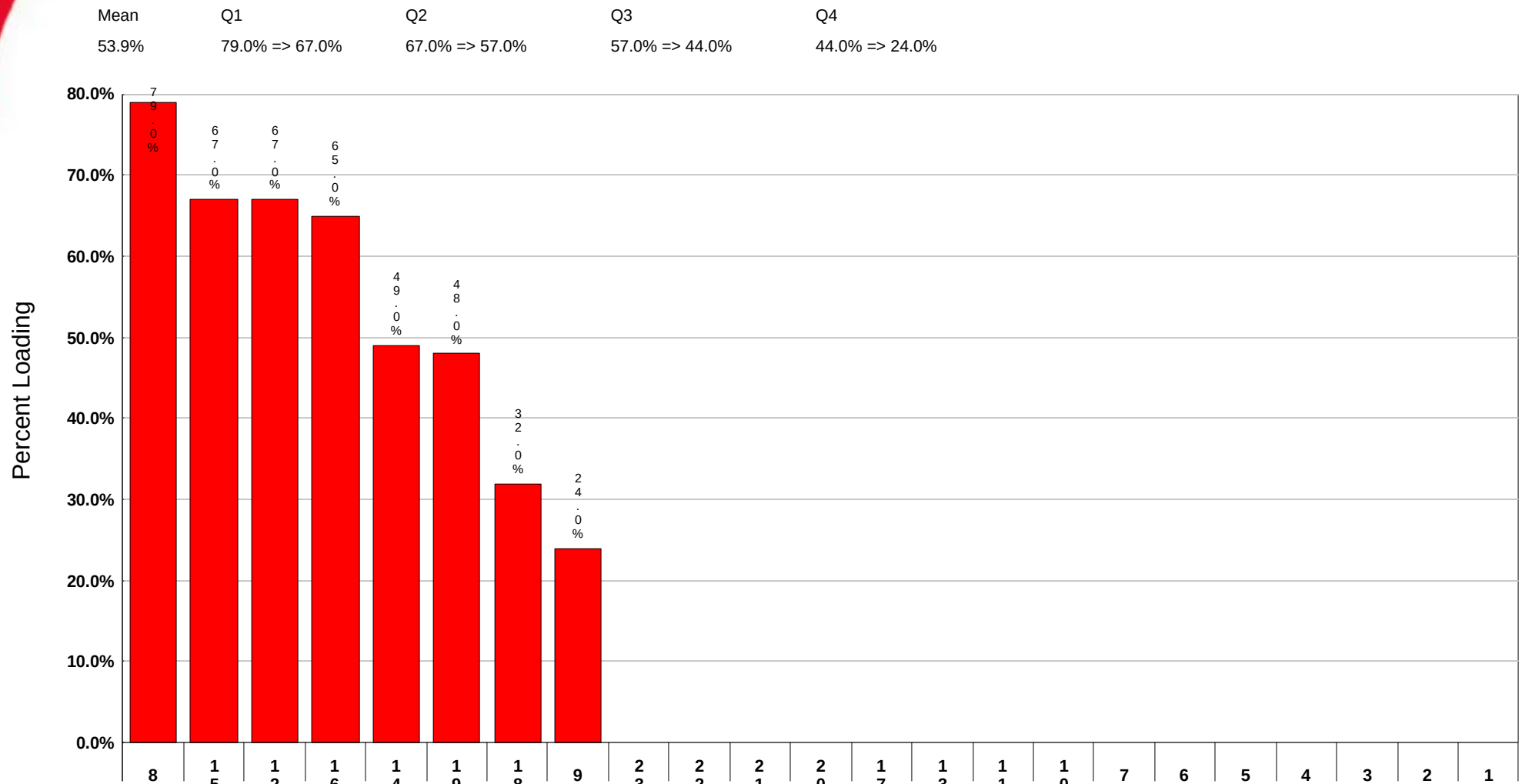
ID Code:27474

Page:1368

Only companies with all the data are shown.

Average Percent Loading of Substation Transformers (Non-Coincident Peak)

Transmission Transformation Substations



Source/Calculation:AQ.15.2

Volume: T&D Substation Statistics, Final Report, 2006

ID Code:27475

Page: 1369

Only companies with all the data are shown.

Substation Transformer Average Loading Definition

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent:
1. Same Definition:		✓		✓			✓	✓	✓			✓	✓	✓	✓	✓		✓						91.7%
99. Other:																			✓					8.3%

Source/Calculation:AQ.16.1

Volume: T&D Substation Statistics, Final Report, 2006

ID Code:2301000

Page:1370

Substation Transformer Average Loading Definition (cont.)

If your definition of substation transformer loading (average) is different from our glossary definition, please provide your definition.

- Average hourly integrated loading at the transformer

Substation Transformer Non-Coincident Peak Loading Definition

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent:
1. Same Definition:		✓		✓				✓	✓			✓	✓	✓	✓	✓		✓						90.9%
99. Describe:																			✓					9.1%

Source/Calculation:AQ.17.1

Volume: T&D Substation Statistics, Final Report, 2006

ID Code:6258

Page:1372

Substation Transformer Non-Coincident Peak Loading Definition (cont.)

If your definition of substation transformer loading (non-coincident peak loading) is different from our definition, please provide your definition.

- Peak hourly integrated loading at the transformer

MVA Nameplate Rating Used

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. FOA:	✓							✓				✓				✓			✓					33.3%
2. FA:									✓		✓		✓		✓			✓						33.3%
3. OA:		✓												✓										13.3%
99. Other:				✓			✓										✓							20.0%

Source/Calculation:AQ.18.1

Volume: T&D Substation Statistics, Final Report, 2006

ID Code:9597

Page:1373

MVA Nameplate Rating Used (cont.)

Which nameplate rating do you predominantly use for MVA?

- ☐ 65 C top rating
- ☐ top rating

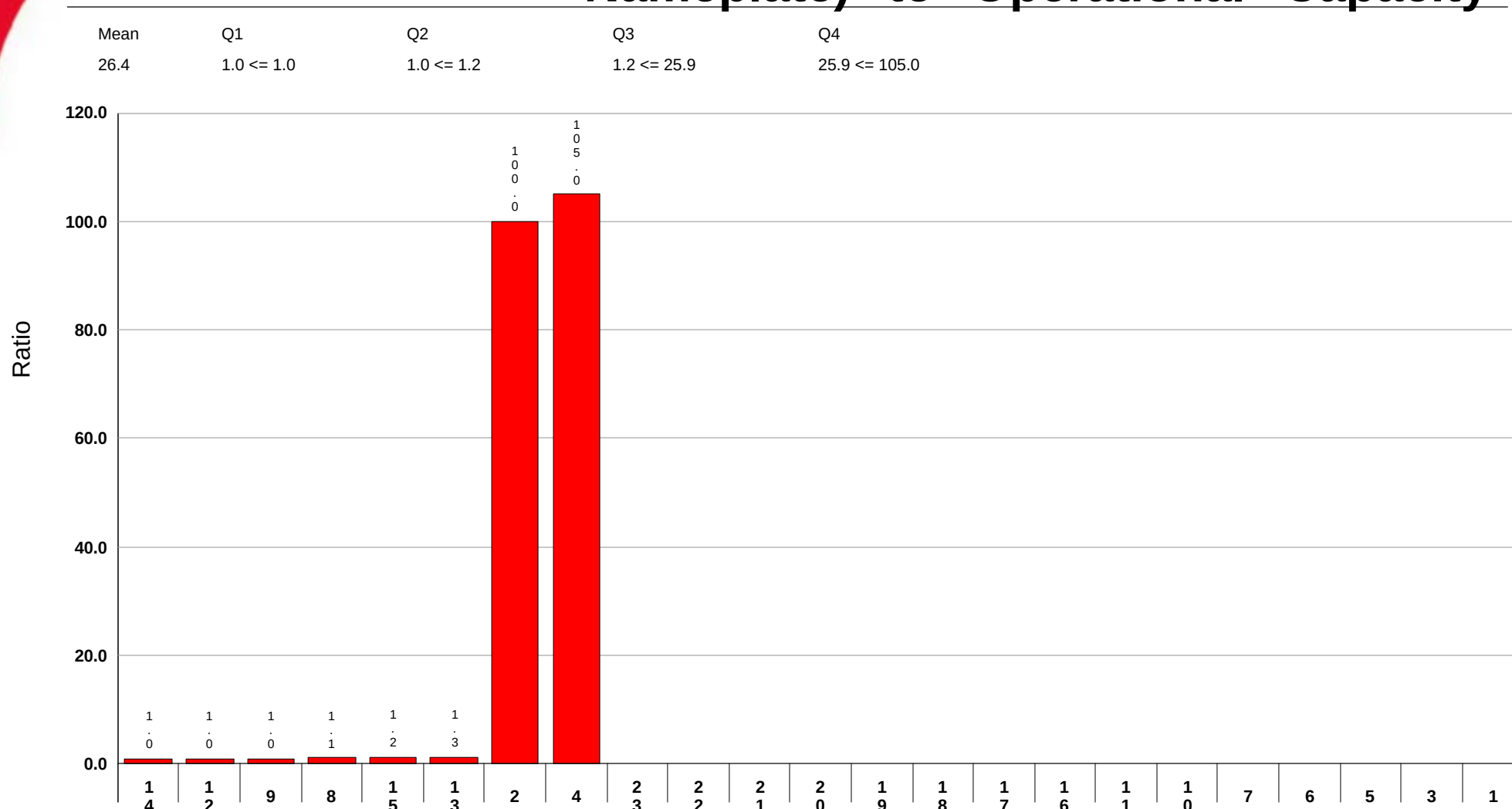
Source/Calculation:AQ.18.99

Volume: T&D Substation Statistics, Final Report, 2006

ID Code:1600251

Page:1373.1

Average Ratio Used to Convert from "Rated (e.g. Nameplate)" to "Operational" Capacity



Source/Calculation:AQ.19.1

Volume: T&D Substation Statistics, Final Report, 2006

ID Code:2300084

Page:1374

Only companies with all the data are shown.

Rules Used to Determine Substation Type

Distribution vs Transmission

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. FERC Definition - a general assessment of use without a specific test:							✓	✓	✓		✓	✓		✓				✓						46.7%
2. Assign Based Upon Predominant Use:												✓							✓					13.3%
3. Divide Substation Into Transmission And Distribution:							✓	✓	✓				✓					✓						33.3%
4. Three Or More 69kV & Above Lines:	✓															✓	✓							20.0%
5. Controlled By ISO:																								0.0%
6. Voltage Level:				✓				✓				✓	✓		✓		✓	✓						46.7%
7. Voltage Conversion Terminals:																								0.0%
8. FERC Eight Factor Test:																								0.0%
9. Dist. does not feed another station:																								0.0%
99. Other:		✓													✓				✓					20.0%

Source/Calculation:AQ.20.1

Volume: T&D Substation Statistics, Final Report, 2006

ID Code:2751

Page:1375

Rules Used to Determine Substation Type (cont.)

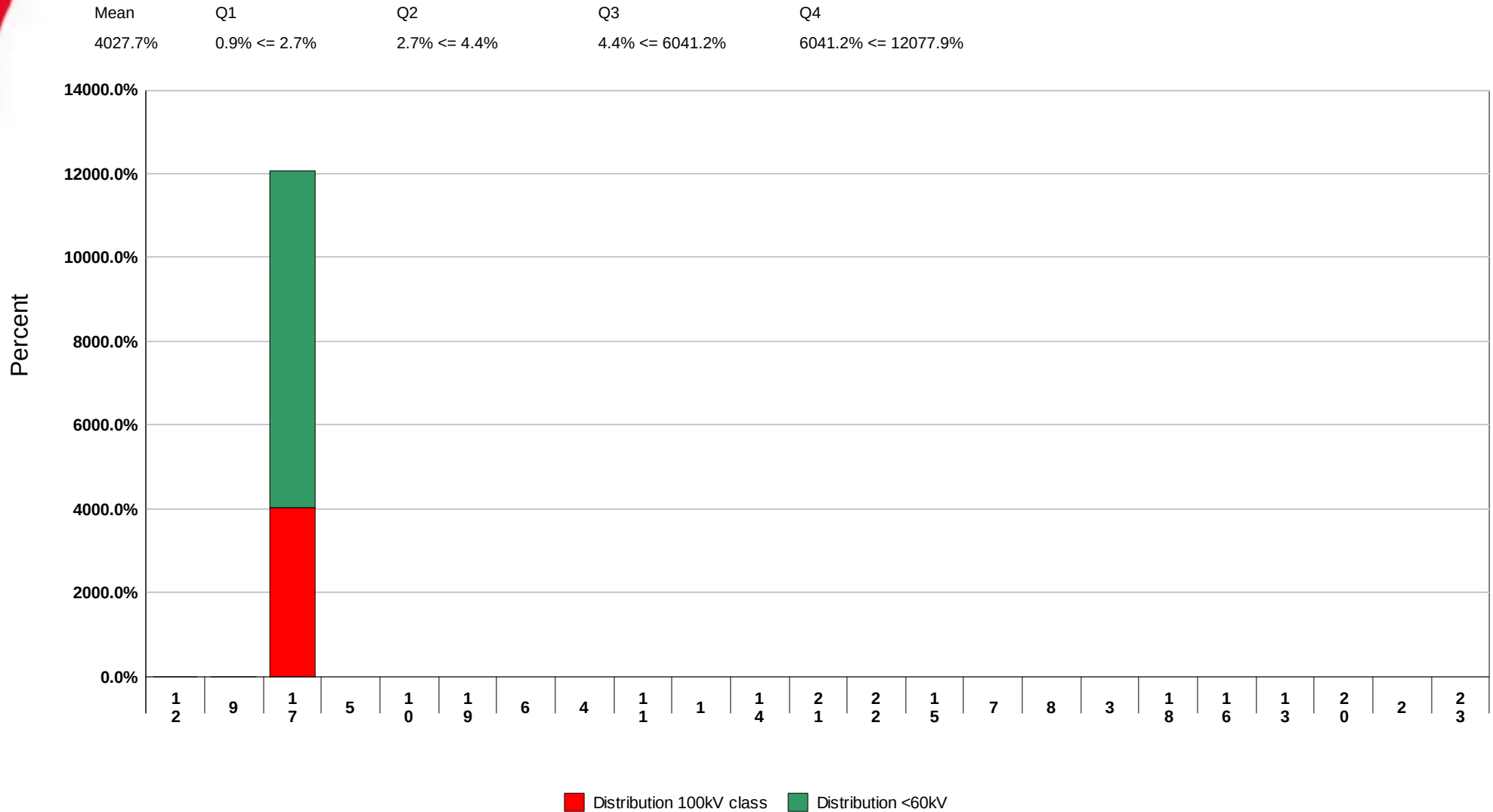
Distribution vs Transmission

What rules of thumb are used to decide whether a substation is distribution or transmission?

- As filed with FERC
- Control center jurisdiction
- H.Q. rules

Distribution "Pole Top" Substations in Service By High Side Voltage Level

As a Percent of Total Substations



Source/Calculation: $AQ.21.1 / (AQ.6.1 + AQ.6.2 + AQ.6.3 + AQ.6.4 + AQ.6.5)$

Volume: T&D Substation Statistics, Final Report, 2006

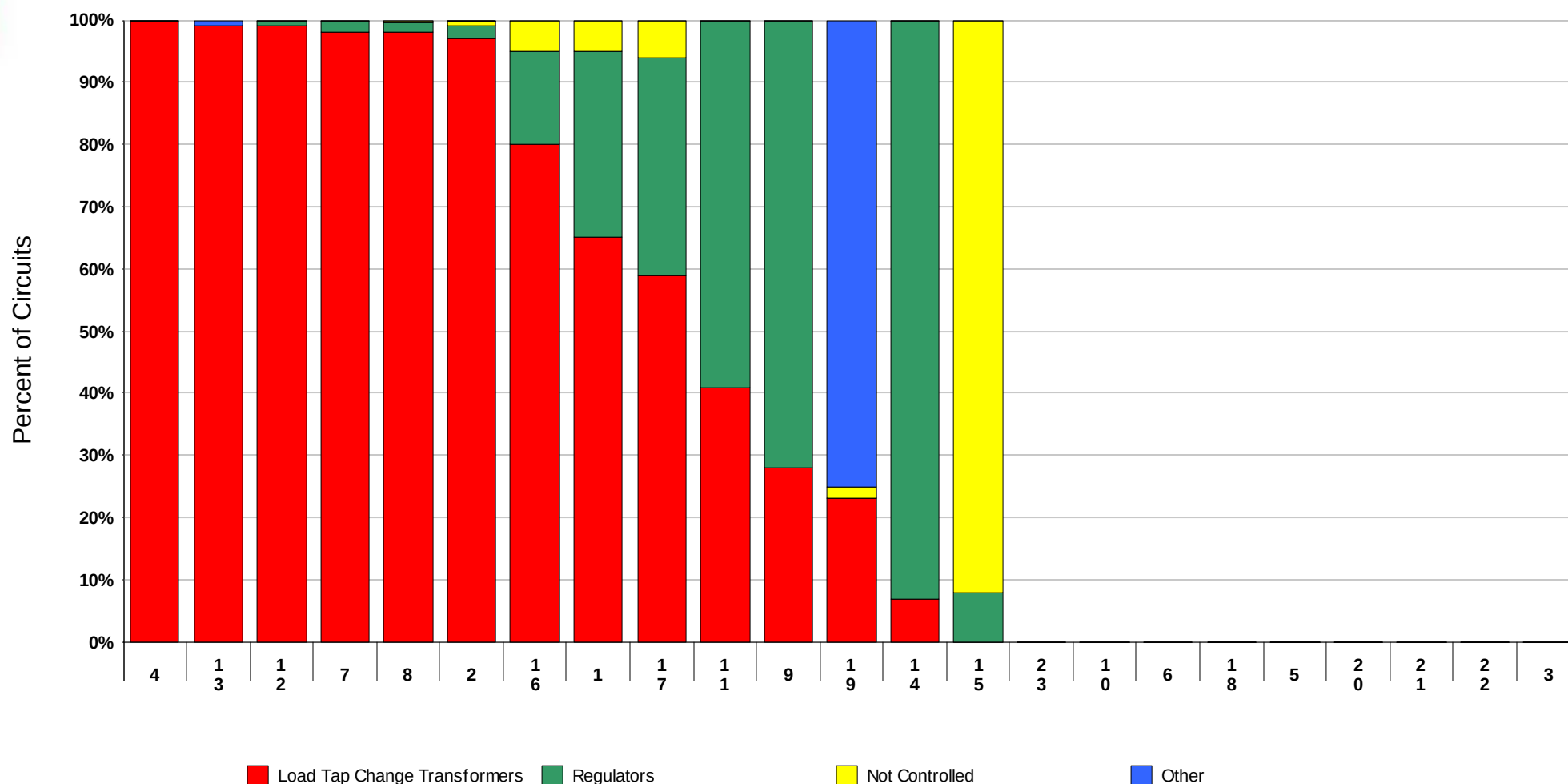
ID Code: 40199

Page: 1377

Calculation shown is for the first piece of the stacked bar only.

Distribution Circuit Control

At the Substation, Inside the Fence



Source/Calculation: AQ.22.1

Volume: T&D Substation Statistics, Final Report, 2006

ID Code: 10553

Page: 1378

Calculation shown is for the first piece of the stacked bar only.

Distribution Circuit Control (cont.)

At the Substation, Inside the Fence

What percentage of distribution circuits are controlled at the substation by the following (inside the fence)?

Capacitor Banks

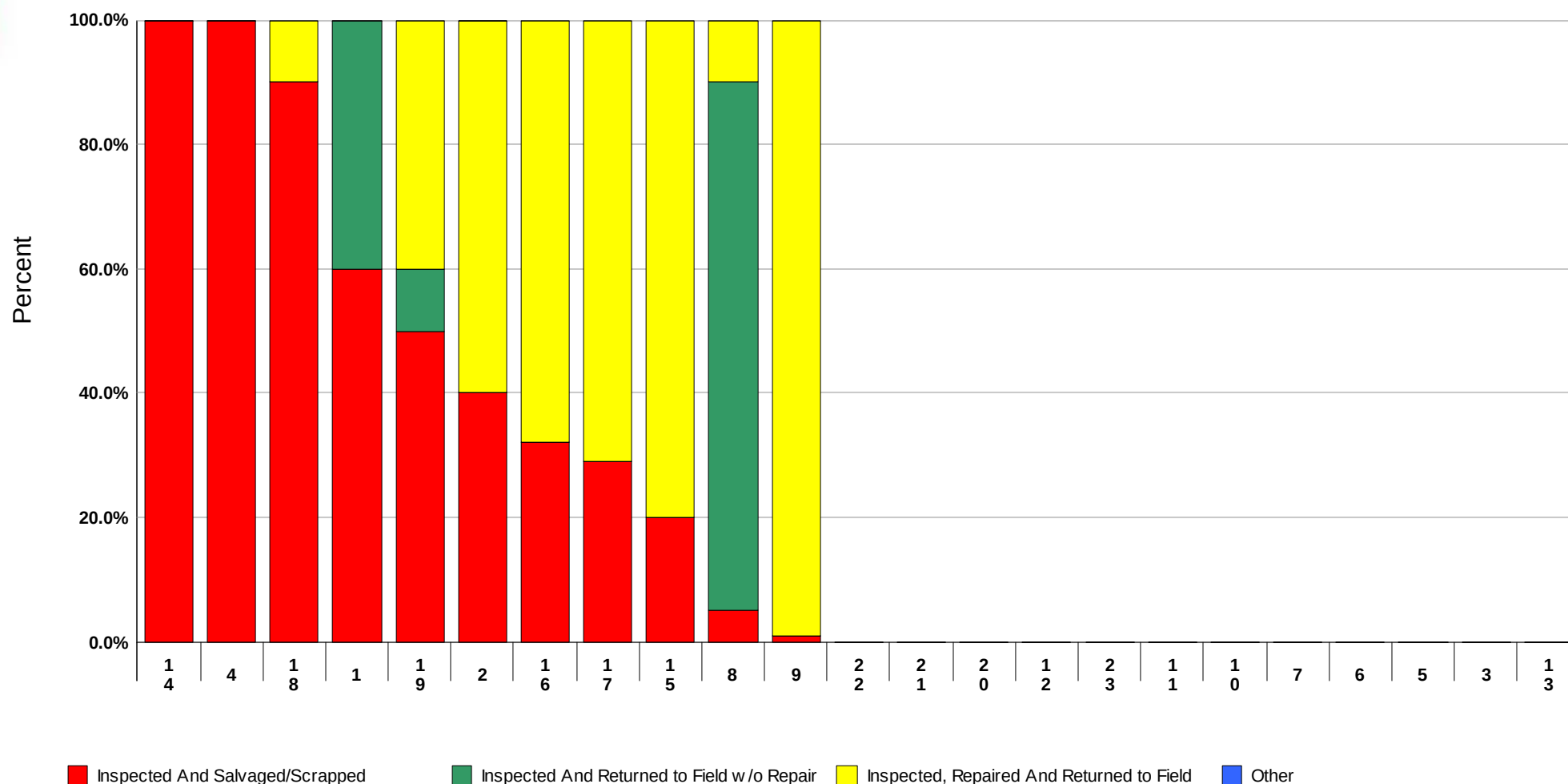
Source/Calculation:AQ.22.99

Volume: T&D Substation Statistics, Final Report, 2006

ID Code:27278

Page:1379

Handling for Substation Transformers Returned From the Field



Source/Calculation:AQ.23.1

Volume: T&D Substation Statistics, Final Report, 2006

ID Code:2300894

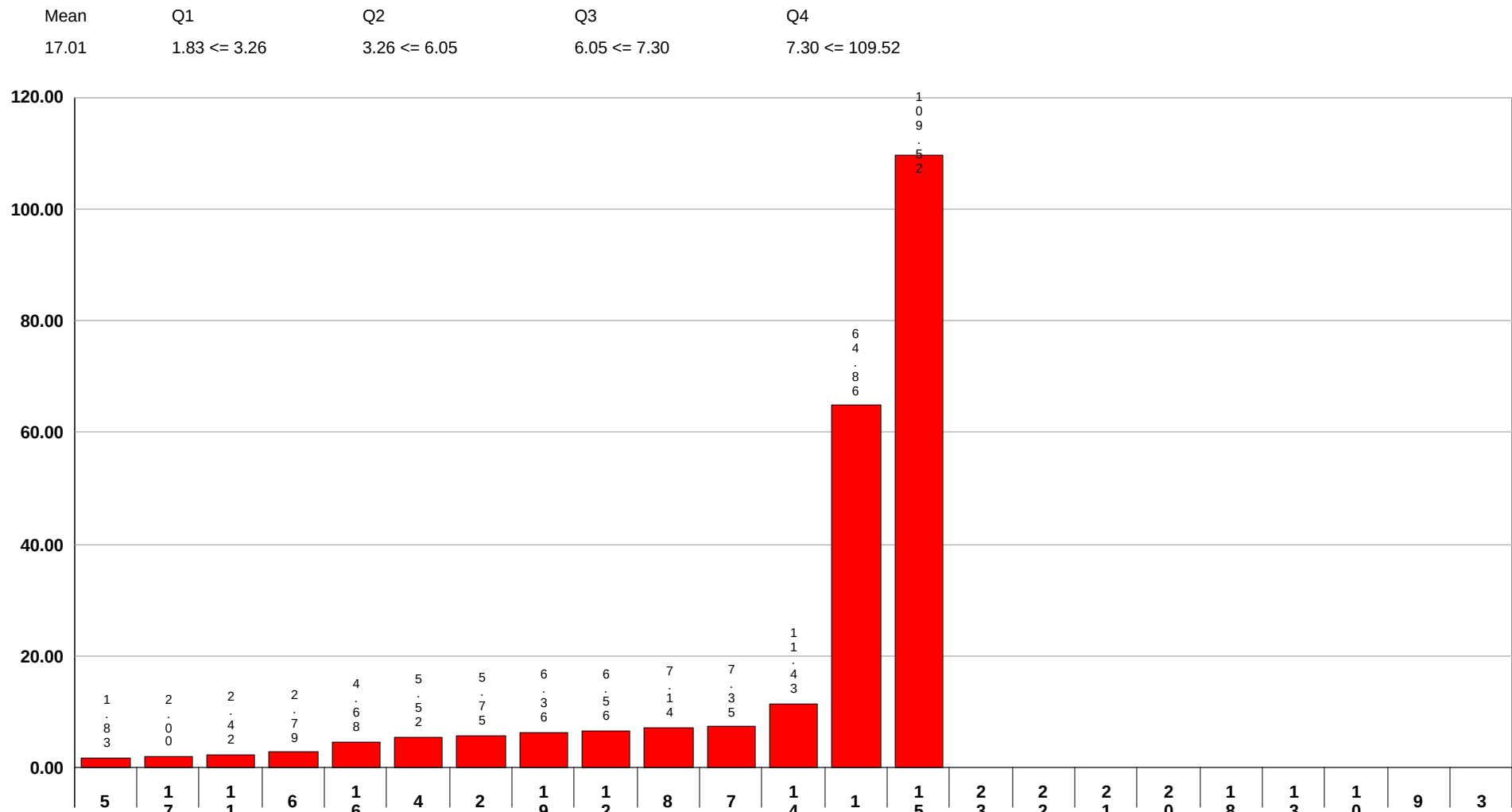
Page: 1380

Calculation shown is for the first piece of the stacked bar only.

Transmission Substation Transformer Spares or Mobiles

Per 100 Transmission Substation Transformers in Service

Spares or Mobiles per 100 Transformers in Service



Source/Calculation: (SUM{AY.3}+SUM{AY.5})/(SUM{AQ.2}/100)

Volume: T&D Substation Statistics, Final Report, 2006

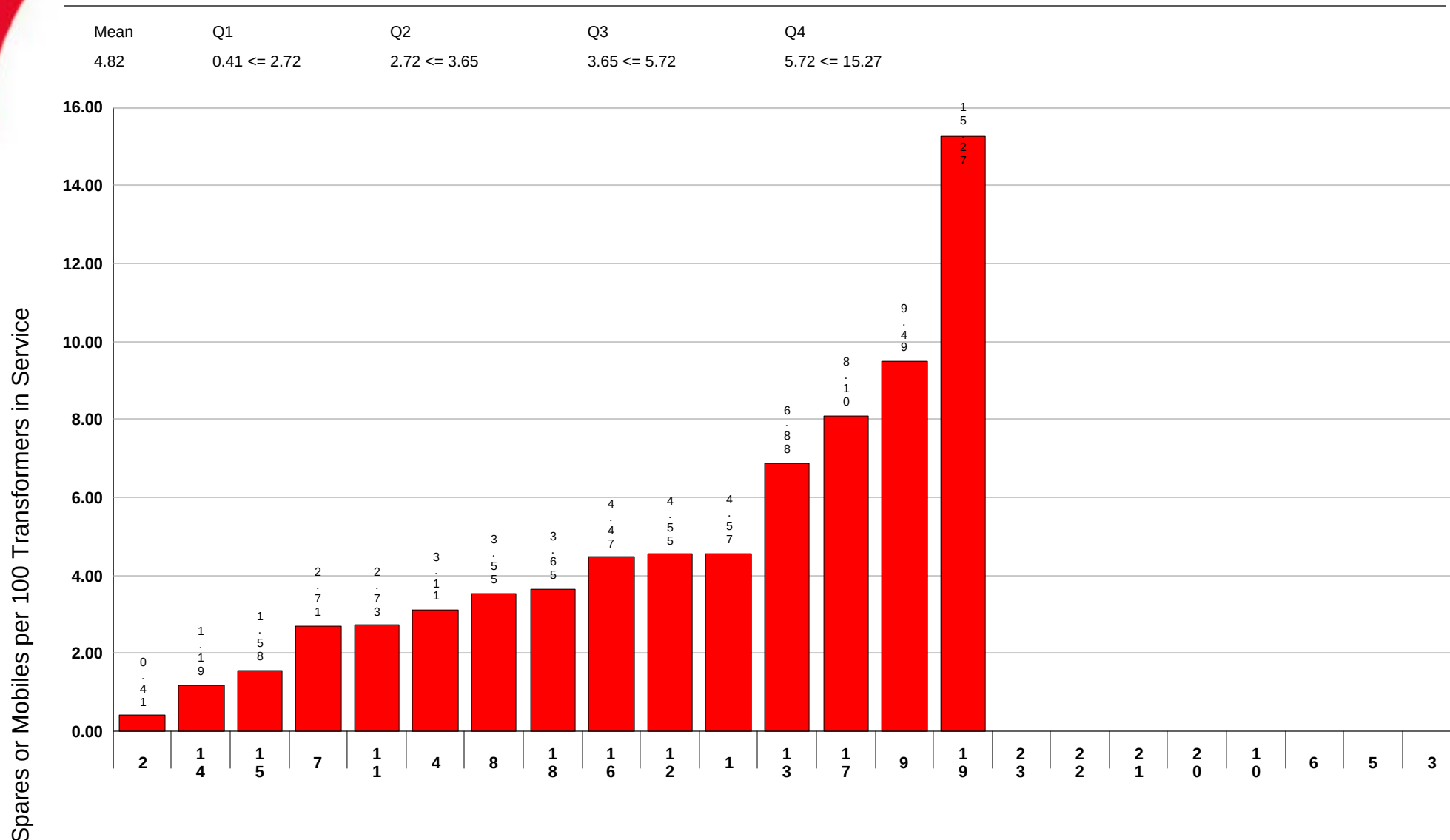
ID Code:1600033

Page:1380.1

Only companies with all the data are shown.

Distribution Substation Transformer Spares or Mobiles

Per 100 Distribution Substation Transformers in Service



Source/Calculation: $(\text{SUM}\{\text{AY}.4\} + \text{SUM}\{\text{AY}.6\}) / (\text{SUM}\{\text{AQ}.3\} / 100)$

Volume: T&D Substation Statistics, Final Report, 2006

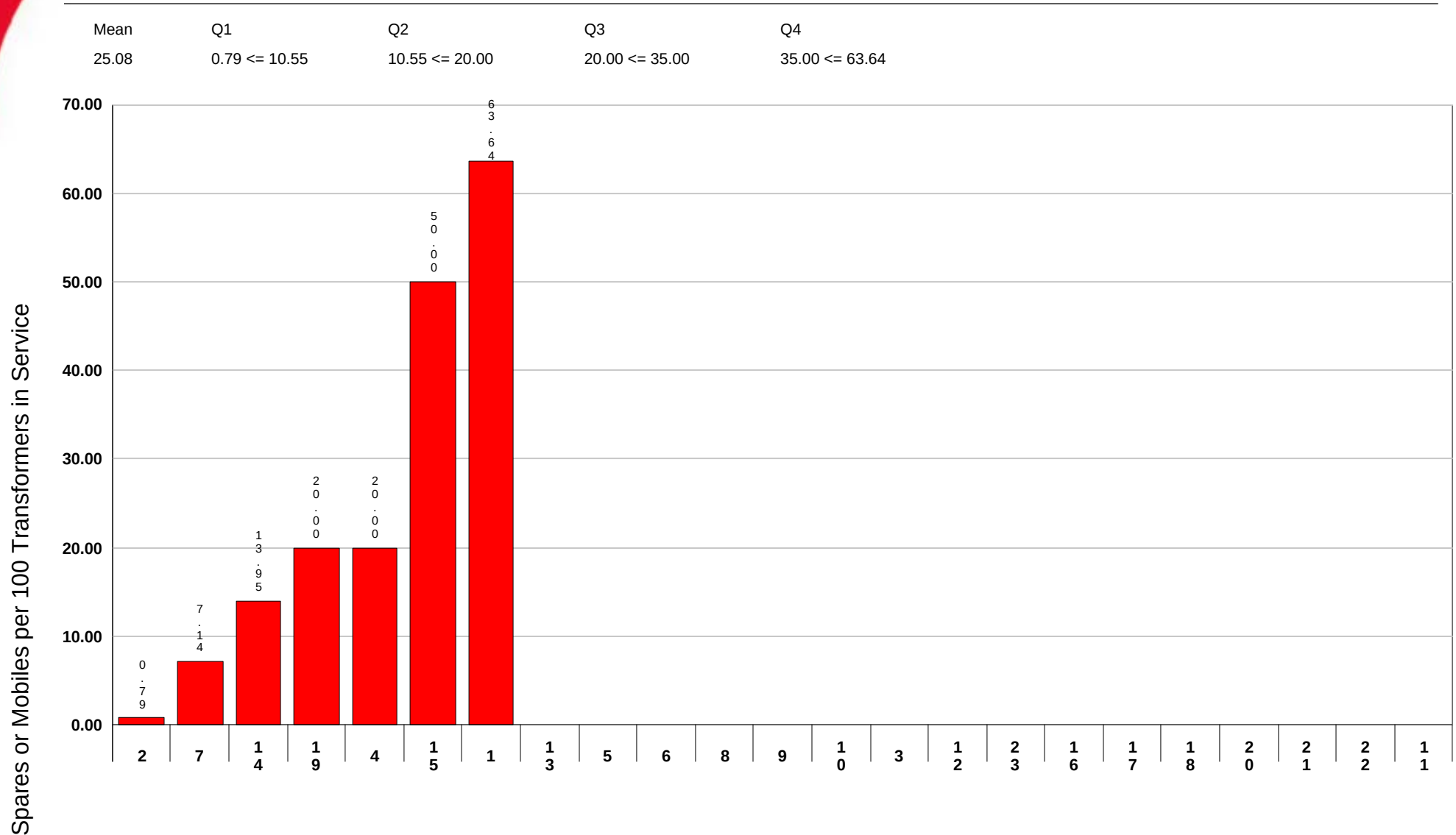
ID Code: 1600034

Page: 1380.2

Only companies with all the data are shown.

Transmission Substation Transformer Spares or Mobiles

Per 100 Substation Transformers in Service -- 500kV or Greater



Source/Calculation: (AY.3.1+AY.5.1)/(AQ.2.1/100)

Volume: T&D Substation Statistics, Final Report, 2006

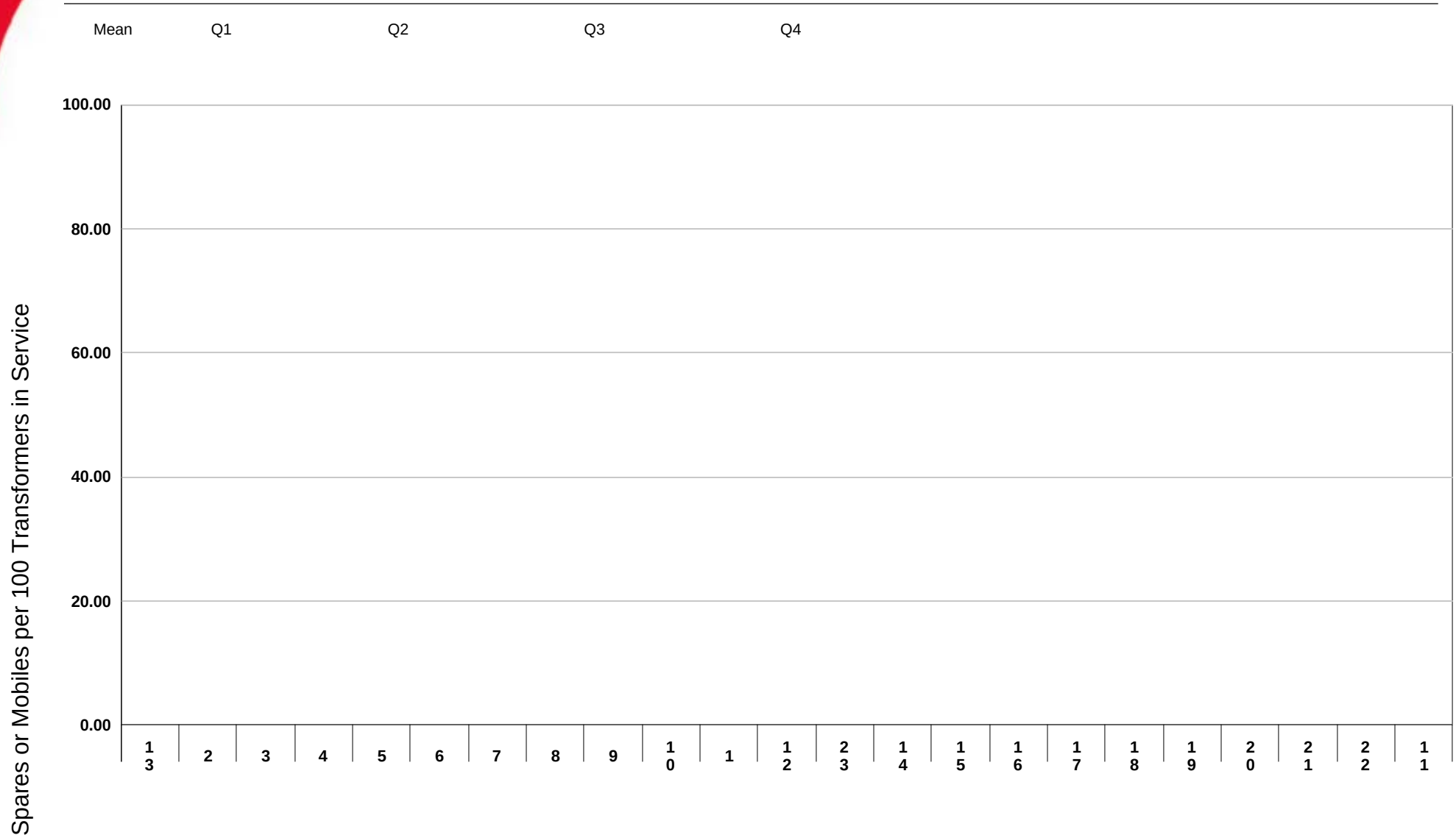
ID Code: 1600035

Page: 1380.3

Only companies with all the data are shown.

Transmission Substation Transformer Spares or Mobiles

Per 100 Substation Transformers in Service -- 400kV - 499kv



Source/Calculation: (AY.3.2+AY.5.2)/(AQ.2.2/100)

Volume: T&D Substation Statistics, Final Report, 2006

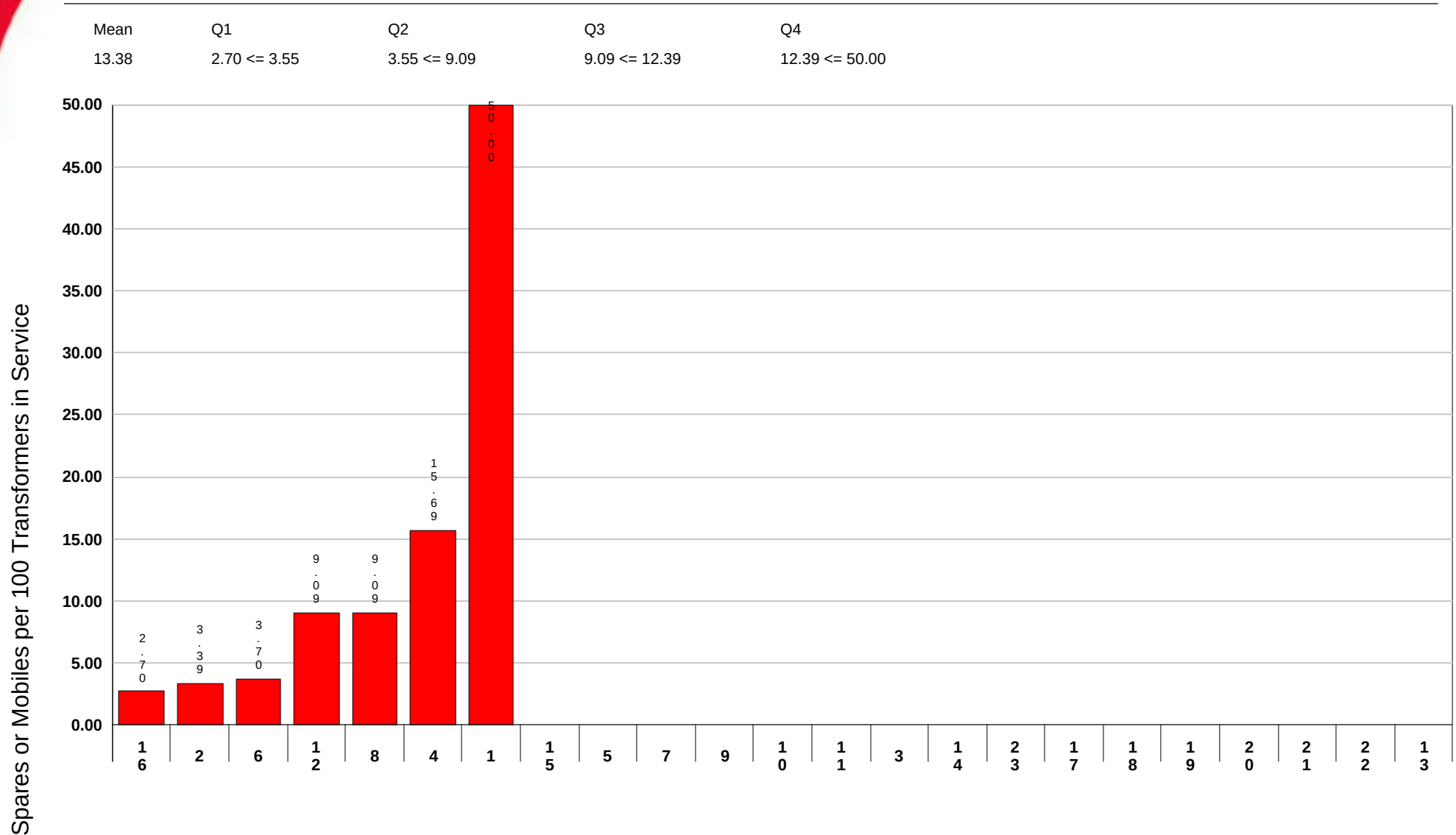
ID Code: 1600036

Page: 1380.4

Only companies with all the data are shown.

Transmission Substation Transformer Spares or Mobiles

Per 100 Substation Transformers in Service -- 300kV - 399kv



Source/Calculation: (AY.3.3+AY.5.3)/(AQ.2.3/100)

Volume: T&D Substation Statistics, Final Report, 2006

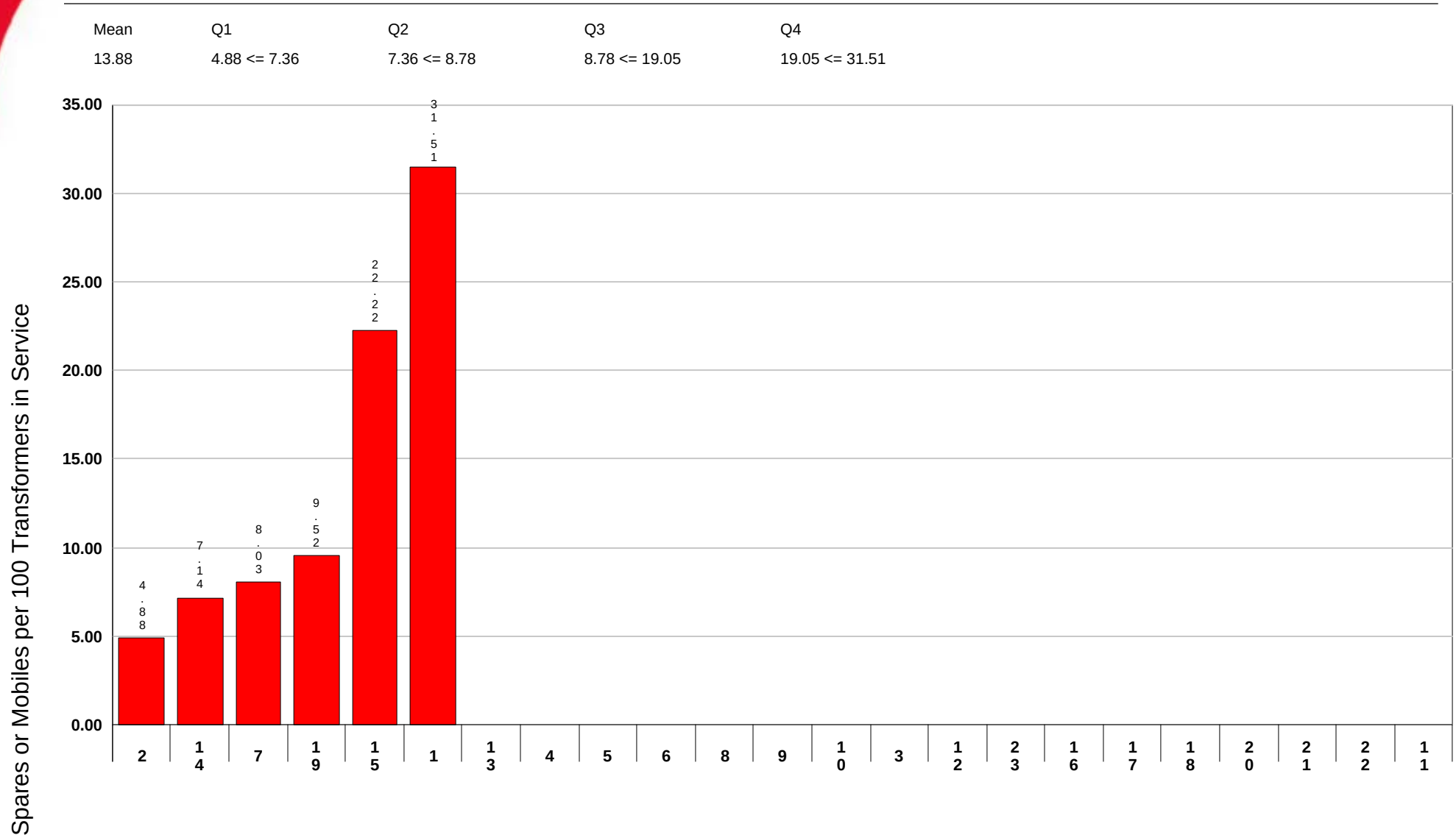
ID Code:1600037

Page:1380.5

Only companies with all the data are shown.

Transmission Substation Transformer Spares or Mobiles

Per 100 Substation Transformers in Service -- 200kV - 299kV



Source/Calculation: (AY.3.4+AY.5.4)/(AQ.2.4/100)

Volume: T&D Substation Statistics, Final Report, 2006

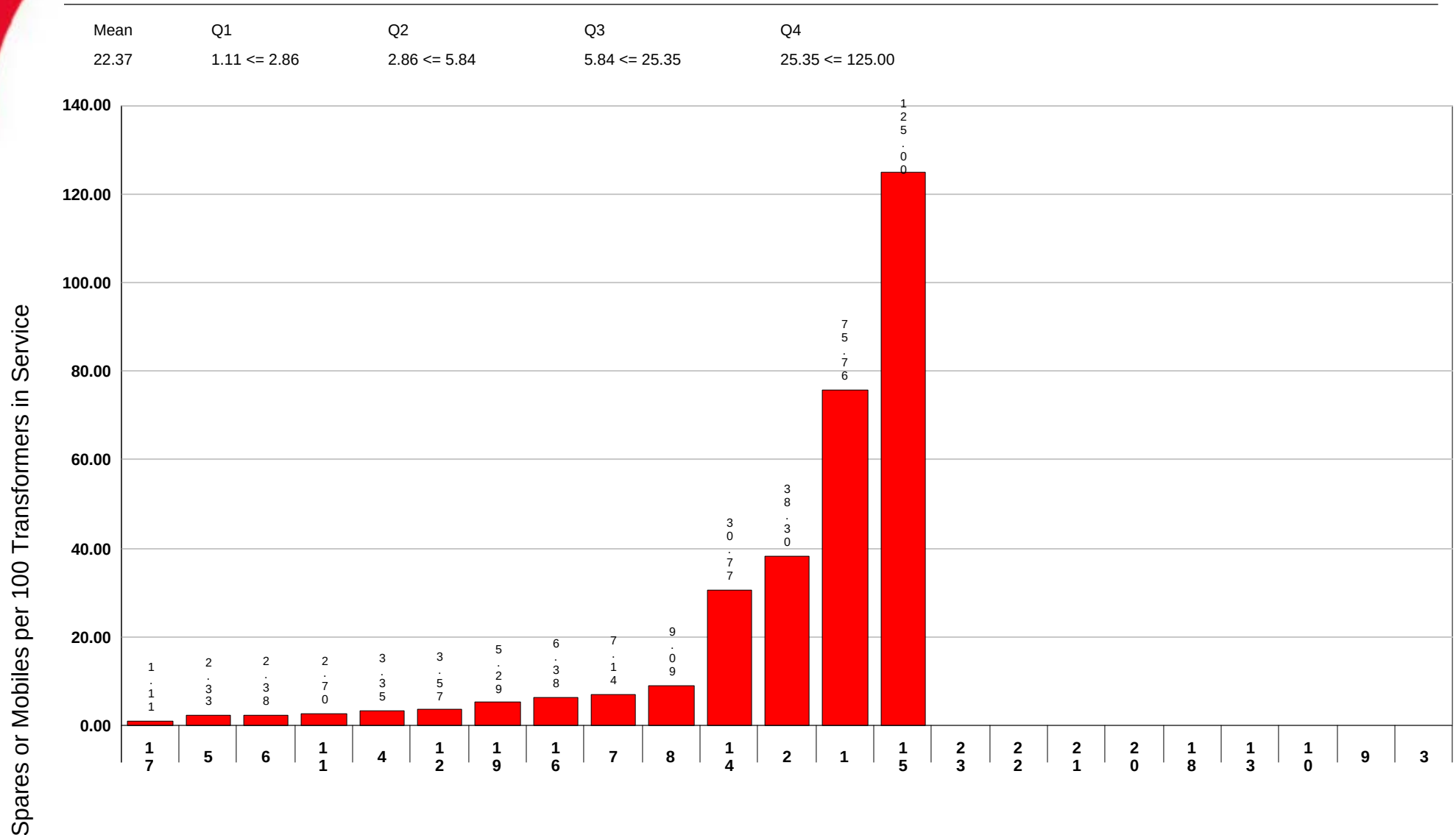
ID Code: 1600038

Page: 1380.6

Only companies with all the data are shown.

Transmission Substation Transformer Spares or Mobiles

Per 100 Substation Transformers in Service -- 100kV - 199kv



Source/Calculation: (AY.3.5+AY.5.5)/(AQ.2.5/100)

Volume: T&D Substation Statistics, Final Report, 2006

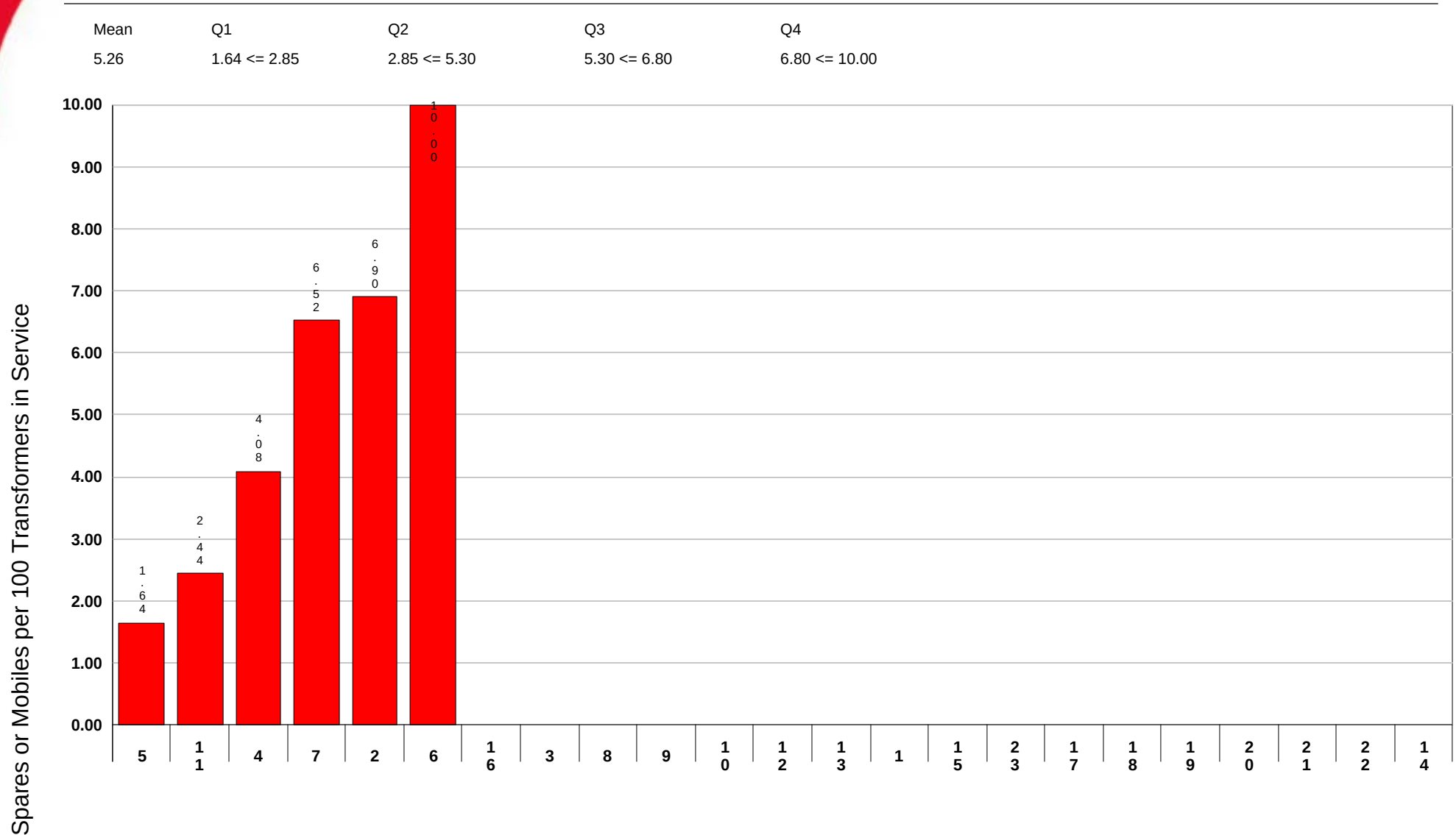
ID Code:1600039

Page:1380.7

Only companies with all the data are shown.

Transmission Substation Transformer Spares or Mobiles

Per 100 Substation Transformers in Service -- 60kV - 99kv



Source/Calculation: (AY.3.6+AY.5.6)/(AQ.2.6/100)

Volume: T&D Substation Statistics, Final Report, 2006

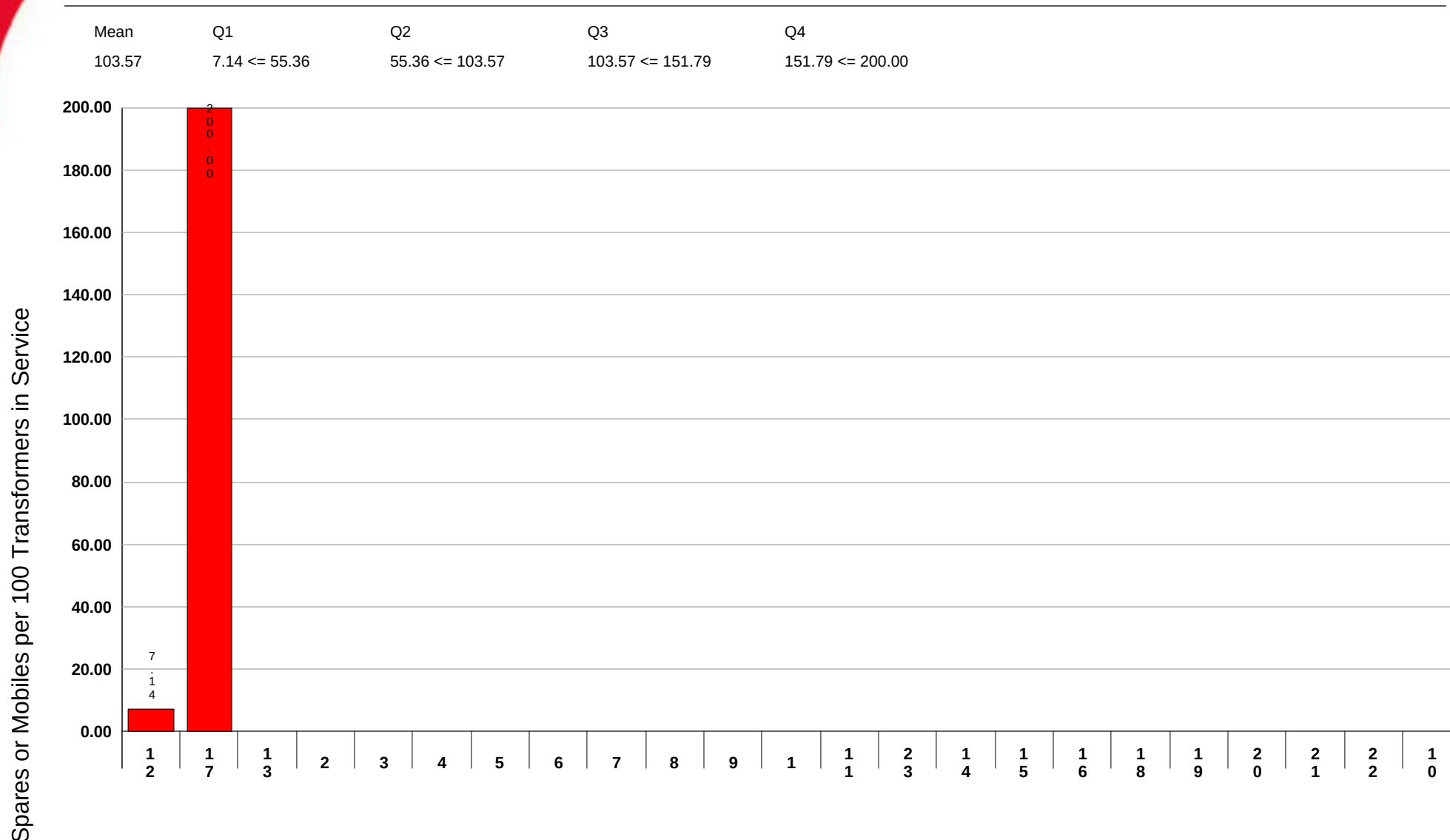
ID Code: 1600040

Page: 1380.8

Only companies with all the data are shown.

Distribution Substation Transformer Spares or Mobiles

Per 100 Substation Transformers in Service -- 35kV - 59kv



Source/Calculation: (AY.4.1+AY.6.1)/(AQ.3.1/100)

Volume: T&D Substation Statistics, Final Report, 2006

ID Code:1600041

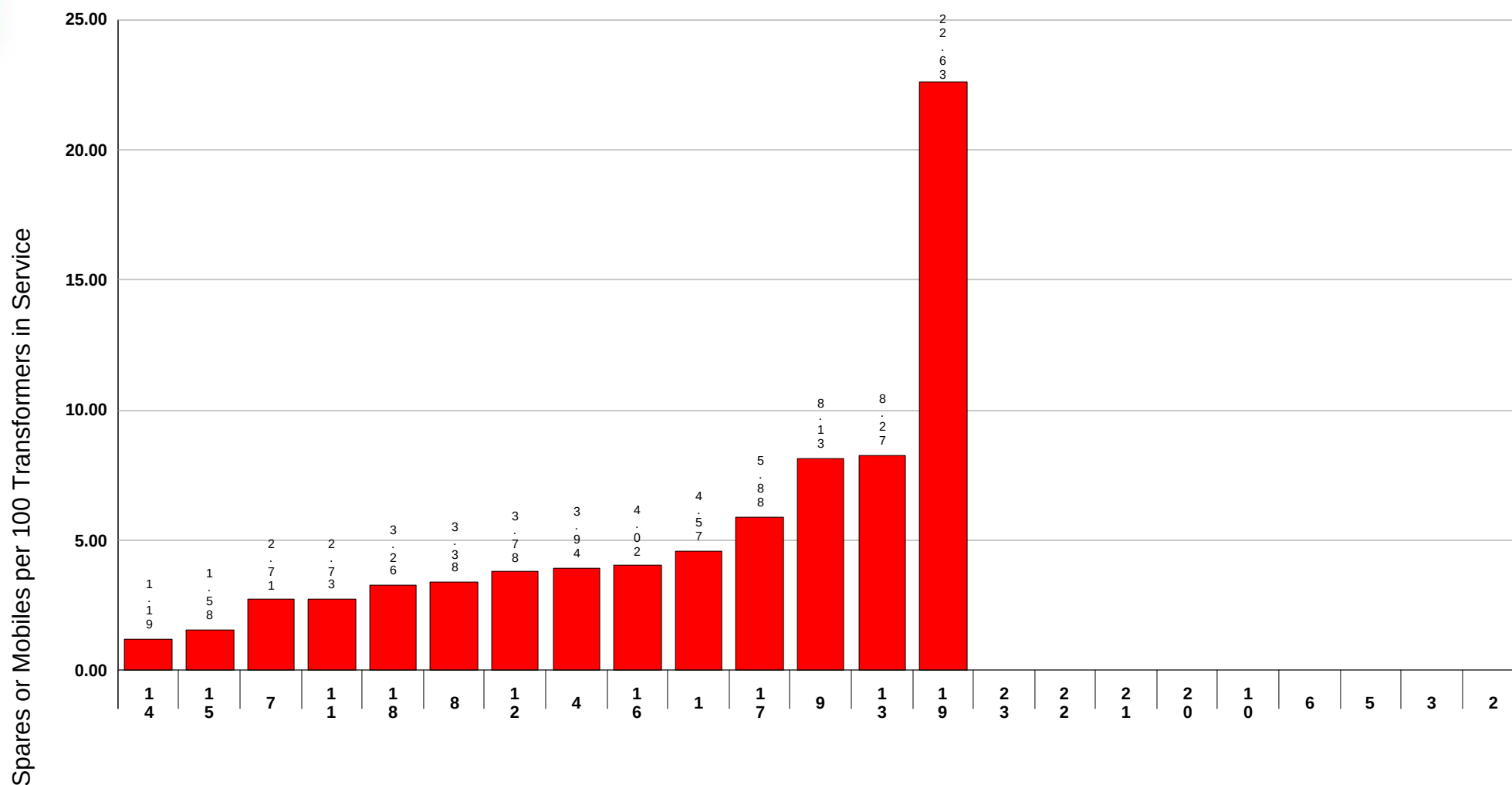
Page:1380.9

Only companies with all the data are shown.

Distribution Substation Transformer Spares or Mobiles

Per 100 Substation Transformers in Service -- 12kV - 34.5kv

Mean	Q1	Q2	Q3	Q4
5.43	1.19 <= 2.86	2.86 <= 3.86	3.86 <= 5.55	5.55 <= 22.63



Source/Calculation: (AY.4.2+AY.6.2)/(AQ.3.2/100)

Volume: T&D Substation Statistics, Final Report, 2006

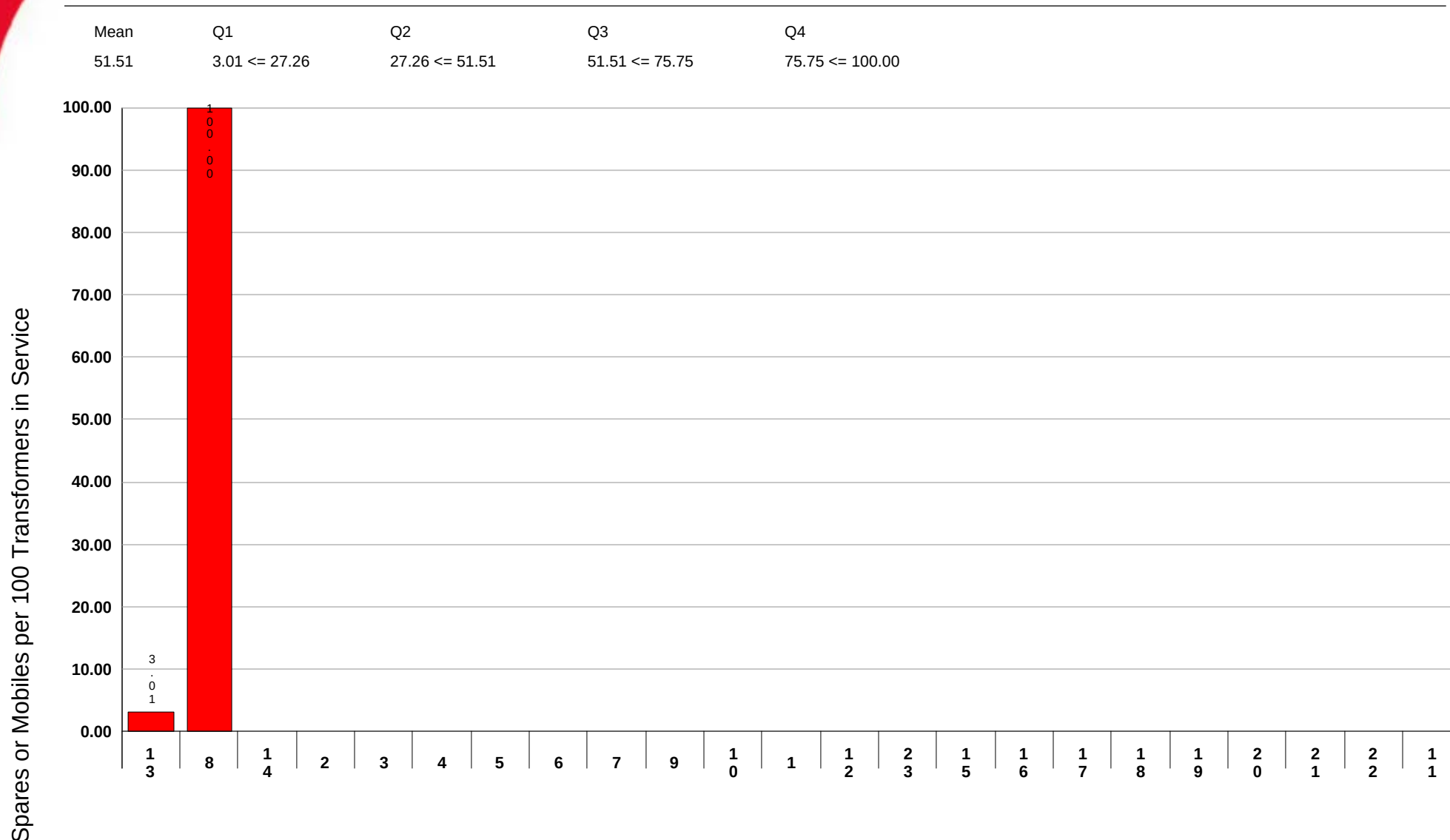
ID Code:1600042

Page:1380.91

Only companies with all the data are shown.

Distribution Substation Transformer Spares or Mobiles

Per 100 Substation Transformers in Service -- 5kV - 11kv



Source/Calculation: (AY.4.3+AY.6.3)/(AQ.3.3/100)

Volume: T&D Substation Statistics, Final Report, 2006

ID Code: 1600043

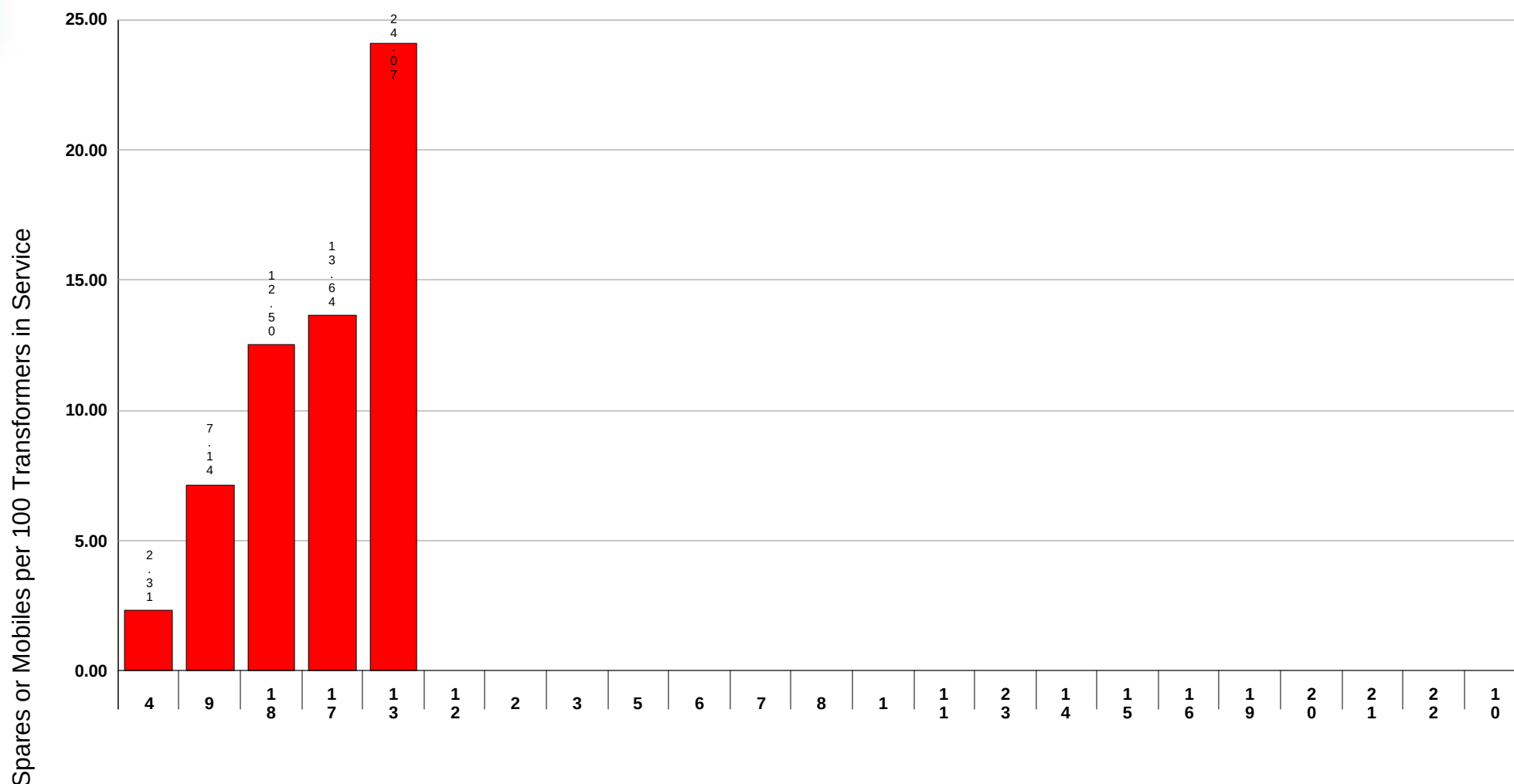
Page: 1380.92

Only companies with all the data are shown.

Distribution Substation Transformer Spares or Mobiles

Per 100 Substation Transformers in Service -- Less than 5kV

Mean	Q1	Q2	Q3	Q4
11.93	2.31 <= 7.14	7.14 <= 12.50	12.50 <= 13.64	13.64 <= 24.07



Source/Calculation: (AY.4.4+AY.6.4)/(AQ.3.4/100)

Volume: T&D Substation Statistics, Final Report, 2006

ID Code: 1600044

Page: 1380.93

Only companies with all the data are shown.

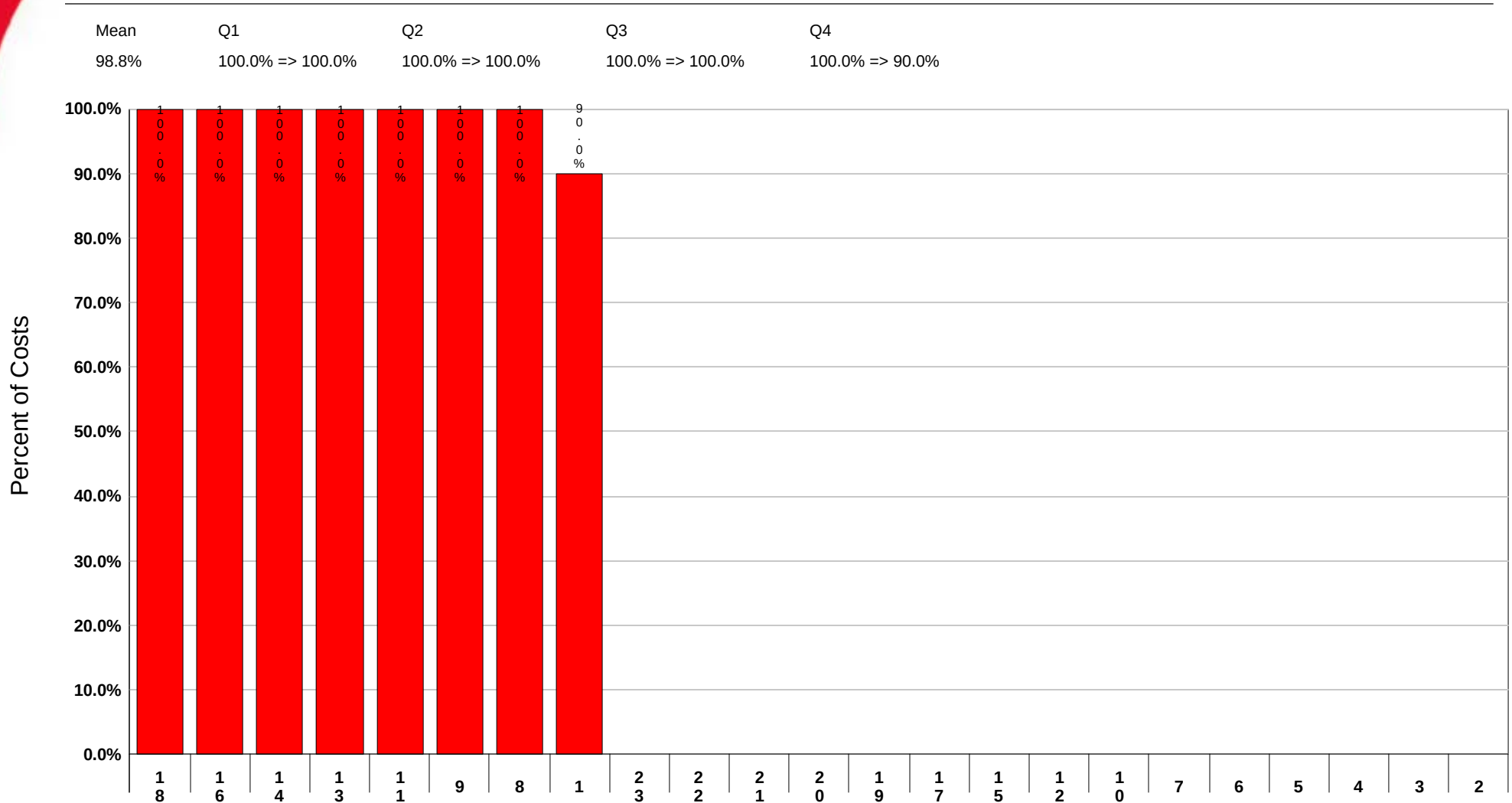
Section Contents

 100% Stacked  Column  Dot Table  Letter Table  Pie  Scatter  Shaded  Stacked Sum  Symbol Table  Number Table  Combo Table  HiLo  Memo Tables

 Pg. 1388 Beautification Costs that Are Passed on to the Customer

 Pg. 1388.1 Distribution Substation Installed Capital Cost - Per New Substation MVA

Beautification Costs that Are Passed on to the Customer



Source/Calculation:AR.4.1

Volume: Focus Area: Distribution Substation Cost Detail, Final Report, 2006

ID Code:2300920

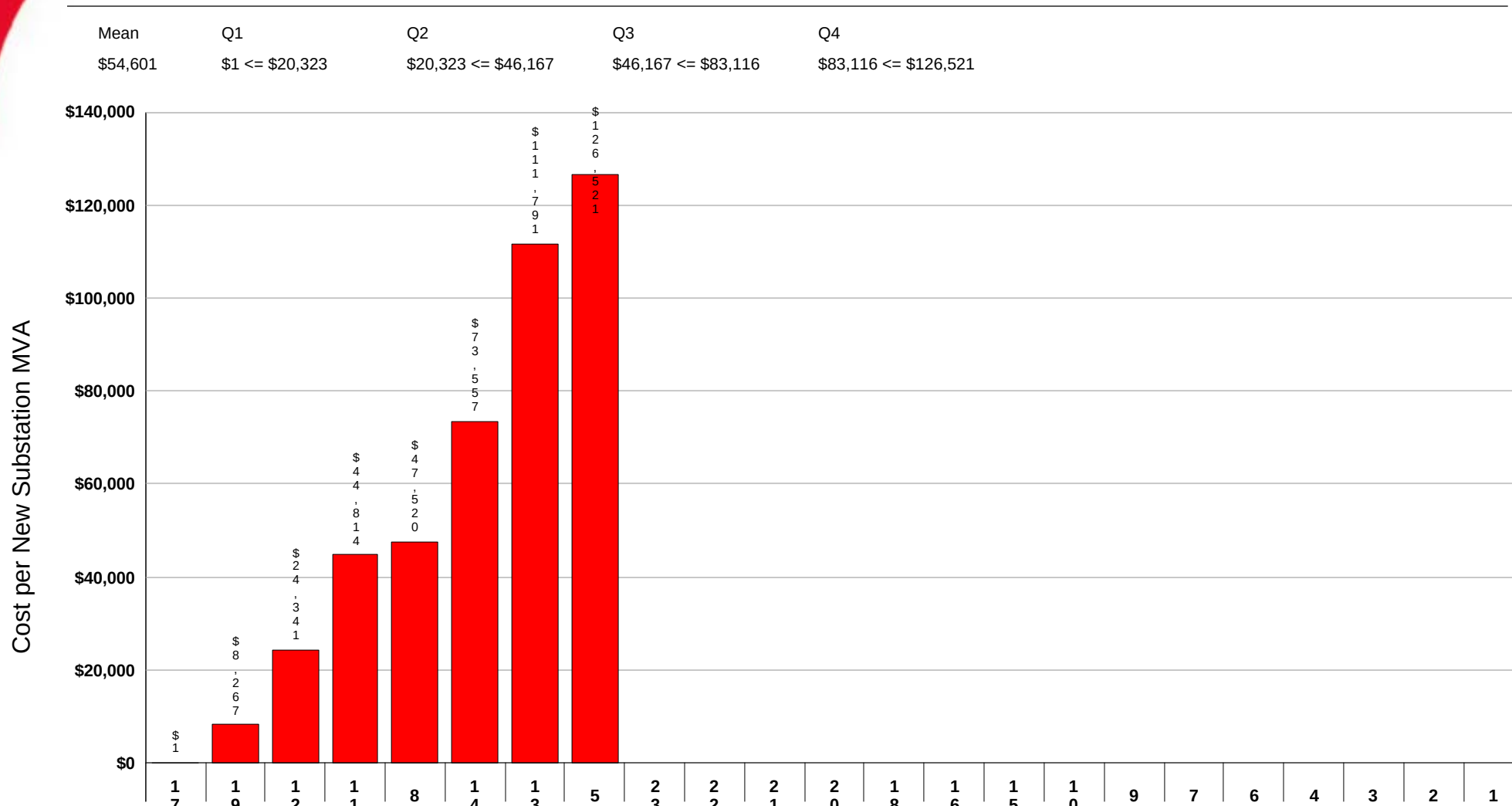
Page: 1388

Only companies with all the data are shown.



Distribution Substation Installed Capital Cost

Per New Substation MVA



Source/Calculation: AR.3.1/AR.3.2

Volume: Focus Area: Distribution Substation Cost Detail, Final Report, 2006

ID Code: 2500000

Page: 1388.1

Only companies with all the data are shown.

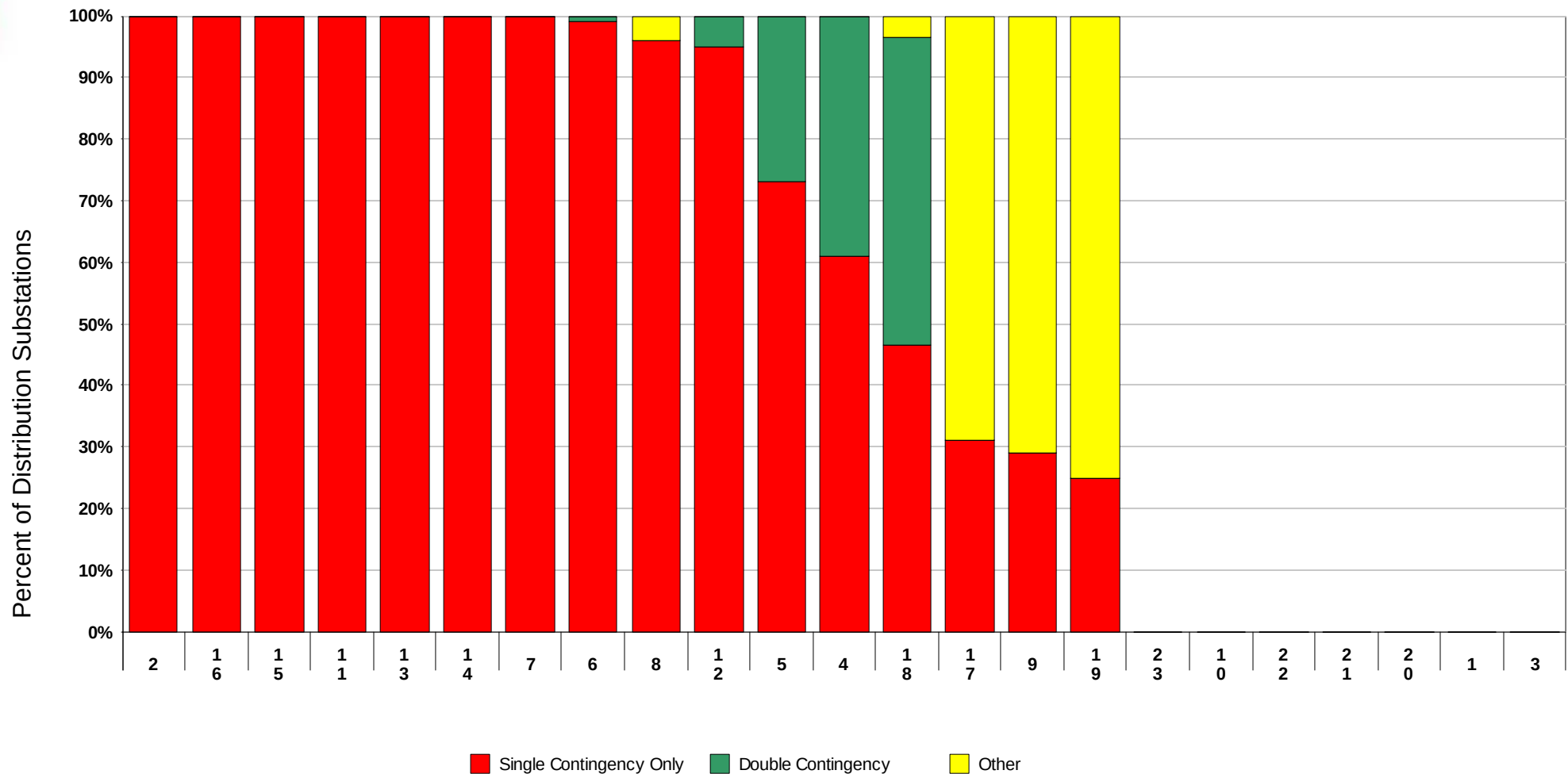


Section Contents

100% Stacked
 Column
 Dot Table
 Letter Table
 Pie
 Scatter
 Shaded
 Stacked Sum
 Symbol Table
 Number Table
 Combo Table
 HiLo
 Memo Tables

- Pg. 1389 Substations Designed to Overcome Contingency Failure - Distribution
- Pg. 1389.1 Substations Designed to Overcome Contingency Failure (cont.) - Distribution
- Pg. 1390 Substations Designed to Overcome Contingency Failure - Transmission
- Pg. 1390.1 Substations Designed to Overcome Contingency Failure (cont.) - Transmission
- Pg. 1390.2 Distribution Substation Power Transformers Percent in Service - By Age
- Pg. 1390.3 Transmission Substation Power/Autotransformers Percent in Service - By Age
- Pg. 1392 Percentage of Distribution Substation Breakers - Put in Service by Decade
- Pg. 1394 Percentage of Transmission Substation Breakers - Put in Service by Decade
- Pg. 1395 Estimate of the Types of Transmission Substations
- Pg. 1395.1 Estimate of the Types of Transmission Substations (cont.)
- Pg. 1396 Estimate of the Types of Distribution Substations
- Pg. 1396.1 Estimate of the Types of Distribution Substations (cont.)
- # Pg. 1397 Average Age of Substations and Their Components - Age in Years
- Pg. 1403 Substation Design/Engineering Efficiency Measurement
- Pg. 1404 Substation Design/Engineering Efficiency Measurement (cont.)
- Pg. 1412 Percent of Time Spent on "Regular" Duties - Compared to Sum of Project and "Regular" Time
- Pg. 1414 Budget Used for Funds for Substation Project Time
- Pg. 1416 Substation Organization Structure
- Pg. 1417 Use of "Substation Owners" - From Operating Perspective
- Pg. 1418 Use of "Project Owners" on New Substation Developments

Substations Designed to Overcome Contingency Failure Distribution



Source/Calculation: AS.2.1

Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code: 6271

Page: 1389

Calculation shown is for the first piece of the stacked bar only.

Substations Designed to Overcome Contingency Failure (cont.)

Distribution

What percent of your distribution substations are designed to overcome contingency failure?

- Mobile Transformer or Feeder Ties
- Use of Portable

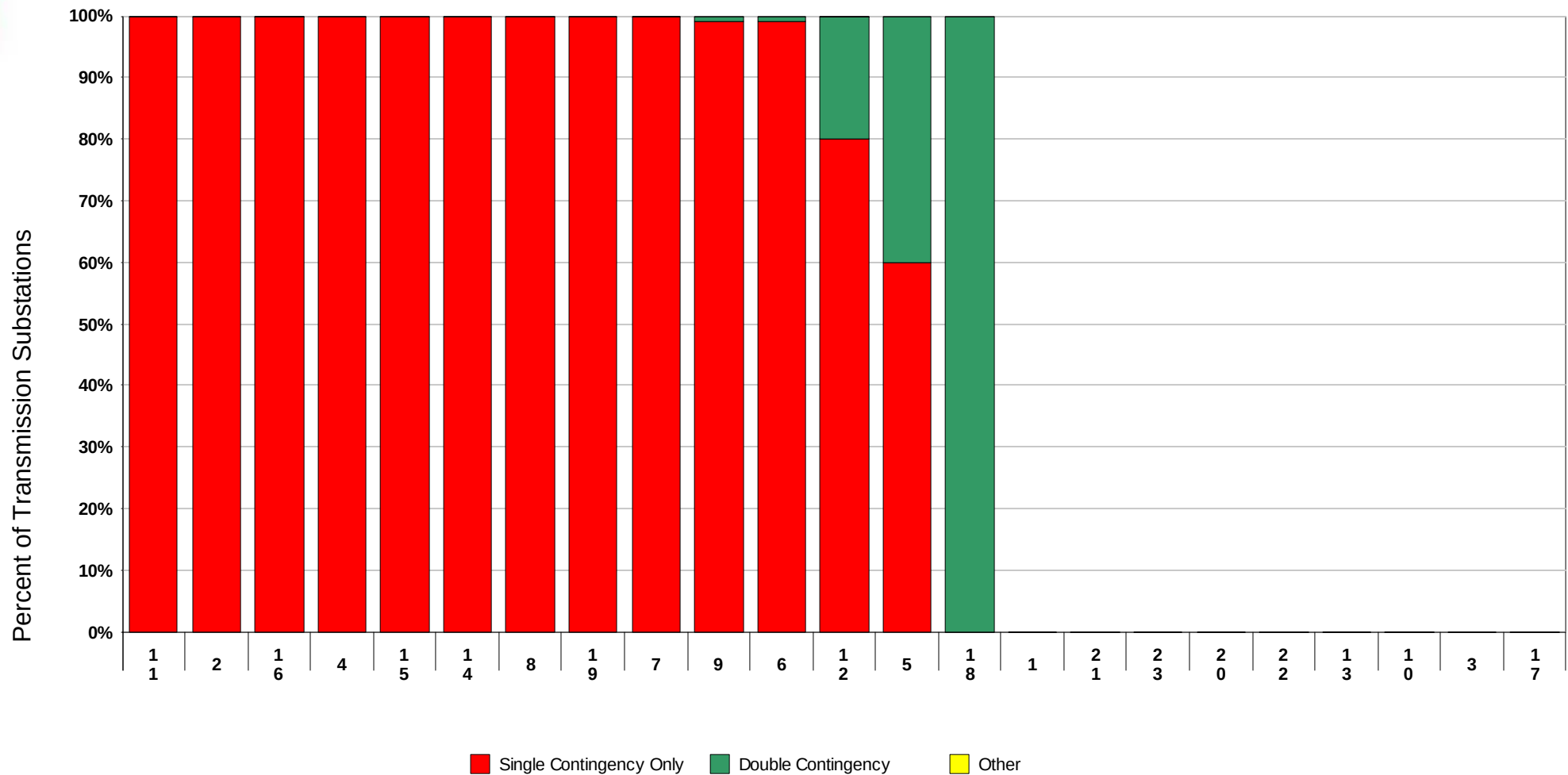
Source/Calculation:AS.2.99

Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code:1600246

Page:1389.1

Substations Designed to Overcome Contingency Failure Transmission



Source/Calculation:AS.3.1

Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code:6394

Page: 1390

Calculation shown is for the first piece of the stacked bar only.

Substations Designed to Overcome Contingency Failure (cont.)

Transmission

What percent of your transmission substations are designed to overcome contingency failure?

NA

Source/Calculation: AS.3.99

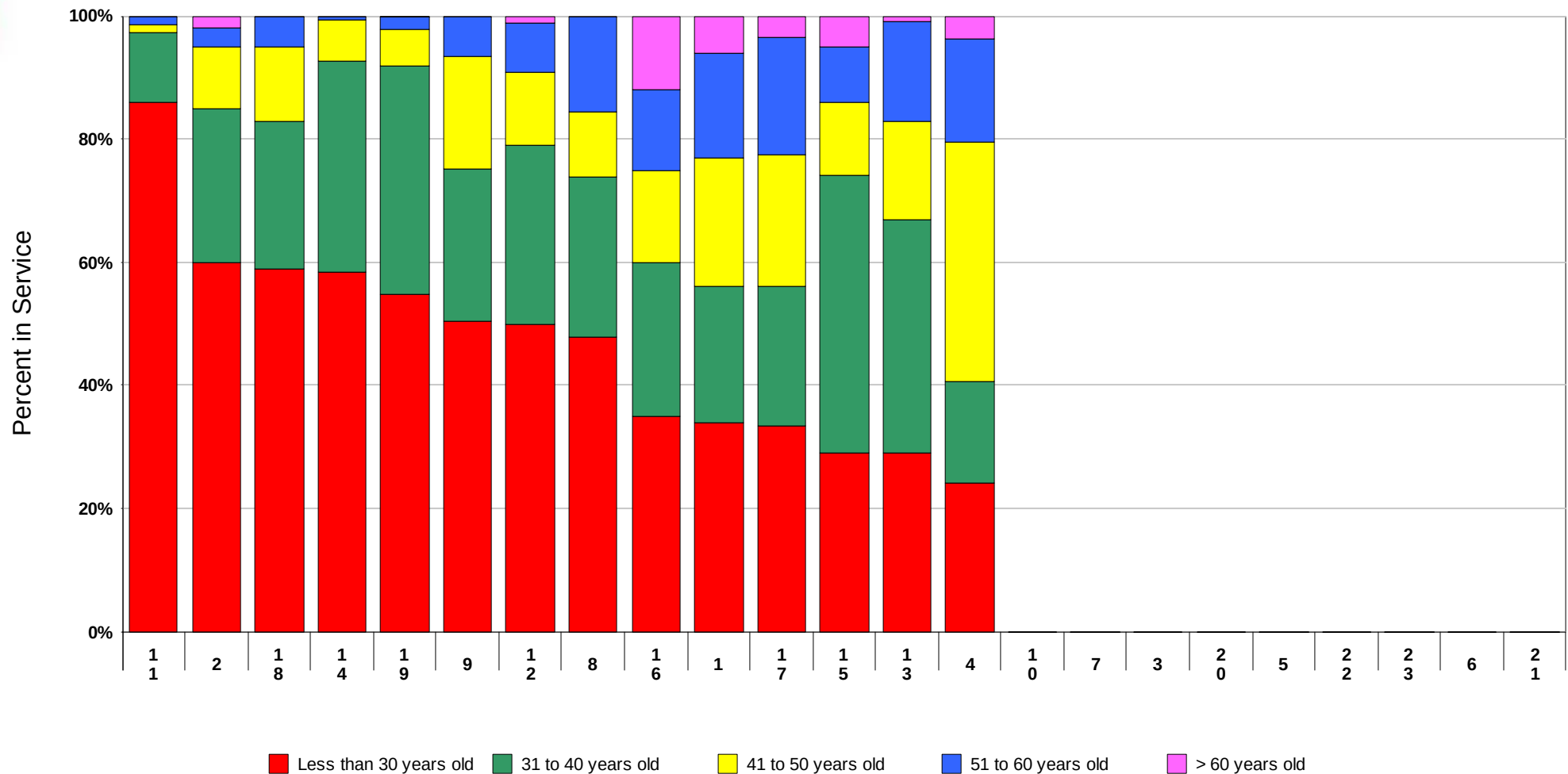
Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code: 1600247

Page: 1390.1

Distribution Substation Power Transformers Percent in Service

By Age



Source/Calculation: AS.4.1/SUM{AS.4}

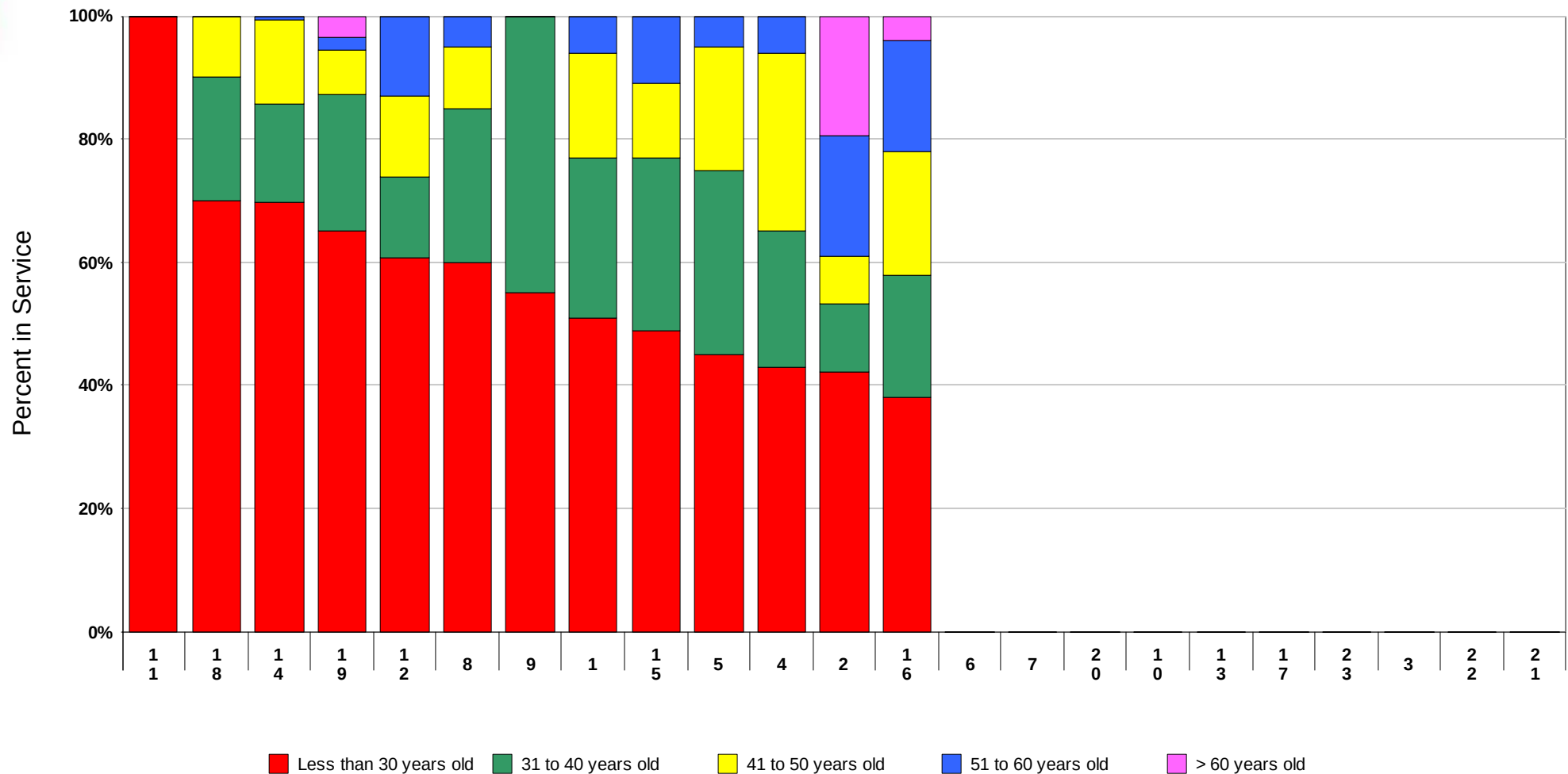
Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code: 1600054

Page: 1390.2

Calculation shown is for the first piece of the stacked bar only.

Transmission Substation Power/Autotransformers Percent in Service By Age



Source/Calculation: AS.6.1/SUM{AS.6}

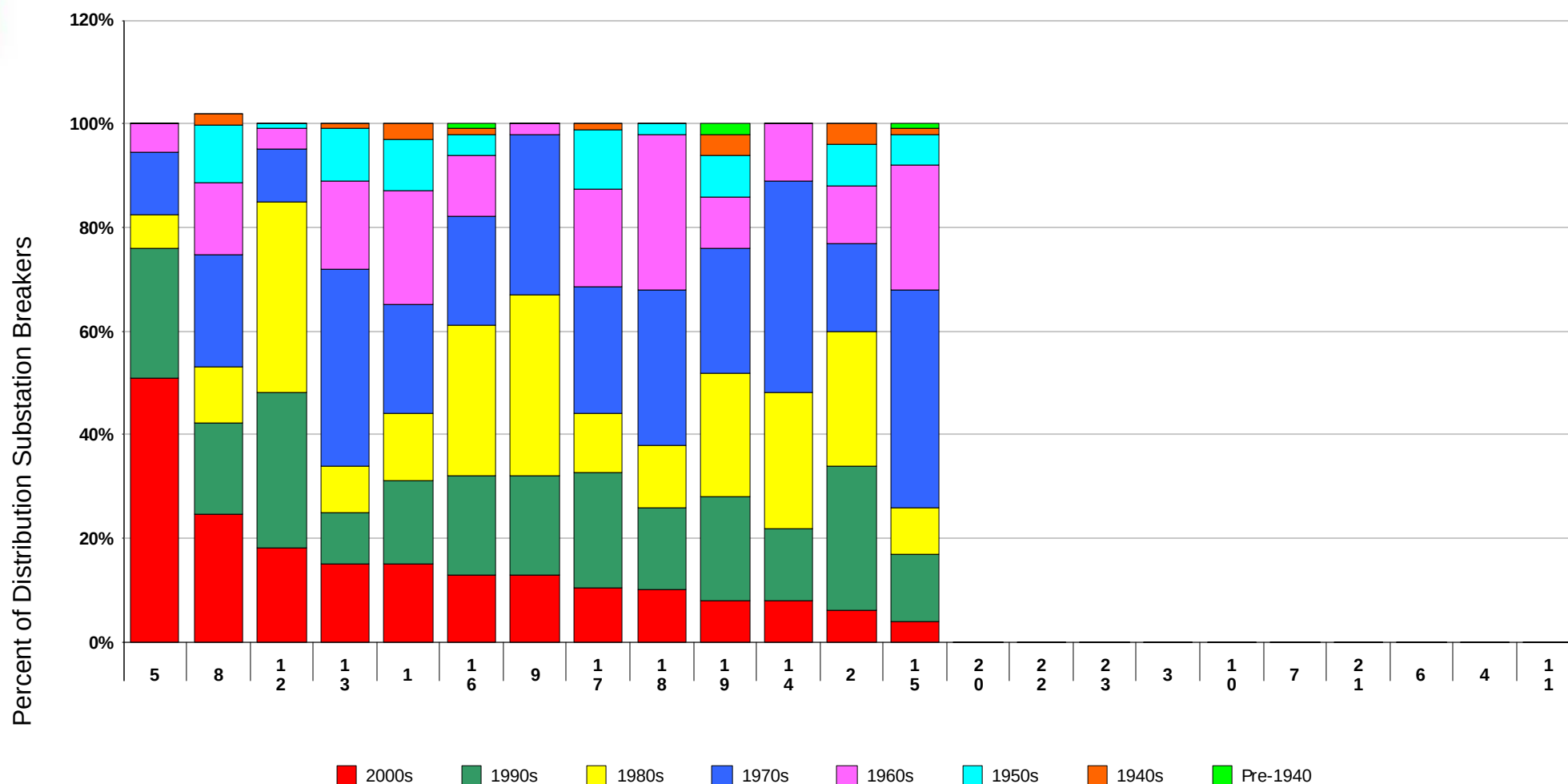
Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code: 1600053

Page: 1390.3

Calculation shown is for the first piece of the stacked bar only.

Percentage of Distribution Substation Breakers Put in Service by Decade



Source/Calculation: AS.5.8

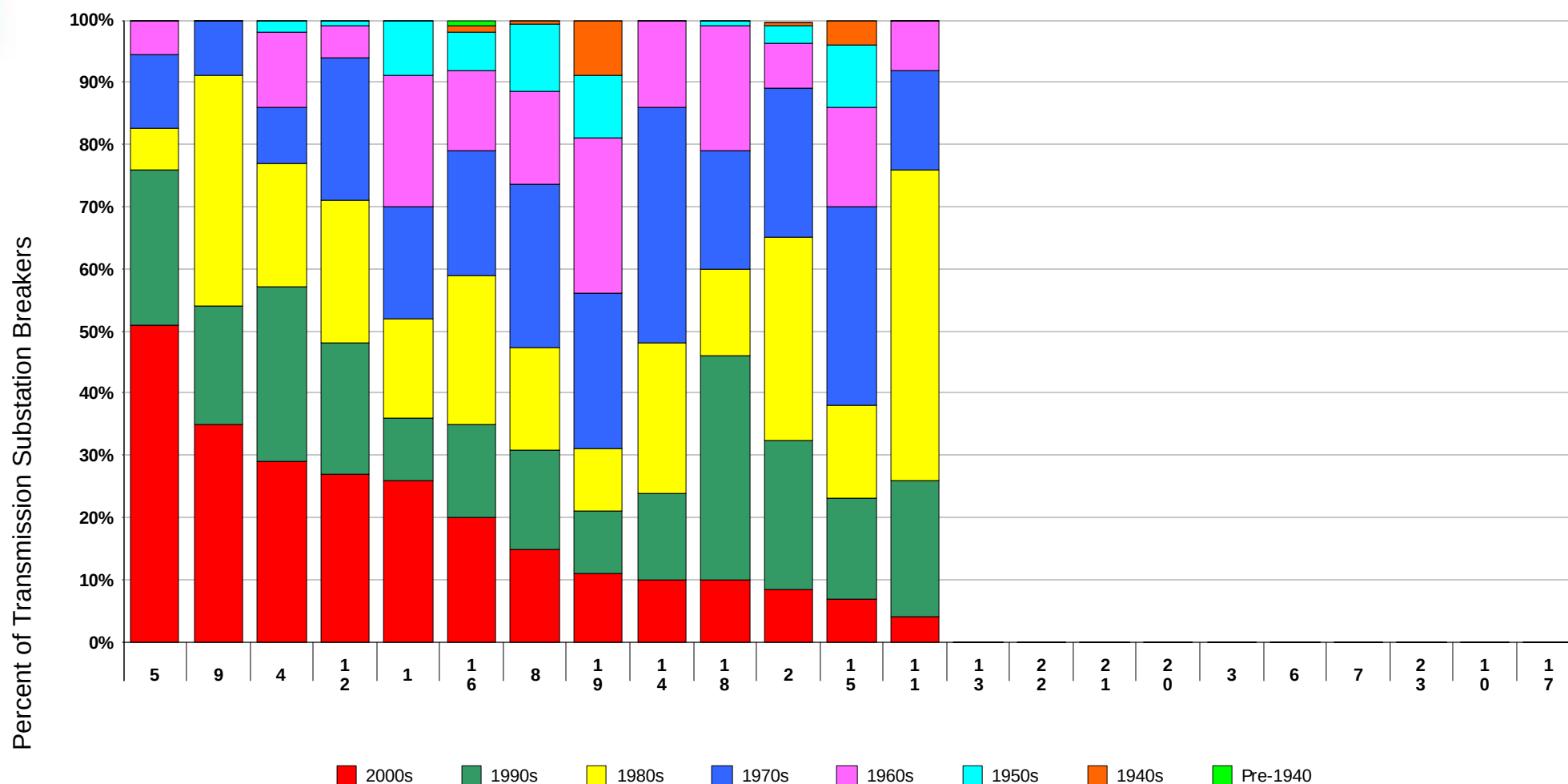
Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code: 40200

Page: 1392

Calculation shown is for the first piece of the stacked bar only.

Percentage of Transmission Substation Breakers Put in Service by Decade



Source/Calculation: AS.7.8

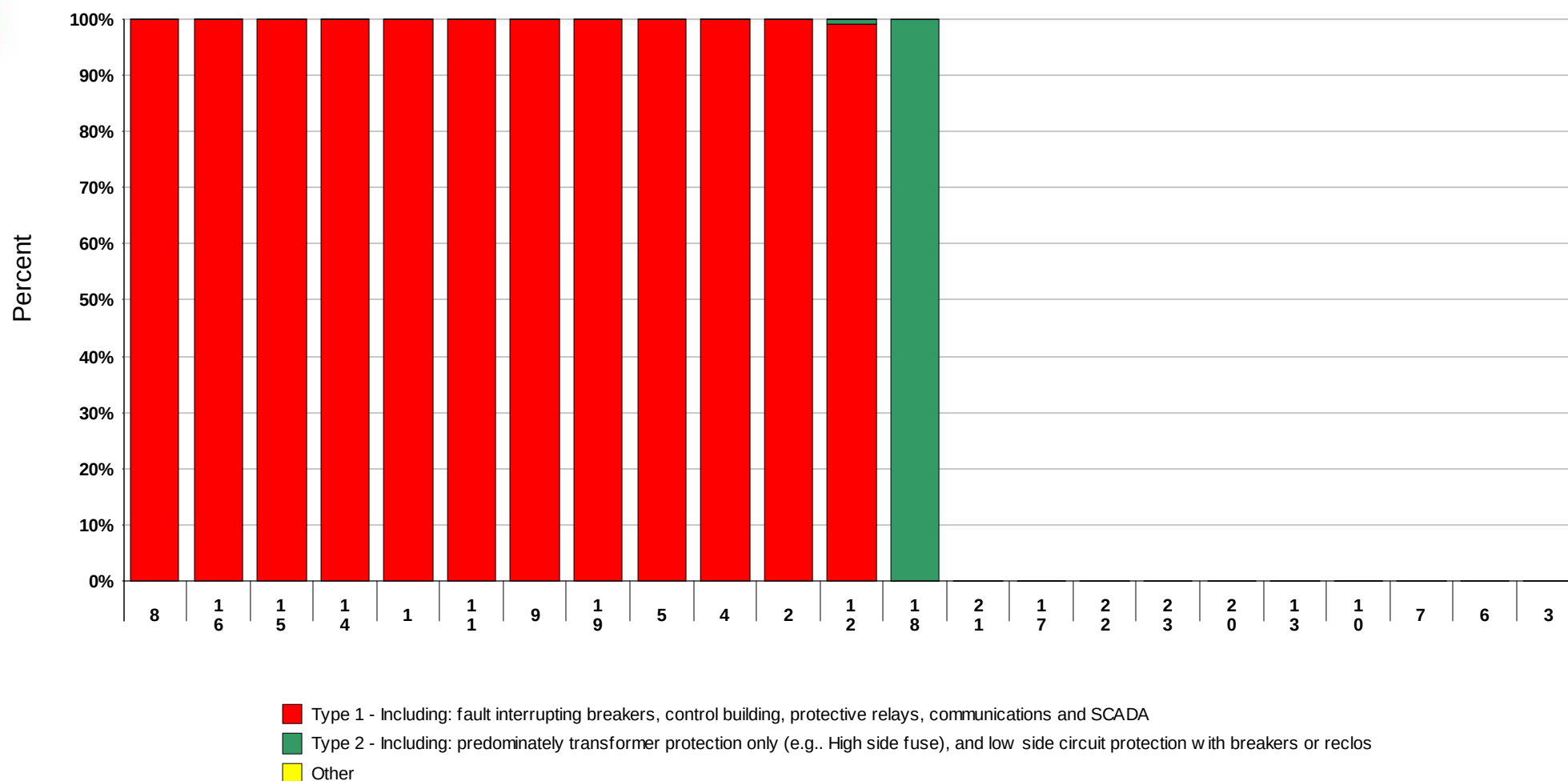
Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code: 40202

Page: 1394

Calculation shown is for the first piece of the stacked bar only.

Estimate of the Types of Transmission Substations



Source/Calculation: AS.8.1

Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code: 2300086

Page: 1395

Calculation shown is for the first piece of the stacked bar only.

Estimate of the Types of Transmission Substations (cont.)

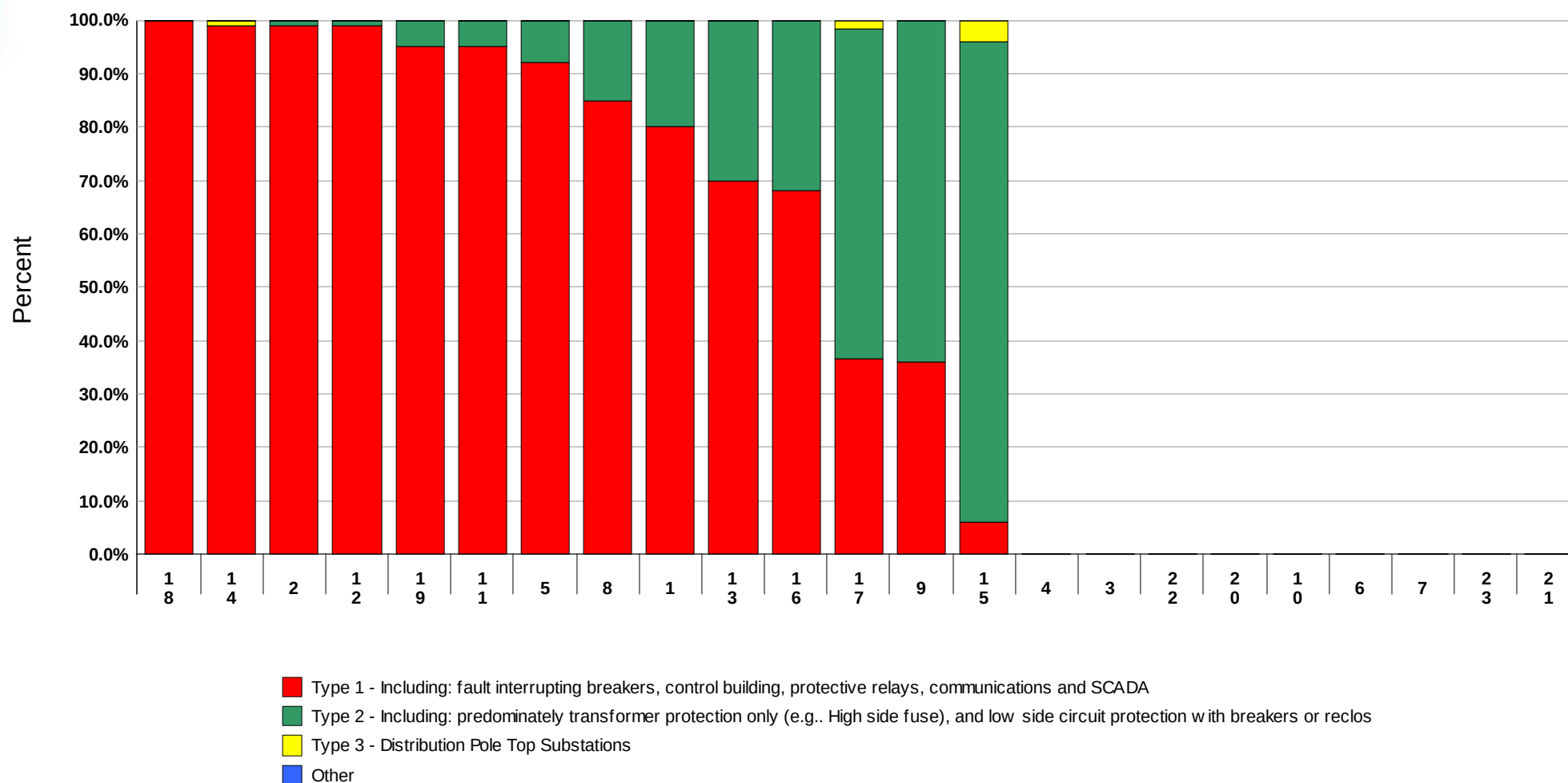
Source/Calculation:AS.8.99

Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code:1600245

Page:1395.1

Estimate of the Types of Distribution Substations



Source/Calculation: AS.9.1

Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code: 2300085

Page: 1396

Calculation shown is for the first piece of the stacked bar only.

Estimate of the Types of Distribution Substations (cont.)

Source/Calculation:AS.9.99

Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code:1600248

Page:1396.1

Average Age of Substations and Their Components

Age in Years

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:
1. Distribution Substation Transformers:	-	-	-	-	27	-	-	31	44	-	35	29	33	22	35	37	37	22	29	-	-	-	-	31.7
2. Distribution Substation Relays:	-	-	-	-	16	-	-	36	24	-	20	-	-	-	29	24	25	-	29	-	-	-	-	25.3
3. Distribution Substation Breakers:	22	-	-	-	-	-	-	24	-	-	-	19	-	24	23	19	31	29	29	-	-	-	-	24.4
4. Distribution Substations:	-	-	-	-	-	-	-	36	44	-	-	-	37	27	42	39	37	31	29	-	-	-	-	35.8
5. Transmission Substation Relays:	-	23	-	-	16	-	-	33	-	-	10	-	-	-	27	20	-	-	37	-	-	-	-	23.7
6. Transmission Substations:	-	30	-	38	-	-	-	33	26	-	31	-	-	35	44	41	-	26	37	-	-	-	-	34.1
7. Transmission Substation Transformers:	28	30	-	29	-	-	-	28	26	-	31	26	-	26	31	34	-	18	37	-	-	-	-	28.7
8. Transmission Substation Breakers:	25	23	-	-	-	-	-	27	-	-	31	19	-	24	31	19	-	24	37	-	-	-	-	25.9
9. Power transformers (>7 MVA):	33	30	-	-	-	-	-	30	35	-	-	28	-	22	35	37	-	22	26	-	-	-	-	29.8
10. Autotransformers (>50 MVA):	28	-	-	27	26	-	-	23	26	-	31	25	-	27	31	32	-	18	26	-	-	-	-	26.6

Source/Calculation:AS.10.1

Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code:1915

Page:1397

Substation Design/Engineering Efficiency Measurement

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent	
1. Not Measured:								✓	✓																14.3%
2. Actual Vs. Estimated Budget:	✓			✓		✓					✓	✓	✓	✓	✓		✓	✓	✓						78.6%
3. Actual Vs. Estimated Hours:	✓			✓		✓						✓	✓	✓	✓	✓			✓						64.3%
4. Utilization Of Personnel:	✓					✓							✓						✓						28.6%
5. Billing Rates Vs. A&E Firms:						✓						✓	✓												21.4%
6. Bids Vs. A&E Firms:													✓	✓											14.3%
7. Design As % Of Total Cost:													✓		✓				✓						21.4%
8. Cost Per New MVA:													✓												7.1%
9. Cost Per Installed MVA:													✓												7.1%
10. Rate of Return - Revenues Expected VS Costs:				✓									✓												14.3%
11. Equipment Utilization:				✓									✓												14.3%
99. Other:																									0.0%

Source/Calculation:AS.11.1

Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code:1221

Page:1403

Substation Design/Engineering Efficiency Measurement (cont.)

Source/Calculation:AS.11.99

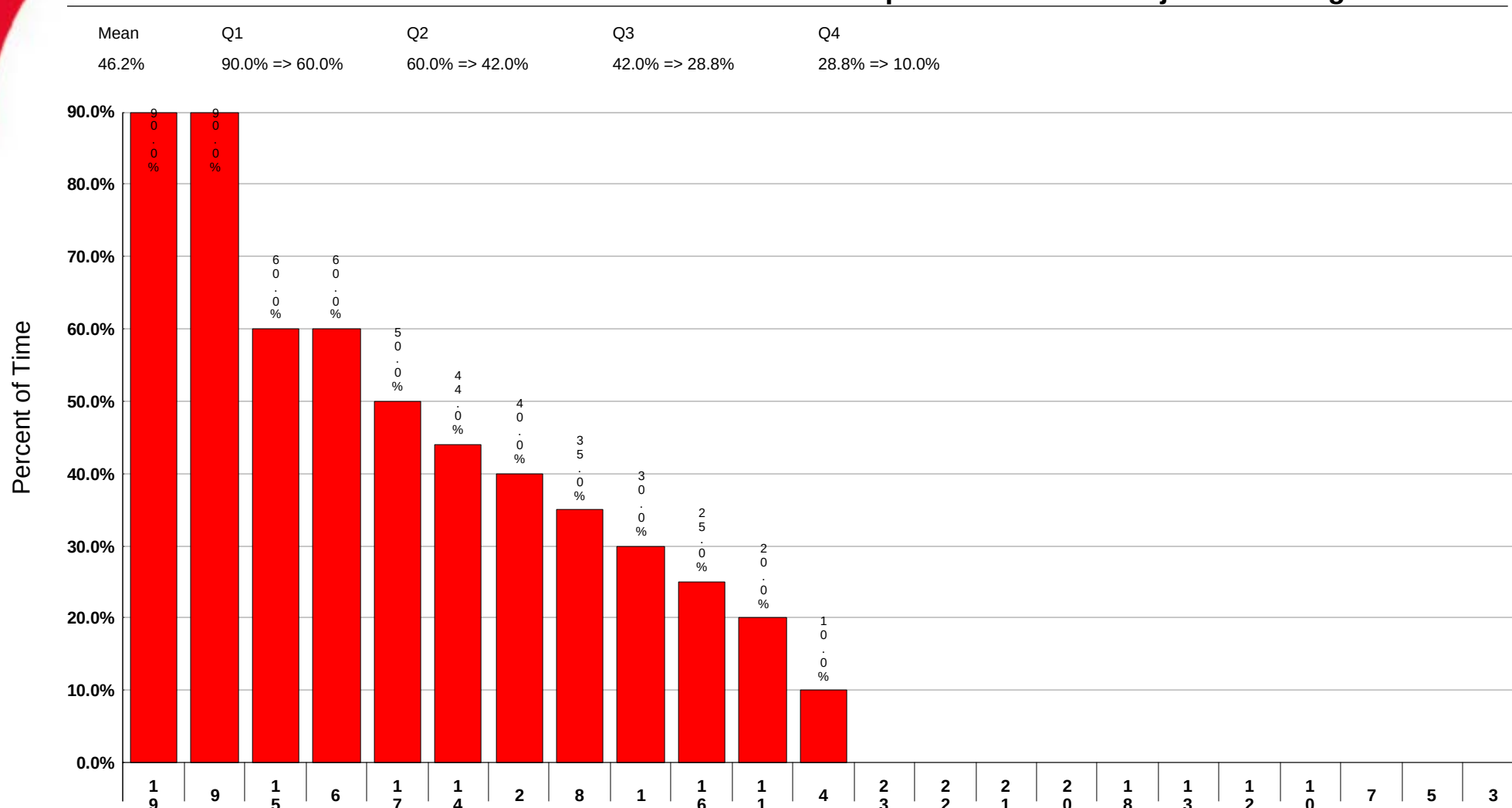
Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code:6571

Page:1404

Percent of Time Spent on "Regular" Duties

Compared to Sum of Project and "Regular" Time



Source/Calculation:AS.12.1

Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code:2300921

Page:1412

Only companies with all the data are shown.

Budget Used for Funds for Substation Project Time

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent:
1. Project Budget:	✓	✓		✓				✓	✓		✓		✓	✓	✓		✓	✓	✓					80.0%
2. Home Department's Budget:						✓						✓				✓								20.0%

Source/Calculation:AS.13.1

Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code:2300840

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Substation Organization Structure

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent:
1. Regional :	✓	✓		✓		✓			✓					✓		✓	✓							53.3%
2. Process :																								0.0%
3. Function:								✓			✓	✓	✓		✓			✓	✓					46.7%

Source/Calculation:AS.14.1

Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code:2300842

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Use of "Substation Owners"

From Operating Perspective

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Yes:	✓	✓		✓		✓			✓			✓		✓	✓	✓		✓	✓					73.3%
2. No:								✓			✓		✓				✓							26.7%

Source/Calculation:AS.15.1

Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code:2300571

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Use of "Project Owners" on New Substation Developments

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Yes:	✓	✓		✓		✓		✓	✓		✓		✓	✓	✓	✓	✓	✓	✓					93.3%
2. No:												✓												6.7%

Source/Calculation:AS.16.1

Volume: T&D Substation Engineering & Design, Final Report, 2006

ID Code:2300572

Page:1418

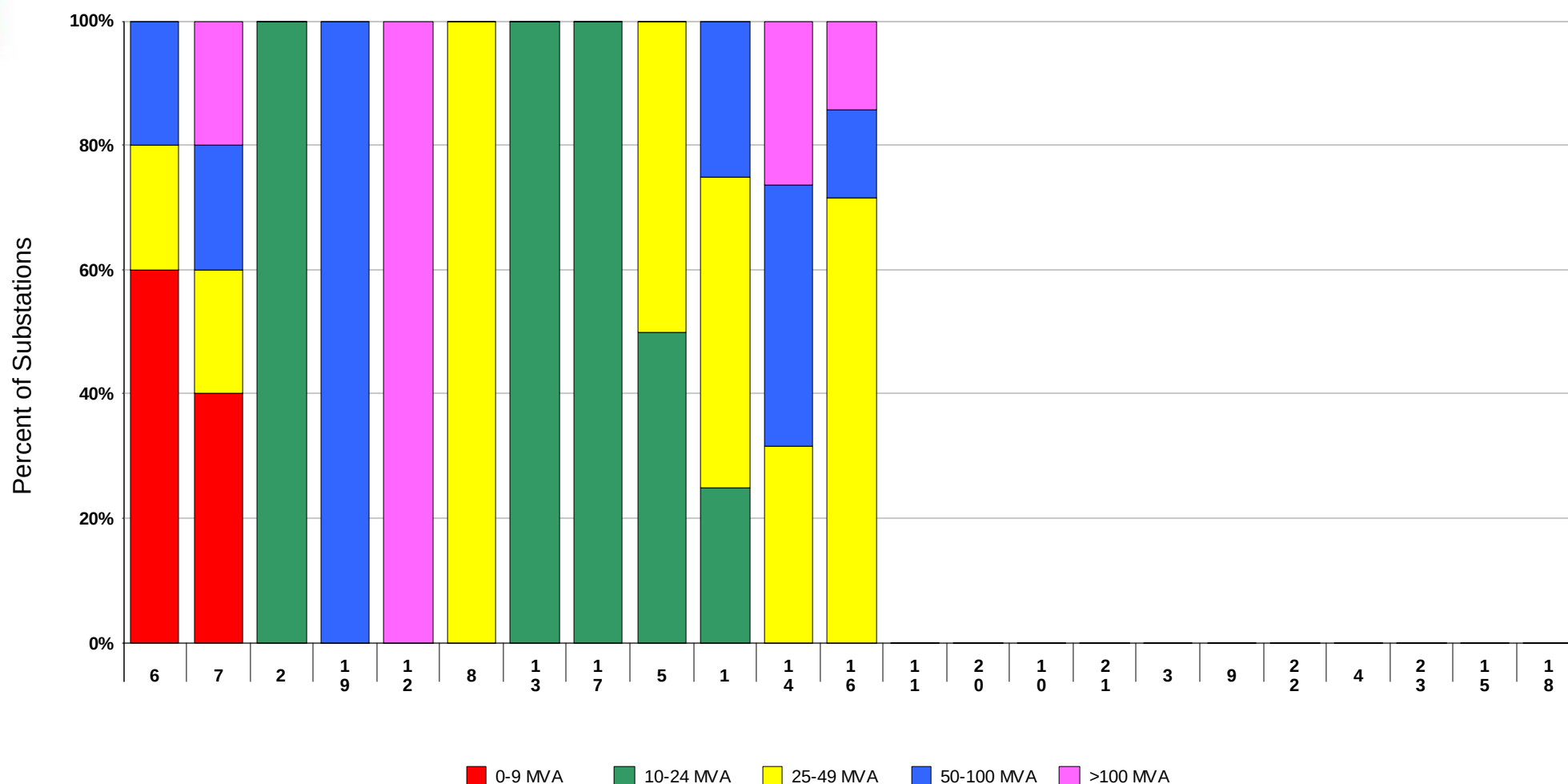
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	Pg. 1451.3	Average Total Installed Capital Costs - Per MVA for New Distribution Substations Put in Service in 2006
	Pg. 1451.4	Percent of Total Substation Transformer MVA Installed in 2006 - Using Rebuilt/Rewound Units
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	Pg. 1451.91	Upgraded Substations Put in Service in 2006 That Included Replacing Switchgear - As a Percent of Total Substations in Service
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	Pg. 1451.97	Percent of Substations in Service - Improved by Adding/Firewall Barriers
	Pg. 1451.98	Percent of Substations in Service - Improved by Adding/Replacing Security

Company-owned Substations Installed Last Year

By Size



Source/Calculation: AT.2.1/SUM{AT.2}

Volume: T&D Substation Field Construction, Final Report, 2006

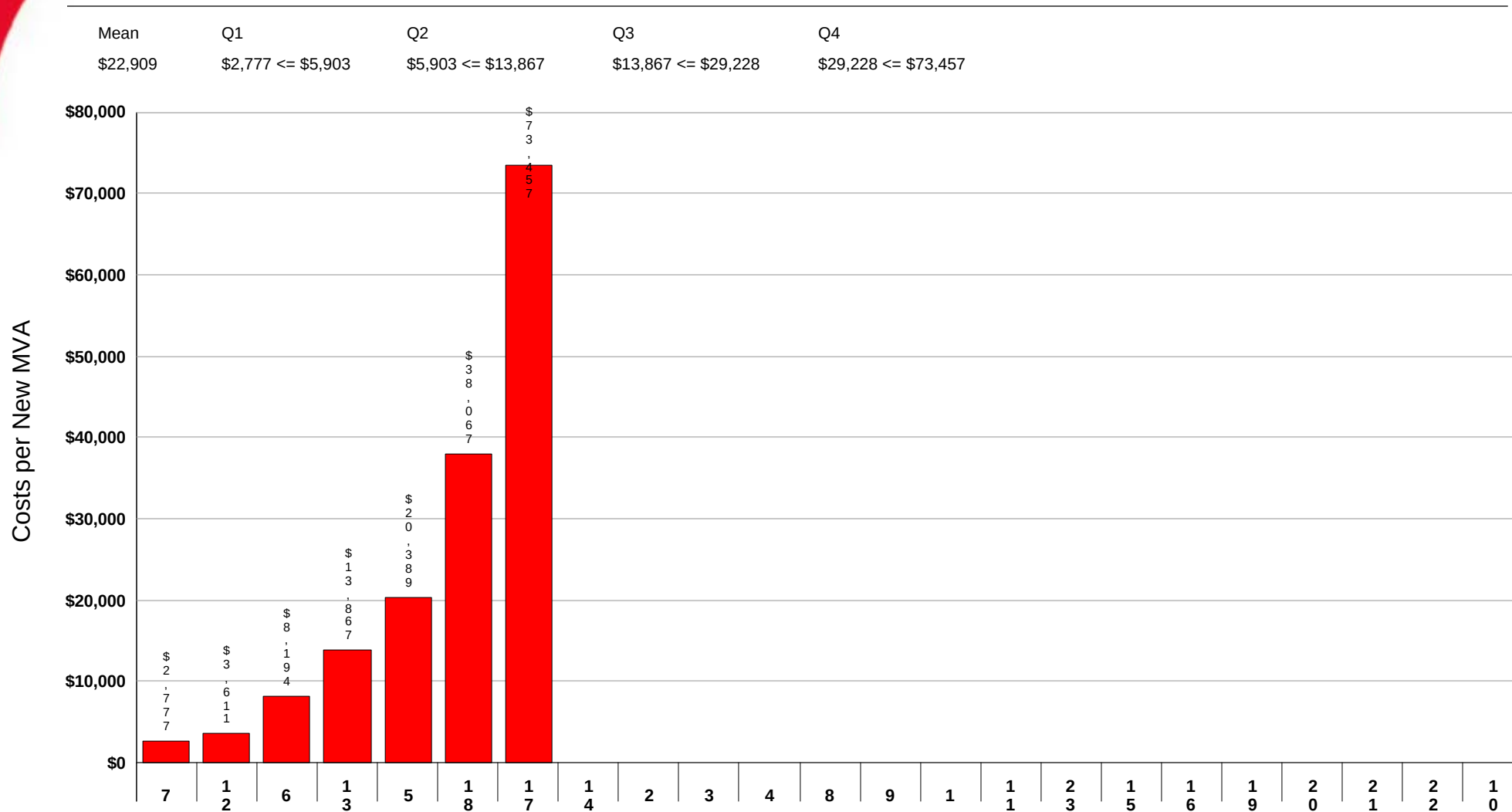
ID Code: 1218

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Calculation shown is for the first piece of the stacked bar only.

New Substation Transformer Purchase Costs

Per New MVA Put in Service



Source/Calculation: (D.10.6+D.26.6)/SUM{AT.3}

Volume: T&D Substation Field Construction, Final Report, 2006

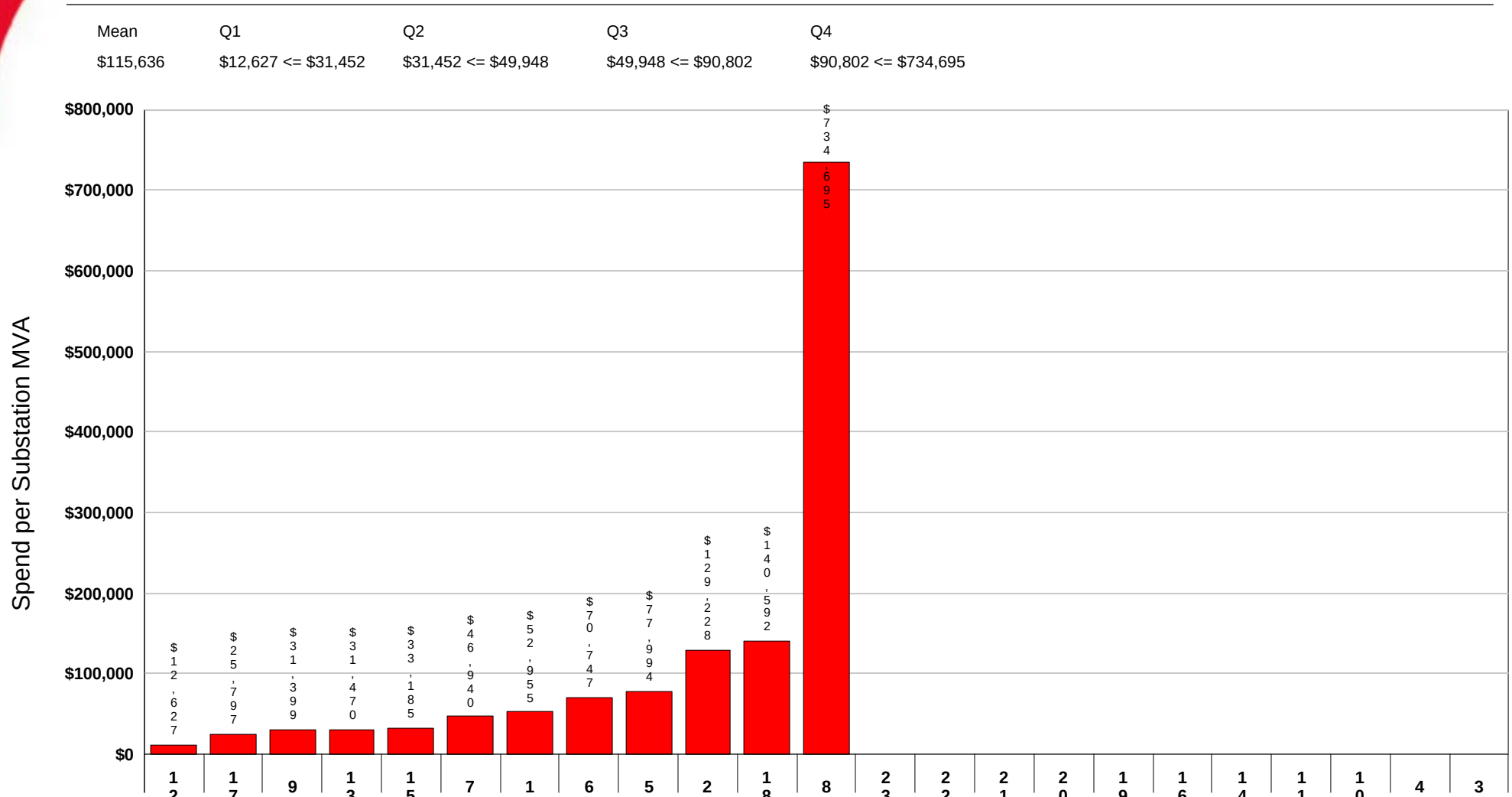
ID Code: 2500023

Page: 1451.1

Only companies with all the data are shown.

Gross T&D Substation Field Construction 2006 ABC Spend

Per Substation MVA Put in Service



Source/Calculation: (SUM{D.5}+(SUM{D.6}-D.6.8)+SUM{D.21}+(SUM{D.22}-D.22.8))/(SUM{AT.3}+SUM{AT.4})

Volume: T&D Substation Field Construction, Final Report, 2006

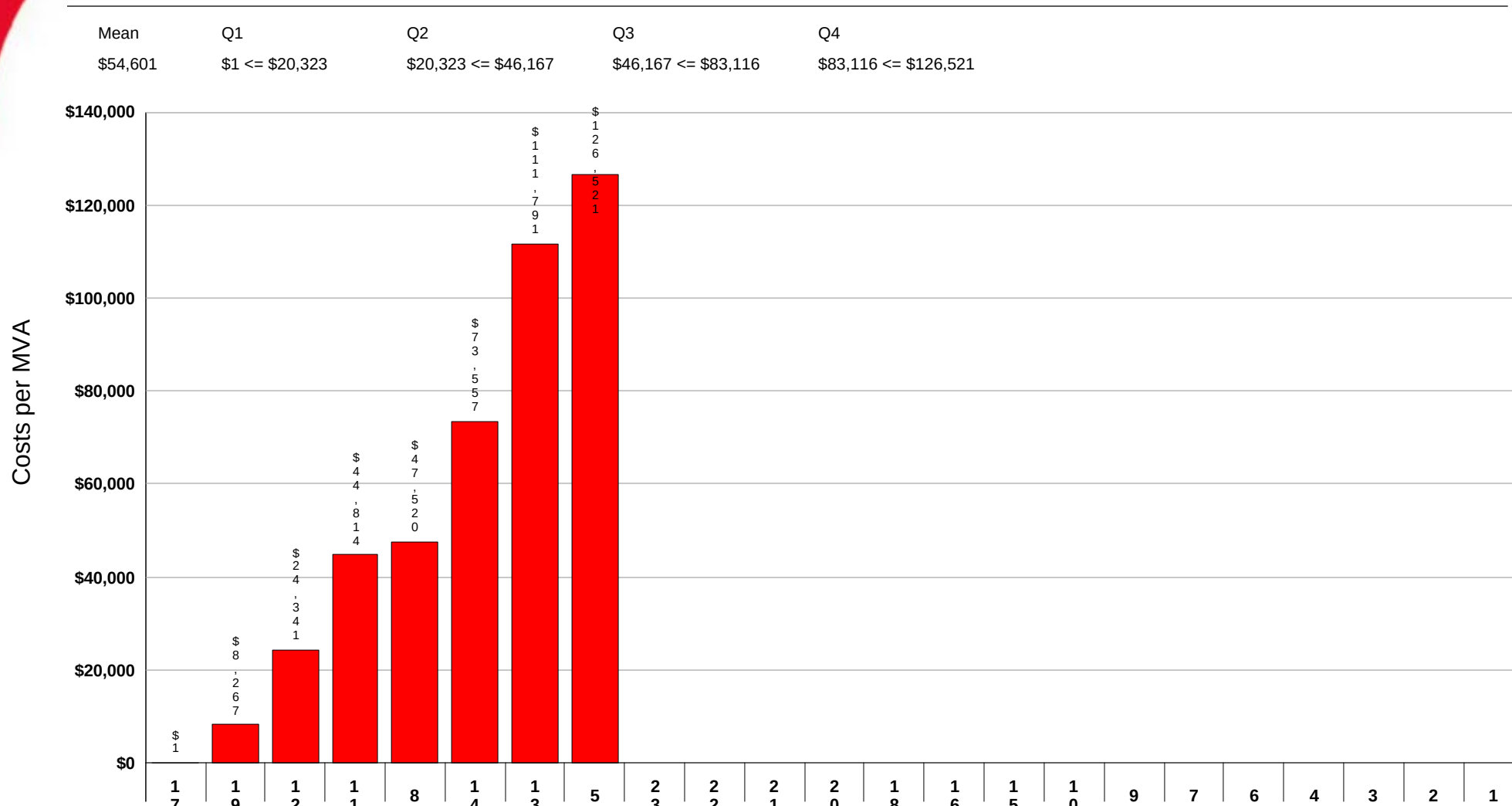
ID Code:1600024

Page:1451.2

Only companies with all the data are shown.



Average Total Installed Capital Costs Per MVA for New Distribution Substations Put in Service in 2006



Source/Calculation: AR.3.1/AR.3.2

Volume: T&D Substation Field Construction, Final Report, 2006

ID Code: 2500021

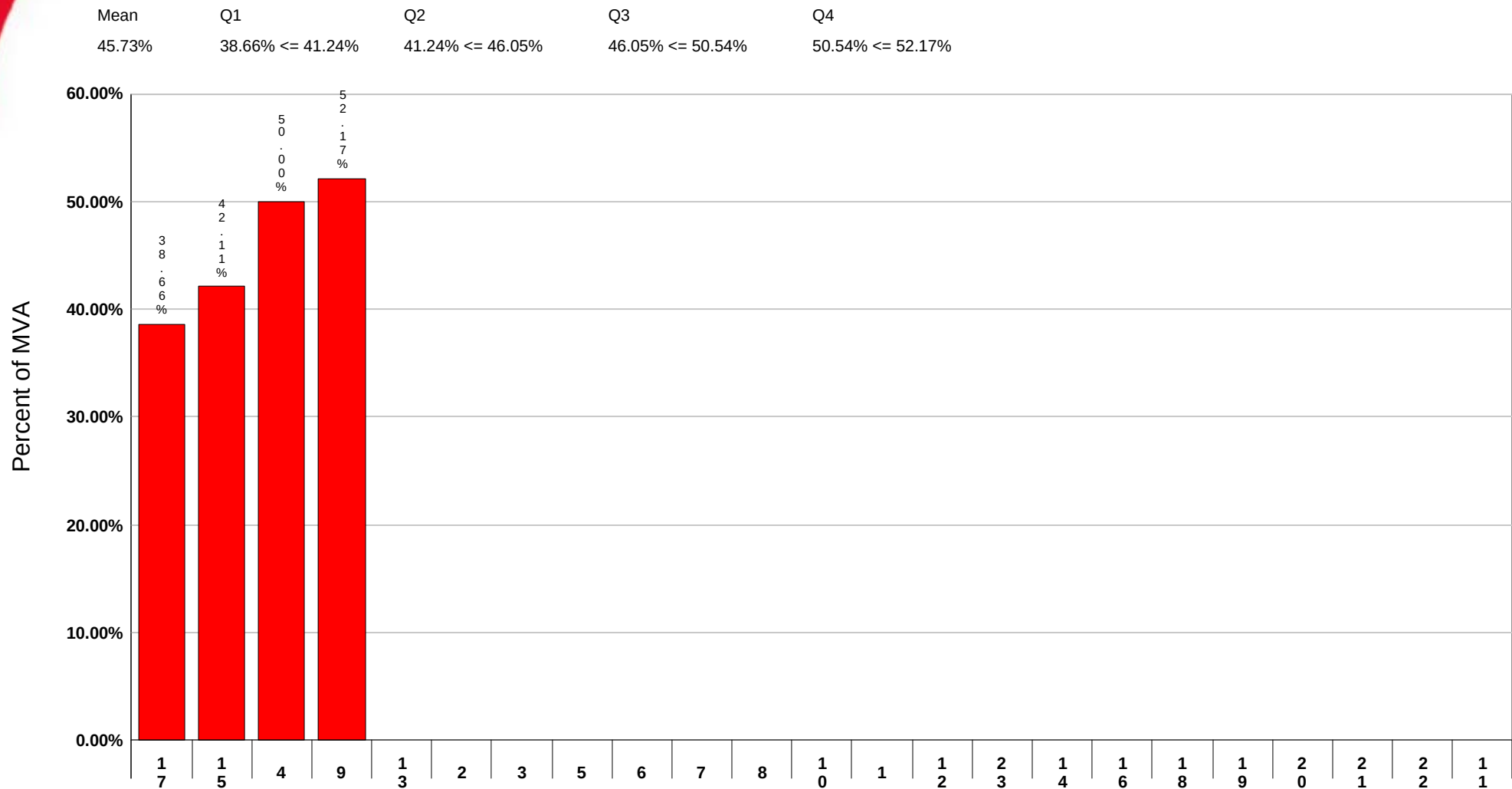
Page: 1451.3

Only companies with all the data are shown.



Percent of Total Substation Transformer MVA Installed in 2006

Using Rebuilt/Rewound Units



Source/Calculation: $\text{SUM}\{\text{AT.4}\} / (\text{SUM}\{\text{AT.3}\} + \text{SUM}\{\text{AT.4}\})$

Volume: T&D Substation Field Construction, Final Report, 2006

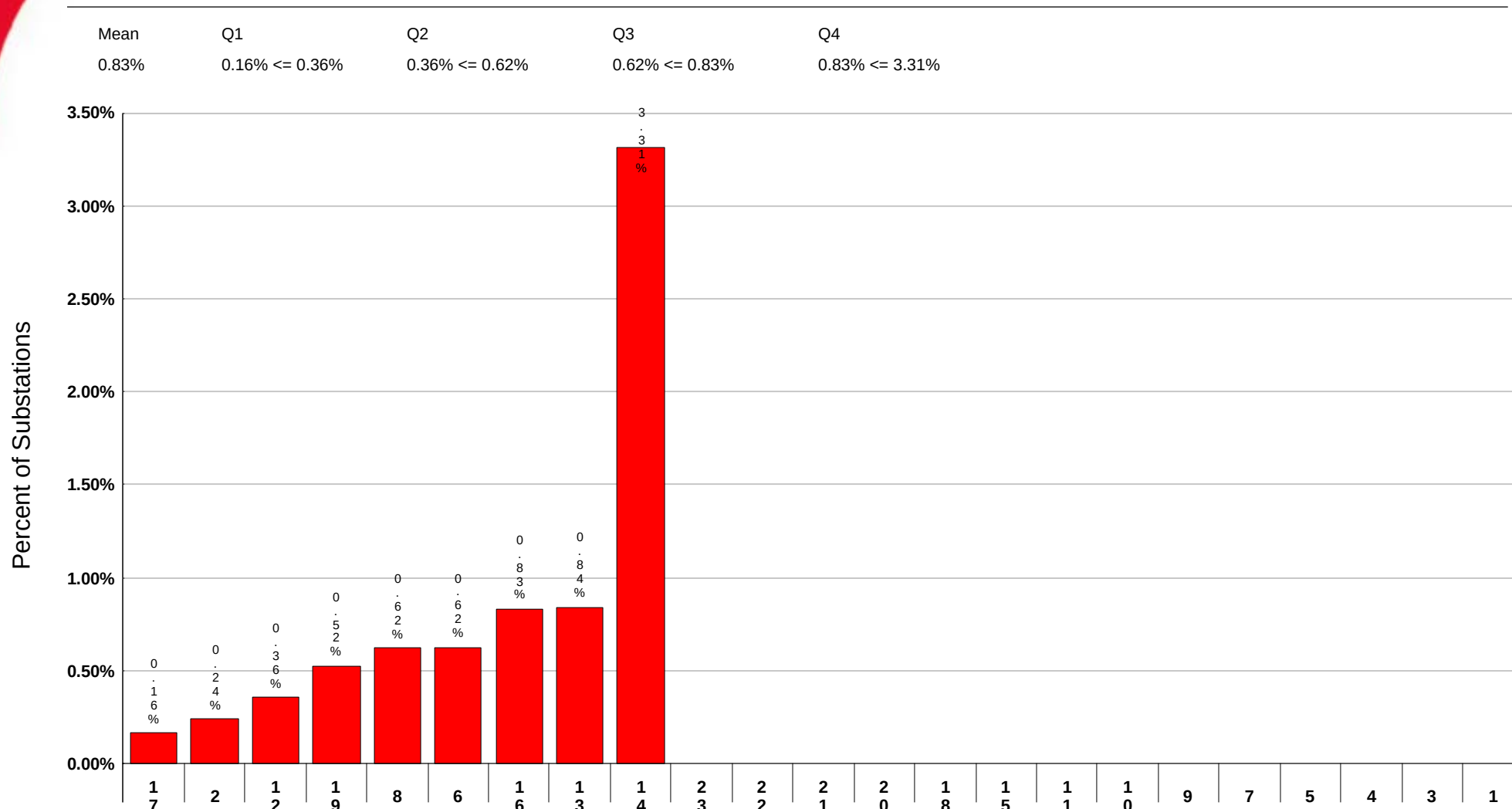
ID Code: 1600025

Page: 1451.4

Only companies with all the data are shown.

New Substations Put in Service in 2006

As a Percent of Total Substations in Service



Source/Calculation: SUM{AT.2}/SUM{AQ.6}

Volume: T&D Substation Field Construction, Final Report, 2006

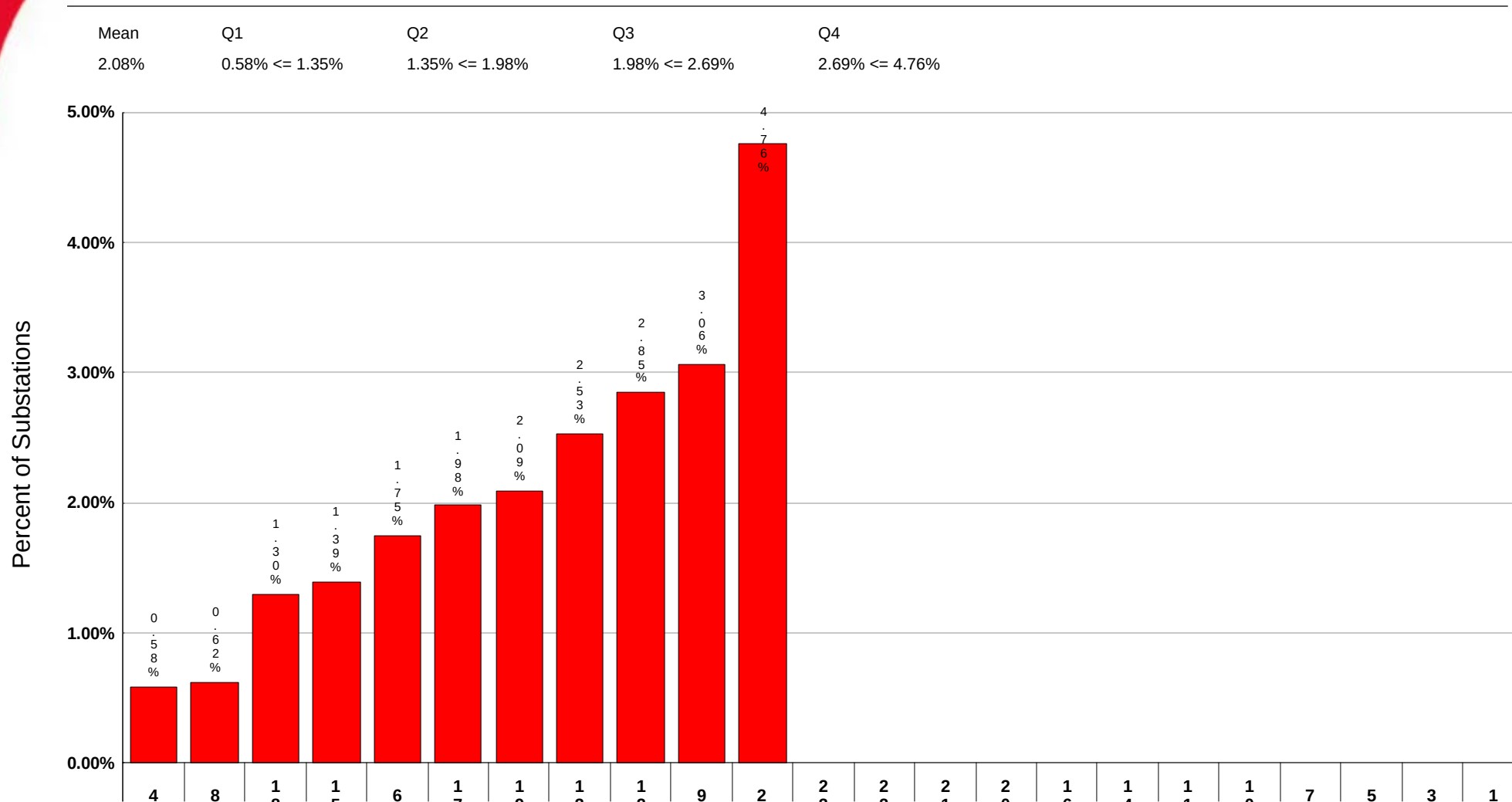
ID Code:1600026

Page:1451.5

Only companies with all the data are shown.

Upgraded Substations Put in Service in 2006

As a Percent of Total Substations in Service



Source/Calculation: SUM{AT.5}/SUM{AQ.6}

Volume: T&D Substation Field Construction, Final Report, 2006

ID Code:1600027

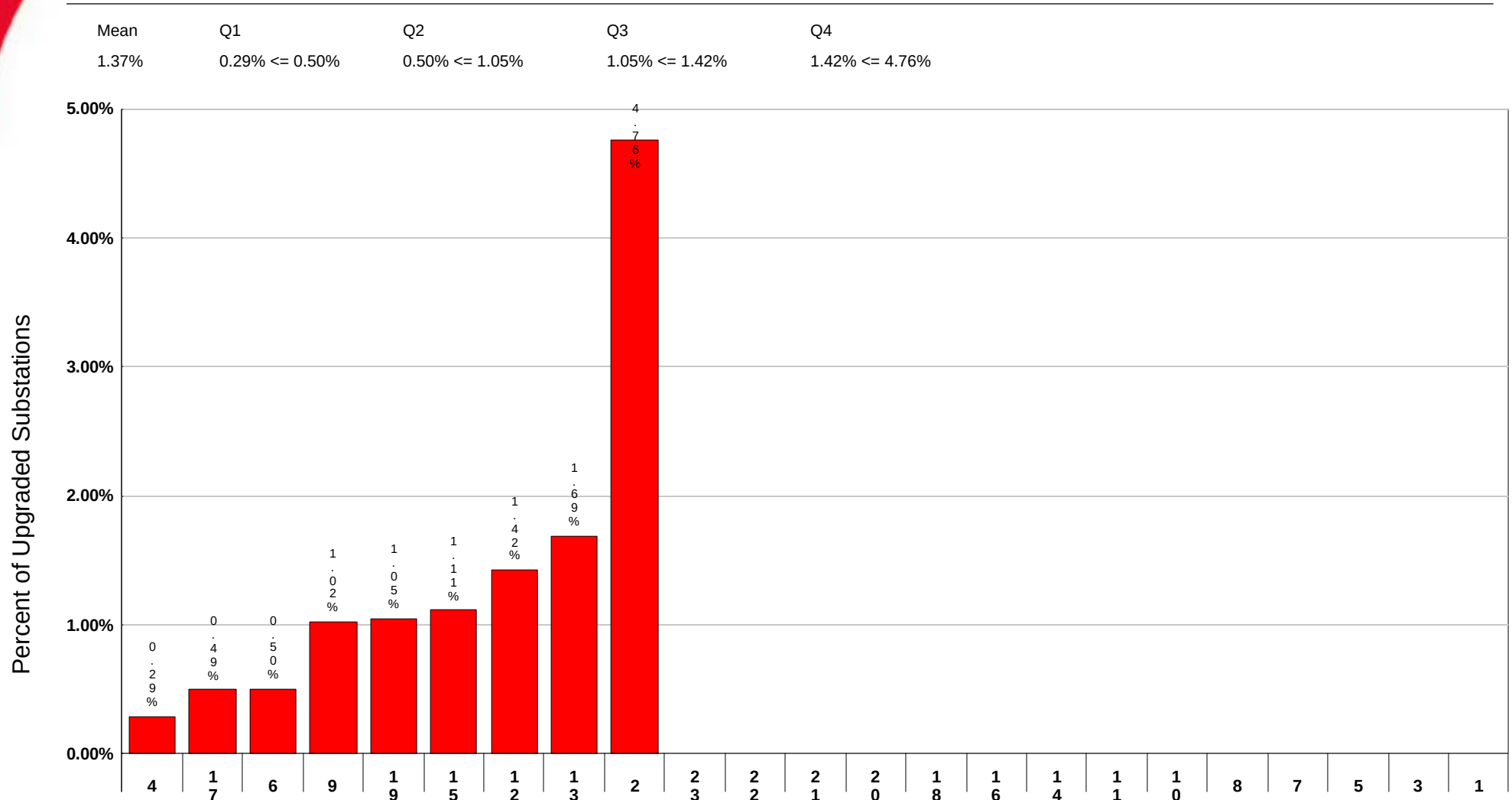
Page:1451.6

Only companies with all the data are shown.



Upgraded Substations Put in Service in 2006 That Included Adding Transformers

As a Percent of Total Substations in Service



Source/Calculation: AT.6.1/SUM{AQ.6}

Volume: T&D Substation Field Construction, Final Report, 2006

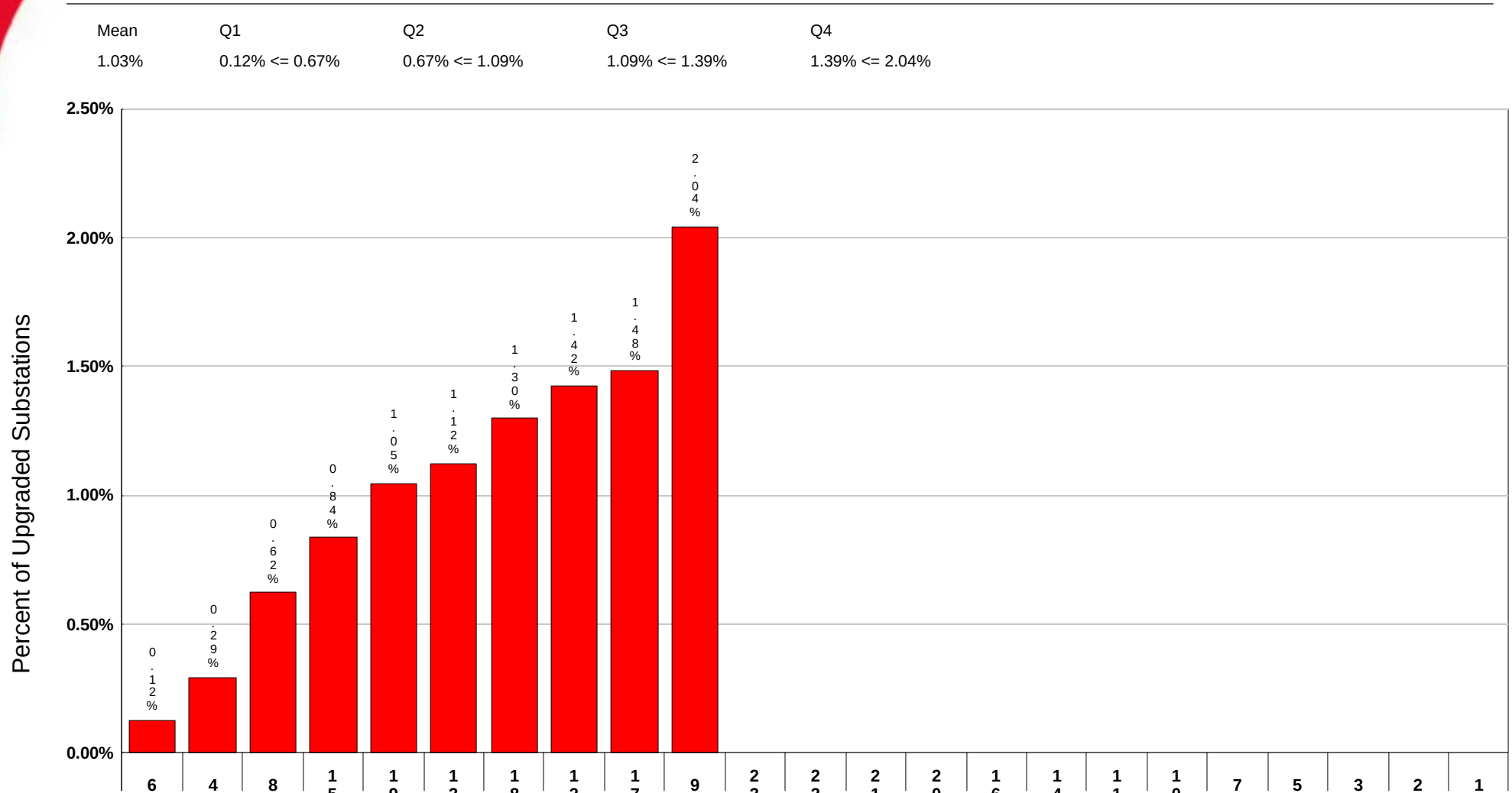
ID Code: 2500017

Page: 1451.7

Only companies with all the data are shown.

Upgraded Substations Put in Service in 2006 That Included Replacing Transformers

As a Percent of Total Substations in Service



Source/Calculation: AT.6.2/SUM{AQ.6}

Volume: T&D Substation Field Construction, Final Report, 2006

ID Code: 2500016

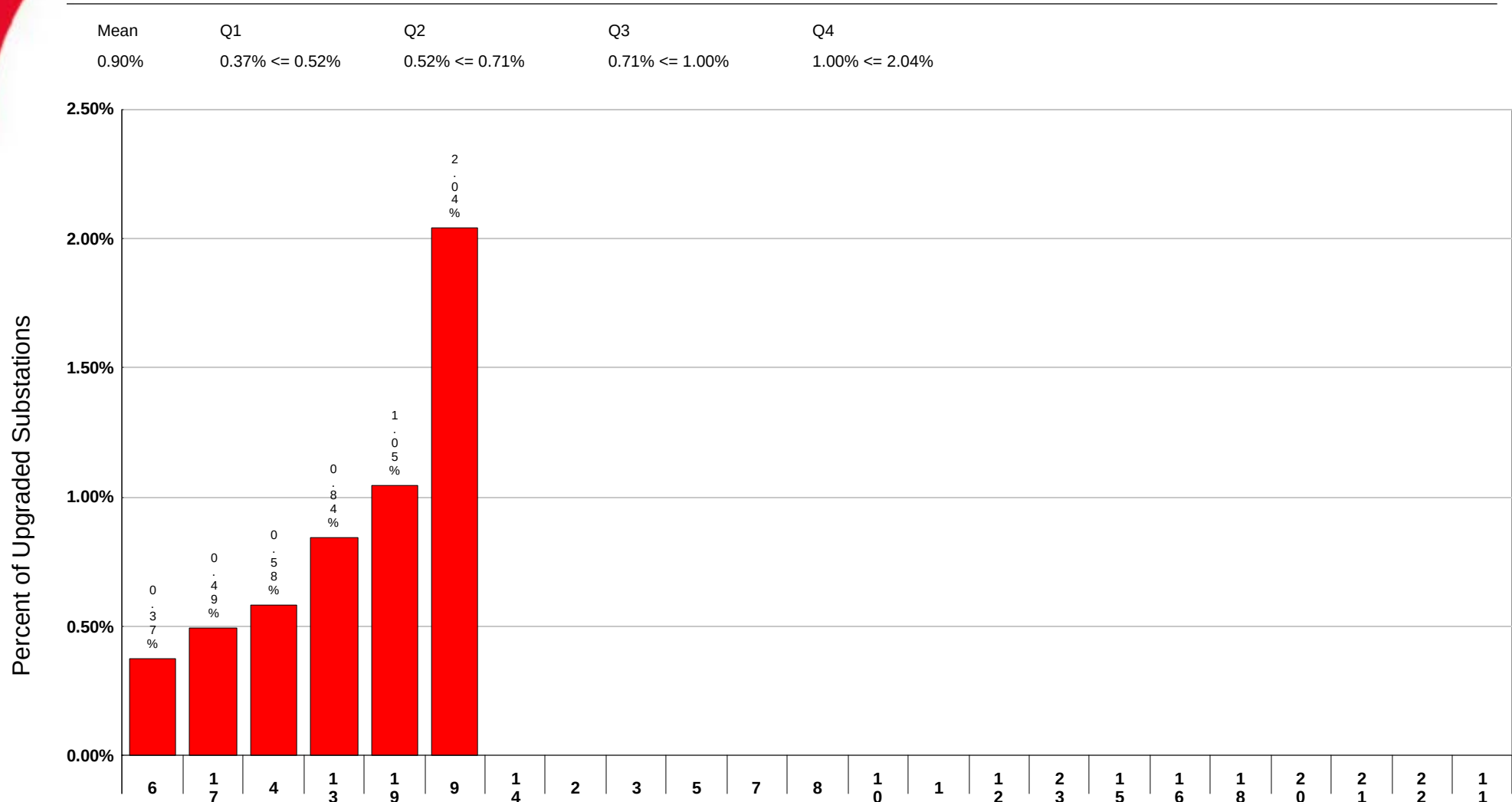
Page: 1451.8

Only companies with all the data are shown.



Upgraded Substations Put in Service in 2006 That Included Adding Switchgear

As a Percent of Total Substations in Service



Source/Calculation: AT.6.3/SUM{AQ.6}

Volume: T&D Substation Field Construction, Final Report, 2006

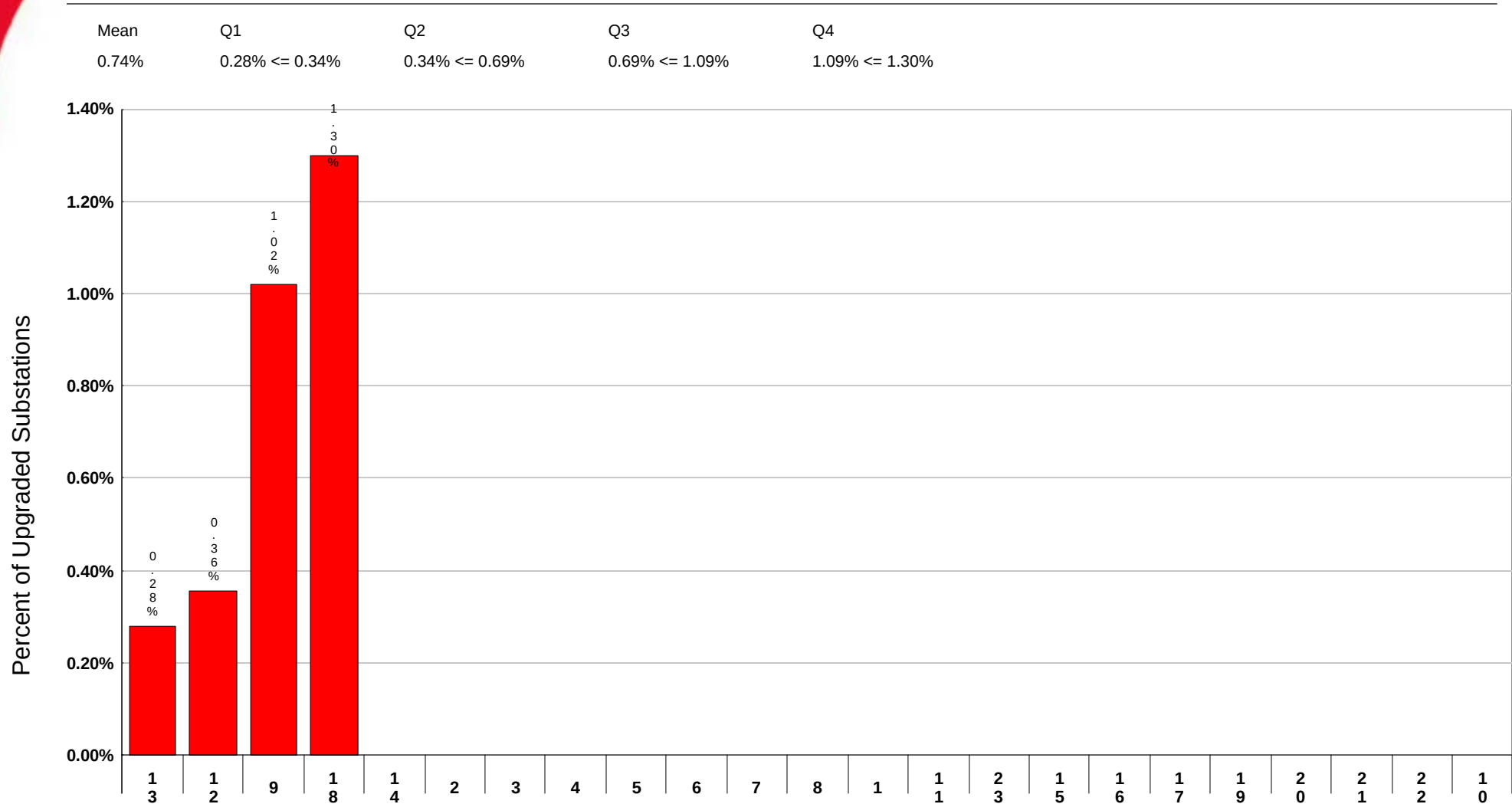
ID Code: 2500015

Page: 1451.9

Only companies with all the data are shown.

Upgraded Substations Put in Service in 2006 That Included Replacing Switchgear

As a Percent of Total Substations in Service



Source/Calculation: AT.6.4/SUM{AQ.6}

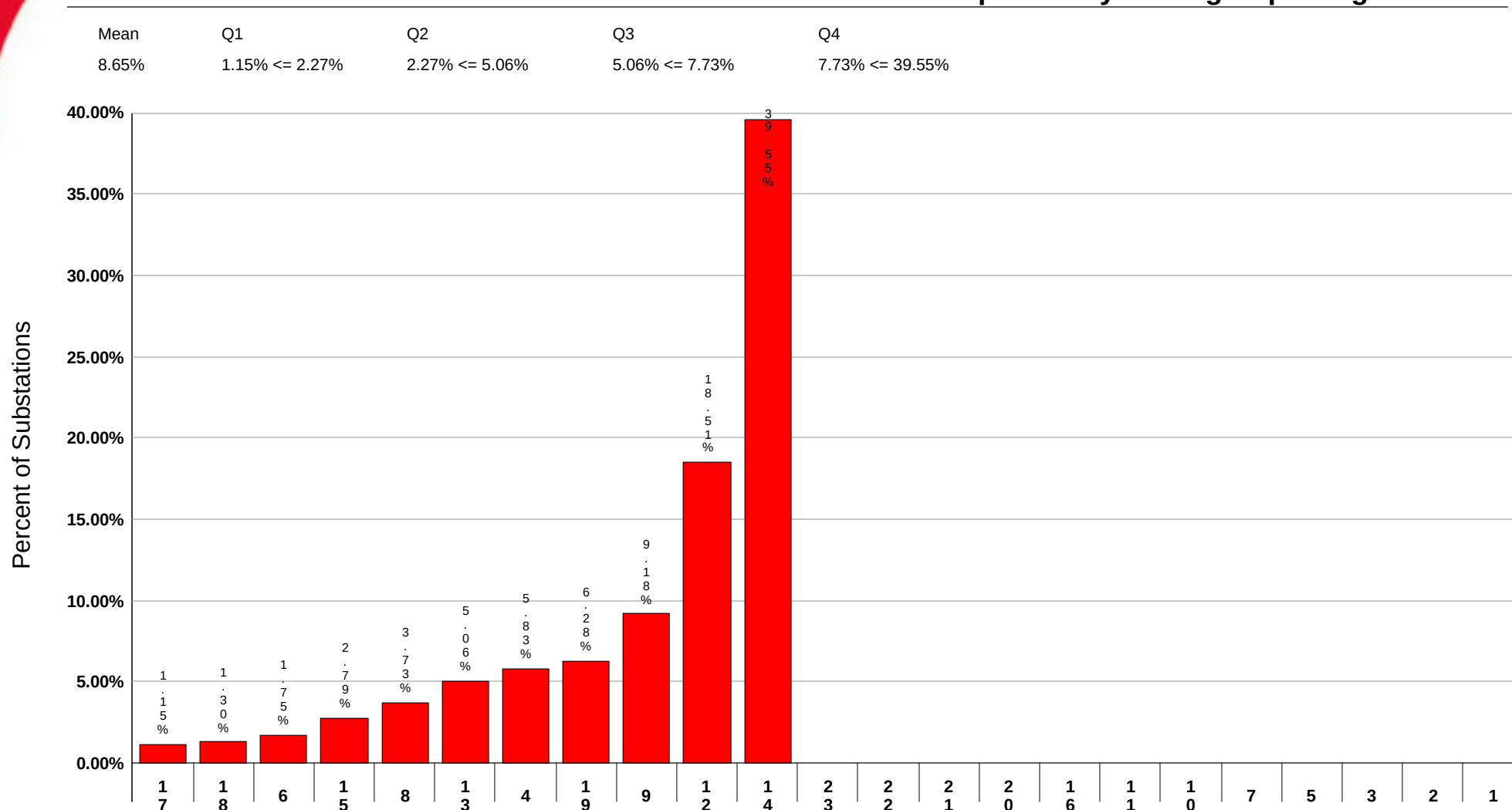
Volume: T&D Substation Field Construction, Final Report, 2006

ID Code: 1600028

Page: 1451.91

Only companies with all the data are shown.

Percent of Substations in Service Improved by Adding/Replacing Feeders



Source/Calculation: AT.8.1/SUM{AQ.6}

Volume: T&D Substation Field Construction, Final Report, 2006

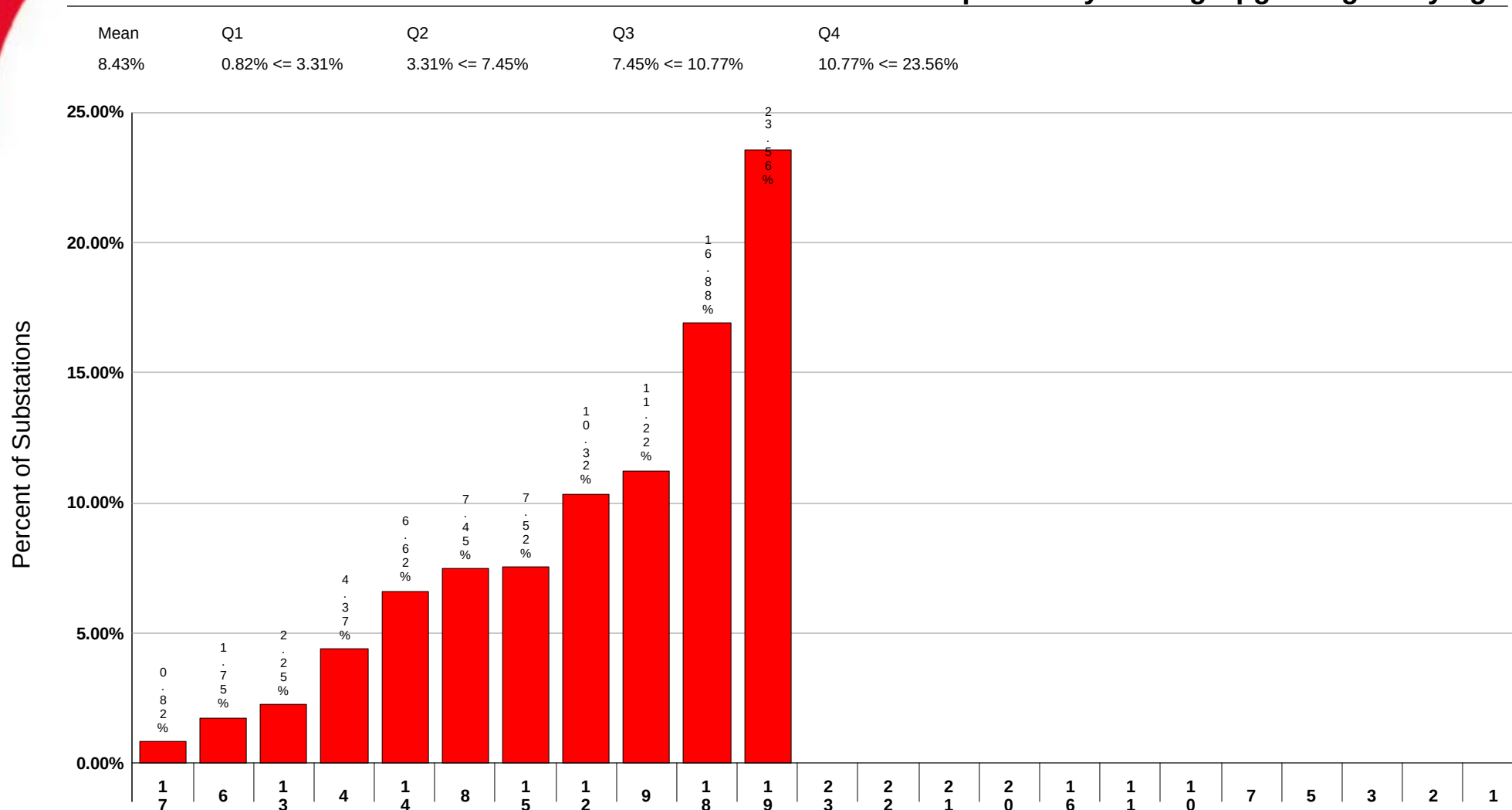
ID Code: 2500013

Page: 1451.92

Only companies with all the data are shown.



Percent of Substations in Service Improved by Adding/Upgrading Relaying



Source/Calculation:AT.8.2/SUM{AQ.6}

Volume: T&D Substation Field Construction, Final Report, 2006

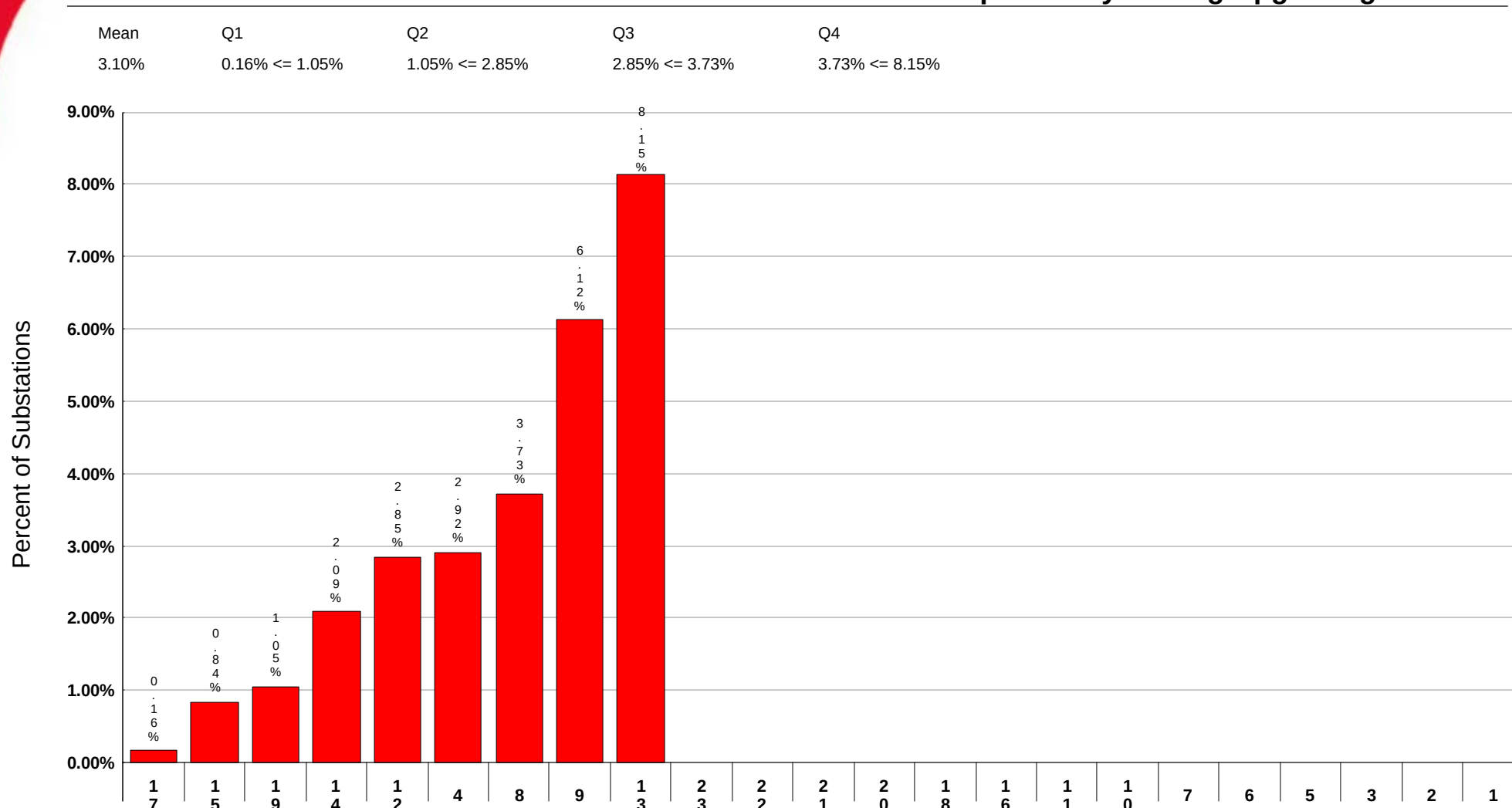
ID Code:1600029

Page:1451.93

Only companies with all the data are shown.



Percent of Substations in Service Improved by Adding/Upgrading SCADA



Source/Calculation: AT.8.3/SUM{AQ.6}

Volume: T&D Substation Field Construction, Final Report, 2006

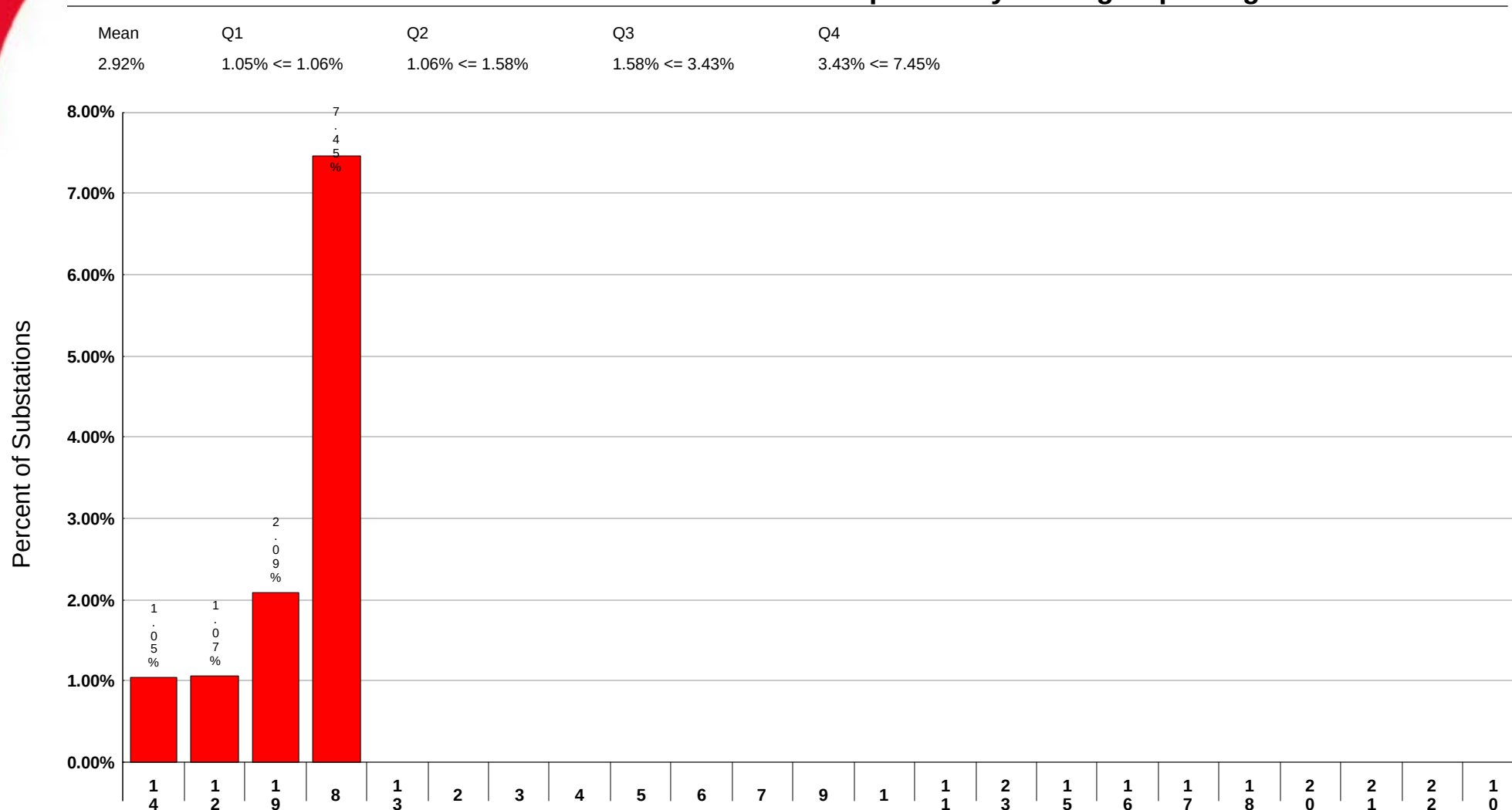
ID Code: 2500011

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Only companies with all the data are shown.



Percent of Substations in Service Improved by Adding/Replacing Fault Recorders



Source/Calculation: AT.8.4/SUM{AQ.6}

Volume: T&D Substation Field Construction, Final Report, 2006

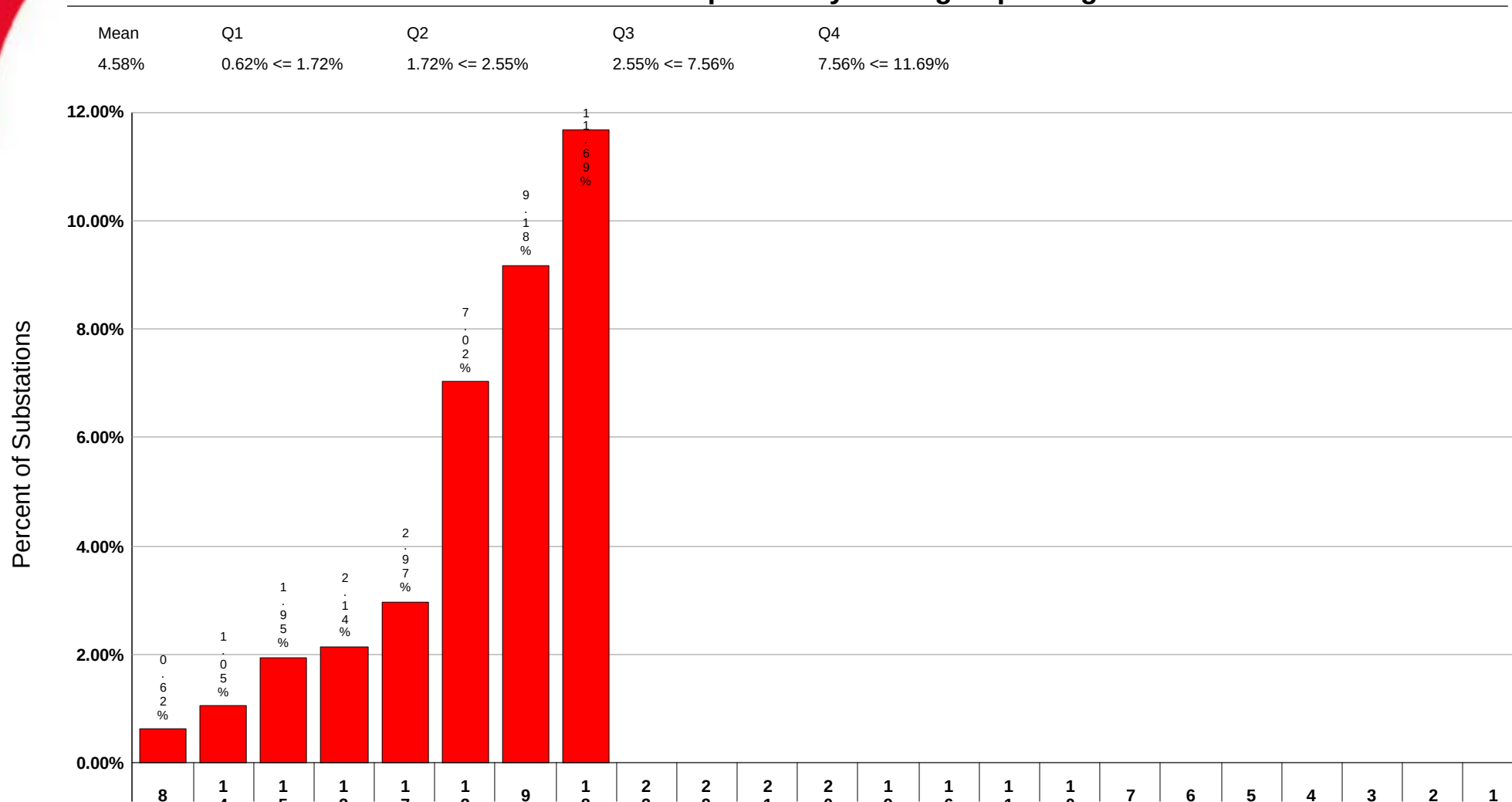
ID Code: 2500010

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Only companies with all the data are shown.



Percent of Substations in Service Improved by Adding/Replacing Wildlife Protection Features



Source/Calculation: AT.8.5/SUM{AQ.6}

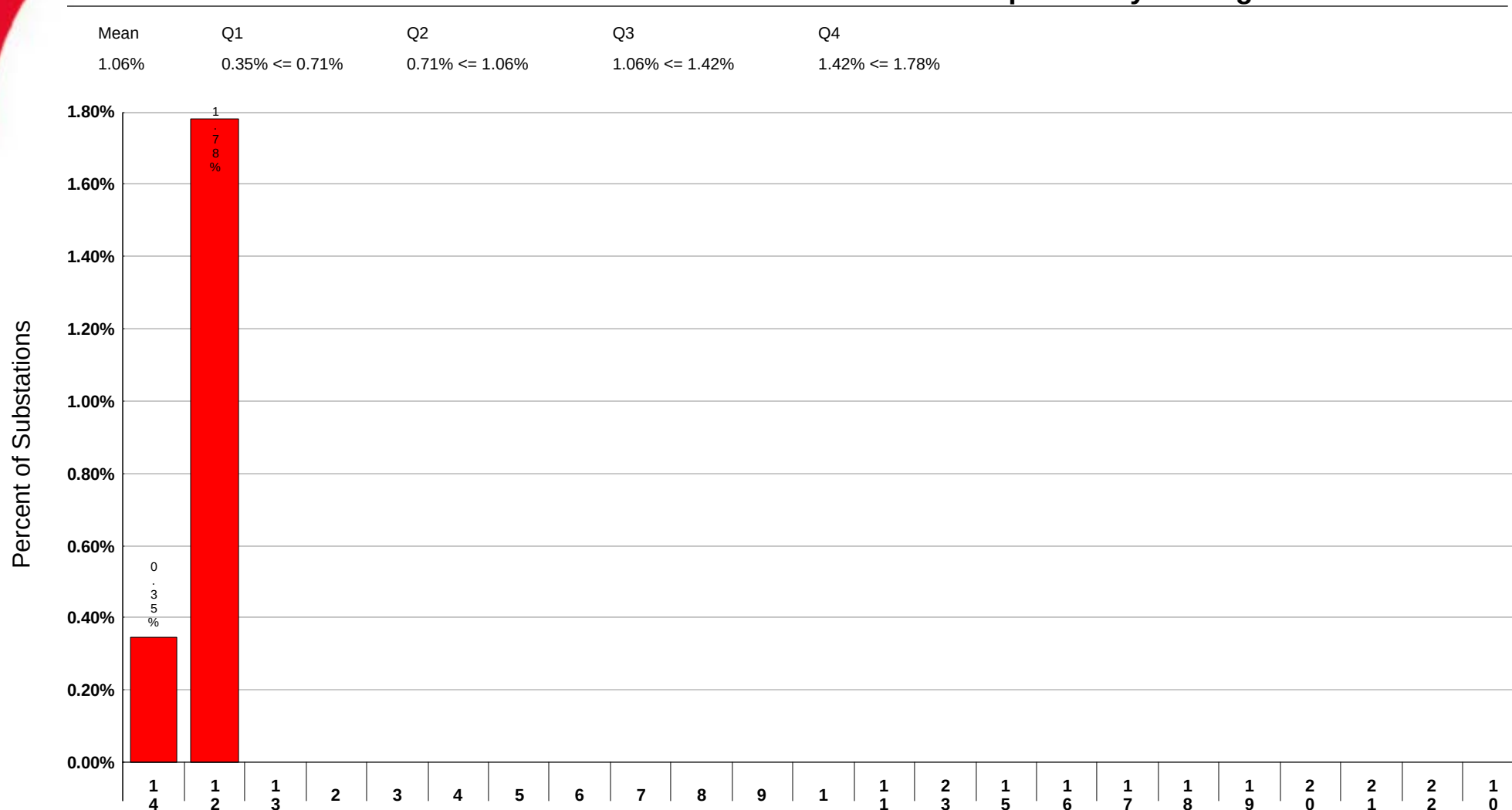
Volume: T&D Substation Field Construction, Final Report, 2006

ID Code: 2500009

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Only companies with all the data are shown.

Percent of Substations in Service Improved by Adding/Firewall Barriers



Source/Calculation: AT.8.6/SUM{AQ.6}

Volume: T&D Substation Field Construction, Final Report, 2006

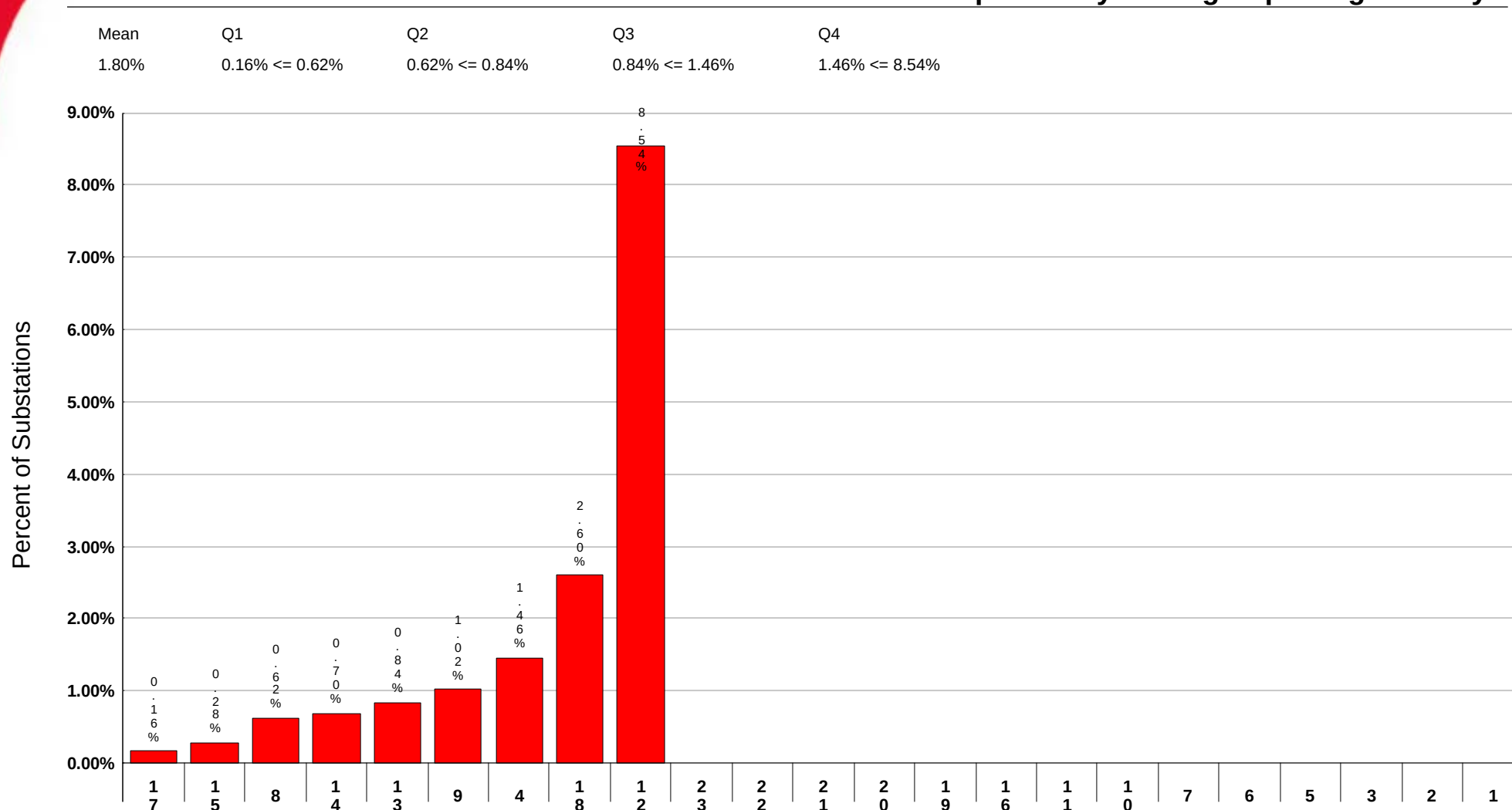
ID Code: 2500008

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Only companies with all the data are shown.



Percent of Substations in Service Improved by Adding/Replacing Security



Source/Calculation: AT.8.7/SUM{AQ.6}

Volume: T&D Substation Field Construction, Final Report, 2006

ID Code: 2500007

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Only companies with all the data are shown.



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	Pg. 1472	Transmission Substation Maintenance Expenses - Per Transmission MVA
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T&D Substation Operations Expenses

Per MWh Transmitted



Source/Calculation: SUM{B.21}/A.2.5

Volume: T&D Substation Field Maintenance/Operations, Final Report, 2006

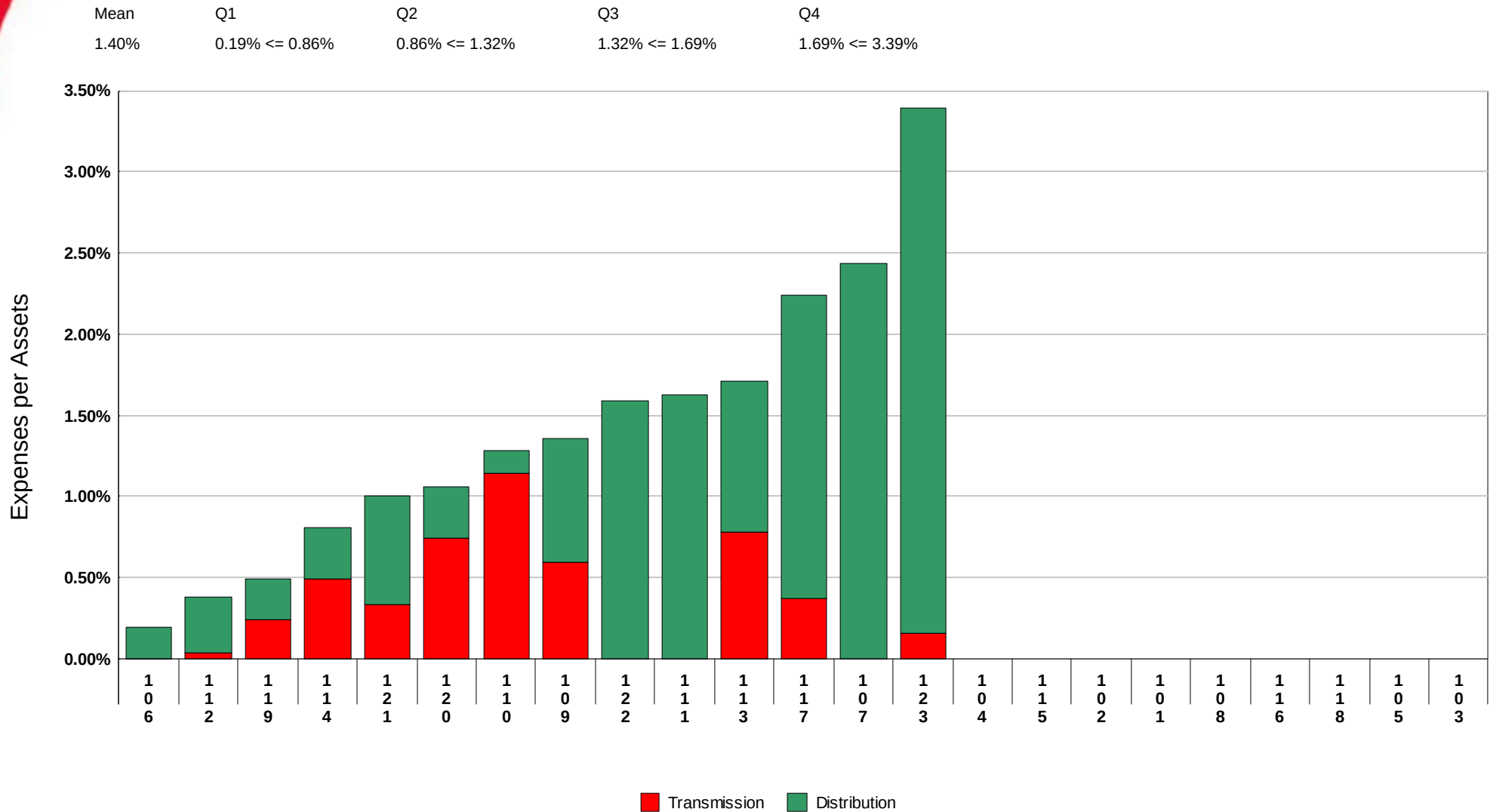
ID Code:27161

Page:1453

Calculation shown is for the first piece of the stacked bar only.

T&D Substation Operations Expenses

Per Total Substation Assets



Source/Calculation: SUM{B.21}/SUM{B.11}

Volume: T&D Substation Field Maintenance/Operations, Final Report, 2006

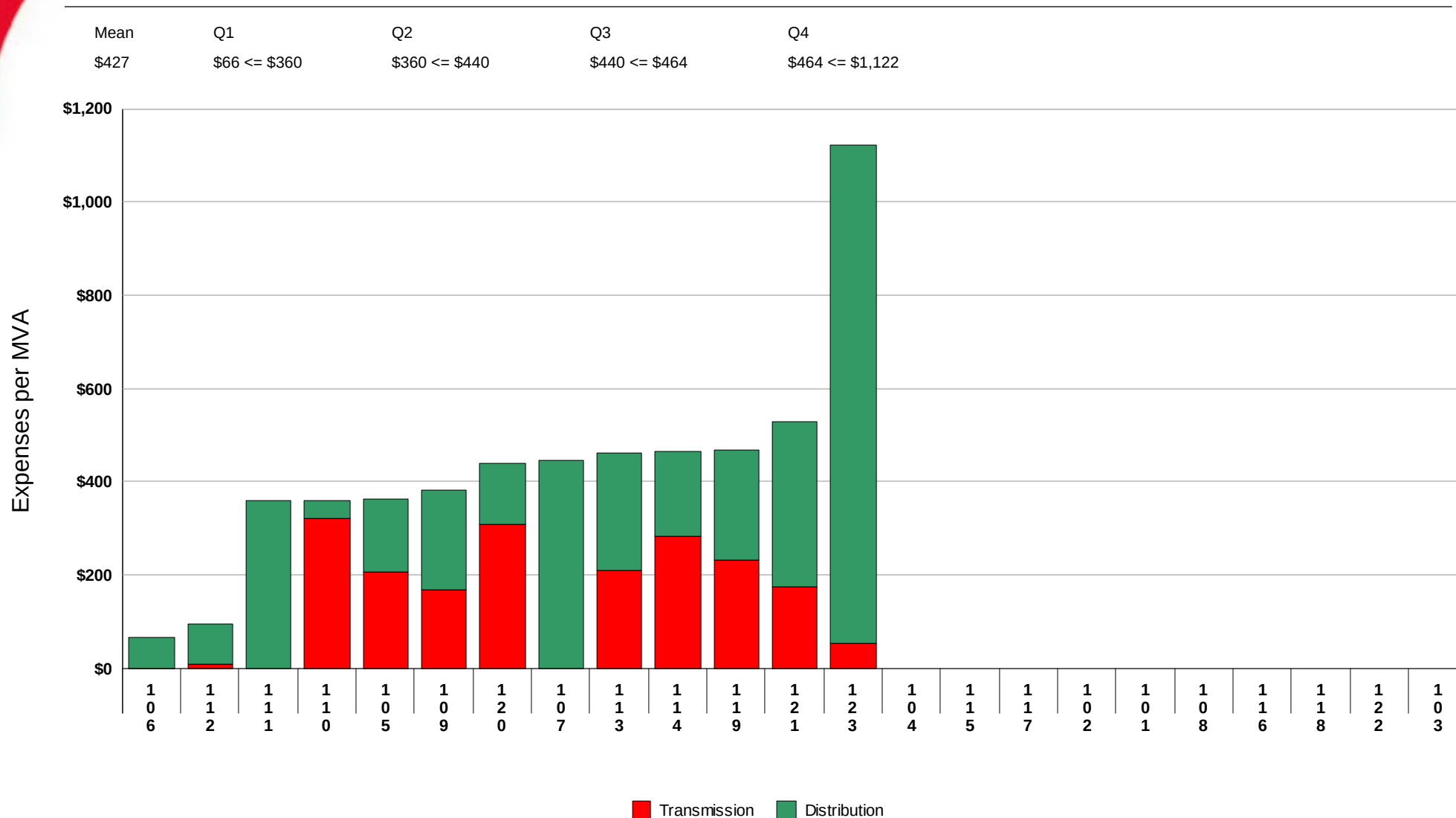
ID Code:2108

Page:1454

Calculation shown is for the first piece of the stacked bar only.

T&D Substation Operations Expenses

Per Substation Total MVA



Source/Calculation: $\text{SUM}\{B.21\} / (\text{SUM}\{AQ.13\} + \text{SUM}\{AQ.12\})$

Volume: T&D Substation Field Maintenance/Operations, Final Report, 2006

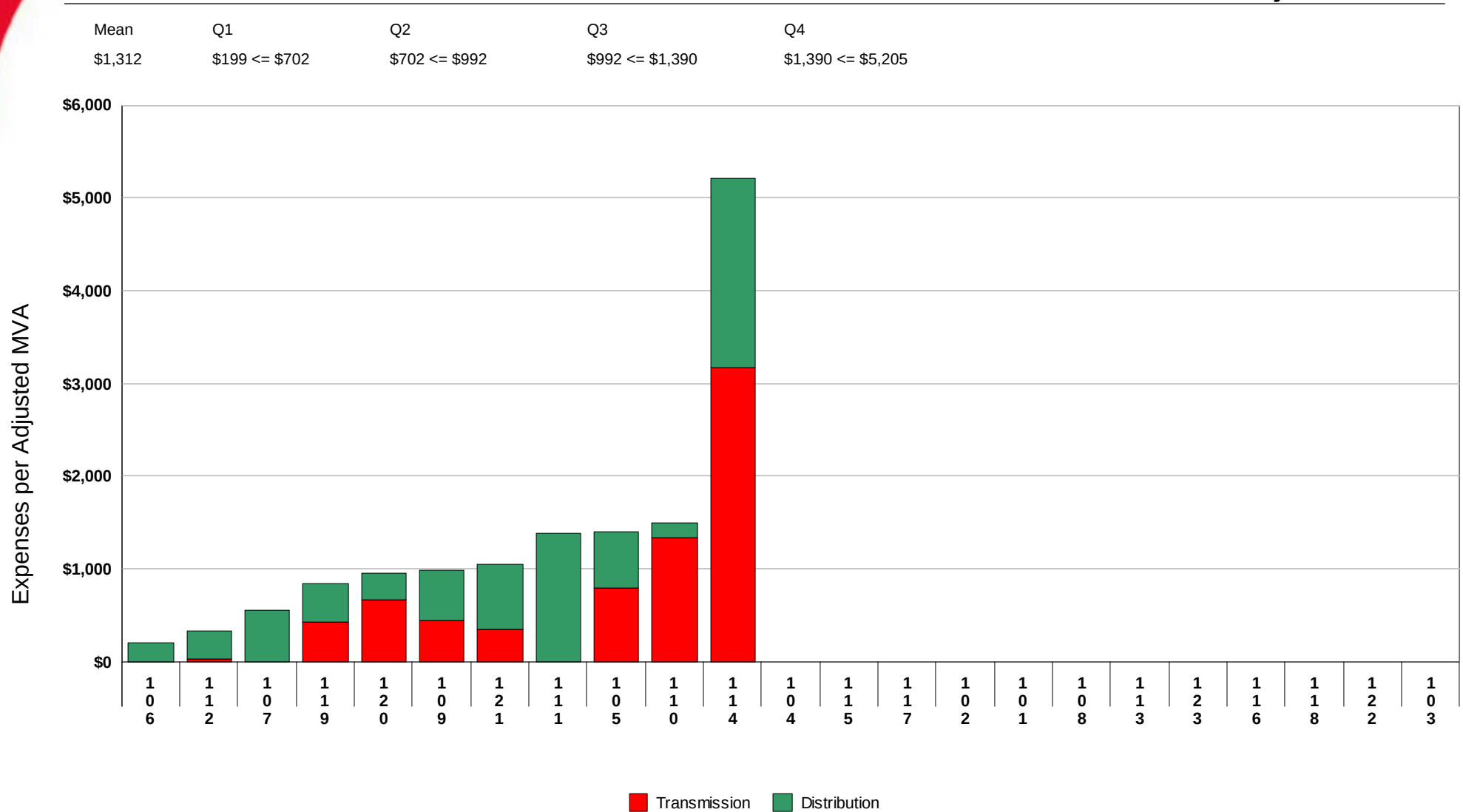
ID Code: 627

Page: 1455

Calculation shown is for the first piece of the stacked bar only.

T&D Substation Operations Expenses

Per Adjusted MVA



Source/Calculation: $\text{SUM}\{B.21\} / ((\text{SUM}\{AQ.12\} * AQ.14.2) + (\text{SUM}\{AQ.13\} * AQ.14.1))$

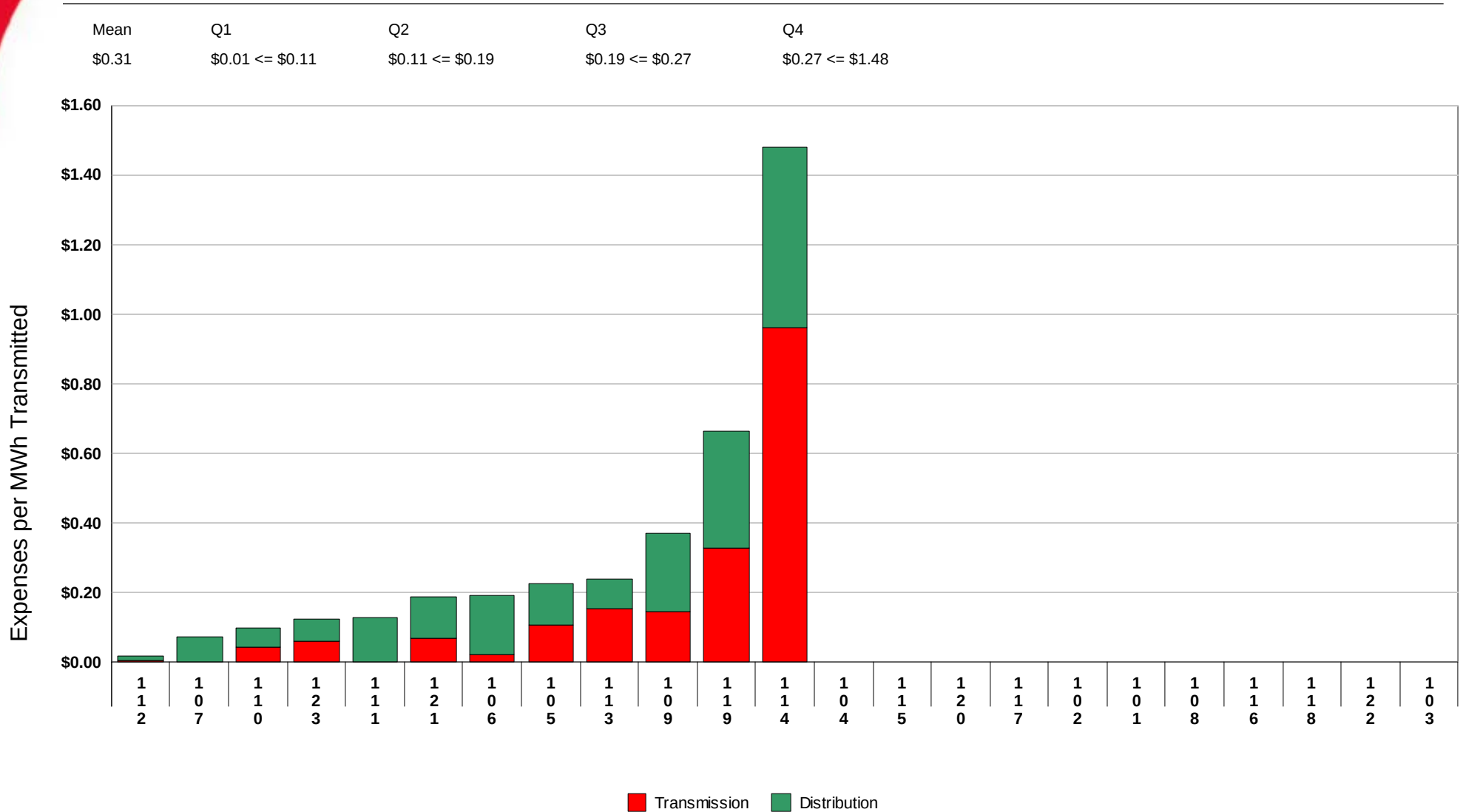
Volume: T&D Substation Field Maintenance/Operations, Final Report, 2006

ID Code:2113

Page:1456

Calculation shown is for the first piece of the stacked bar only.

T&D Substation Maintenance Expenses Per MWh Transmitted



Source/Calculation: SUM{B.23}/A.2.5

Volume: T&D Substation Field Maintenance/Operations, Final Report, 2006

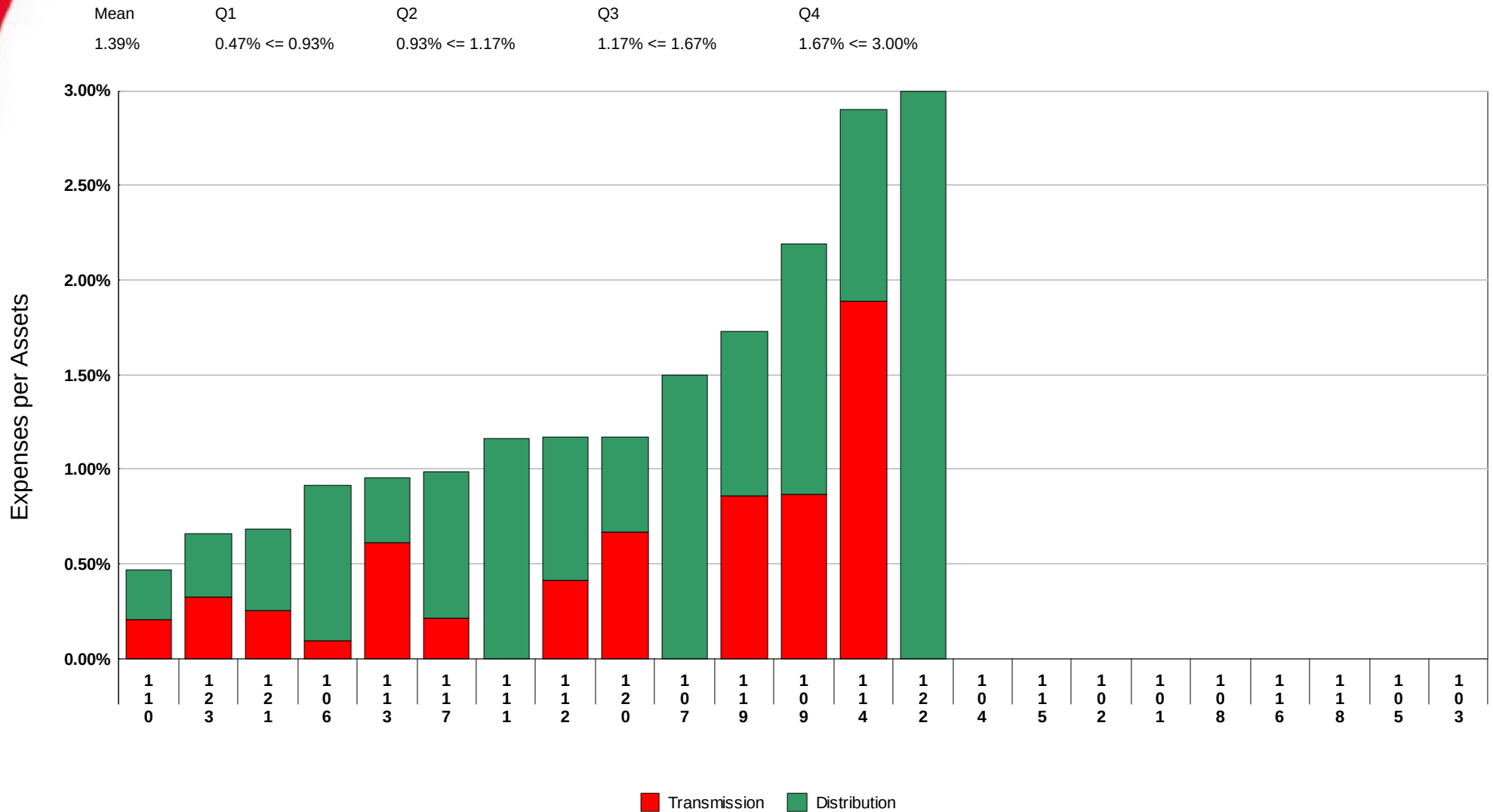
ID Code: 27162

Page: 1458

Calculation shown is for the first piece of the stacked bar only.

T&D Substation Maintenance Expenses

Per Total Substation Assets



Source/Calculation: SUM{B.23}/SUM{B.11}

Volume: T&D Substation Field Maintenance/Operations, Final Report, 2006

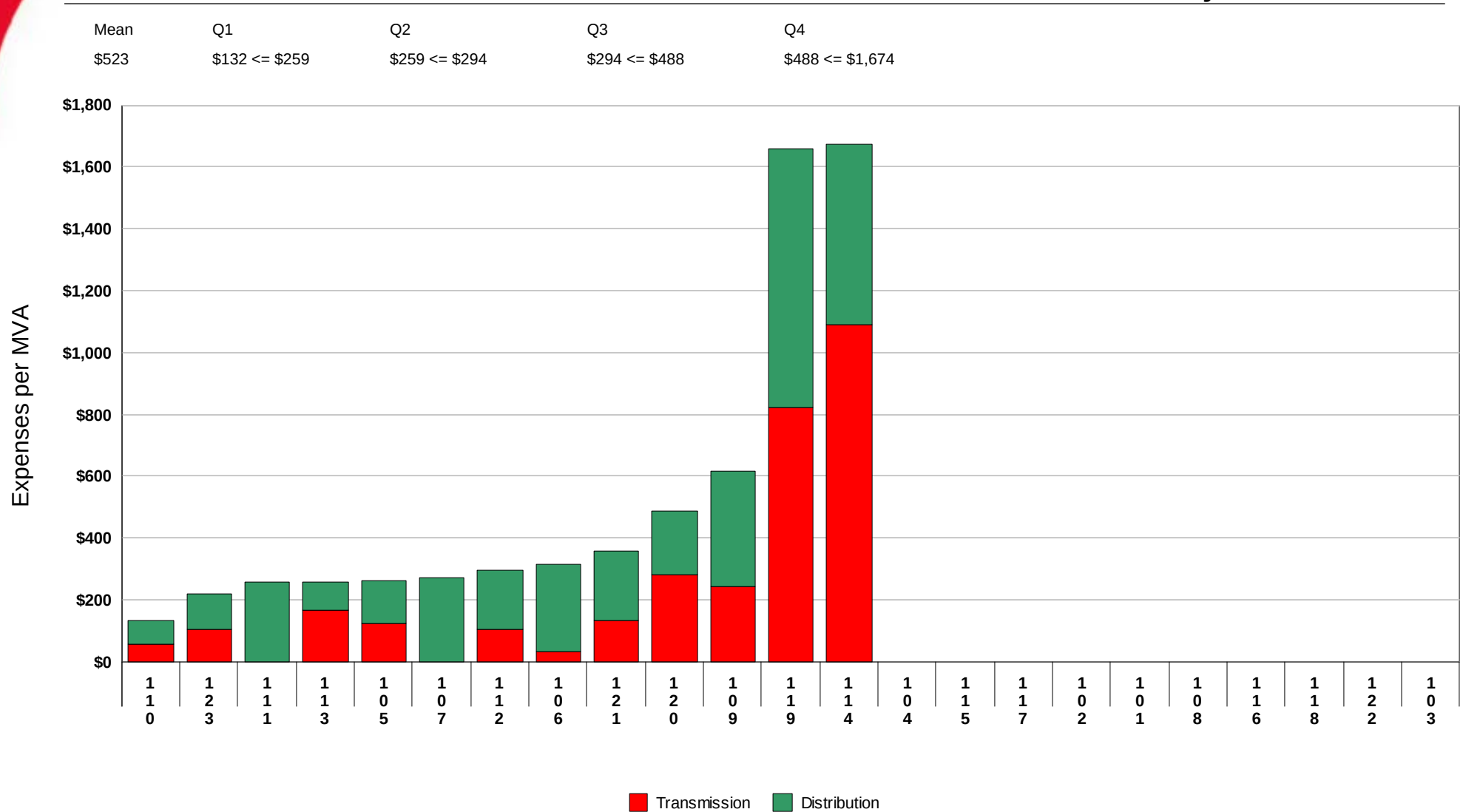
ID Code:2106

Page:1459

Calculation shown is for the first piece of the stacked bar only.

T&D Substation Maintenance Expenses

Per System Total MVA



Source/Calculation: SUM{B.23}/(SUM{AQ.12}+SUM{AQ.13})

Volume: T&D Substation Field Maintenance/Operations, Final Report, 2006

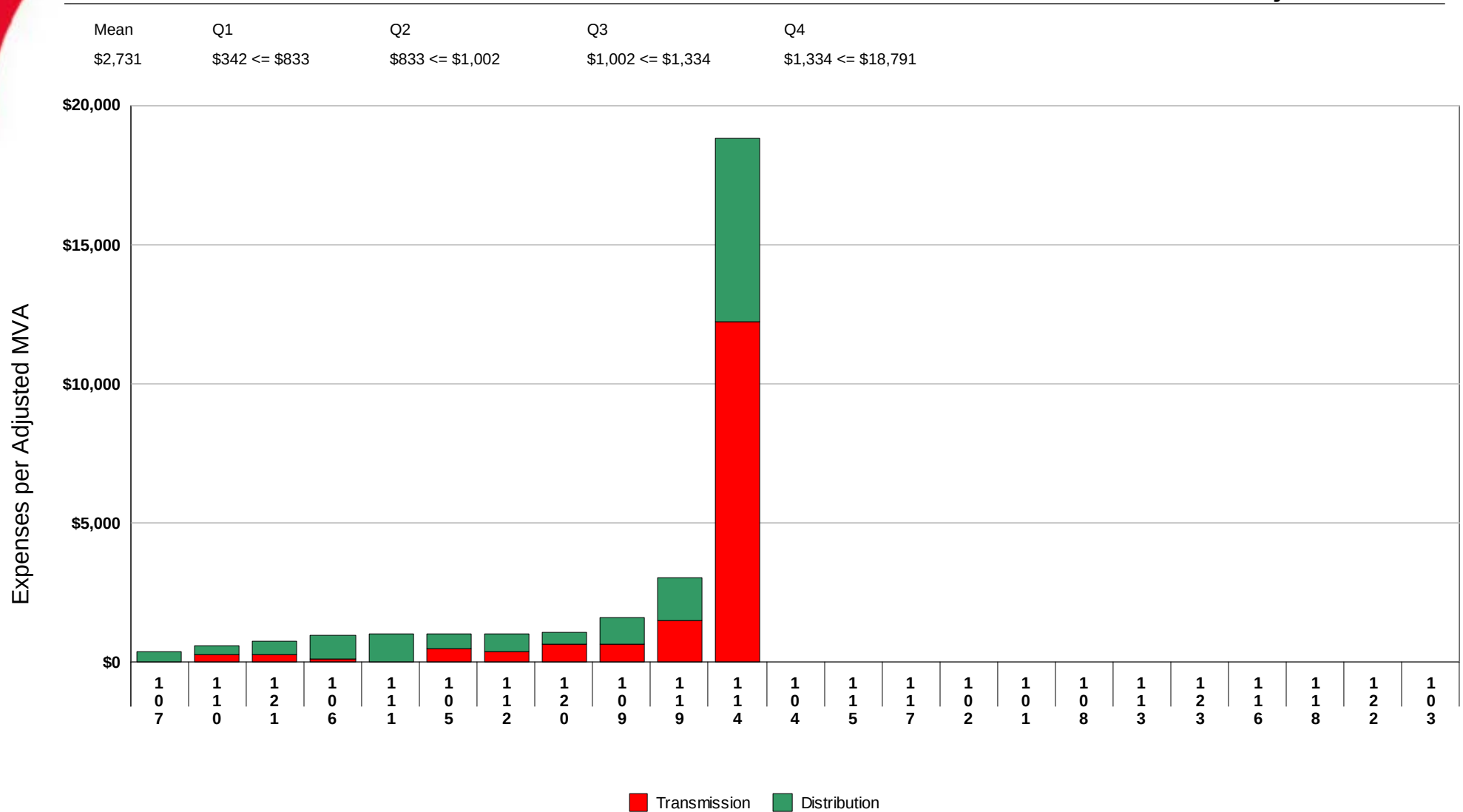
ID Code:629

Page:1460

Calculation shown is for the first piece of the stacked bar only.

T&D Substation Maintenance Expenses

Per Adjusted MVA



Source/Calculation: SUM{B.23}/((SUM{AQ.13}*AQ.14.1)+(SUM{AQ.12}*AQ.14.2))

Volume: T&D Substation Field Maintenance/Operations, Final Report, 2006

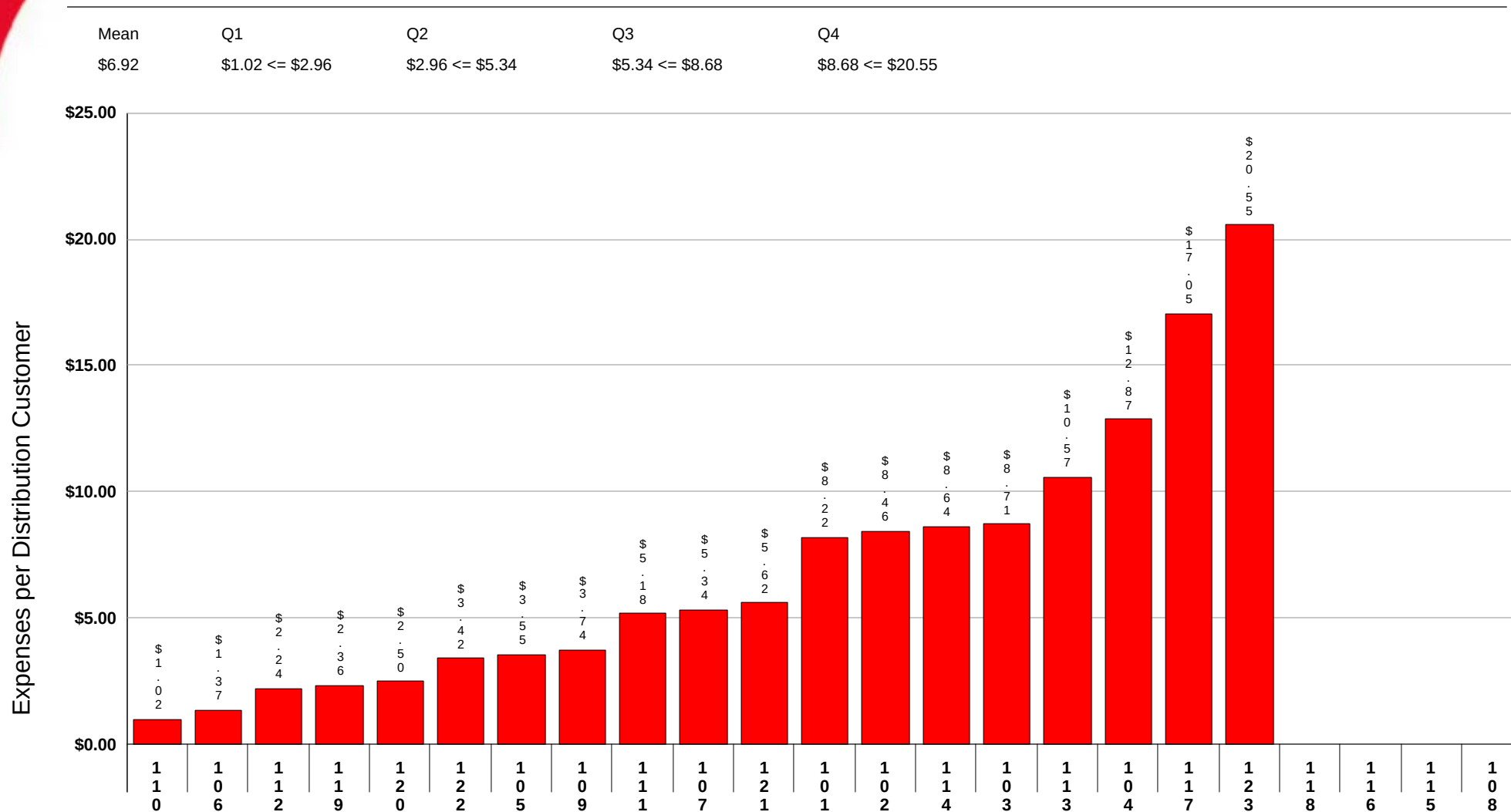
ID Code:2111

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Calculation shown is for the first piece of the stacked bar only.

Distribution Substation Operations Expenses

Per Distribution Customer



Source/Calculation: SUM{B.25}/A.2.2

Volume: T&D Substation Field Maintenance/Operations, Final Report, 2006

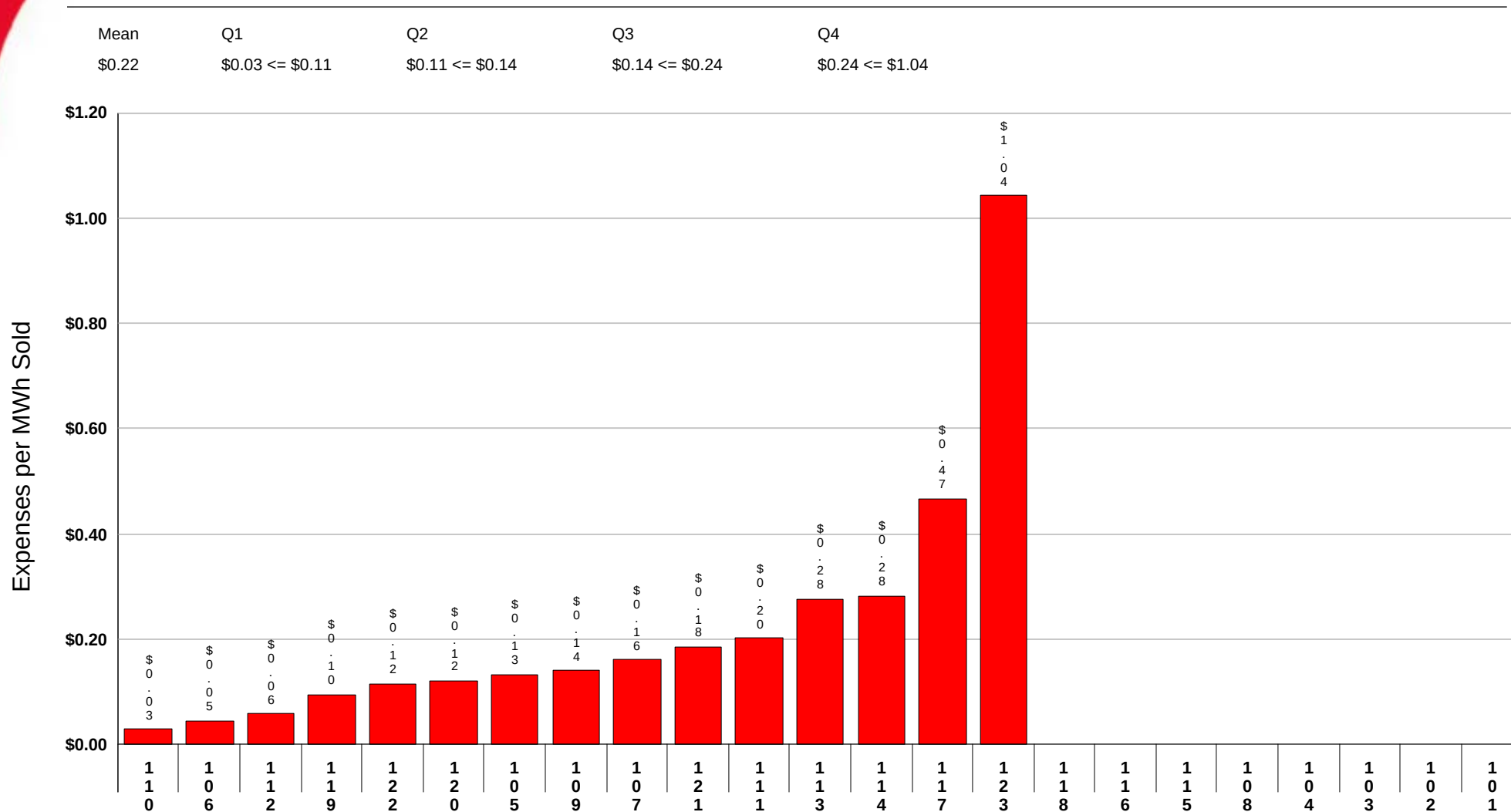
ID Code:534

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Only companies with all the data are shown.

Distribution Substation Operations Expenses

Per MWh Sold



Source/Calculation: SUM{B.25}/A.2.4

Volume: T&D Substation Field Maintenance/Operations, Final Report, 2006

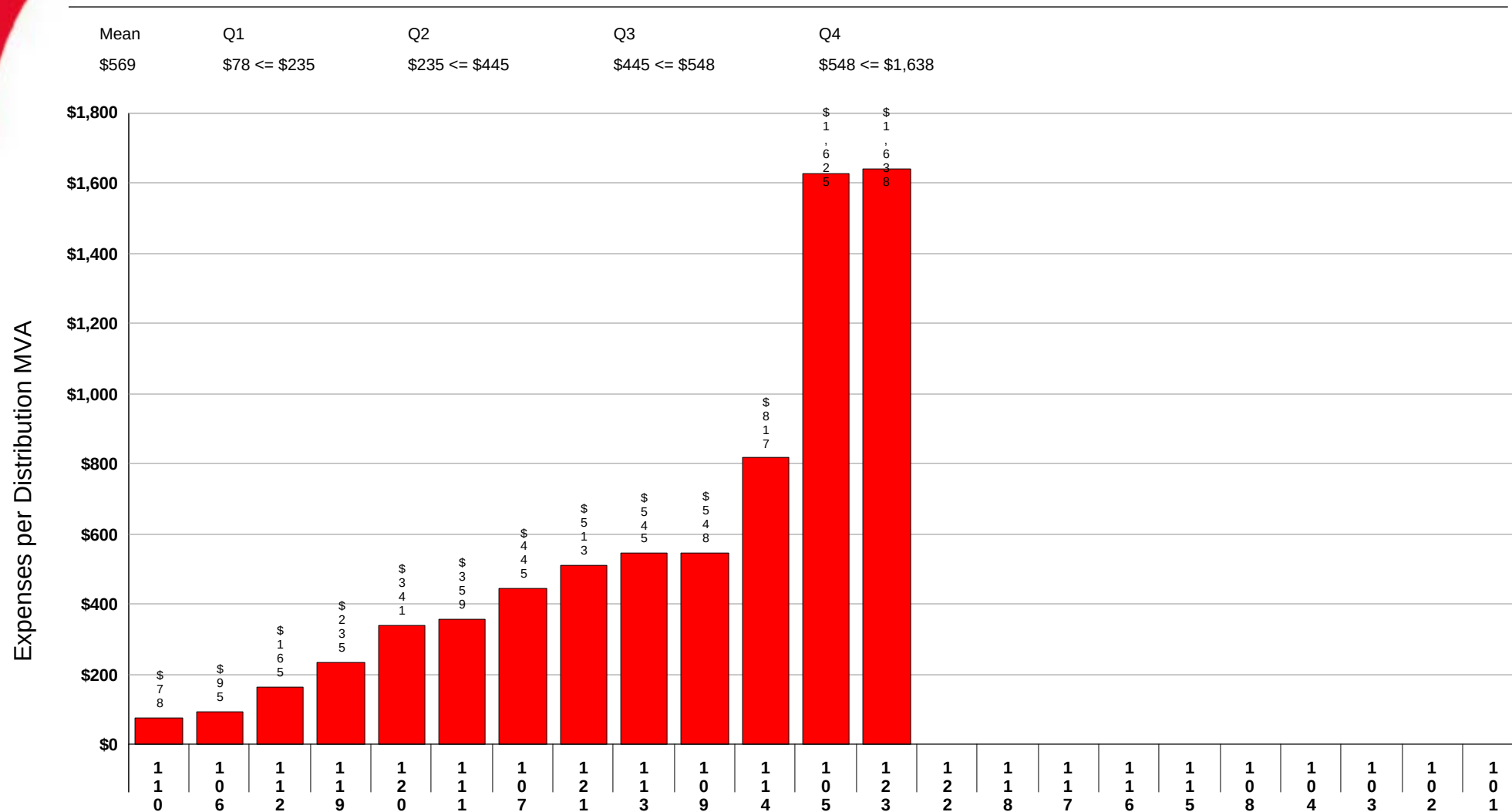
ID Code: 27163

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Only companies with all the data are shown.

Distribution Substation Operations Expenses

Per Distribution MVA



Source/Calculation: SUM{B.25}/SUM{AQ.13}

Volume: T&D Substation Field Maintenance/Operations, Final Report, 2006

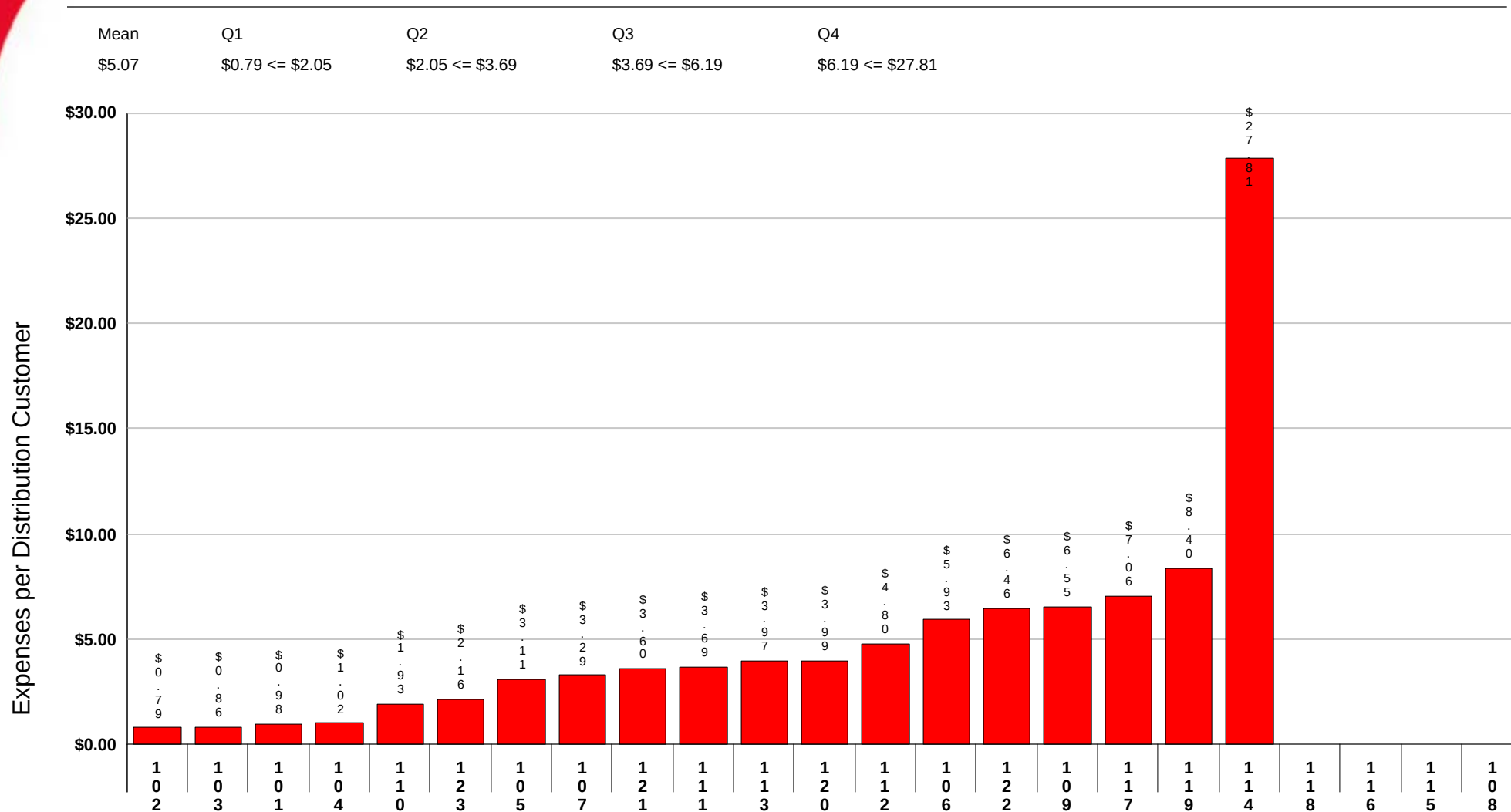
ID Code:536

Page: 1465

Only companies with all the data are shown.

Distribution Substation Maintenance Expenses

Per Distribution Customer



Source/Calculation: SUM{B.27}/A.2.2

Volume: T&D Substation Field Maintenance/Operations, Final Report, 2006

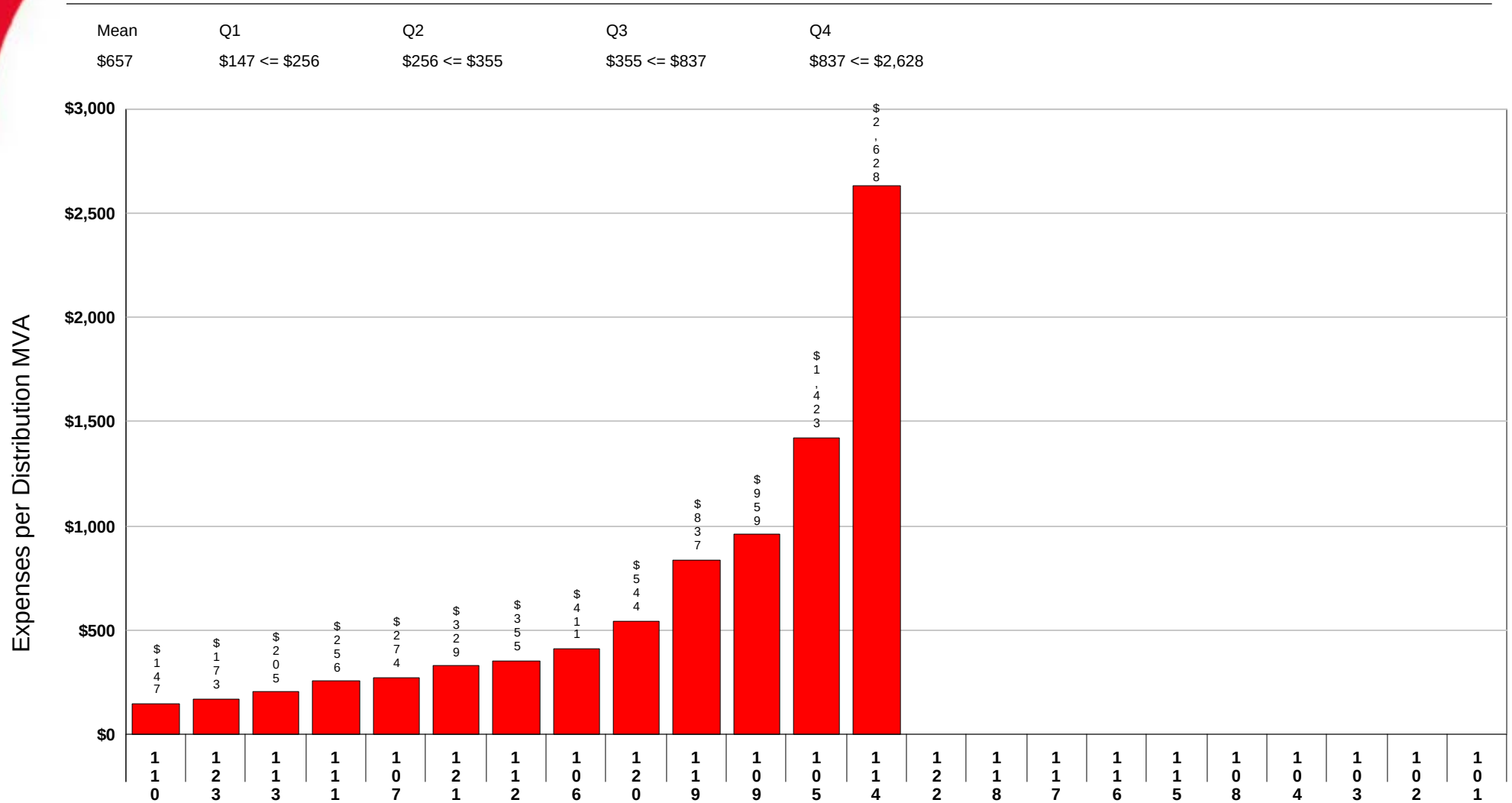
ID Code:540

Page: 1466

Only companies with all the data are shown.

Distribution Substation Maintenance Expenses

Per Distribution MVA



Source/Calculation: SUM{B.27}/SUM{AQ.13}

Volume: T&D Substation Field Maintenance/Operations, Final Report, 2006

ID Code:542

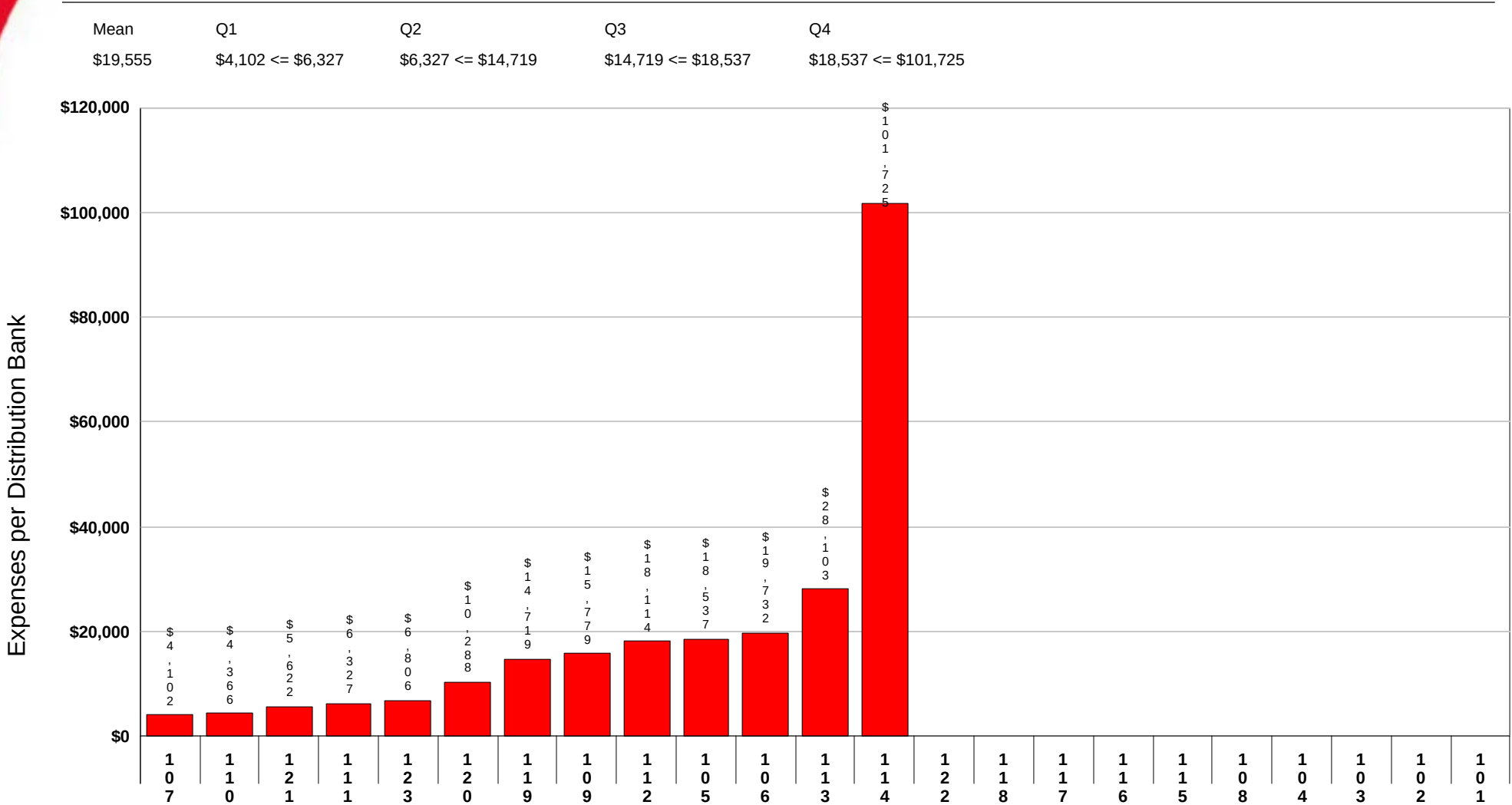
Page: 1467

Only companies with all the data are shown.



Distribution Substation Maintenance Expenses

Per Distribution Bank



Source/Calculation:SUM{B.27}/SUM{AQ.3}

Volume: T&D Substation Field Maintenance/Operations, Final Report, 2006

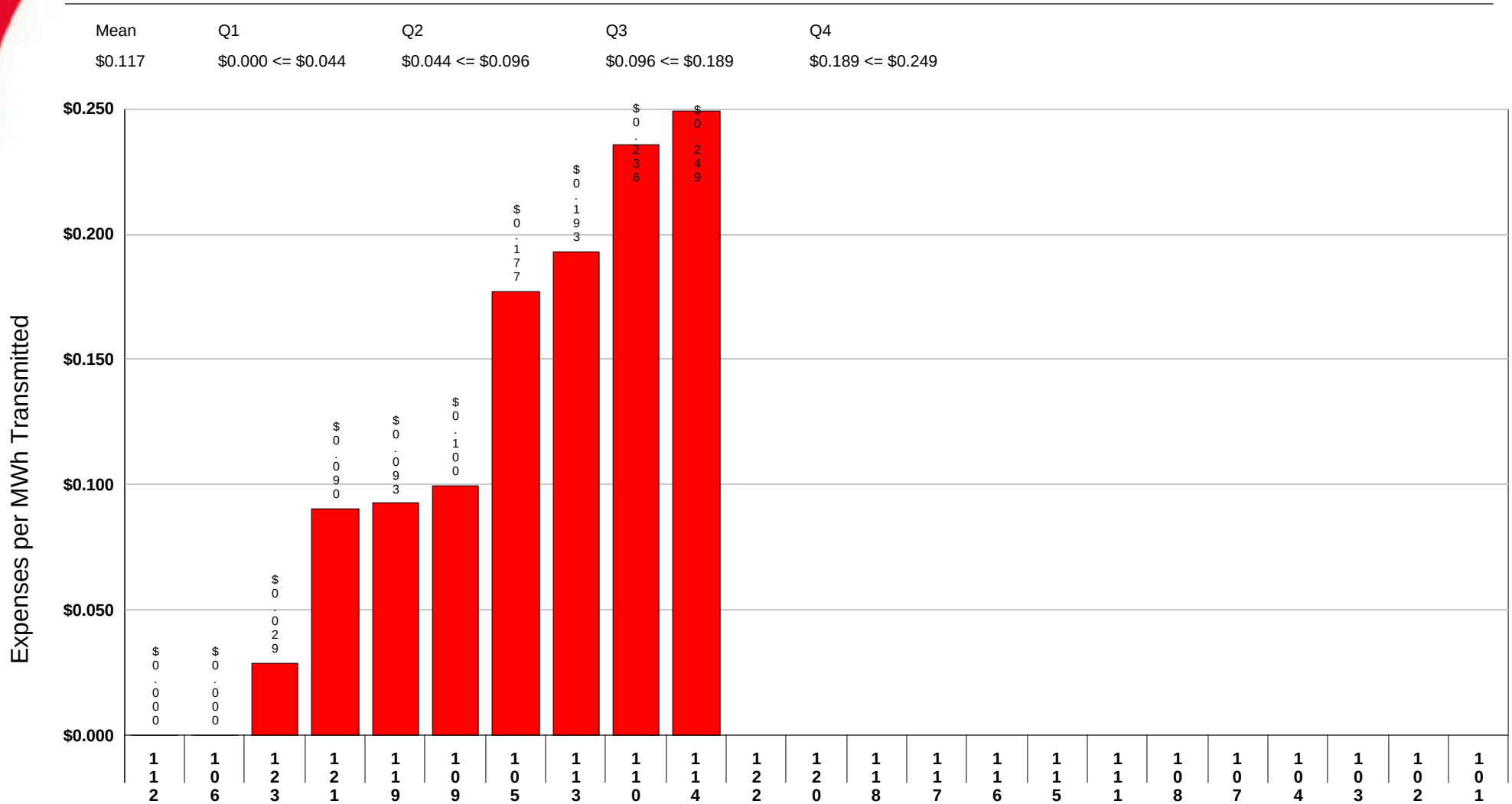
ID Code:27346

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Only companies with all the data are shown.

Transmission Substation Operations Expenses

Per MWh Transmitted



Source/Calculation:SUM{B.21}/A.2.5

Volume: T&D Substation Field Maintenance/Operations, Final Report, 2006

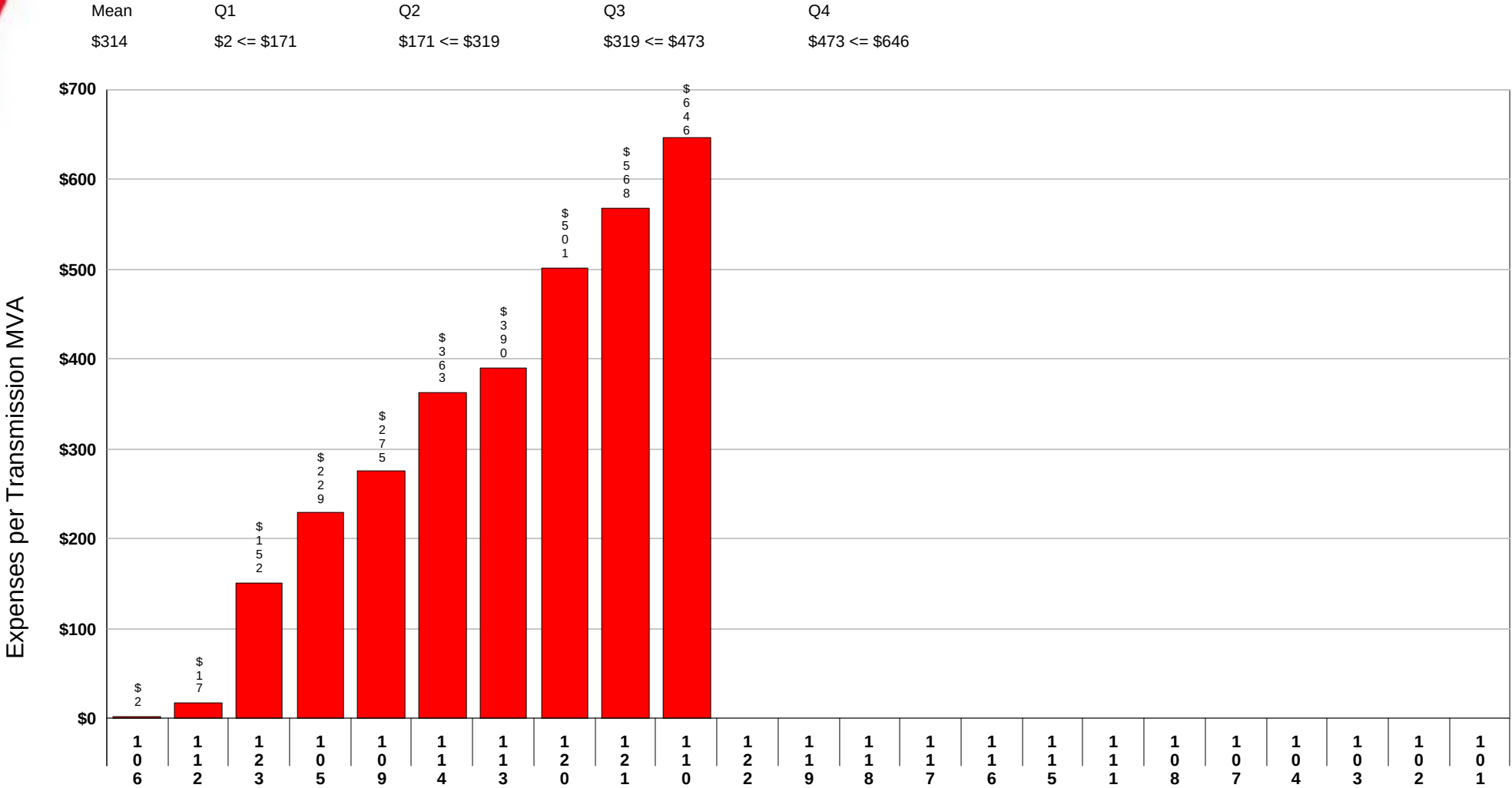
ID Code:535

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Only companies with all the data are shown.

Transmission Substation Operations Expenses

Per Transmission MVA



Source/Calculation:SUM{B.21}/SUM{AQ.12}

Volume: T&D Substation Field Maintenance/Operations, Final Report, 2006

ID Code:537

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Only companies with all the data are shown.

Improvement Initiatives Undertaken to Optimize Substation Costs (cont.)

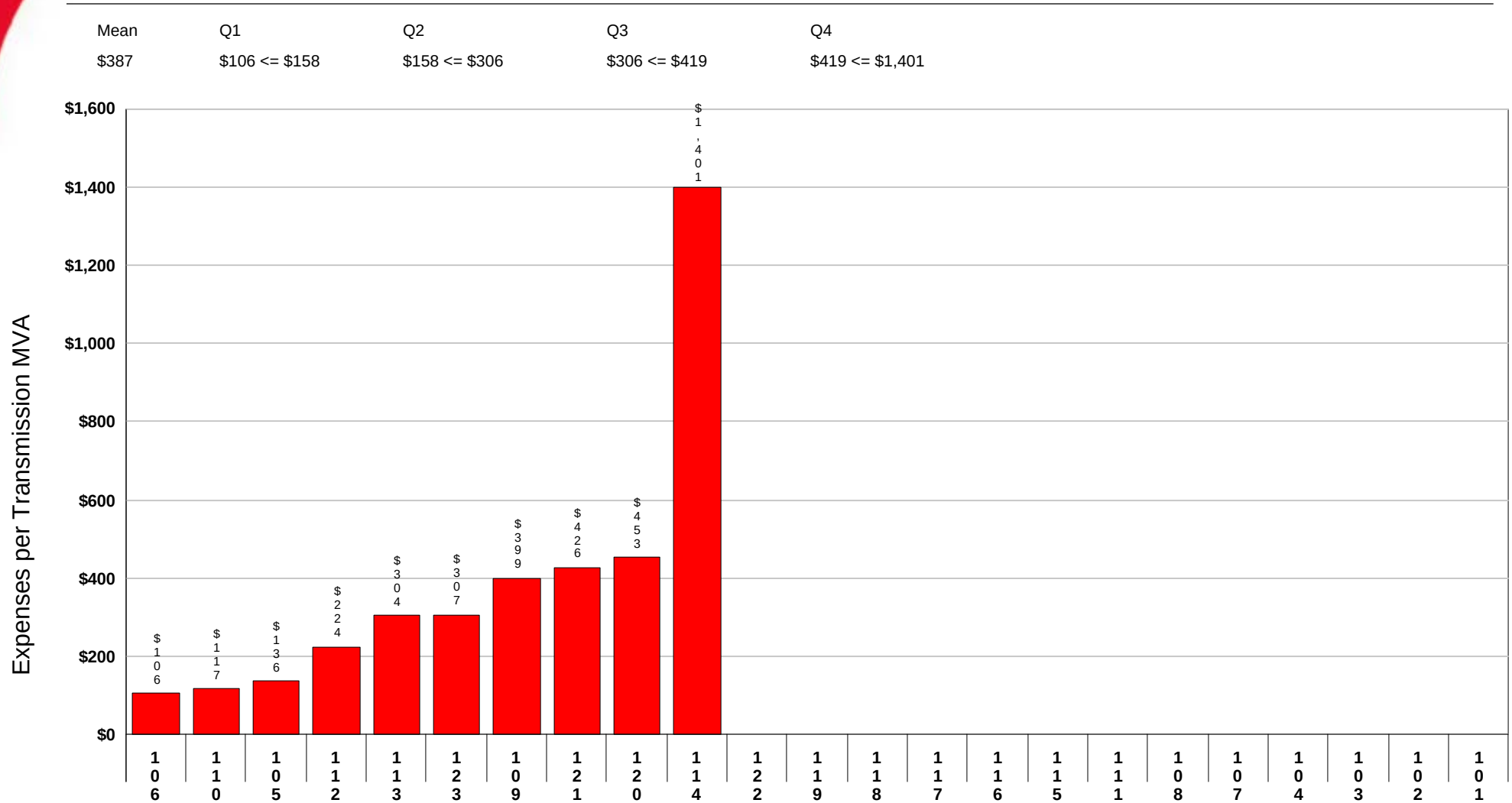
1 = Lowest, 5 = Highest

Please rank the initiatives you have undertaken to optimize substation maintenance costs?

- Hired Maintenance Program Manager
- Predictive Maintenance

Transmission Substation Maintenance Expenses

Per Transmission MVA



Source/Calculation: SUM{B.23}/SUM{AQ.12}

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Only companies with all the data are shown.

Improvement Initiatives Undertaken to Optimize Substation Costs

1 = Lowest, 5 = Highest

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:
1. Preventive Maintenance Program:	4	4	-	4	-	5	5	-	4	-	3	5	-	2	4	4	4	2	4	-	-	-	-	3.9
2. Reliability Centered Maintenance (RCM):	3	-	-	-	-	3	3	5	5	-	4	3	-	5	-	-	1	1	5	-	-	-	-	3.5
3. Work Management System:	5	5	-	5	-	4	4	4	-	-	5	2	3	3	-	5	2	5	-	-	-	-	-	4.0
4. Enlarged SCADA system:	-	-	-	-	-	-	-	3	-	-	-	-	-	-	3	-	-	-	3	-	-	-	-	3.0
5. Extend Maintenance Cycles:	2	3	-	-	-	-	-	1	3	-	-	4	2	1	2	3	3	-	-	-	-	-	-	2.4
6. Extend Inspection Cycles:	-	-	-	-	-	-	-	-	2	-	-	-	-	-	1	2	5	-	-	-	-	-	-	2.5
7. Standardized Equipment and/or Designs:	1	2	-	2	-	1	-	2	-	-	-	-	-	4	5	1	-	4	1	-	-	-	-	2.3
8. Overtime reductions:	-	1	-	-	-	2	1	-	-	-	-	1	4	-	-	-	-	-	-	-	-	-	-	1.8
9. Multiskilling of workforce:	-	-	-	3	-	-	2	-	1	-	-	-	5	-	-	-	-	3	2	-	-	-	-	2.7
99. Other:	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1.0

Source/Calculation: AU.2.1

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Methods Used to Measure Effectiveness of Preventive Maintenance Program

How do you measure the effectiveness of the preventive maintenance program?

- Actual vs estimated time - preventative vs corrective - percent complete
- Being evaluated,
- effective, results are in resulting reliability and O & M costs
- Effectiveness is measured by degree of equipment life extension, reliability metrics, cost metrics.
- Fewer outages caused by S.S. equipment
- Good, continuously evaluating.
- Information system, maintenance audit
- Level of increase in corrective maintenance work in the backlog.
- Maintenance feedback, failure rates of equipment
- Measure of forced outages.
- Monthly Performance Indicator reports track PM completions YTD and number of overdue PMs. Additionally, we track the reduction of transmission and substation equipment contribution to system SAIFI and CAIDI, as well as bus outages and equipment failures.
- Number of breaker operations; misoperations; trouble reporting system for 21 unique equipment types.
- Number of outages/failures
- Target vs. actual cost, number of outages from equipment failures, and number of customer interruptions from equipment failures
- The reduction in SAIFI, bus outages, equipment failures, and reduction in CM backlog
- Track Diagnostic VS. Overall maintenance, corrective work, equipment performance, maintenance compliance

New Technologies Used to Prioritize Maintenance

What new technologies are used to prioritize maintenance?

- circuit breakers signature analysis, enhanced oil analysis for transformer LTC maintenance.
- Computer based Maintenance Management System with priority coding for corrective only
- DGA, Infrared
- DGA; detailed infrared inspections; Doble testing.
- Diagnostic testing (DGA, power factor, SFRA, etc.). We have just begun using TDS for repairing oil leaks. That has not been a big help in reducing outage time and manpower requirements.
- Infrared camera, P1 Breaker profiler
- infrared thermography, oil sampling
- Maintenance and risk management software.
- Oil tests, Infrared
- See answer AU3
- Sweep Frequency Response Analysis (SFRA)
- TASA, BOA, thermal scanning, TCA
- We have just begun using TDS for repairing oil leaks. That has been a big help in reducing outage time and manpower requirements.

Conduct Routine Root Cause Evaluation of Failures

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Yes:	✓	✓		✓		✓	✓		✓		✓		✓	✓		✓		✓	✓					75.0%
2. No:								✓				✓			✓		✓							25.0%

Source/Calculation:AU.5.1

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Changes Made Based Upon Root Cause Analysis of Substation Failures

What changes have you made based upon root cause analysis of substation failures?

- Adding surge arresters to some substations, adding inverters for HMI power supply
- Arrester upgrade to MCOV LTC oil filtration units, transformer differential monitoring, cool cell units for statin batteries.
- Changes in new equipment specifications, new or changed maintenance practices.
- Eliminated tertiary feeds to reactors
- Extend maintenance frequency cycle
- Improvements in animal proffing, relay setting changes, thermography is included in routine substation inspections, adjusted maintenance frequncies and tasks.
- Improvements in animal proofing, relay setting changes, thermography included inrouine substation inspections, adjusted maintenance frequencies and tasks.
- Increased inspections and replace equipment on a planned time interval; Relay modifications
- Increased intervals of infrared inspection on all substation components.
- maintenance practices, new equipment specifications
- Manufacturer/model specific programs - pro-active maintenance and replacemment programs
- None
- Relay settings
- Work practices and design practices.

Implementation of Reliability Centered Maintenance (RCM) Program Status

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. No RCM:				✓											✓									12.5%
2. Planning:											✓							✓						12.5%
3. Pilot:																								0.0%
4. Rollout:																								0.0%
5. Fully Implemented:	✓							✓									✓		✓					25.0%
6. Reduced Level From Previous Year:																								0.0%
7. Tried And Stopped:																✓								6.3%
8. Modified Concepts:		✓				✓	✓	✓			✓		✓											37.5%
9. Use Other Ideas:																								0.0%
99. Other:													✓											6.3%

Source/Calculation:AU.7.1

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Implementation of RCM Program Status (cont.)

What is the status of implementation of Reliability Centered Maintenance (RCM)?

- Implementing where cost effective

RCM Implementation Affecting Maintenance Decisions

If you have implemented RCM, how is it affecting maintenance decisions?

- Affecting budget prioritization and scope of planned maintenance.
- Allows for targeted spending
- Best maintenance practices determined using equipment and industry trends
- Extended maint. cycles
- Gas breaker maintenance has moved towards condition based intervals based on diagnostic testing.
- Higher levels of maintenance controlled by patrols and condition monitoring.
- intervals and maintenance types are changed
- Maintenance decisions are based on the data collected. Affecting budget prioritization and scope of planned maintenance.
- Prevents unnecessary work.
- Prioritizing maintenance work on the most important substation and equipment.
- Yes, extending maintenance cycle and end of life evaluation

Planned Replacement Program for Substation Components

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Yes:		✓		✓							✓	✓	✓	✓	✓				✓					50.0%
2. No:	✓					✓	✓	✓	✓							✓	✓	✓						50.0%

Source/Calculation: AU.9.1

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Initiatives in Wildlife Mitigation

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. No Wildlife Mitigation Initiatives:																								0.0%
2. Enclosing Substations:						✓	✓	✓				✓	✓						✓					37.5%
3. Traps:				✓		✓							✓	✓										25.0%
4. Enclosing Specific Substation Components:	✓					✓	✓	✓	✓			✓	✓					✓	✓	✓				62.5%
5. Substation Designs:	✓					✓			✓			✓	✓	✓	✓	✓	✓	✓	✓					68.8%
6. New Designs:	✓	✓											✓	✓	✓			✓		✓				43.8%
7. Insulation:	✓						✓	✓	✓			✓	✓	✓			✓	✓	✓	✓				68.8%
8. Wildlife deterring fences:	✓					✓	✓					✓	✓	✓	✓		✓		✓					56.3%
9. Spraying with Animal Repellant:				✓									✓											12.5%
99. Other:				✓		✓							✓	✓	✓									31.3%

Source/Calculation: AU.10.1

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Initiatives in Wildlife Mitigation (cont.)

What are your initiatives in wildlife mitigation in substations?

- Animal barriers installed on equipment
- animal guards
- Bird netting
- Habitat control/removal
- Professional rodent control services (Ehlich, etc.); animal guards applied to lower voltage (typically just 12kV) transformer and CB bushings.

Transformer & Breaker Diagnostic Testing Program

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. No Diagnostic Testing Program:																								0.0%
2. Less Than EHV Transformers:	✓	✓		✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓					100.0%
3. EHV Transformers:	✓	✓		✓		✓	✓	✓			✓	✓		✓	✓	✓	✓	✓	✓					87.5%
4. EHV Breakers :	✓	✓		✓		✓	✓	✓			✓	✓		✓	✓	✓	✓	✓	✓					87.5%
5. Non-EHV breakers:	✓	✓		✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓					100.0%
99. Other:																								0.0%

Source/Calculation:AU.11.1

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Transformer & Breaker Diagnostic Testing Program (cont.)

Source/Calculation:AU.11.99

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Predictive/Diagnostic Tests Used to Change Planned Replacement Cycles

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. None:								✓																6.7%
2. Infrared Inspections performed on Arrestors:	✓	✓				✓	✓		✓		✓	✓		✓		✓		✓	✓					73.3%
3. Doble Power Factor Test-Bushings:	✓	✓		✓		✓	✓				✓	✓	✓	✓	✓	✓		✓	✓					86.7%
4. Remote Terminal Recorder (RTR):												✓						✓						13.3%
5. DGA (Dissolved Gas in Oil Analysis):	✓	✓		✓		✓	✓		✓		✓	✓	✓	✓	✓	✓		✓	✓					93.3%
6. Thermal vision:	✓	✓				✓	✓					✓	✓	✓	✓	✓			✓					66.7%
7. Annual radiographic inspection (x-ray):																								0.0%
99. Describe:													✓											6.7%

Source/Calculation:AU.12.1

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Predictive/Diagnostic Tests Used to Change Planned Replacement Cycles (cont.)

Which of the following predictive/diagnostic tests have you used to change planned replacement cycles?

- TASA's on LTC's (won't do LTC maintenance if TASA show's it's OK.

Diagnostic Tools Used to Evaluate Equipment Breakers

Identify what diagnostic tools you use to evaluate the following equipment?

- Contact resistance, power factor, oil and gas analysis
- DGA, Infrared
- Double PF, Timing, ductor.
- Double power factor tests; Double timing tests; "Cracker" sequence of events analyzer; infrared camera.
- Double, BOA, timing test, and Kelman 1st trip test
- Double, breaker timing
- Double, Kelman, SF6 Tester, Ductor, Infrared Scan
- Ductor, Oil Quality (kV), Infrared, Double Speed Test, P1 Profiler, Condition Base Maintenance (# of fault operation algorithm)
- Inservice profile timing, oil dielectric tests, SF6 moisture/purity/arc byproduct tests, Double power factor tests, Infra red scans, contact resistance tests.
- Motion analyzer, power factor, ductur resistance
- oil sampling, IR, PF
- Oil sampling, thermography, power factor testing, travel timing tests
- Power factor, infrared, gas analysis
- reliability data
- Travel test, P1/P2 timing test, power factor, oil quality, thermography, contact resistance, moisture in SF6 and gas purity

Diagnostic Tools Used to Evaluate Equipment

Transformers

Identify what diagnostic tools you use to evaluate the following equipment?

- DGA, Infrared
- DGA, Oil Quality, Meggar, TTR, Infrared, Doble Power Factor, FRA (Frequency Response Analyser)
- DGA, thermography, oil quality, guage verification, power factor, LV excitation, TTR, winding resistance, SFRA, limited acoustic testing for PD
- DGA/Oil quality testing, Doble power factor tests, transformer turns ratio test, Infra red scans, Sweep frequency response analysis tests.
- Doble PF, TTR megger, winding resistance, leakage reactance, frequency response.
- Doble power factor tests; DGA; infrared
- Doble, DGA, Infrared, Paper insulation testing
- Doble, DGA, TASA, online monitoring, Furan analysis, Corrosive Sulfur, TCA
- Gas in oil
- Oil analysis, Framit, Sonic, Infrared Scan
- oil and gas sampling, IR
- Oil quality, dga, thermography, power factor testing, TTR, tap changer continuity, FRA
- On line monitoring, microprocessor relay monitoring, trending capacitance changes of windings, infrared, DGA main tank and tap changer
- Power factor, incipient and dissolved gas analysis, oil dielectric test, ratio test
- reliability data, DGA and oil analysis
- TGR, meggar, framet, DGA, power factor

New Tests Performed on Substation Equipment

What new tests are you performing on substation equipment?

- acoustical monitoring, corona
- Doble Frequency Response Analyser on transformers.
- FRAMIT
- Frequency Response Analysis (FRA)
- Frequency response analysis (FRA)
- Infrared scan
- None
- None
- Sweep Frequency Response Analysis (SFRA)
- TCA
- Use "Crakker" analyzer device when necessary to evaluate sequence of events for stubborn breaker mechanism operation problems and as a temporary annunciator to capture spurious, non-latching alarms initiations at non-SCADA substations.
- Vibration Analysis, Accoustic Analysis, Partial Discharge Analysis
- vibro-acoustic analysis on tap changers

Source/Calculation:AU.14.1

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Frequency of Infrared Testing for Substation Equipment

In Years

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:
1. Transformers:	0.1	1.0	-	1.0	-	1.0	1.0	1.0	1.0	-	1.5	0.5	1.0	0.5	0.0	1.0	1.0	1.0	1.0	-	-	-	-	0.86
2. Circuit Breakers:	0.1	1.0	-	1.0	-	1.0	1.0	1.0	1.0	-	1.5	0.5	1.0	0.5	0.0	1.0	1.0	1.0	1.0	-	-	-	-	0.86
3. Bus Connections :	0.1	1.0	-	1.0	-	1.0	1.0	1.0	1.0	-	1.5	0.5	1.0	0.5	0.0	1.0	1.0	1.0	1.0	-	-	-	-	0.86
4. Line Connections:	0.1	1.0	-	1.0	-	1.0	1.0	1.0	1.0	-	1.5	0.5	1.0	0.5	0.0	1.0	1.0	1.0	1.0	-	-	-	-	0.86
5. Disconnect Switches:	0.1	1.0	-	1.0	-	1.0	1.0	1.0	1.0	-	1.5	0.5	1.0	0.5	0.0	1.0	1.0	1.0	1.0	-	-	-	-	0.86
6. Terminations:	0.1	1.0	-	1.0	-	1.0	1.0	1.0	1.0	-	1.5	0.5	1.0	0.5	0.0	1.0	1.0	1.0	1.0	-	-	-	-	0.86

Source/Calculation:AU.15.1

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Change in Maintenance Cycle Times

Due to Predictive Technology

If you have changed maintenance cycles in the last year, what were the changes and why?

- Decreased intervals on 15kv or greater potential devices based on equipment trends in the industry.
- Distribution vacuum breaker cycle shortened from 12 to 6 years due to observed failures.
- Extended interval on certain gas breakers/switches after gaining several years of operating experience.
- Financial driven change of Doble PF test on bushings from 4 to 8 years.
- Maintenance cycles extended based on age of equipment to help reduce costs.
- no
- No change.
- Question not marked
- Run through neutral went from 6 years to 3. Vacuum circuit breaker maintenance went from 12 years to 6. All based on engineering review of the PDM and maintenance history information.

Source/Calculation:AU.16.1

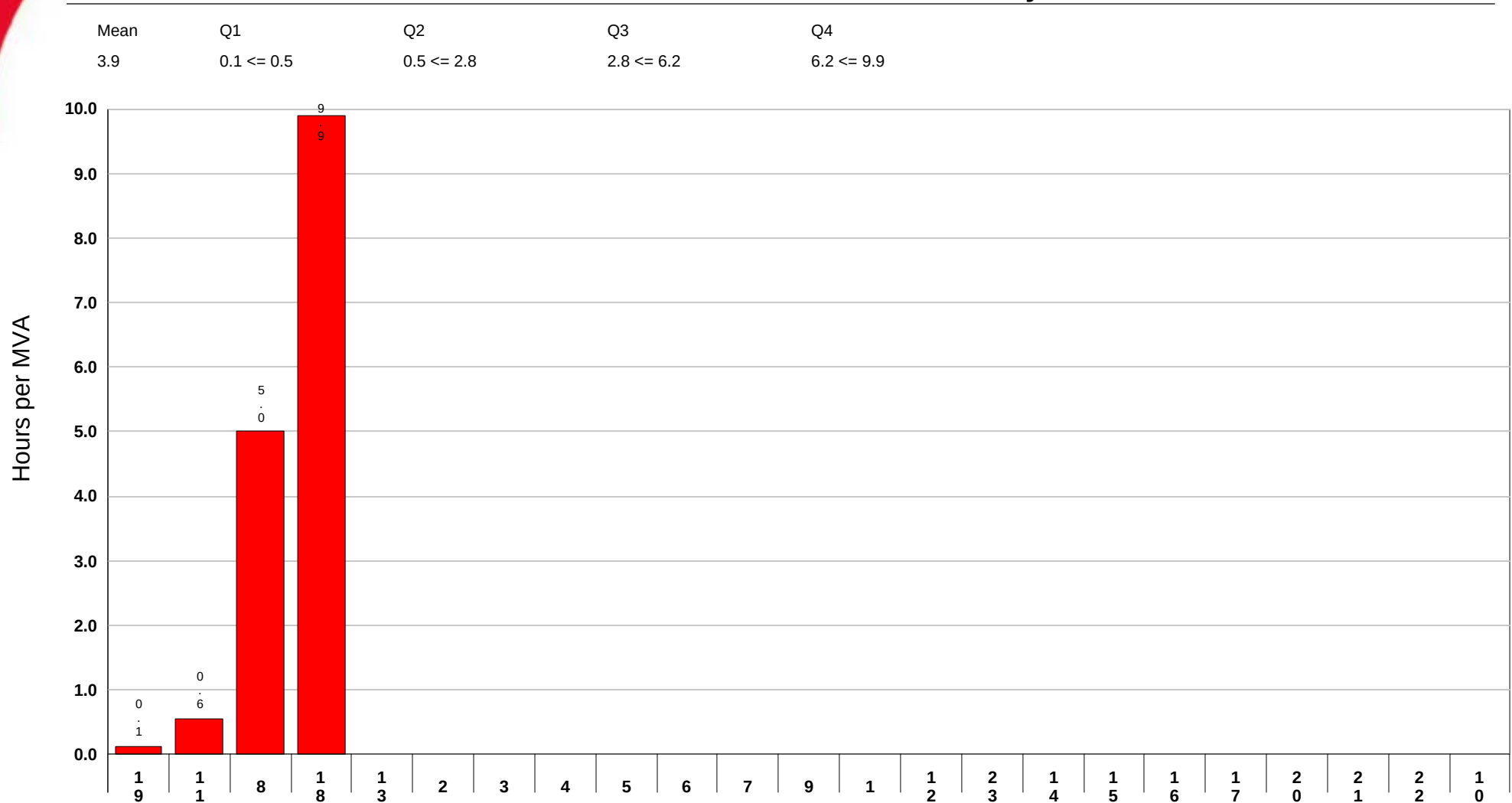
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Total Annual Labor Hours Required Specifically to Maintain 3rd Party-Owned Substations

Per MVA 3rd Party-Owned Substations Maintained



Source/Calculation:AU.17.1/AQ.11.1

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Only companies with all the data are shown.

Determining Maintenance Plan for Major Equipment

Question:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total:
1. Time-interval based (e.g. every X years):	✓	✓		✓		✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓					93.8%
2. Diagnostics:		✓		✓		✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓						81.3%
3. Operational based (e.g. after X operations):	✓	✓		✓			✓	✓	✓		✓	✓	✓	✓	✓		✓							75.0%
99. Other:																	✓		✓					12.5%

Source/Calculation:AU.19.1

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Determining Maintenance Plan for Major Equipment (cont.)

How do you determine your maintenance plan for major equipment (breakers, transformers)?

- Condition directed on 13.8kv oil breakers
- Y, RCM

Substation Electricians' Qualified to Work on Construction and O&M Multi-Skilling

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Yes:	✓					✓	✓	✓	✓		✓		✓	✓	✓		✓	✓	✓					75.0%
2. No:		✓		✓								✓				✓								25.0%

Source/Calculation: AU.20.1

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- Pg. 1504.1 Methods Used to Determine Aging Substation Equipment (cont.)
- Pg. 1505 Refurbishment and/or Replacement Policies for Major Substation Equipment Currently Used
- Pg. 1506 Activities Included in a Typical Load Tap Changer Refurbishment
- Pg. 1507 Activities Included in Refurbishment of a Typical Load Tap Changer (LTC) (cont.)
- Pg. 1508 Methods Used to Detect Substation Equipment Deterioration Failures
- Pg. 1509 Methods Used to Detect Substation Equipment Deterioration Failures (cont.)
- Pg. 1510 Preventive Maintenance Period Much Longer Than the Average Duration of the Optimal Preventive Replacement Interval - For Major Substation Equipment
- Pg. 1511 Definition of Substation "Refurbishment"
- Pg. 1512 Line Between Refurbishment, Maintenance, and Capital Expenditures
- Pg. 1513 Need for Refurbishment of Aging Substation Infrastructure Identification
- Pg. 1514 Use of "Fleet" Studies of Substation Equipment to Determine the Need for Refurbishment or Replacement
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- Pg. 1516 Introduction of New Types of Substation Equipment (cont.)
- Pg. 1517 Procedure for Testing and Verifying New Equipment

Methods Used to Determine Aging Substation Equipment

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent:
1. Age:		✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓					88.2%
2. Load Served:					✓			✓	✓		✓	✓			✓	✓	✓							41.2%
3. Testing:					✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓						70.6%
4. Failure:	✓	✓		✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓						76.5%
99. Other:				✓									✓						✓					17.6%

Source/Calculation: AV.2.1

Volume: Focus Area: T&D Substation Refurbishment, Final Report, 2006

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Methods Used to Determine Aging Substation Equipment (cont.)

What methods are utilized to determine aging Substation equipment in the system?

- Maintenance History
- Revenue Cycle Management
- Visual inspection, operational history.

Refurbishment and/or Replacement Policies for Major Substation Equipment Currently Used

What are the refurbishment and/or replacement policies for major substation equipment currently used in your company?

- 70% of replacement cost
- Equipment determined to have failed by electrical test results; I/S equipment failure
- Equipment is replaced if testing indicates failure is imminent.
- Equipment type analysis, and business case
- Life extension where financially feasible.
- Mostly run to failure
- No formal policy. It is based on equipment performance, site and equipment criticality and available funding.
- No formal policy, but it is based on equipment performance, site/equipment criticality, and available funding
- none
- None
- Reclosers refurbished based on age, , Batteries replaced based on age and/or condition, , Transformers refurbished or replaced based on condition on case by case basis,, Breakers replaced based on condition,
- Run to Failure/major problems revealed by diagnostics
- Total rebuild or replacement
- Transformers are run to failure but have spares. Breakers and relays are replaced based on condition, availability of parts, and importance
- Under Evaluation
- Upgrade
- We do not have any refurbish or replacement program, run to failure.

Activities Included in a Typical Load Tap Changer Refurbishment

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent	
1. Complete overhaul of the regulating transformer:									✓				✓												13.3%
2. An increase in insulation levels:						✓	✓																		13.3%
3. A decrease in noise levels:																									0.0%
4. Replacement of the bushings:						✓	✓					✓	✓												26.7%
5. Complete overhaul of the LTC:		✓		✓		✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓						93.3%
6. Improvements regarding loading capability:								✓				✓													13.3%
99. Other:						✓					✓	✓		✓					✓						33.3%

Source/Calculation:AV.4.1

Volume: Focus Area: T&D Substation Refurbishment, Final Report, 2006

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Activities Included in Refurbishment of a Typical Load Tap Changer (LTC) (cont.)

Refurbishment of a typical load tap changer (LTC) includes) which of the following?

- Addition of LTC oil filters
- Infrared Thermography
- May include retrofit of a new LTC.
- No LTC's

Methods Used to Detect Substation Equipment Deterioration Failures

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent:
1. Increased inspection frequency:				✓		✓	✓	✓	✓		✓	✓		✓	✓			✓						66.7%
2. Outage management statistics:	✓	✓		✓		✓	✓					✓			✓			✓						53.3%
99. Other:				✓		✓	✓						✓			✓			✓					40.0%

Source/Calculation:AV.5.1

Volume: Focus Area: T&D Substation Refurbishment, Final Report, 2006

ID Code:2300756

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Methods Used to Detect Substation Equipment Deterioration Failures (cont.)

What methods are utilized to detect substation equipment deterioration failures?

- Equipment diagnostics and failure trend / history
- Equipment diagnostics and failure trend / history
- IDB (Incidental Database)
- Spare parts usage
- Testing - Doble, DGA, etc.
- Visual inspection, oil analysis, diagnostic testing, operational history, infrared

Preventive Maintenance Period Much Longer Than the Average Duration of the Optimal Preventive Replacement Interval For Major Substation Equipment

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent	
1. Yes:															✓	✓		✓							21.4%
2. No:		✓		✓		✓	✓	✓	✓		✓	✓	✓	✓						✓					78.6%

Source/Calculation:AV.6.1

Volume: Focus Area: T&D Substation Refurbishment, Final Report, 2006

ID Code:2300576

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Definition of Substation "Refurbishment"

How is "refurbishment" of a substation defined?

- Equipment upgrades and improvements to equipment that is not going to be replaced or equipment that has failed and sent in to a repair shop.
- Good as new.
- Key equipment improvement / performance and life extension
- Key equipment improvement / performance and life extension
- none
- Not defined
- Refurbishment is defined as restoring equipment to a state that results in a life extension beyond what was originally designed/planned.
- Replace transformer, switchgear, control house.
- Replacement of all parts that wear
- Replacement of bushing, gasket, pump and oil.,
- Replacement or refurbishment of 40% to 60% of substation equipment
- See Notes
- Site and asset specific revamping/replacement/refurbishment/rebuilds

Line Between Refurbishment, Maintenance, and Capital Expenditures

Where is the line drawn between refurbishment, maintenance, and capital expenditures?

- "Replace vs. Maintain/Repair" cost analysis; corporate financial accounting rules for determination of capitalization and maintenance costs.
- 70% of replacement cost
- All expenditures are divided between capital and maintenance dollars. If item can not be paid for in maintenance budget, look to capitalize the cost. Determination if capital or maintenance on case by case basis.
- Cost to benefit analysis.
- Decisions regarding the 3 options are determined by repair versus replace costs analysis compared to an on-going cost to maintain
- Failure history, Age , Number of Faults, Critical Customers
- Maintain - maintenace or refurbishment/Capital - replacement or new installation,
- maintenance is done during the life of an asset, refurbishment is done near end of life to extend end of life, and capital expenditures are done at end of life to replace the equipment.
- No hard coded rule.
- No solid line. Decisions regarding the 3 options are determined by a repair vesus replacement cost analysis compared to on-going cost to maintain.
- Prioritization determined by software optimizer
- Question not marked
- System improvement and upgrades.
- Unit of Property is determined by the Property Record Department; 80% refurbishment/replacement

Need for Refurbishment of Aging Substation Infrastructure Identification

How is the need for refurbishment of aging substation infrastructure identified? Is it an outgrowth of "normal" survey activity, or are focused surveys specific to refurbishment conducted?

- Based on equipment performance , site/equipment criticality and available funding
- Close visual inspections during routine station visits; infrared inspections; electrical monitoring of secondary quantities via SCADA; periodic Doble tests; periodic electrical (relay) tests.
- Combination work management diagnosis. Evaluation system prioritization.
- end of life
- Equipment in low growth areas; no future system voltage upgrades; diagnostic testing shows good ratings.
- focused surveys specific to refurbishment
- It is based on equipment performance, site and equipment criticality and available funding.
- It is generally an outgrowth of "normal" survey activity. Sometimes, after the need is identified, focused surveys specific to refurbishment are conducted to help prioritize.
- Load, Age, Condition
- Maintenance and survey activities identify degradation and parts availability/cost issues. These are used to determine need for replacement
- Normal study based on MAXIMO, age and maintenance requirements
- normal survey activity
- Outgrowth of "normal" survey activity.
- System planning for load/revenue cycle management for aging asset specific
- Typically results from normal activities.

Source/Calculation:AV.9.1

Volume: Focus Area: T&D Substation Refurbishment, Final Report, 2006

ID Code:2300664

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Use of "Fleet" Studies of Substation Equipment to Determine the Need for Refurbishment or Replacement

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Yes:						✓	✓				✓	✓						✓	✓					35.3%
2. No:	✓	✓		✓	✓			✓	✓				✓	✓	✓	✓	✓							64.7%

Source/Calculation:AV.10.1

Volume: Focus Area: T&D Substation Refurbishment, Final Report, 2006

ID Code:2300577

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Introduction of New Types of Substation Equipment

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent:
1. Vendors:	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓					100.0%
2. Trade magazines:													✓				✓	✓	✓					23.5%
3. Contractors:						✓	✓											✓						17.6%
4. In-house expertise:		✓		✓		✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓					82.4%
99. Other:													✓											5.9%

Source/Calculation:AV.11.1

Volume: Focus Area: T&D Substation Refurbishment, Final Report, 2006

ID Code:2300760

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Introduction of New Types of Substation Equipment (cont.)

How are new types of substation equipment introduced to your company?

- Trade shows and conferences

Procedure for Testing and Verifying New Equipment

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent:
1. Relays:	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓					100.0%
2. Circuit breakers:	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓					100.0%
3. Surge arresters:				✓	✓	✓	✓	✓			✓	✓			✓	✓	✓	✓	✓					70.6%
4. Major equipment and components:	✓			✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓					88.2%

Source/Calculation:AV.12.1

Volume: Focus Area: T&D Substation Refurbishment, Final Report, 2006

ID Code:2300762

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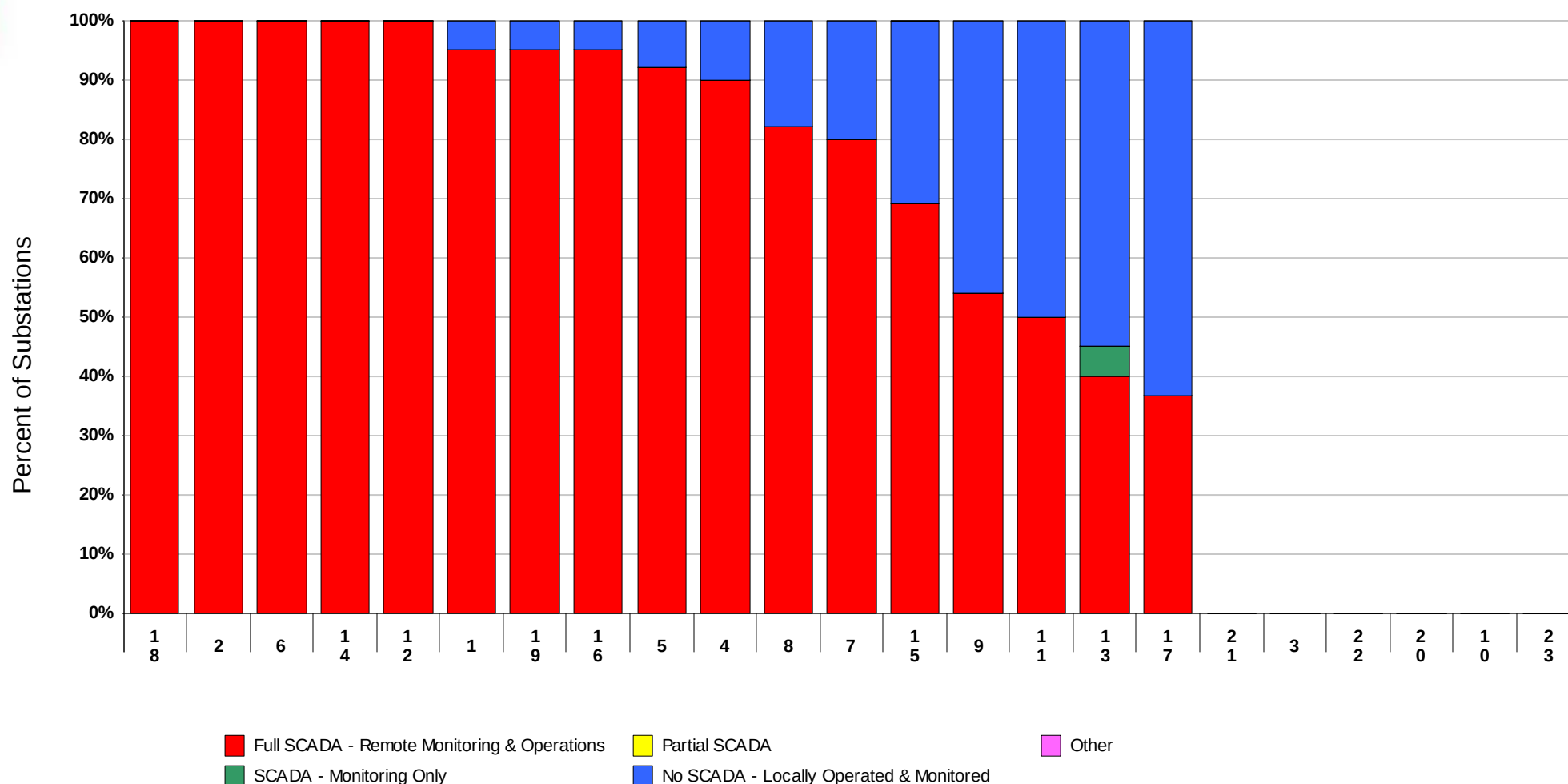
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- Pg. 1521 Distribution Substation SCADA Sophistication - Substations with SCADA Equipment Installed
- Pg. 1521.1 Distribution Substation SCADA Sophistication (cont.) - Substations with SCADA Equipment Installed
- Pg. 1522 Transmission Substation SCADA Sophistication - Substations with SCADA Equipment Installed
- Pg. 1522.1 Transmission Substation SCADA Sophistication (cont.) - Substations with SCADA Equipment Installed
- Pg. 1523 Transmission Breaker Supervisory Control - EHV Transmission Breakers
- Pg. 1524 Transmission Breaker Supervisory Control - HV Transmission Breakers
- Pg. 1525 Distribution Breaker Supervisory Control
- Pg. 1526 Use On-Line Monitoring of Substation Components
- Pg. 1527 Future Strategies for the Use of SCADA in Substations
- Pg. 1528 Strategies for the Use of SCADA in Substations (cont.) - Role of Control Center
- Pg. 1529 Automated Distribution Substation Components - Status of Automation: N = None, M = Monitored, R = Remote Controlled, D = Distributed (Local Control)
- Pg. 1530 Components Where an Increase in the Level of Automation Is Planned - In the Next Three Years (Distribution Substations)
- Pg. 1531 Components Where an Increase in the Level of Automation Is Planned (cont.) - In the Next Three Years

Distribution Substation SCADA Sophistication

Substations with SCADA Equipment Installed



Source/Calculation:AW.2.2

Volume: Focus Area: T&D Substation Automation, Final Report, 2006

ID Code:1035

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Calculation shown is for the first piece of the stacked bar only.

Distribution Substation SCADA Sophistication (cont.)

Substations with SCADA Equipment Installed

Source/Calculation:AW.2.99

Volume: Focus Area: T&D Substation Automation, Final Report, 2006

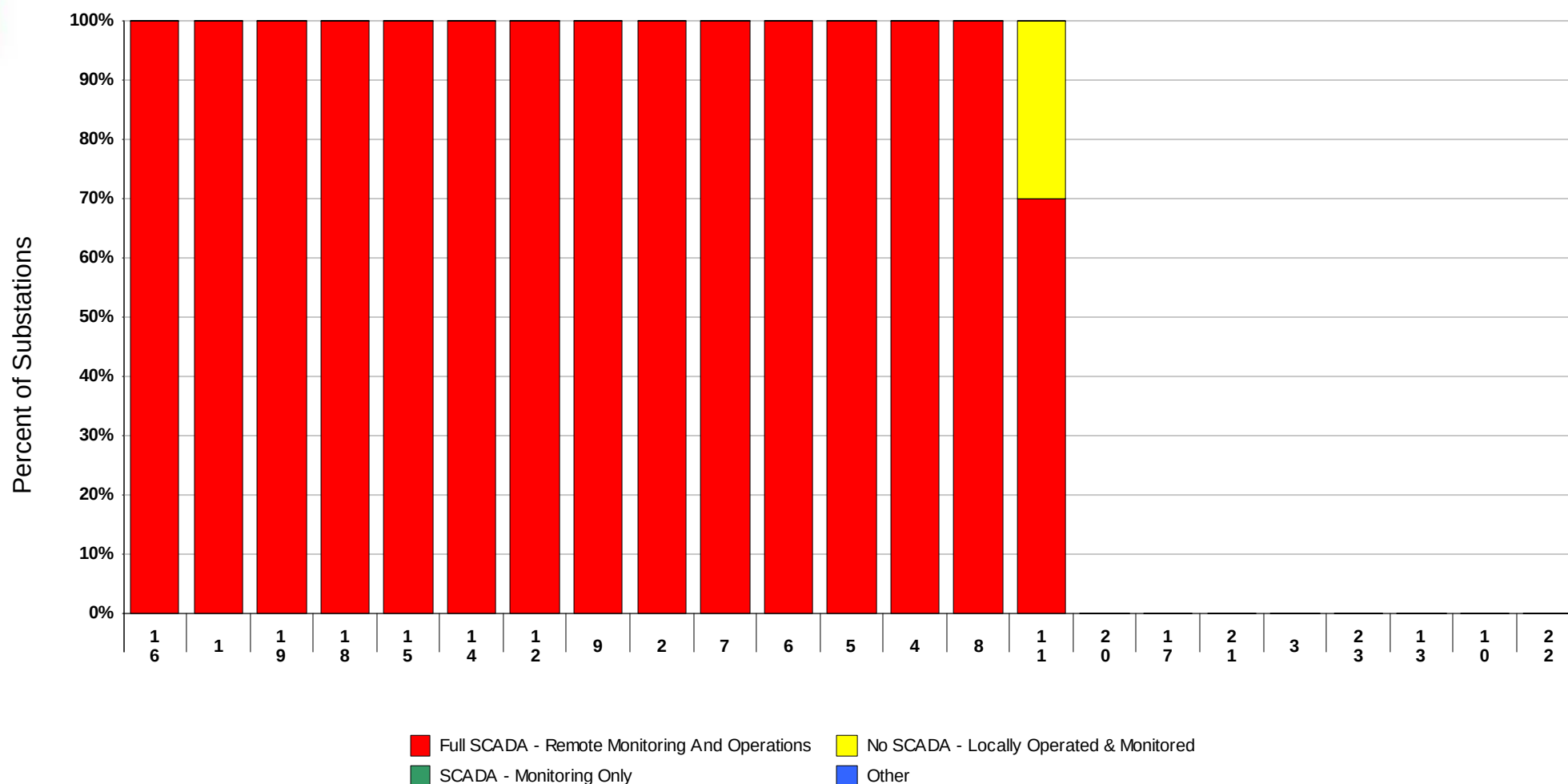
ID Code:1600249

Page:1521.1



Transmission Substation SCADA Sophistication

Substations with SCADA Equipment Installed



Source/Calculation:AW.3.2

Volume: Focus Area: T&D Substation Automation, Final Report, 2006

ID Code:1036

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Calculation shown is for the first piece of the stacked bar only.

Transmission Substation SCADA Sophistication (cont.)

Substations with SCADA Equipment Installed

Source/Calculation:AW.3.99

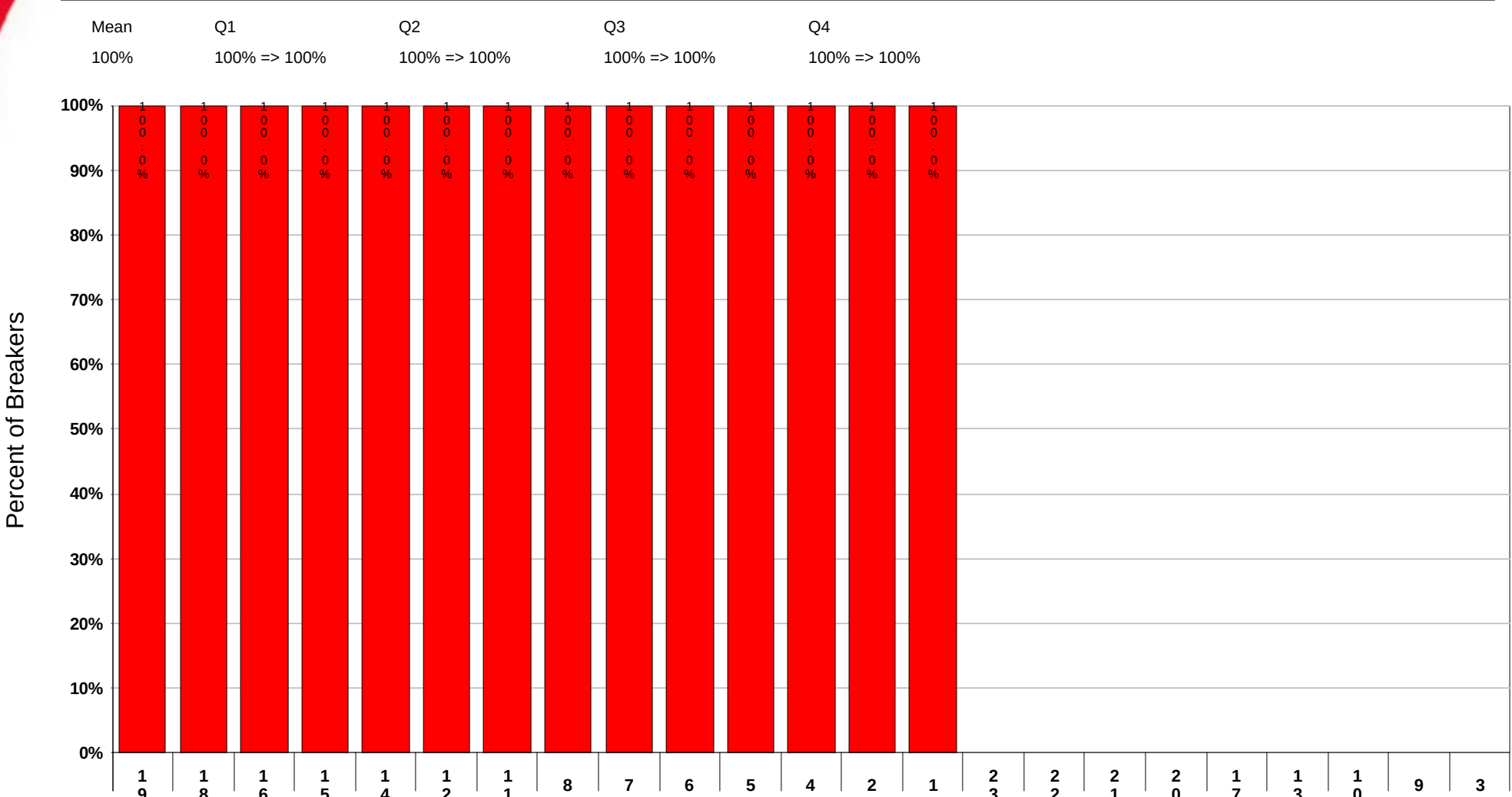
Volume: Focus Area: T&D Substation Automation, Final Report, 2006

ID Code:1600250

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Transmission Breaker Supervisory Control

EHV Transmission Breakers



Source/Calculation:AW.4.1

Volume: Focus Area: T&D Substation Automation, Final Report, 2006

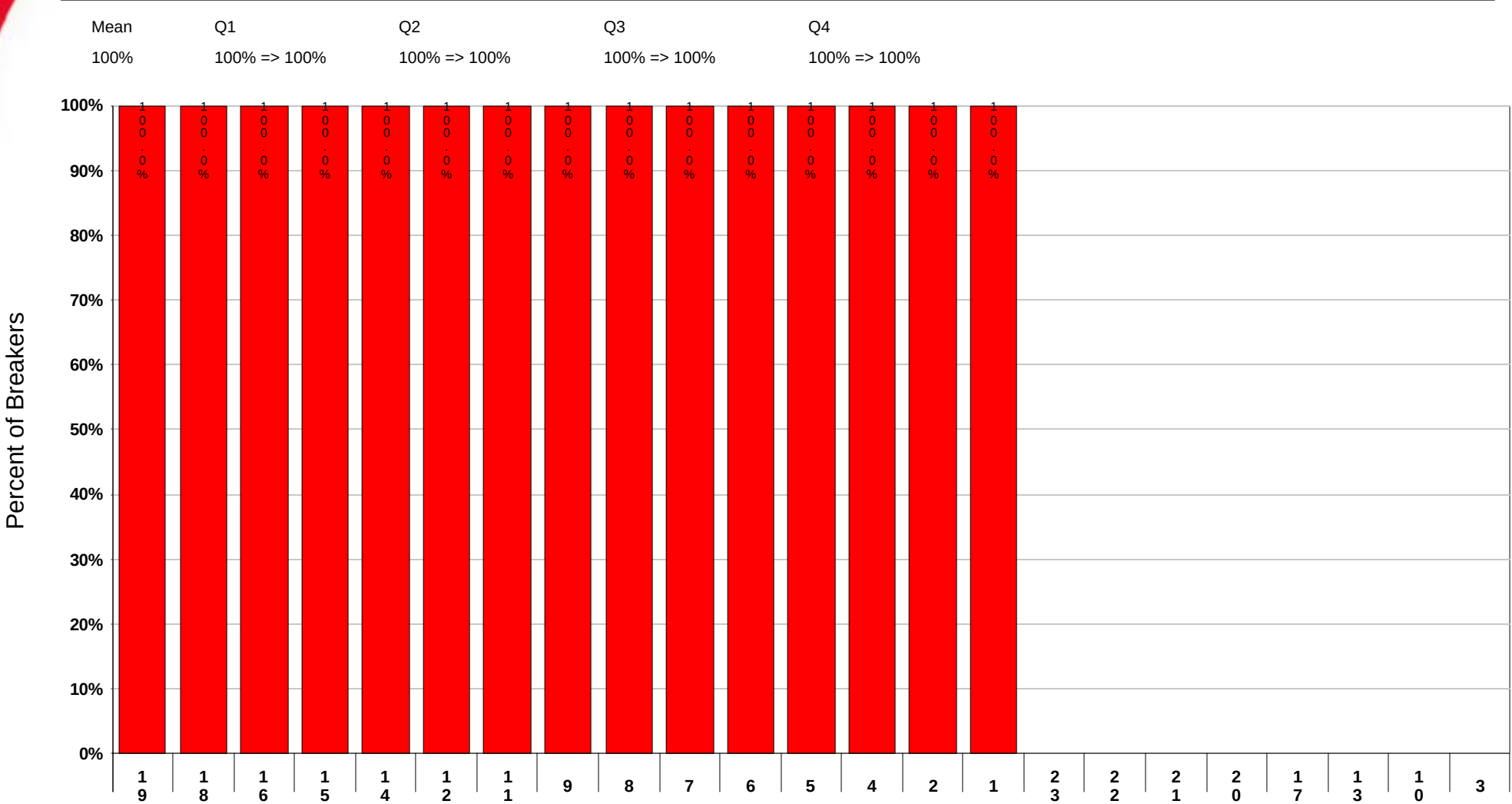
ID Code:1039

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Only companies with all the data are shown.

Transmission Breaker Supervisory Control

HV Transmission Breakers



Source/Calculation:AW.4.2

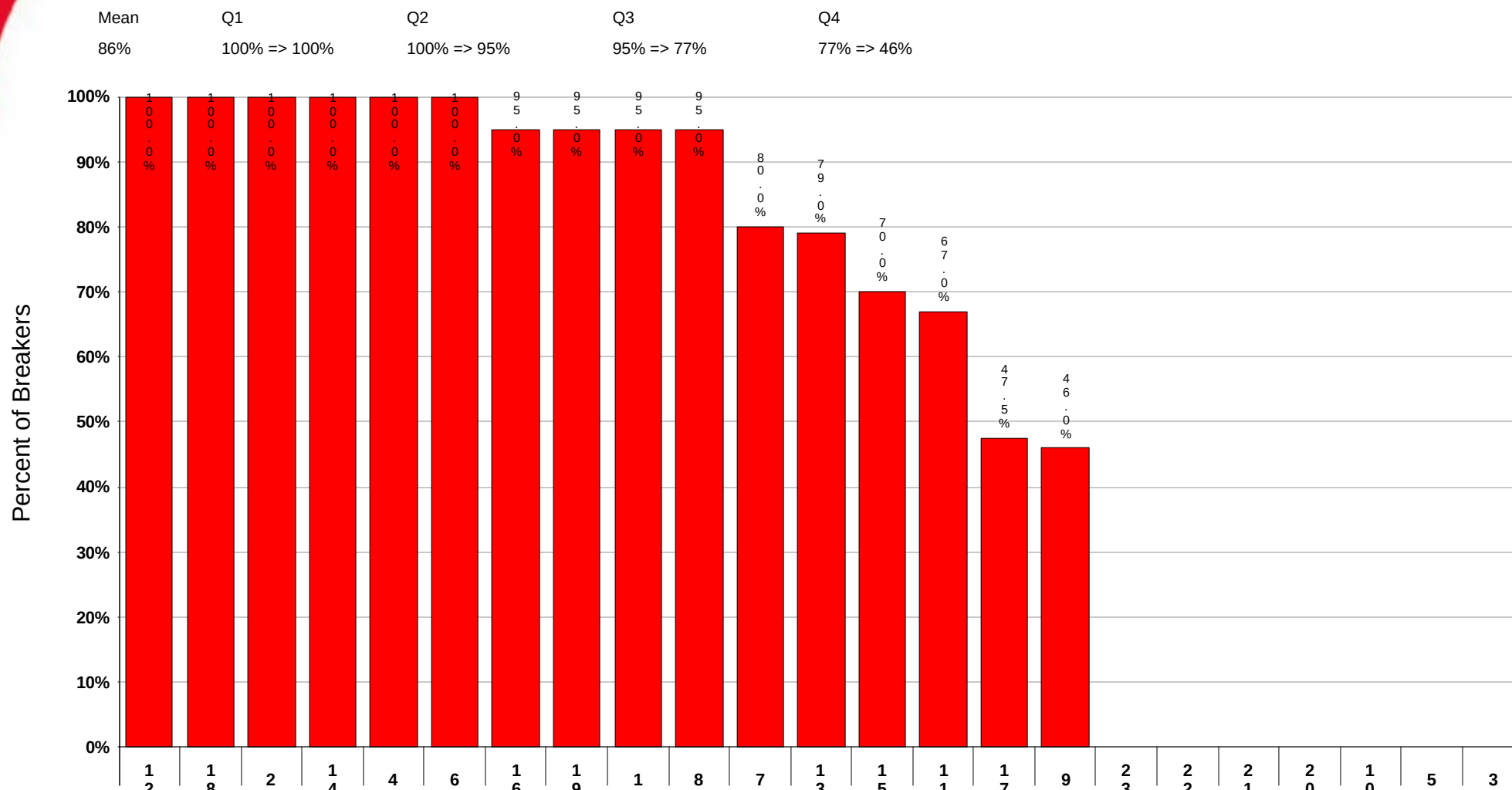
Volume: Focus Area: T&D Substation Automation, Final Report, 2006

ID Code:1040

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Only companies with all the data are shown.

Distribution Breaker Supervisory Control



Source/Calculation:AW.4.3

Volume: Focus Area: T&D Substation Automation, Final Report, 2006

ID Code:1041

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Only companies with all the data are shown.

Use On-Line Monitoring of Substation Components

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Yes:	✓	✓		✓	✓	✓	✓	✓	✓			✓	✓			✓	✓	✓						76.5%
2. No:											✓			✓	✓				✓					23.5%

Source/Calculation:AW.5.1

Volume: Focus Area: T&D Substation Automation, Final Report, 2006

ID Code:6277

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Future Strategies for the Use of SCADA in Substations

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. No Specific Strategies:																		✓						5.9%
2. For New Facilities:					✓	✓	✓	✓	✓		✓		✓		✓	✓	✓		✓					64.7%
3. Update Existing Facilities:	✓	✓		✓	✓	✓	✓	✓	✓				✓	✓	✓		✓		✓					76.5%
99. Other:				✓							✓	✓												17.6%

Source/Calculation:AW.6.1

Volume: Focus Area: T&D Substation Automation, Final Report, 2006

ID Code:1046

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Strategies for the Use of SCADA in Substations (cont.)

Role of Control Center

What are your future strategies for the use of SCADA in distribution substations?

- Intelligent grid automation
- update existing facilities when upgrades are made
- Use HMI data for trouble shooting and maintenance periodicity determination/evaluation

Source/Calculation:AW.6.99

Volume: Focus Area: T&D Substation Automation, Final Report, 2006

ID Code:6562

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Automated Distribution Substation Components

Status of Automation: N = None, M = Monitored, R = Remote Controlled, D = Distributed (Local Control)

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	None	
1. Fault Locations:	d	m		m m	m	d	r	m	m		m	m	m	m	n	m	n	m	n						73.9%
2. Relaying:	r	m		m	m	m	m	m	r		m	m	m	m	n	d	r	n	m						73.9%
3. Alarms:	m	m		m	m	m	m	m	m		m	m	m	m	m	m	m	n	m						73.9%
4. Controls:	r	r		r	r	r	r	r	r		r	r	r	r	r	r	r	n	r						73.9%
5. Switches:	m	m		m	r	r	d	r	n		n	r	r	r	d	r	n	n	r						73.9%
6. Monitoring Devices:	d	m		m	m	m	m	m	m		m	m	m	m	n	m	n	m	n						73.9%
7. Analogs:	m	n		m	m	m	m	m	m		m	m	m	m	m	m	m	m	m						73.9%
8. Security:	n	m		m	n	m	m	m	m		d	r	n	m	n	m	n	n	m						73.9%

Source/Calculation:AW.7.1

Volume: Focus Area: T&D Substation Automation, Final Report, 2006

ID Code:1620

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Components Where an Increase in the Level of Automation Is Planned

In the Next Three Years (Distribution Substations)

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Fault Locations:				✓	✓			✓			✓	✓	✓	✓		✓	✓	✓						58.8%
2. Relaying:	✓	✓		✓			✓	✓	✓		✓	✓	✓	✓		✓	✓	✓						76.5%
3. Alarms:				✓			✓		✓				✓	✓	✓	✓	✓							47.1%
4. Controls:	✓				✓		✓		✓				✓		✓		✓							41.2%
5. Switches:								✓					✓											11.8%
6. Monitoring Devices:		✓		✓	✓	✓		✓	✓		✓	✓	✓	✓		✓		✓						70.6%
7. Analogs:				✓	✓				✓			✓			✓		✓							35.3%
8. Security:		✓				✓	✓		✓		✓	✓		✓		✓		✓						52.9%
9. Fuses:																			✓					5.9%
10. Re-closers:						✓	✓	✓	✓			✓	✓		✓		✓	✓						52.9%
99. Other:								✓																5.9%

Source/Calculation:AW.8.1

Volume: Focus Area: T&D Substation Automation, Final Report, 2006

ID Code:7033

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Components Where an Increase in the Level of Automation Is Planned (cont.)

In the Next Three Years

In which components do you plan to increase the level of automation in the next three years (distribution substations)?

● Voltage regulators

Source/Calculation:AW.8.99

Volume: Focus Area: T&D Substation Automation, Final Report, 2006

ID Code:7078

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-  ● Pg. 1532 Components Monitored
-   Pg. 1533 Components Monitored (cont.)
-   Pg. 1534 Percent of Equipment Monitored - T&D Substation Components
-  ● Pg. 1535 T&D Substation Alarm Monitoring - Groups Informed
-   Pg. 1536 Group Informed of Monitor Alarms (cont.)
-  ● Pg. 1537 Monitored Data Archived for Later Analysis

Components Monitored

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. None:	✓																							5.9%
2. Auto Transformers:		✓		✓	✓	✓	✓	✓				✓		✓	✓	✓		✓						64.7%
3. Power Transformers:		✓		✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓						82.4%
4. Circuit breakers:		✓		✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓					88.2%
5. Relays:		✓		✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓					88.2%
6. Capacitor banks:		✓			✓	✓	✓	✓				✓	✓	✓	✓		✓							64.7%
7. Regulators:		✓				✓	✓	✓				✓		✓		✓								41.2%
8. Circuit switches:		✓			✓	✓		✓				✓	✓	✓	✓	✓								52.9%
9. Load Tap Changers:		✓		✓	✓	✓	✓	✓				✓	✓	✓	✓			✓	✓					70.6%
99. Other:													✓											5.9%

Source/Calculation:AX.2.1

Volume: Focus Area: On-line Monitoring of T&D Substation Components, Final Report, 2006

ID Code:2301001

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Components Monitored (cont.)

What components do you monitor?

- AC-DC systems, RTUs

Source/Calculation:AX.2.99

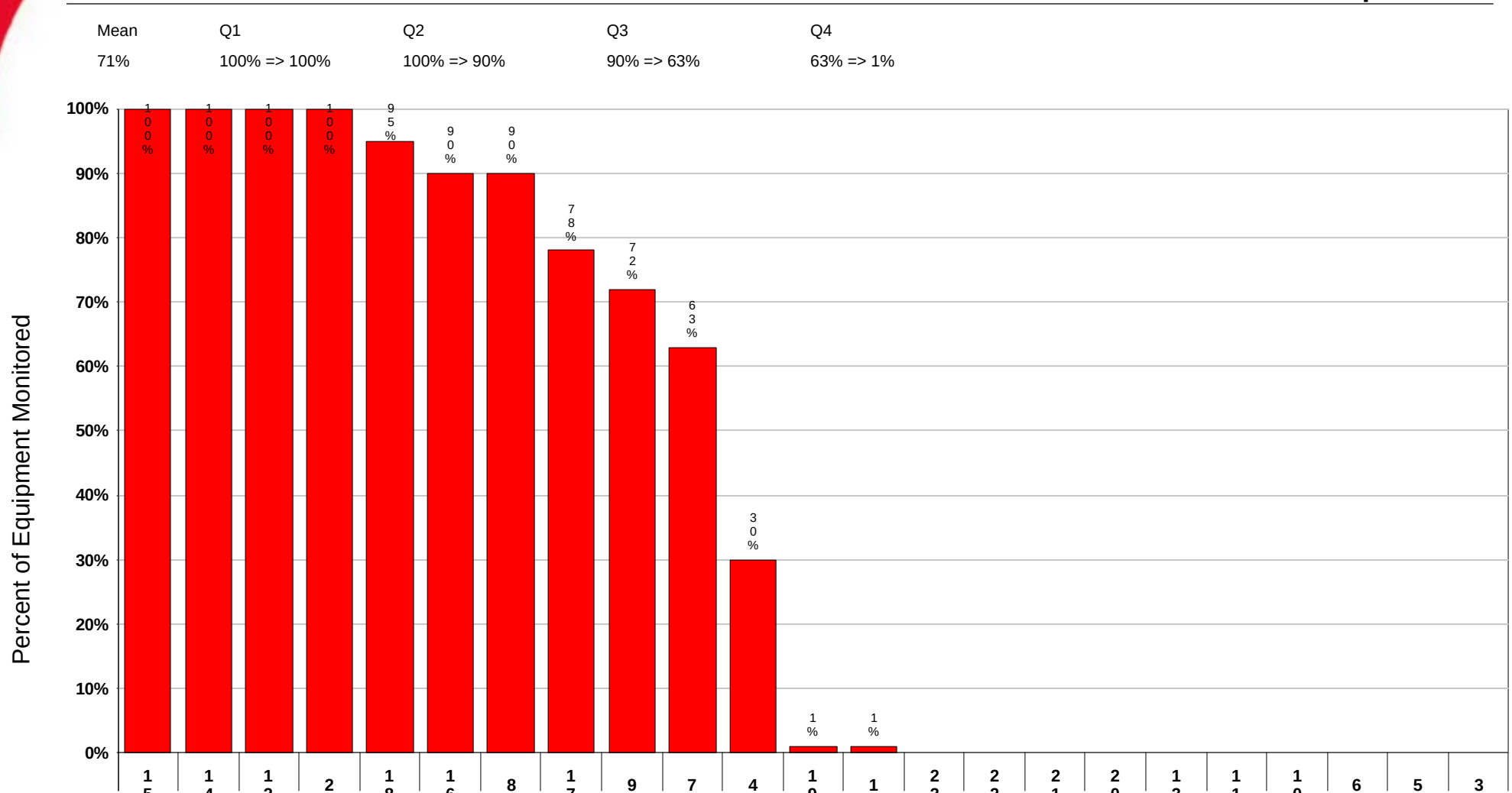
Volume: Focus Area: On-line Monitoring of T&D Substation Components, Final Report, 2006

ID Code:65244

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Percent of Equipment Monitored

T&D Substation Components



Source/Calculation:AX.3.1

Volume: Focus Area: On-line Monitoring of T&D Substation Components, Final Report, 2006

ID Code:65375

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Only companies with all the data are shown.

T&D Substation Alarm Monitoring

Groups Informed

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Service Dispatcher:					✓						✓	✓		✓		✓								29.4%
2. System Operations:		✓			✓		✓	✓	✓		✓	✓	✓	✓	✓			✓						64.7%
3. Load Dispatcher:		✓				✓	✓					✓	✓	✓			✓							41.2%
4. Maintenance Foremen or Engineer:				✓	✓						✓		✓					✓	✓					35.3%
99. Other:	✓			✓																				11.8%

Source/Calculation:AX.4.1

Volume: Focus Area: On-line Monitoring of T&D Substation Components, Final Report, 2006

ID Code:2301002

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Group Informed of Monitor Alarms (cont.)

Who is informed of monitor alarms?

- Engineering
- Process is not built, in the process of implementing systems

Monitored Data Archived for Later Analysis

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Yes:		✓		✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓			✓					81.3%
2. No:	✓										✓							✓						18.8%

Source/Calculation:AX.5.1

Volume: Focus Area: On-line Monitoring of T&D Substation Components, Final Report, 2006

ID Code:65091

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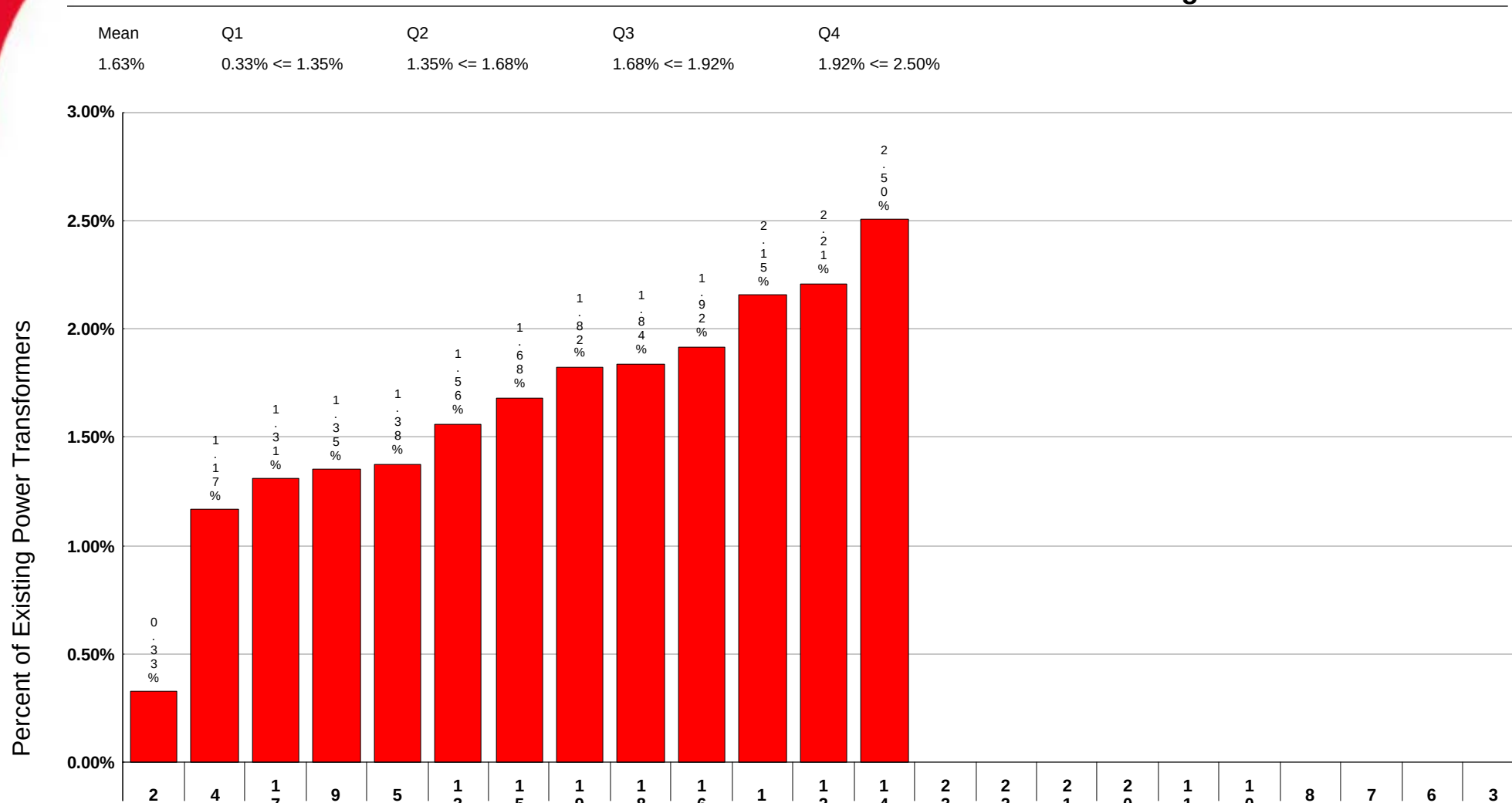
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-  Pg. 1546 Power Transformers Purchased Last Year - Percent of Existing Power Transformers
-  Pg. 1546.1 Spare Distribution Power Transformers - Per Distribution Substation Transformer Bank
-  Pg. 1546.2 Mobile Distribution Power Transformers - Per Distribution Substation Transformer Bank
-  Pg. 1547 Accounting for Installation of Power Transformers
-  Pg. 1551 In-Service Load Serving Load Tap Change Transformers - Percent of In-Service Transformers
-  Pg. 1552 In-Service Auto Transformation Load Tap Change Transformers - Percent of In-Service Transformers
-  Pg. 1553 In-Service Load Tap Change Transformers -- Breakdown Unavailable - Percent of In-Service Transformers

Power Transformers Purchased Last Year

Percent of Existing Power Transformers



Source/Calculation: AY.2.1/(SUM{AQ.2}+SUM{AQ.3})

Volume: T&D Substation Transformer Shops, Final Report, 2006

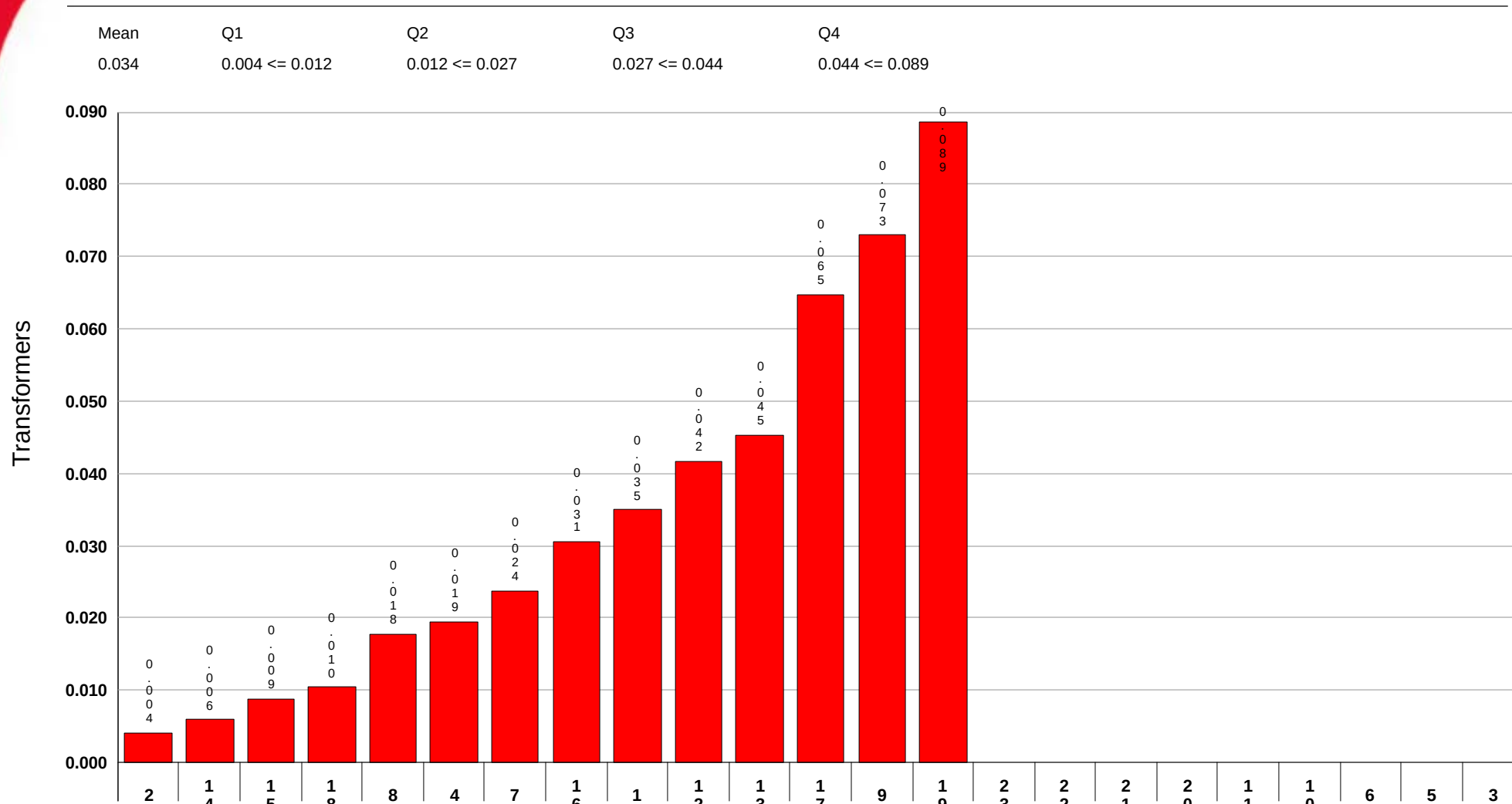
ID Code:2300979

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Only companies with all the data are shown.

Spare Distribution Power Transformers

Per Distribution Substation Transformer Bank



Source/Calculation: SUM{AY.4}/SUM{AQ.3}

Volume: T&D Substation Transformer Shops, Final Report, 2006

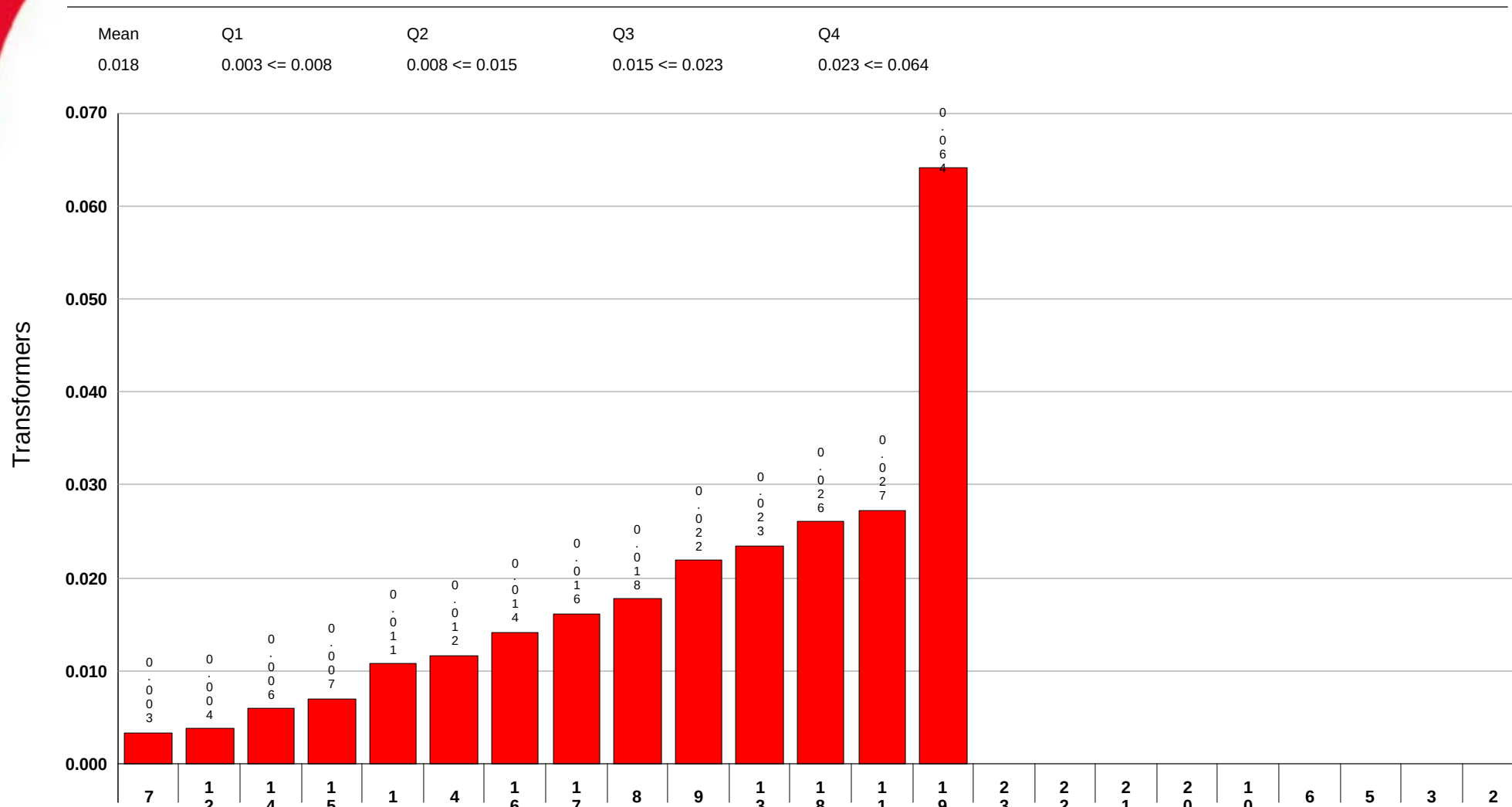
ID Code: 2500006

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Only companies with all the data are shown.

Mobile Distribution Power Transformers

Per Distribution Substation Transformer Bank



Source/Calculation: SUM{AY.6}/SUM{AQ.3}

Volume: T&D Substation Transformer Shops, Final Report, 2006

ID Code: 2500005

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Only companies with all the data are shown.

Accounting for Installation of Power Transformers

How is the installation of power transformers charged (e.g. first installation is capitalized)?

- All are capital!
- all capital
- All installations and replacements are capitalized.
- Capitalized
- Capitalized
- Capitalized
- Capitalized
- First installation and failure capitalized; Upgrade capitalized
- First installation is capitalized
- First installation is capitalized
- First installation is capitalized
- First installation is capitalized
- First installation is capitalized
- First installation is capitalized.
- First installation is capitalized

Source/Calculation: AY.7.1

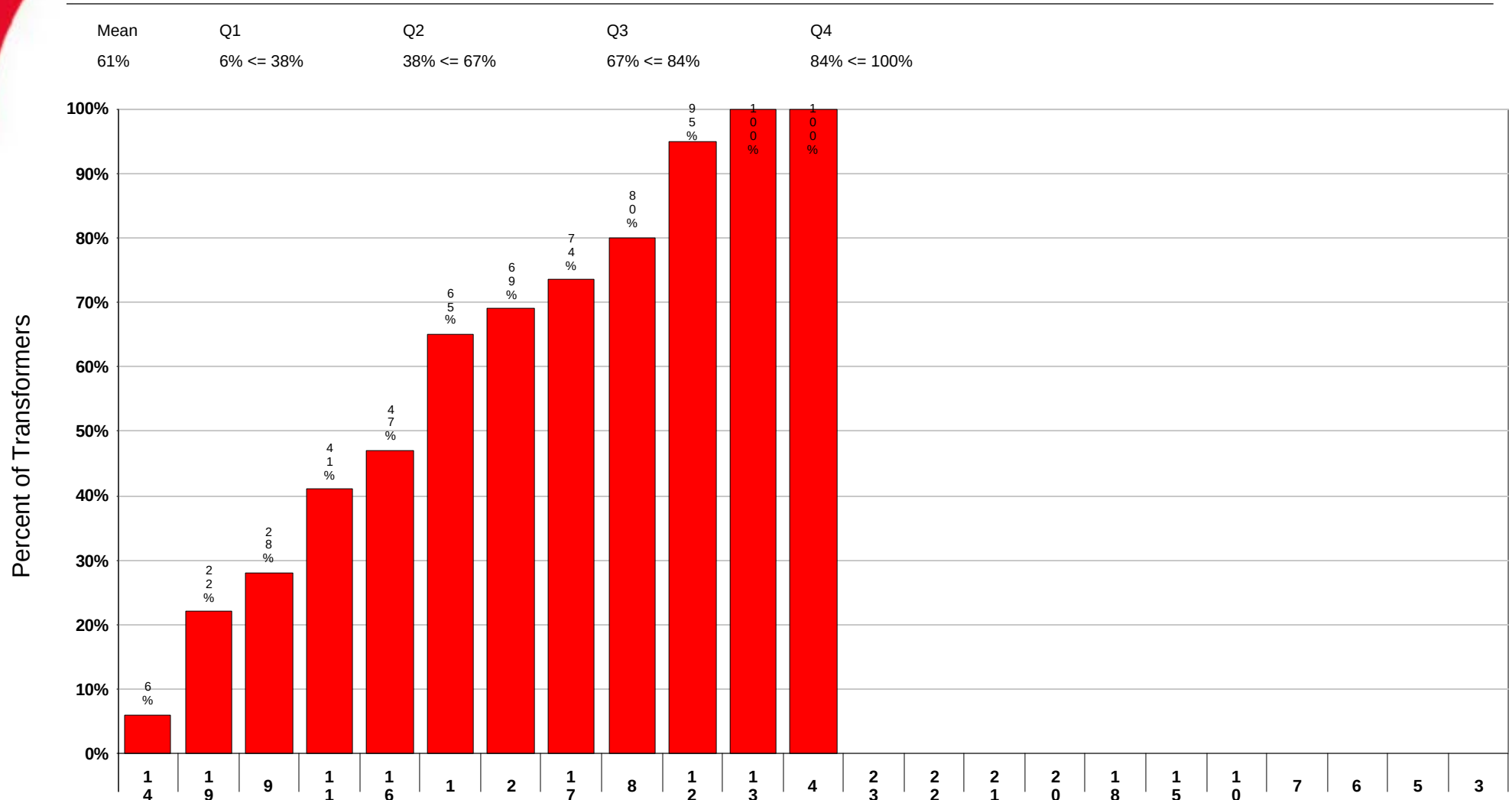
Volume: T&D Substation Transformer Shops, Final Report, 2006

ID Code: 2300671

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In-Service Load Serving Load Tap Change Transformers

Percent of In-Service Transformers



Source/Calculation:AQ.24.1

Volume: T&D Substation Transformer Shops, Final Report, 2006

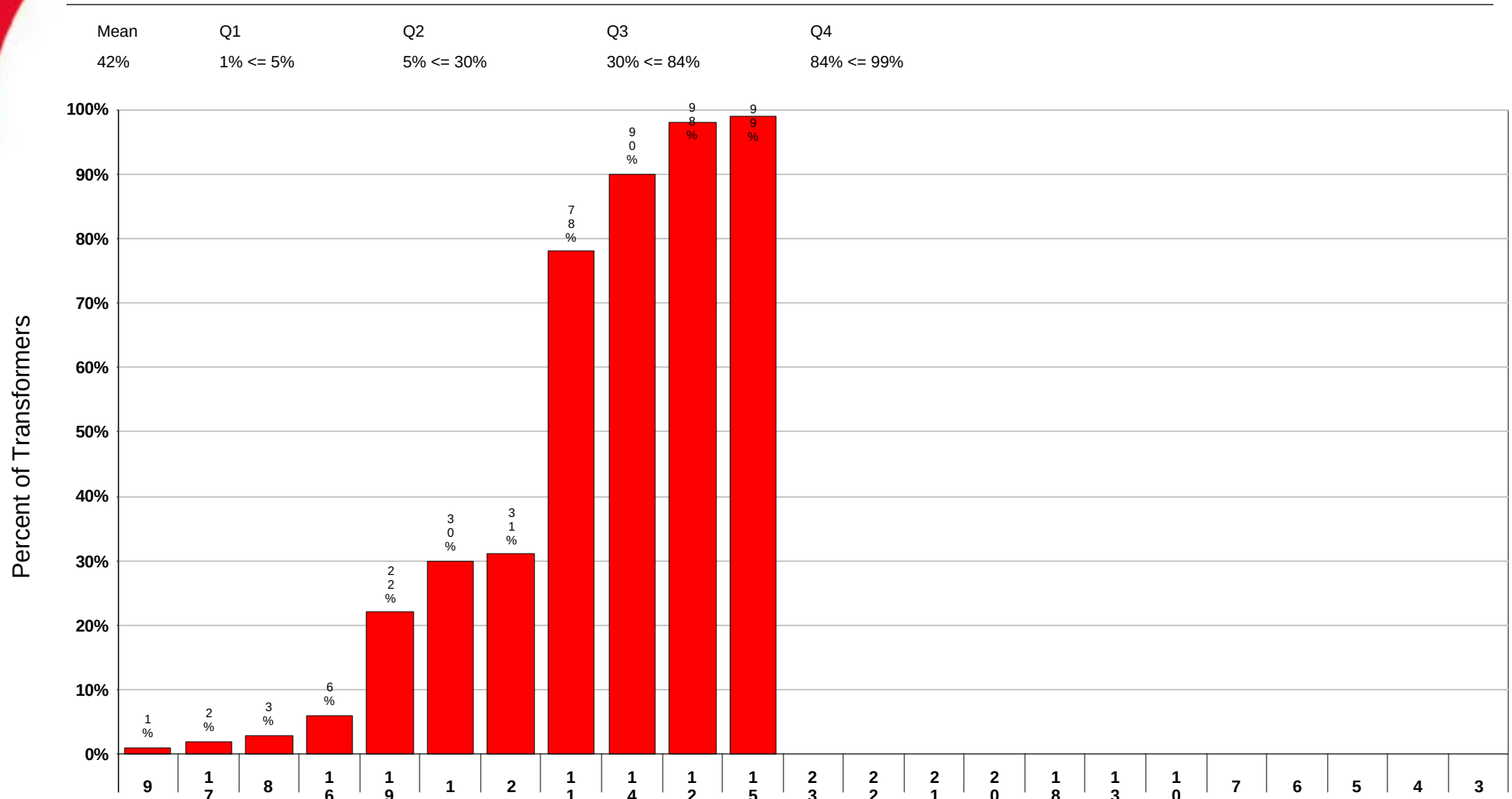
ID Code:27048

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Only companies with all the data are shown.

In-Service Auto Transformation Load Tap Change Transformers

Percent of In-Service Transformers



Source/Calculation:AQ.24.2

Volume: T&D Substation Transformer Shops, Final Report, 2006

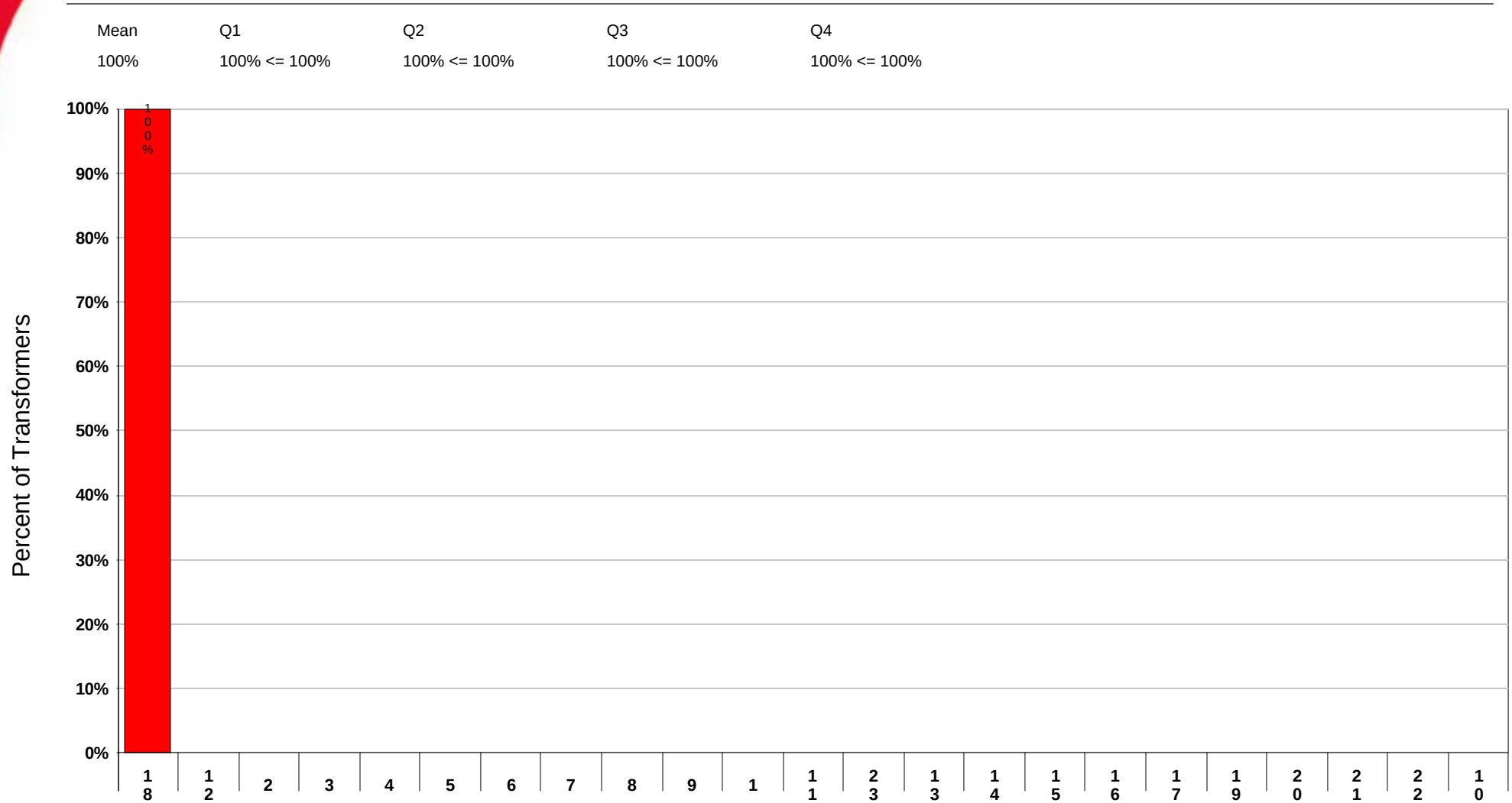
ID Code:27047

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Only companies with all the data are shown.

In-Service Load Tap Change Transformers -- Breakdown Unavailable

Percent of In-Service Transformers



Source/Calculation:AQ.24.100

Volume: T&D Substation Transformer Shops, Final Report, 2006

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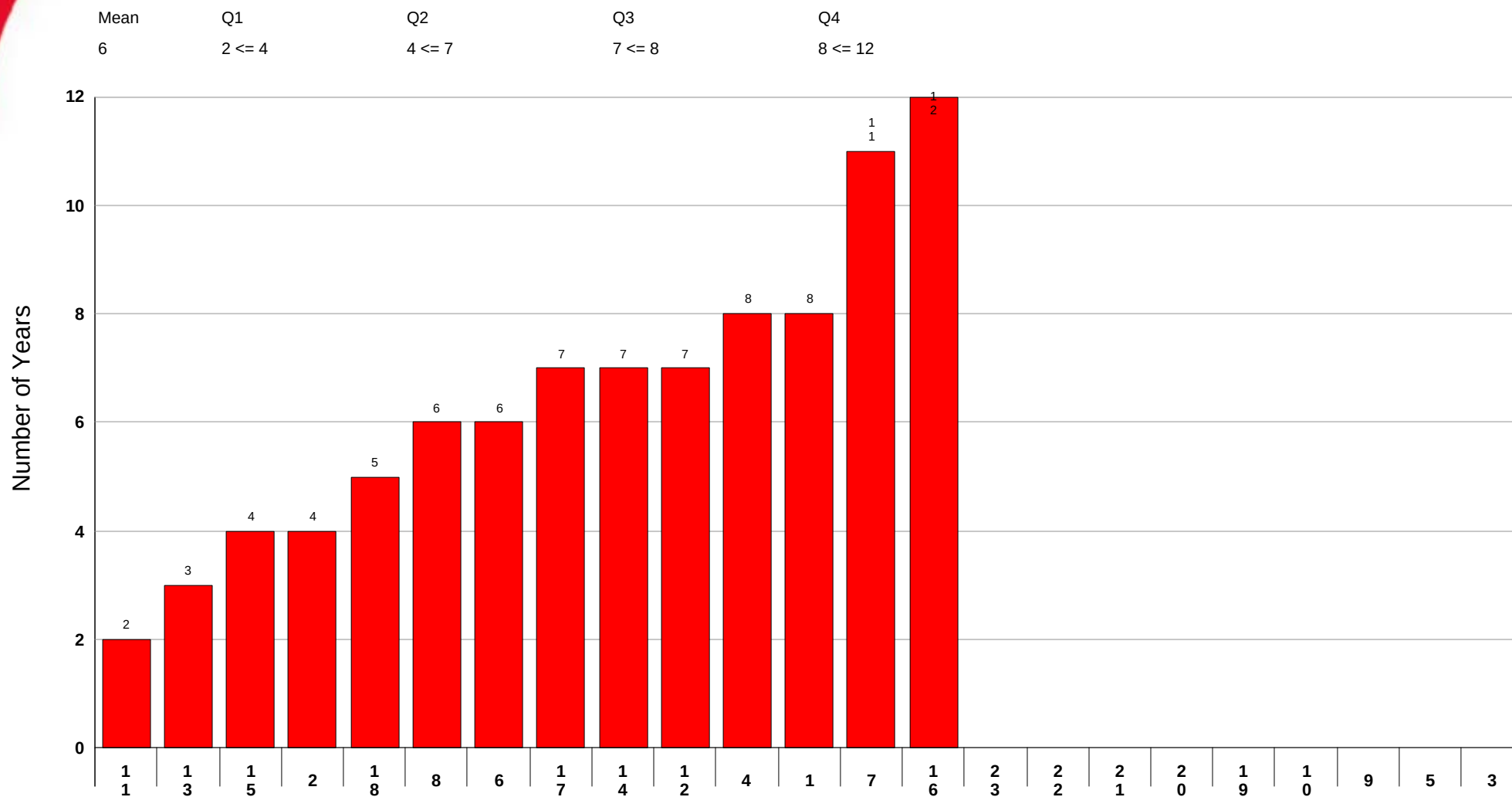
Only companies with all the data are shown.

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Years Since Substation Work Management System Was Installed



Source/Calculation: 2006-AZ.2.1

Volume: Focus Area: T&D Substation Work Management Processes, Final Report, 2006

ID Code: 8173

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Only companies with all the data are shown.

Substation Work Management System Vendor

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Designed In-House:	✓													✓										12.5%
2. Indus (Passport):					✓	✓	✓								✓									25.0%
3. PSDI (Maximo):		✓		✓												✓	✓							25.0%
4. Severn Trent (Storms):													✓		✓									12.5%
5. Synercom:																								0.0%
6. SAP:												✓						✓						12.5%
99. Other:					✓			✓	✓		✓													25.0%

Source/Calculation:AZ.3.1

Volume: Focus Area: T&D Substation Work Management Processes, Final Report, 2006

ID Code:2735

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Substation Work Management System Vendor (cont.)

Who is the vendor for your substation work management system?

- Cascade
- Cascade (Maintenance)
- Digital Inspections (Cascade)
- Marked N/A

Substation Crew Performance Measures

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Not Measured:					✓						✓			✓		✓	✓							31.3%
2. Actual Vs. Estimated Hours:	✓	✓		✓		✓	✓	✓				✓			✓			✓						56.3%
3. Utilization By Activity:		✓				✓		✓				✓			✓									31.3%
4. Actual Vs. Estimated Dollars:							✓					✓			✓			✓						25.0%
5. Required Vs. Actual Crew Size:		✓				✓	✓								✓									25.0%
6. Actual Vs. Standard Hours:		✓		✓								✓			✓									25.0%
99. Other:							✓		✓				✓					✓						25.0%

Source/Calculation: AZ.4.1

Volume: Focus Area: T&D Substation Work Management Processes, Final Report, 2006

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Substation Crew Performance Measures (cont.)

How is each substation crew's performance measured?

- Accounting purposes only; no productivity measures or scheduling are utilized.
- Adherence to Schedule
- Marked N/A
- Project schedule.

Management Processes Supported by a Computerized Work Management System

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Priority Setting:	✓	✓		✓		✓	✓	✓			✓	✓			✓	✓	✓							68.8%
2. Resource Leveling:	✓					✓	✓							✓	✓			✓						37.5%
3. Work Order Generation:	✓	✓		✓	✓	✓	✓	✓			✓	✓			✓	✓	✓	✓						81.3%
4. Productivity Tracking:	✓	✓				✓	✓	✓				✓			✓			✓						50.0%
5. Cost Tracking:		✓		✓			✓	✓				✓			✓	✓	✓	✓						56.3%
6. Scheduling Field Personnel:	✓	✓				✓	✓	✓			✓	✓		✓	✓		✓	✓						68.8%
7. Scheduling Design Personnel:						✓	✓								✓									18.8%
8. Long-term Staff Scheduling:												✓		✓	✓			✓						25.0%
99. Other:									✓				✓											12.5%

Source/Calculation: AZ.5.1

Volume: Focus Area: T&D Substation Work Management Processes, Final Report, 2006

ID Code: 2733

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Management Processes Supported by a Computerized Work Management System (cont.)

Which of the following management processes are supported by a computerized Work Management System?

- ☐ Accounting purposes only; no productivity measures or scheduling are utilized.
- ☐ Question not marked

Work Management System Activities

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Field Inspections:	✓	✓		✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓						93.8%
2. Preventive Maintenance:	✓	✓		✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓						93.8%
3. New Construction:				✓	✓	✓	✓	✓				✓	✓		✓	✓		✓						62.5%
4. Reactive/Corrective Maintenance:	✓	✓		✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓						93.8%
99. Other:							✓		✓															12.5%

Source/Calculation:AZ.6.1

Volume: Focus Area: T&D Substation Work Management Processes, Final Report, 2006

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Work Management System Activities (cont.)

What type of activities are covered by the work management system?

- Compliance Audit
- Question not marked

Source/Calculation:AZ.6.99

Volume: Focus Area: T&D Substation Work Management Processes, Final Report, 2006

ID Code:6619

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Tracking Substation Maintenance Activity by Component

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Cost:		✓		✓				✓				✓					✓	✓						37.5%
2. Failure Rates:	✓	✓		✓		✓	✓	✓				✓		✓			✓	✓						62.5%
3. Maintenance Activities:	✓	✓		✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓						93.8%
99. Other:									✓															6.3%

Source/Calculation:AZ.7.1

Volume: Focus Area: T&D Substation Work Management Processes, Final Report, 2006

ID Code:6279

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Substation Maintenance Unit Costs Tracked (cont.)

Which of the following do you generally track by individual component (e.g. such as a circuit breaker)?

 Question not marked

Source/Calculation:AZ.7.99

Volume: Focus Area: T&D Substation Work Management Processes, Final Report, 2006

ID Code:627999

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Substation Maintenance Work Coordinated to Minimize Multiple Outages

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Not coordinated:					✓																			6.3%
2. All maintenance schedules done by one group:				✓			✓	✓			✓				✓		✓							37.5%
3. One central outage database communicated to all parties:	✓	✓		✓				✓			✓	✓		✓	✓									50.0%
4. Scheduling meetings:	✓	✓		✓		✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓						87.5%
5. Work Management System:	✓					✓	✓	✓			✓	✓		✓	✓		✓	✓						62.5%
99. Other:						✓	✓		✓			✓												25.0%

Source/Calculation: AZ.8.1

Volume: Focus Area: T&D Substation Work Management Processes, Final Report, 2006

ID Code: 27051

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Substation Maintenance Work Coordinated to Minimize Multiple Outages (cont.)

How do you coordinate substation maintenance work to minimize multiple outages?

- Dedicated outage coordinator for transmission level outages.
- Long range planning
- Question not marked
- System Operations maintains functional equipment groupings

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-  # Pg. 1579 Substation O&M Contracting - Percent of Activity Contracted
-  # Pg. 1580 Substation O&M Contracting (cont.) - Percent of Activity Contracted
-   Pg. 1581 Overall Percentage of Substation Work Contracted
-  # Pg. 1584 Substation Management Activities Contracted - Percent of Activity Contracted

Substation Engineering Contracting

Percent of Activity Contracted

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:
1. Structural:	5%	-	75%	23%	-	-	-	30%	90%	-	-	87%	15%	10%	0%	75%	50%	0%	50%	-	-	-	-	39.2%
2. Relay:	5%	-	75%	26%	0%	80%	-	30%	30%	-	-	94%	0%	5%	0%	75%	40%	8%	50%	-	-	-	-	34.5%
3. Foundation:	5%	-	75%	8%	-	60%	-	30%	100%	-	-	100%	0%	0%	0%	75%	80%	0%	50%	-	-	-	-	35.9%
4. Site Improvements:	5%	-	75%	3%	-	60%	-	80%	50%	-	-	100%	85%	85%	0%	0%	0%	8%	100%	-	-	-	-	46.5%
99. Other:	67%	-	-	43%	-	-	-	10%	-	-	-	-	-	98%	-	0%	0%	0%	50%	-	-	-	-	33.5%
100. Total Substation Engineering Activities Contracted:	5%	-	75%	41%	-	65%	-	70%	-	-	-	73%	10%	25%	0%	75%	0%	8%	-	-	-	-	-	37.3%

Source/Calculation:BA.2.1

Volume: Focus Area: T&D Substation Contracting, Final Report, 2006

ID Code:1093

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Substation Construction Contracting

Percent of Activity Contracted

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:
1. New Stations:	95%	-	100%	100%	-	100%	100%	50%	100%	-	-	93%	6%	80%	70%	90%	60%	0%	60%	-	-	-	-	73.6%
2. Load Growth:	95%	-	75%	85%	-	95%	95%	-	-	-	-	71%	6%	80%	35%	90%	0%	0%	50%	-	-	-	-	59.8%
3. Replacement In Kind:	100%	-	50%	0%	0%	100%	100%	80%	0%	-	-	49%	6%	30%	35%	90%	0%	0%	40%	-	-	-	-	31.3%
4. Reliability Improvement:	95%	-	50%	100%	-	100%	100%	100%	0%	-	-	64%	6%	30%	35%	90%	0%	0%	40%	-	-	-	-	36.0%
5. IPP/Interconnect:	100%	-	100%	0%	-	100%	100%	0%	0%	-	-	100%	-	0%	0%	0%	0%	-	-	-	-	-	-	60.0%
6. New Construction Inside Plant Projects (IP) projects:	100%	-	90%	0%	-	-	95%	100%	0%	-	-	-	-	90%	-	90%	0%	-	-	-	-	-	-	62.8%
7. New Construction Outside Plant Projects (OP) projects:	95%	-	0%	100%	-	-	100%	0%	0%	-	-	-	-	70%	-	90%	0%	-	-	-	-	-	-	56.9%
8. Maintenance and Repair IP Projects:	25%	-	10%	0%	-	-	0%	0%	0%	-	-	-	-	10%	-	15%	0%	-	-	-	-	-	-	13.1%
9. Maintenance and Repair OP Projects:	25%	-	0%	0%	-	-	100%	0%	0%	-	-	-	-	40%	-	15%	0%	-	-	-	-	-	-	28.1%
10. Reimbursable 3rd Party IP Projects:	95%	-	75%	0%	-	-	100%	0%	0%	-	-	-	-	0%	-	10%	0%	-	-	-	-	-	-	35.0%
11. Reimbursable 3rd Party OP Projects:	95%	-	0%	0%	-	-	100%	0%	0%	-	-	-	-	1%	-	10%	0%	-	-	-	-	-	-	25.8%
99. Other:	-	-	-	0%	-	-	-	-	-	-	-	82%	-	0%	-	0%	0%	-	-	-	-	-	-	16.5%
100. Total Substation Construction Activities Contracted:	95%	-	86%	60%	-	-	60%	0%	0%	-	-	72%	-	70%	60%	93%	30%	45%	-	-	-	-	-	55.2%

Source/Calculation:BA.3.1

Volume: Focus Area: T&D Substation Contracting, Final Report, 2006

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Substation O&M Contracting

Percent of Activity Contracted

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:
1. Substation Inspections:	-	-	0%	-	0%	0%	0%	-	0%	-	10%	0%	0%	10%	0%	0%	25%	0%	-	-	-	-	-	3.5%
2. Switching In Substations:	-	-	0%	-	0%	0%	0%	-	0%	-	0%	0%	0%	0%	0%	0%	0%	0%	-	-	-	-	-	
3. Emergency Corrective Maintenance:	-	-	5%	-	0%	2%	2%	-	0%	-	0%	0%	0%	0%	0%	0%	31%	0%	-	-	-	-	-	3.1%
4. Transformer LTC Maintenance (Diagnostic Tests, Overhauls):	1%	-	5%	-	0%	0%	0%	-	90%	-	0%	0%	1%	10%	0%	0%	31%	0%	-	-	-	-	-	16.3%
5. Transformer Maintenance:	-	-	5%	-	0%	2%	1%	-	0%	-	0%	23%	0%	90%	0%	2%	31%	0%	-	-	-	-	-	11.8%
6. Breaker Maintenance (Diagnostic Tests, Overhauls):	2%	-	5%	-	0%	2%	1%	-	0%	-	10%	2%	0%	90%	0%	5%	31%	0%	-	-	-	-	-	10.6%
7. Relay Maintenance (Diagnostic Tests, Overhauls):	-	-	0%	-	0%	0%	5%	-	0%	-	0%	5%	0%	5%	0%	0%	31%	0%	-	-	-	-	-	3.5%

Source/Calculation:BA.4.1

Volume: Focus Area: T&D Substation Contracting, Final Report, 2006

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Substation O&M Contracting (cont.)

Percent of Activity Contracted

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:
8. Recloser Maintenance (Diagnostic Tests, Overhauls):	-	-	0%	-	0%	0%	0%	-	0%	-	0%	0%	0%	-	0%	0%	0%	-	-	-	-	-	-	
9. Station Property Maintenance (Grounding Systems, Etc.):	90%	-	50%	-	-	50%	90%	-	100%	-	100%	100%	90%	100%	0%	100%	55%	0%	-	-	-	-	-	57.3%
10. Management & Supervision, Engineering, Clerical:	-	-	0%	-	0%	2%	2%	-	0%	-	0%	0%	0%	2%	0%	0%	0%	100%	-	-	-	-	-	8.2%
99. Other:		-	0%	-	-	-	-	-	-	-	0%	4%	-	0%	-	0%	0%	0%	-	-	-	-	-	0.6%
100. Total Substation Maintenance Activities Contracted:	-	-	10%	-	-	5%	5%	-	20%	-	-	15%	2%	40%	0%	5%	31%	1%	0%	-	-	-	-	11.2%

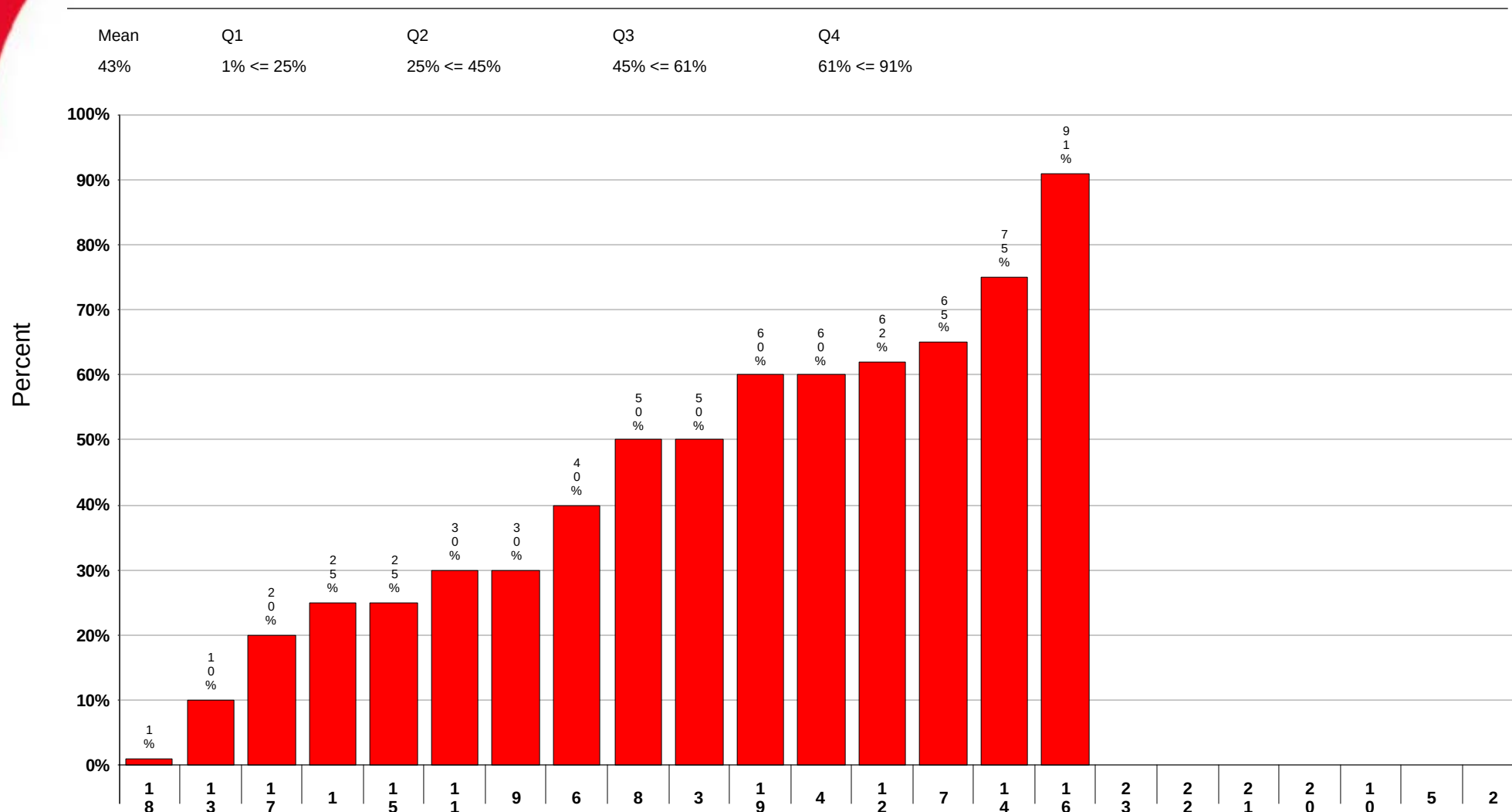
Source/Calculation: BA.4.8

Volume: Focus Area: T&D Substation Contracting, Final Report, 2006

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Overall Percentage of Substation Work Contracted



Source/Calculation:BA.5.1

Volume: Focus Area: T&D Substation Contracting, Final Report, 2006

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Only companies with all the data are shown.

Substation Management Activities Contracted

Percent of Activity Contracted

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:
1. Project Management/Control:	30%	-	20%	0%	0%	-	35%	30%	0%	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	-	-	-	7.2%
2. Construction Management:	15%	-	50%	0%	25%	-	80%	30%	0%	-	0%	0%	0%	15%	0%	0%	0%	0%	25%	-	-	-	-	15.0%
100. Total Substation Management Work Contracted:	20%	-	40%	0%	-	-	65%	30%	0%	-	0%	0%	0%	5%	0%	0%	0%	0%	25%	-	-	-	-	12.3%

Source/Calculation:BA.6.1

Volume: Focus Area: T&D Substation Contracting, Final Report, 2006

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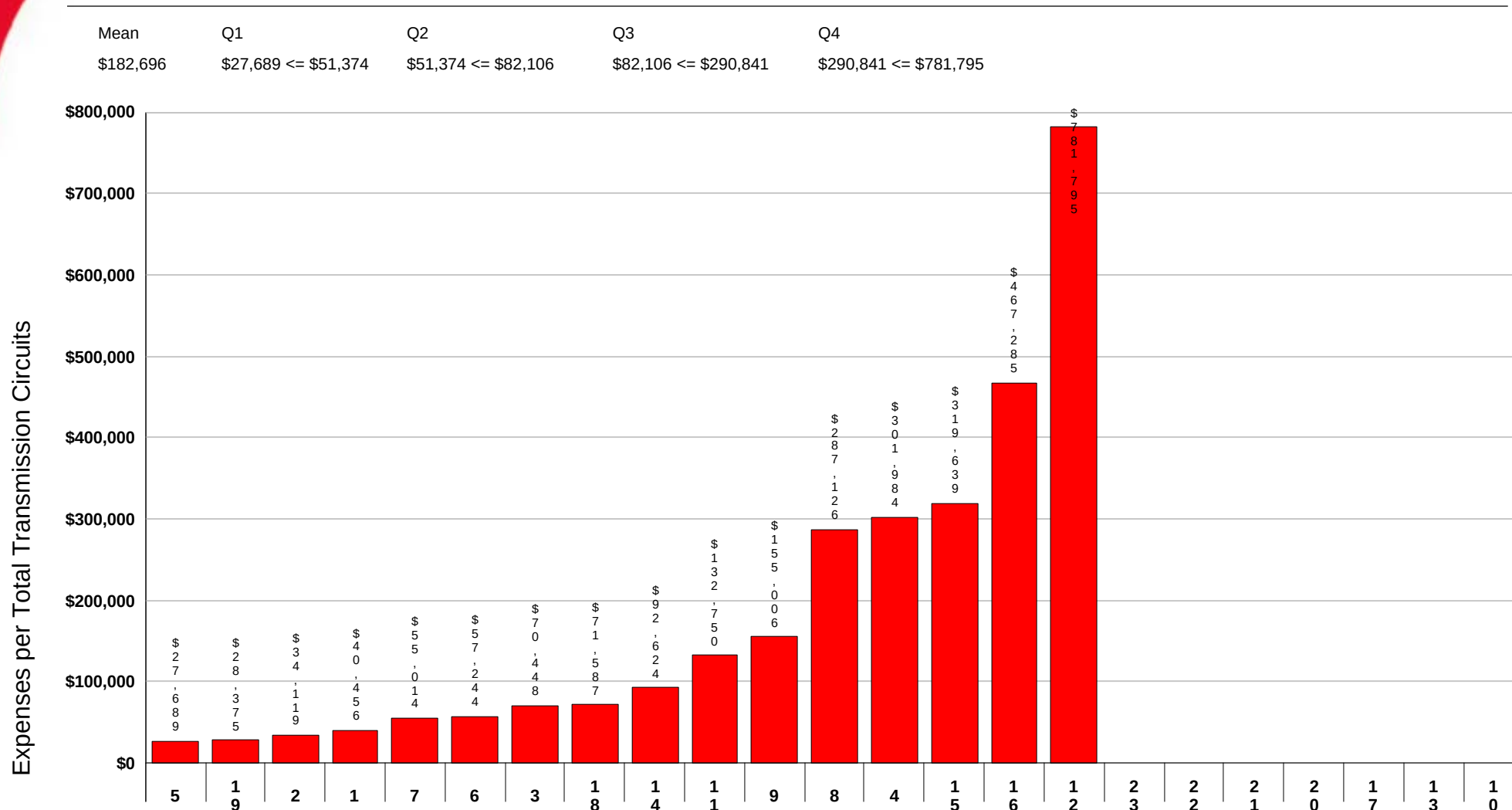
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 HiLo
 Memo Tables

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	Pg. 1660.2	Transmission Operations Expense - Per Total Transmission Breakers
	Pg. 1660.3	Transmission Line Operations Expense - Per Total Transmission Circuits
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Transmission Line Operations Expenses

Per Total Transmission Circuits



Source/Calculation: (SUM{B.20}-SUM{B.21})/SUM{BB.2}

Volume: Transmission Line Statistics, Final Report, 2006

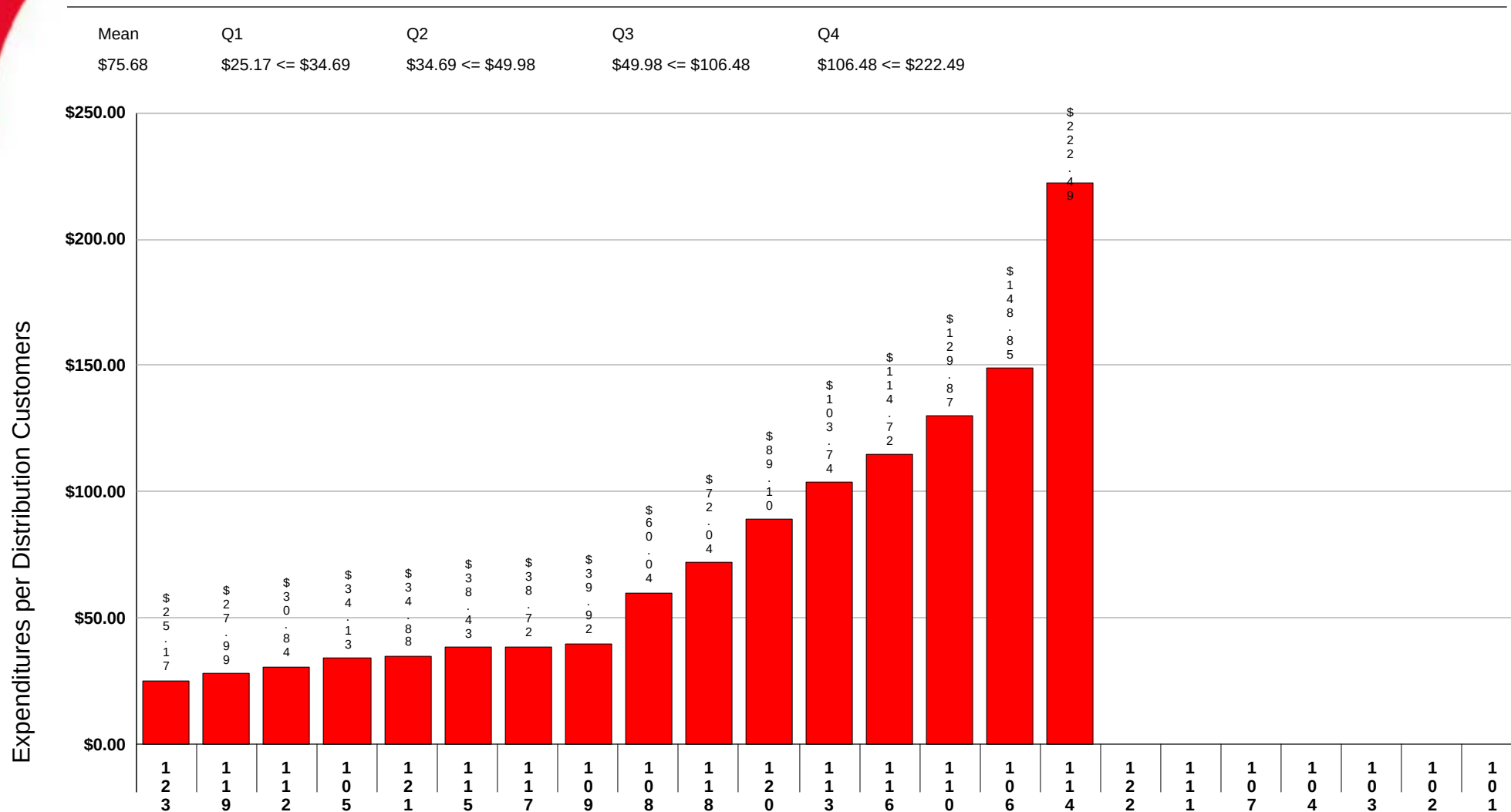
ID Code:2500043

Page:1586

Only companies with all the data are shown.

Transmission Expenditures

Per Distribution Customers



Source/Calculation: ((SUM{B.2}+SUM{B.20}-B.20.6+SUM{B.22})/A.2.2)

Volume: Transmission Line Statistics, Final Report, 2006

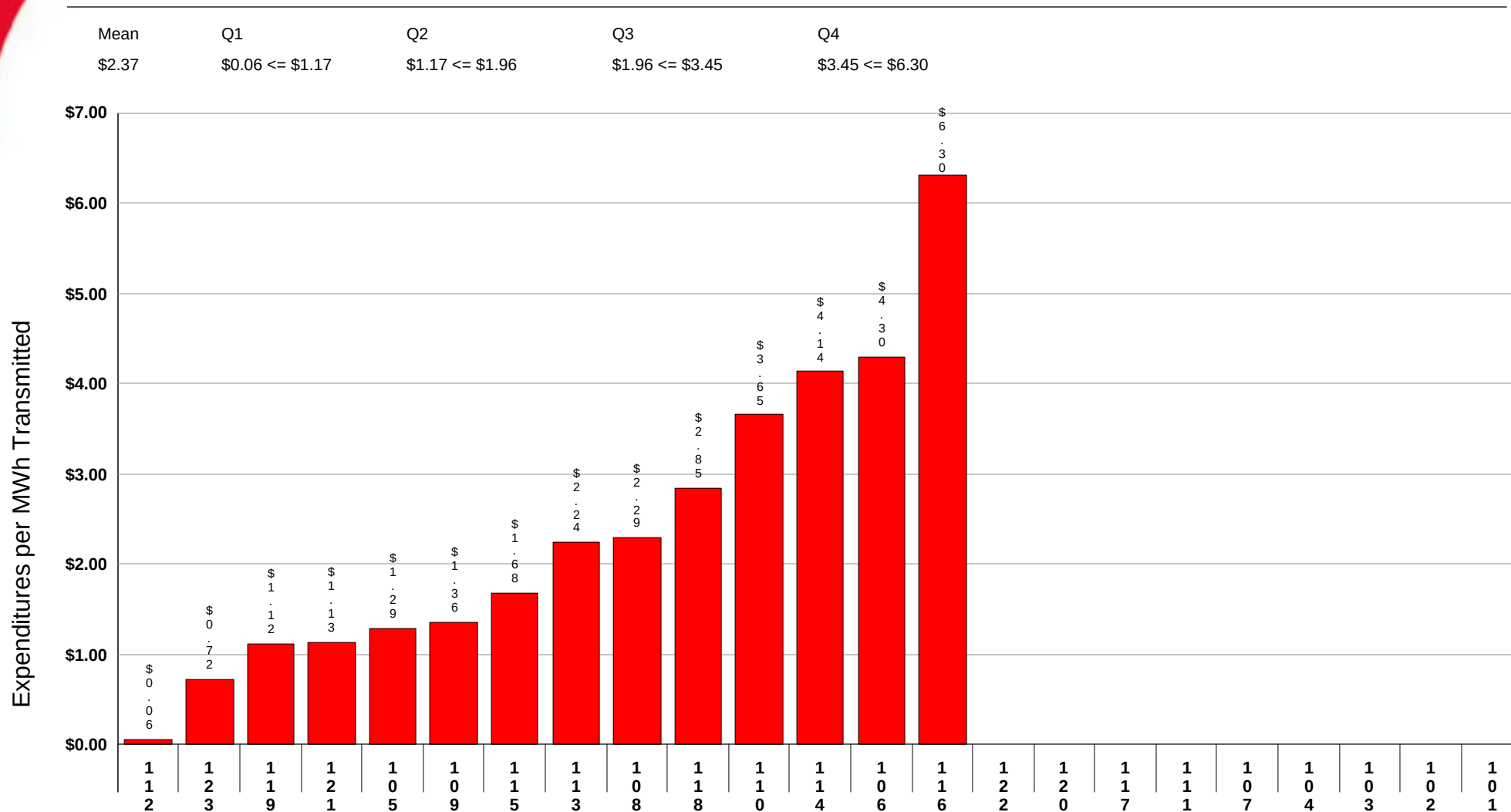
ID Code:8504

Page:1587

Only companies with all the data are shown.

Transmission Expenditures

Per MWh Transmitted



Source/Calculation: $(\text{SUM}\{B.2\} + \text{SUM}\{B.20\} - B.20.6 + \text{SUM}\{B.22\}) / A.2.5$

Volume: Transmission Line Statistics, Final Report, 2006

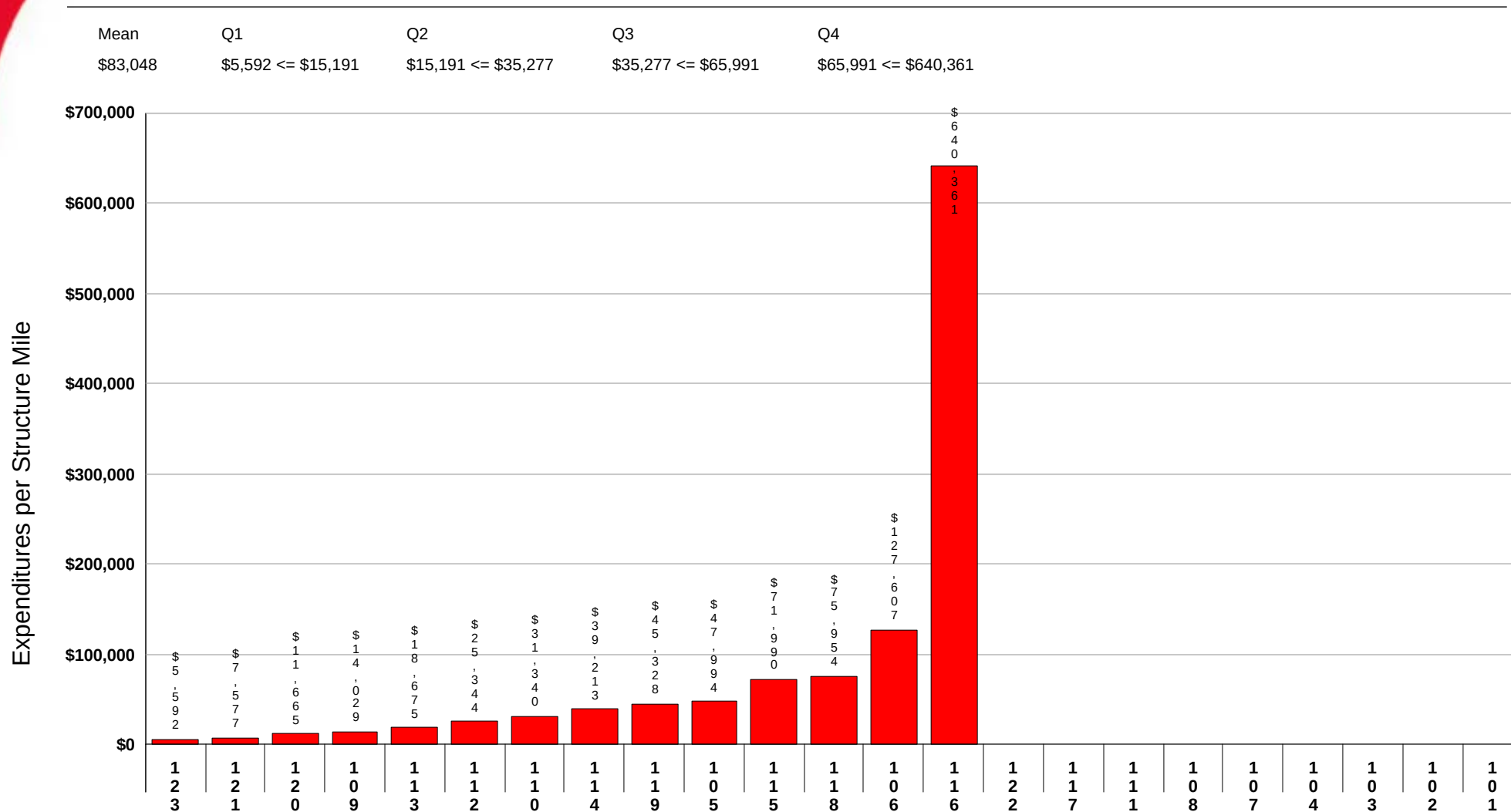
ID Code: 639

Only companies with all the data are shown.

Page: 1588

Transmission Expenditures

Per Transmission Structure Mile



Source/Calculation: $(\text{SUM}\{B.2\} + \text{SUM}\{B.20\} - B.20.6 + \text{SUM}\{B.22\}) / (\text{SUM}\{BB.5\} + \text{SUM}\{BB.6\})$

Volume: Transmission Line Statistics, Final Report, 2006

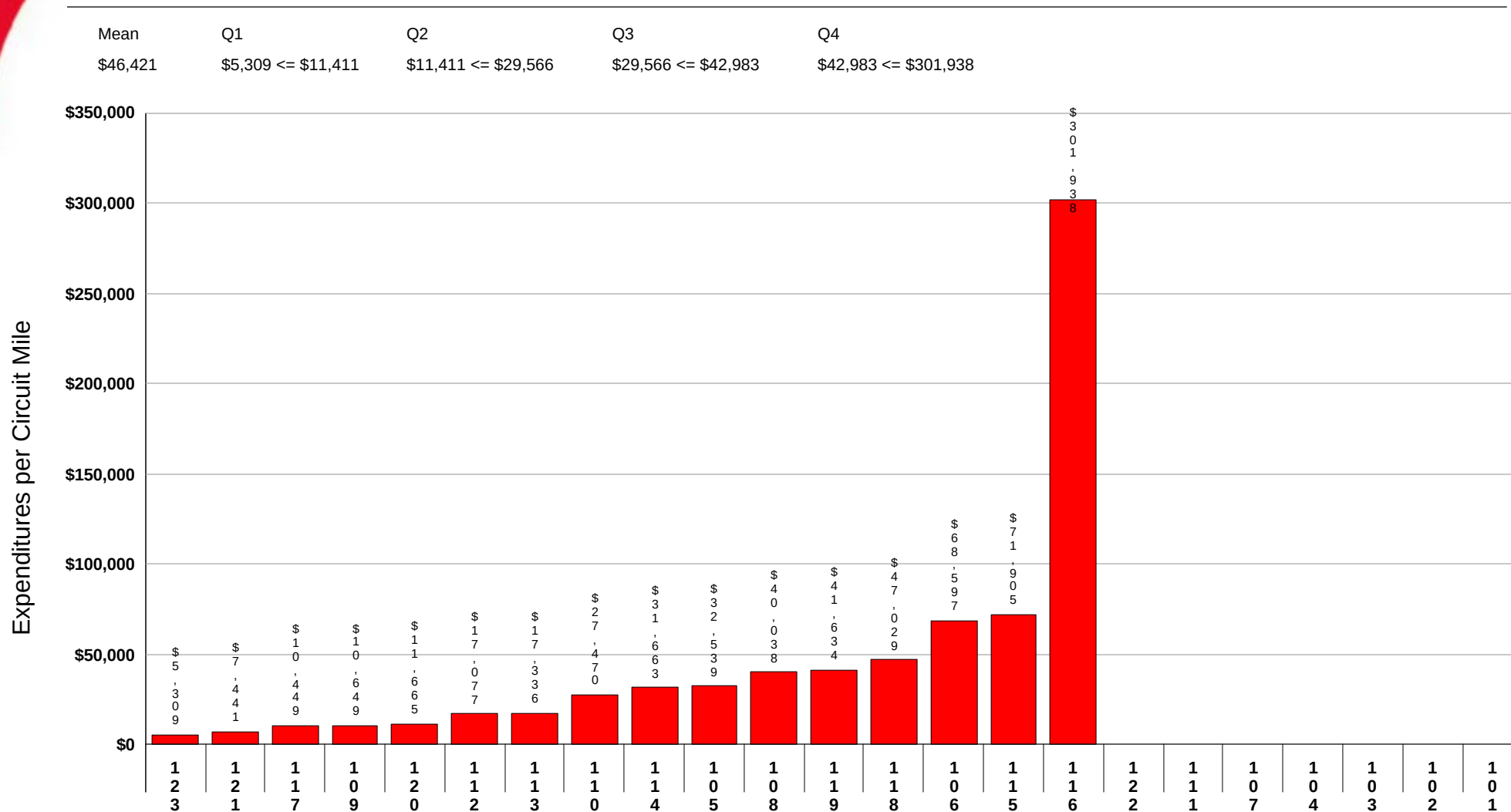
ID Code: 638

Page: 1589

Only companies with all the data are shown.

Transmission Expenditures

Per Transmission Circuit Mile



Source/Calculation: $(\text{SUM}\{B.2\} + \text{SUM}\{B.20\} - B.20.6 + \text{SUM}\{B.22\}) / (\text{SUM}\{BB.3\} + \text{SUM}\{BB.4\})$

Volume: Transmission Line Statistics, Final Report, 2006

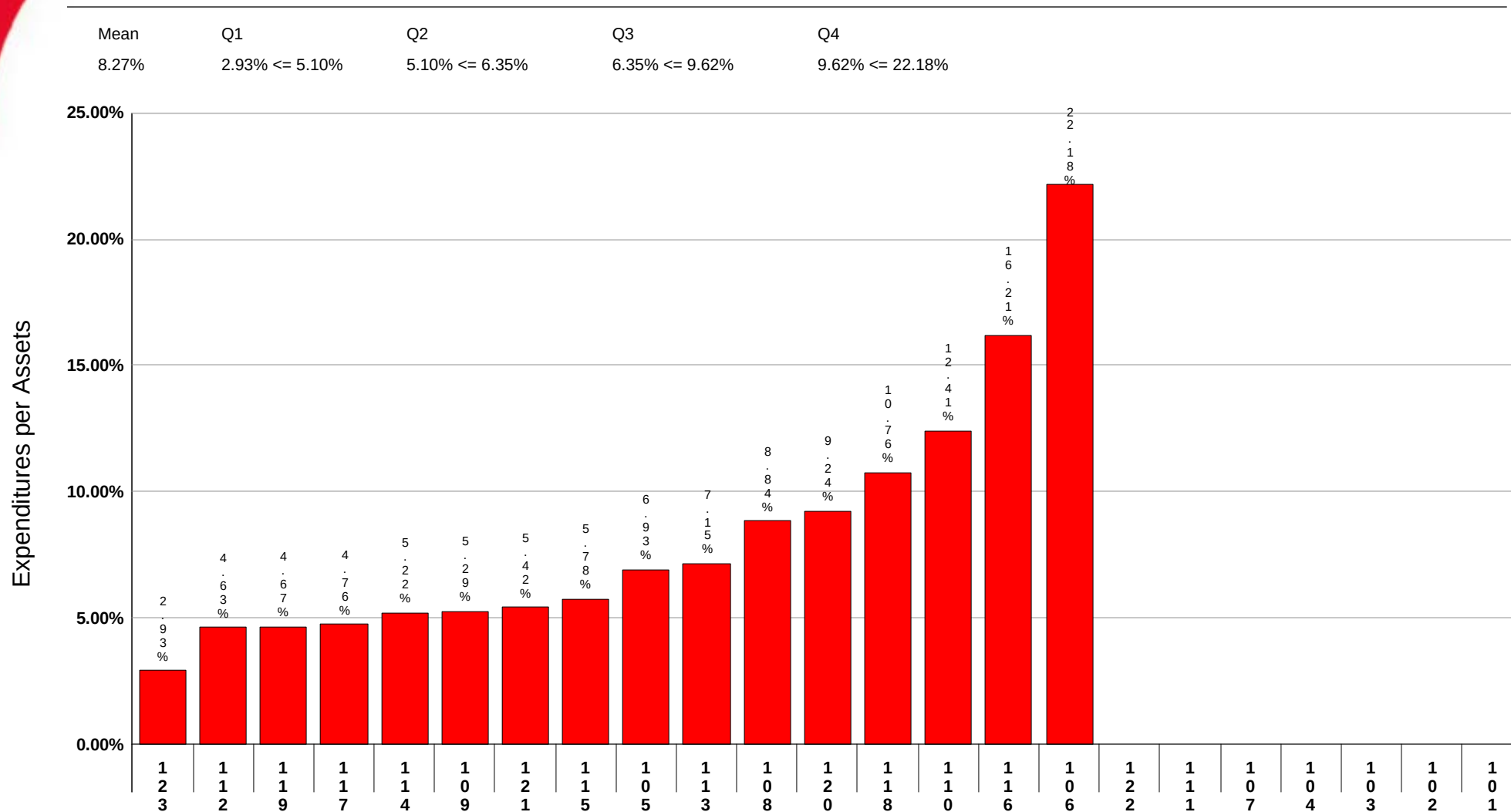
ID Code: 2004

Page: 1590

Only companies with all the data are shown.

Transmission Expenditures

Per Assets



Source/Calculation: (SUM{B.2}+SUM{B.20}-B.20.6+SUM{B.22})/B.10.1

Volume: Transmission Line Statistics, Final Report, 2006

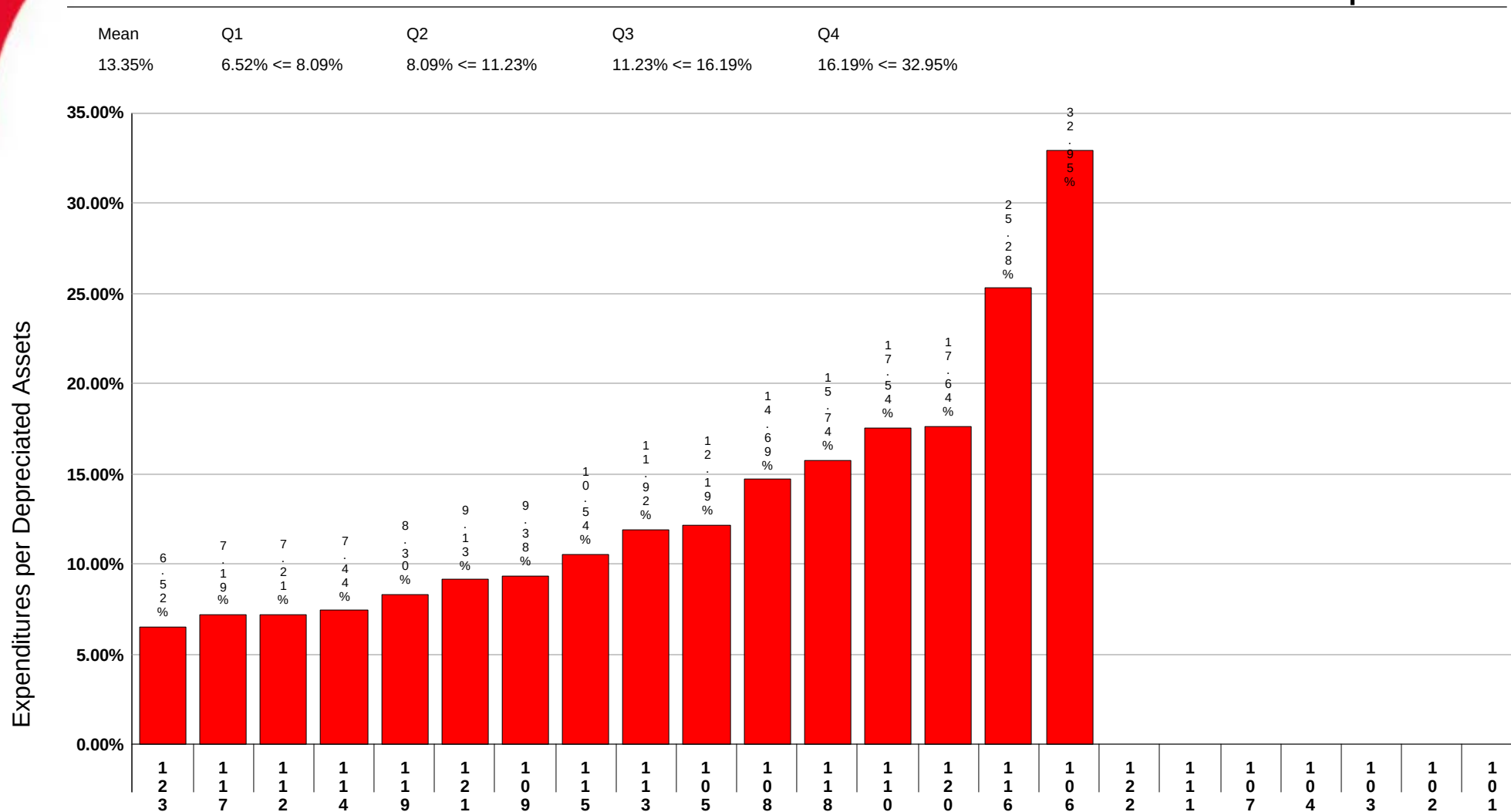
ID Code: 2120

Page: 1591

Only companies with all the data are shown.

Transmission Expenditures

Per Assets Less Depreciation



Source/Calculation: $(\text{SUM}\{B.20\} + \text{SUM}\{B.2\} - B.20.6 + \text{SUM}\{B.22\}) / (B.10.1 - B.14.2)$

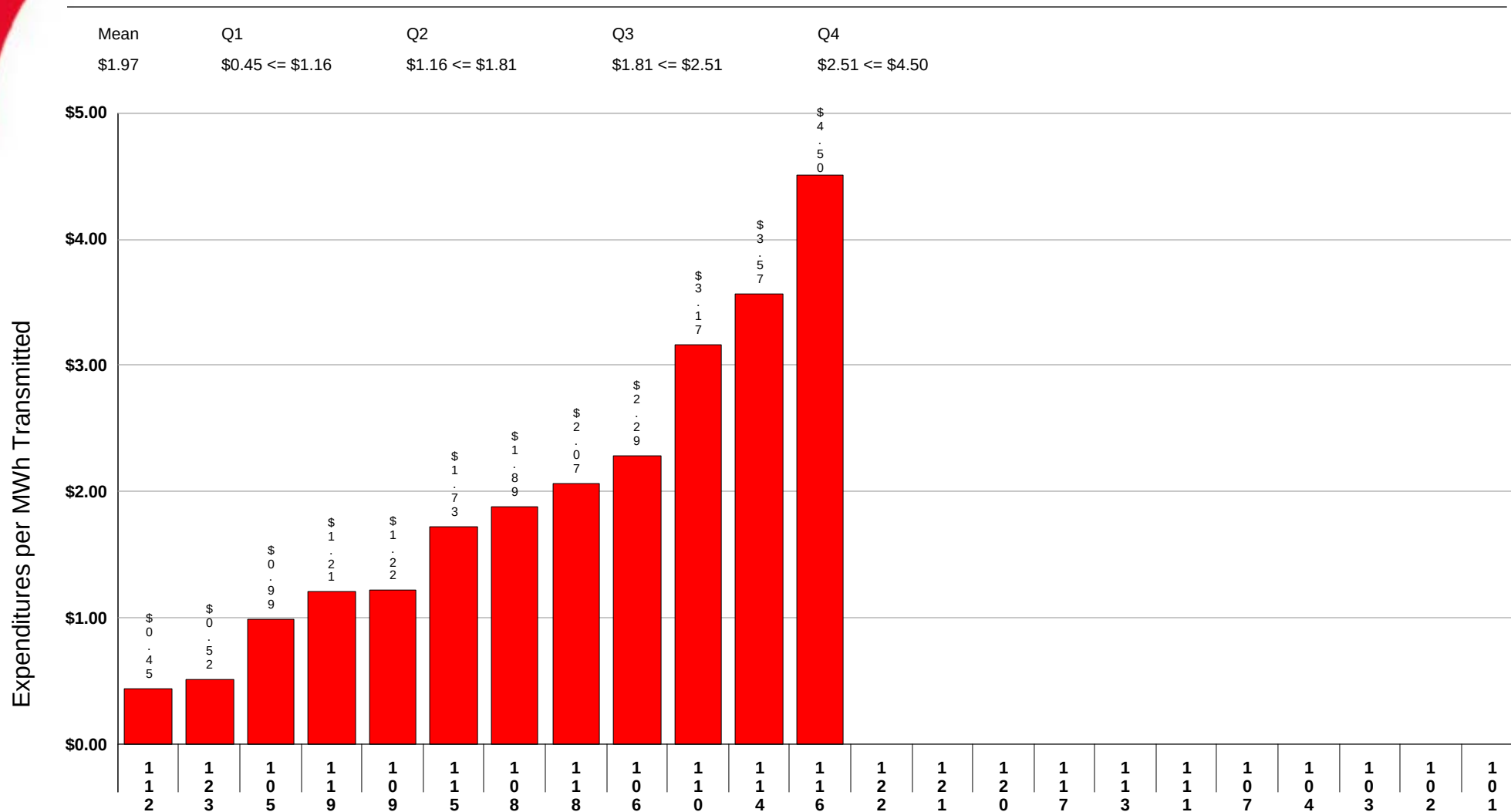
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 6491

Page: 1592

Only companies with all the data are shown.

3-Year Average Transmission Expenditures Per MWh Transmitted



Source/Calculation: ((SUM{B.2}+SUM{B.20}-B.20.6+SUM{B.22})/A.2.5+(B.8.1+B.28.1)/(A.3.5)+(B.8.2+B.28.2)/(A.3.6))/3

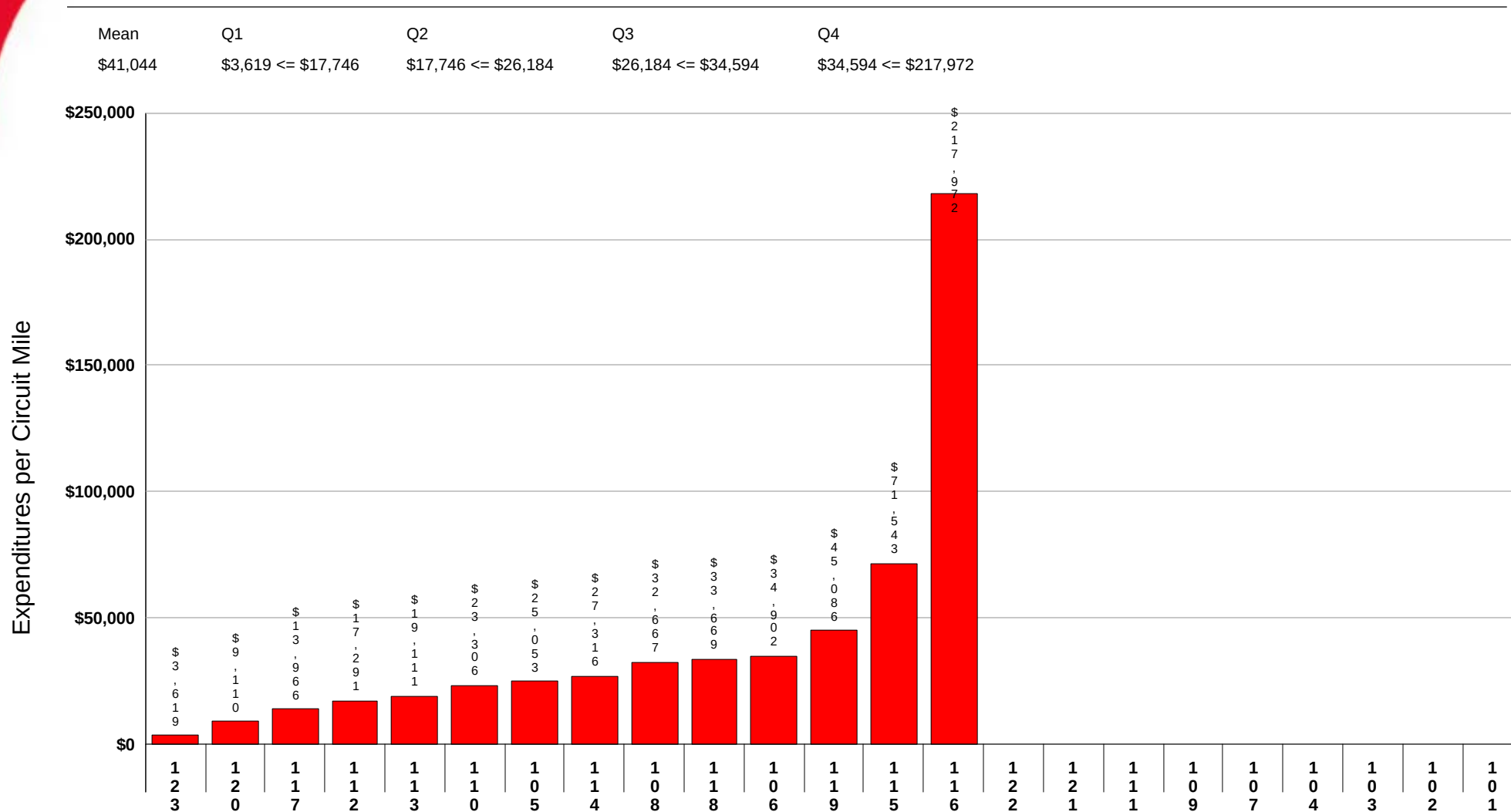
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 27125

Only companies with all the data are shown.

Page: 1597

3-Year Average Transmission Expenditures Per Transmission Circuit Mile



Source/Calculation: $((\text{SUM}\{B.2\} + \text{SUM}\{B.20\} - B.20.6 + \text{SUM}\{B.22\}) / (\text{SUM}\{BB.3\} + \text{SUM}\{BB.4\}) + (B.8.1 + B.28.1) / (BB.8.1) + (B.8.2 + B.28.2) / (BB.8.2)) / 3$

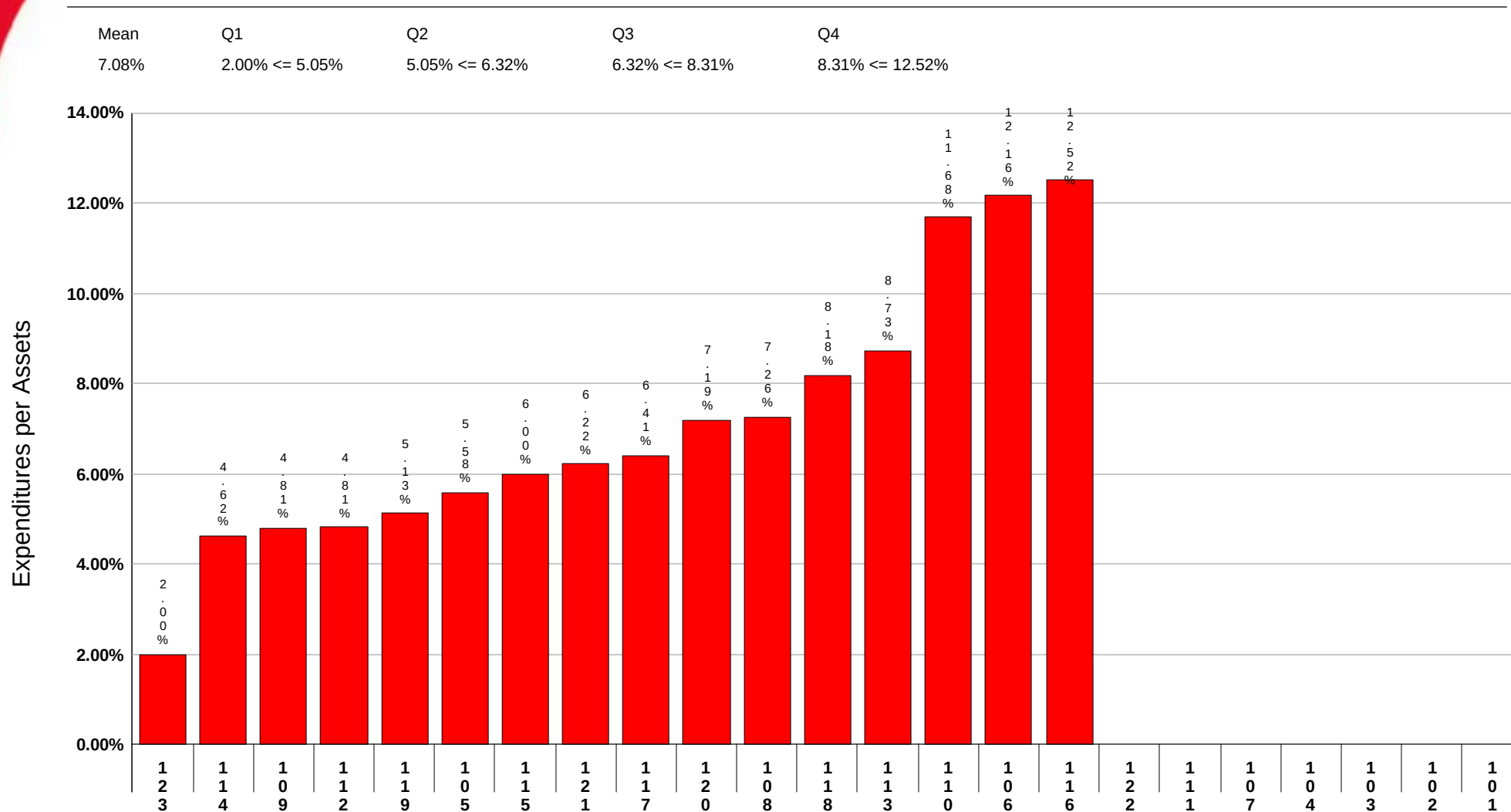
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 27129

Page: 1598

Only companies with all the data are shown.

3-Year Average Transmission Expenditures Per Assets



Source/Calculation: $((\text{SUM}\{B.2\} + \text{SUM}\{B.20\} - B.20.6 + \text{SUM}\{B.22\}) / B.10.1 + (B.8.1 + B.28.1) / B.12.1 + (B.8.2 + B.28.2) / B.12.2) / 3$

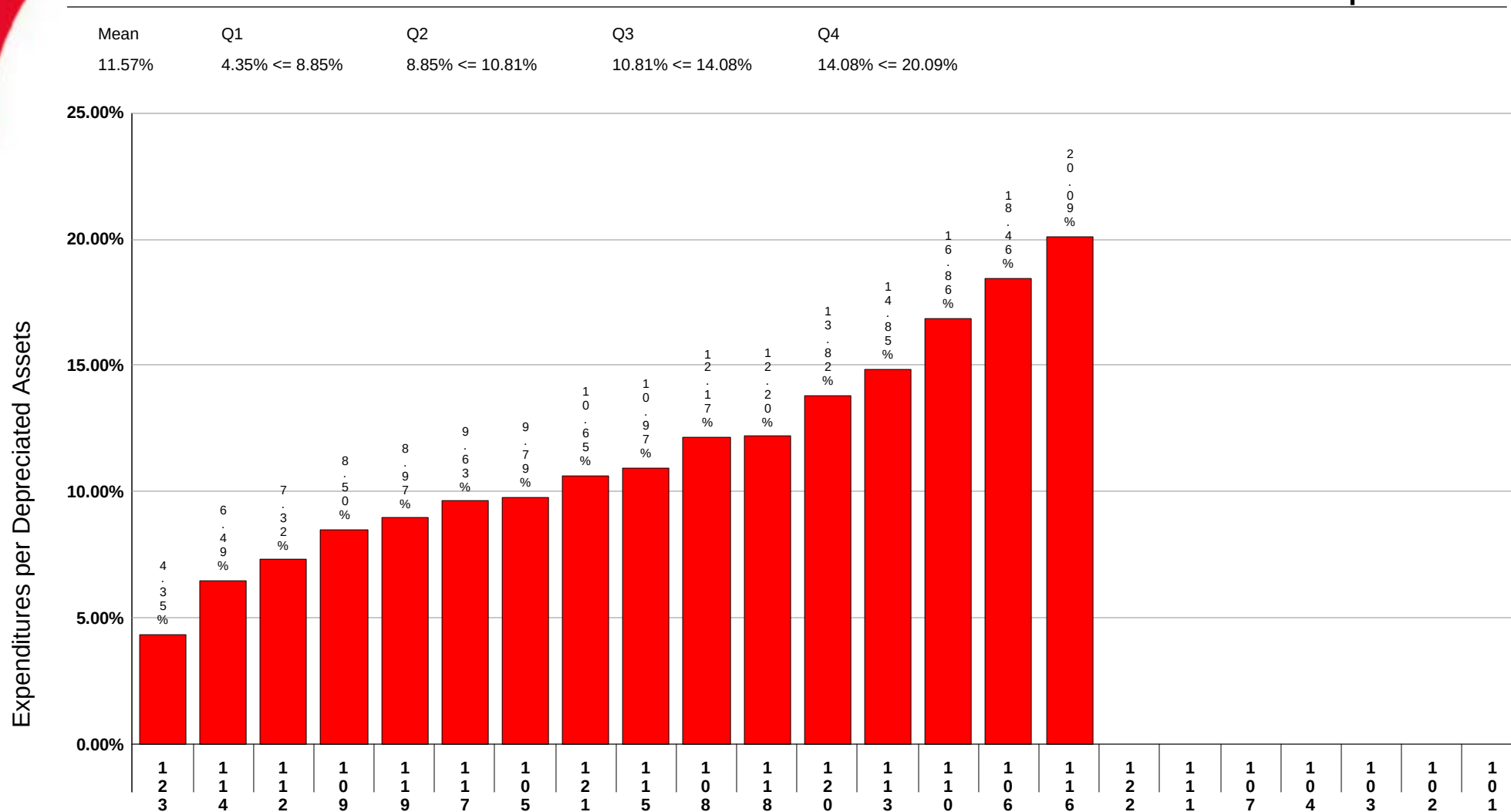
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 27453

Page: 1599

Only companies with all the data are shown.

3-Year Average Transmission Expenditures Per Assets Less Depreciation



Source/Calculation:(((SUM{B.2}+SUM{B.20}-B.20.6+SUM{B.22})/(B.10.1-B.14.2))+(B.8.1+B.28.1)/(B.12.1-B.16.3)+(B.8.2+B.28.2)/(B.12.2-B.16.4))/3

Volume: Transmission Line Statistics, Final Report, 2006

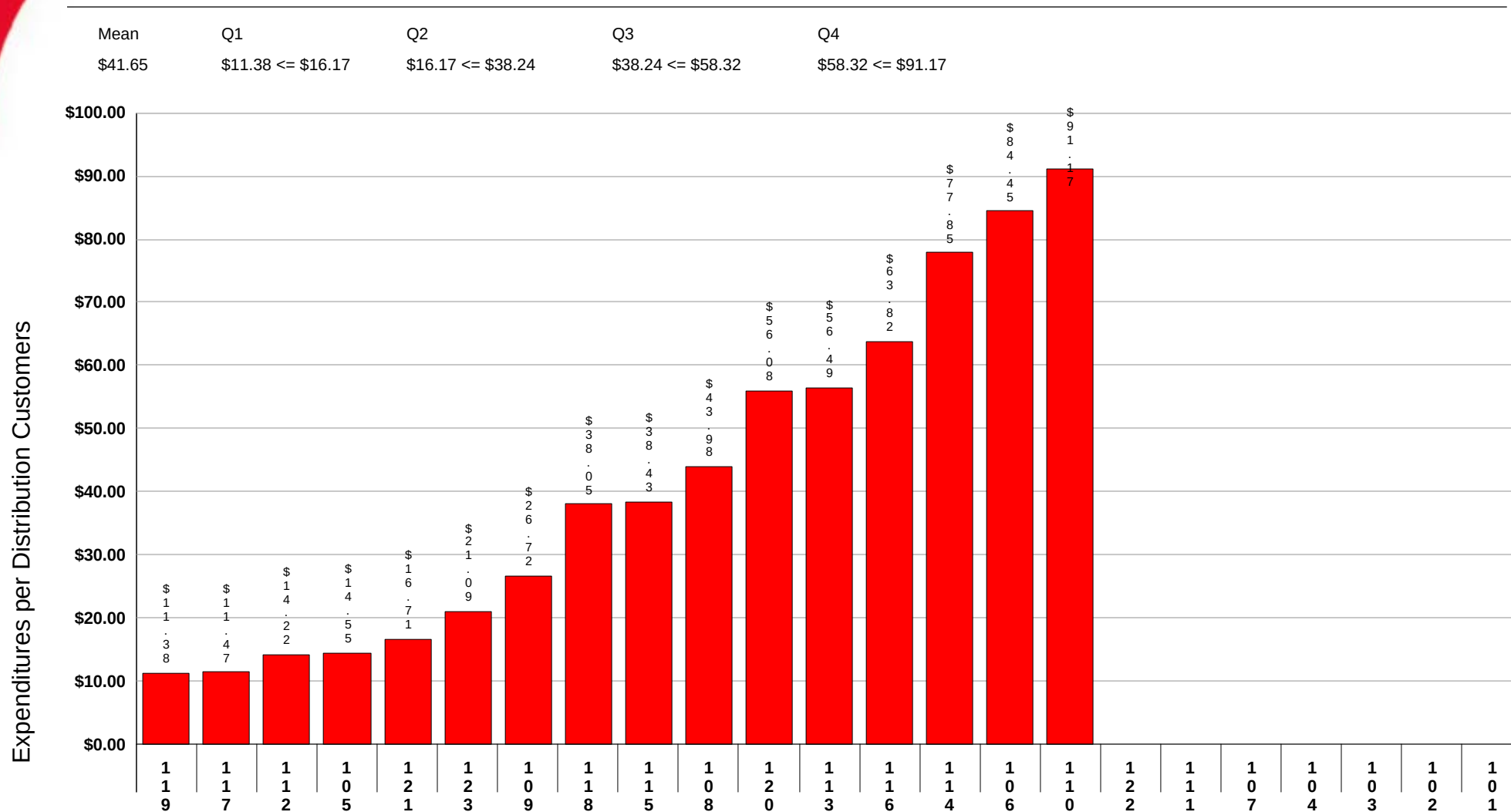
ID Code:27140

Page:1600

Only companies with all the data are shown.

Transmission Line Expenditures

Per Distribution Customers



Source/Calculation: ((SUM{B.2}+SUM{B.20}-B.20.6+SUM{B.22}-SUM{B.3}-SUM{B.21}-SUM{B.23})/A.2.2)

Volume: Transmission Line Statistics, Final Report, 2006

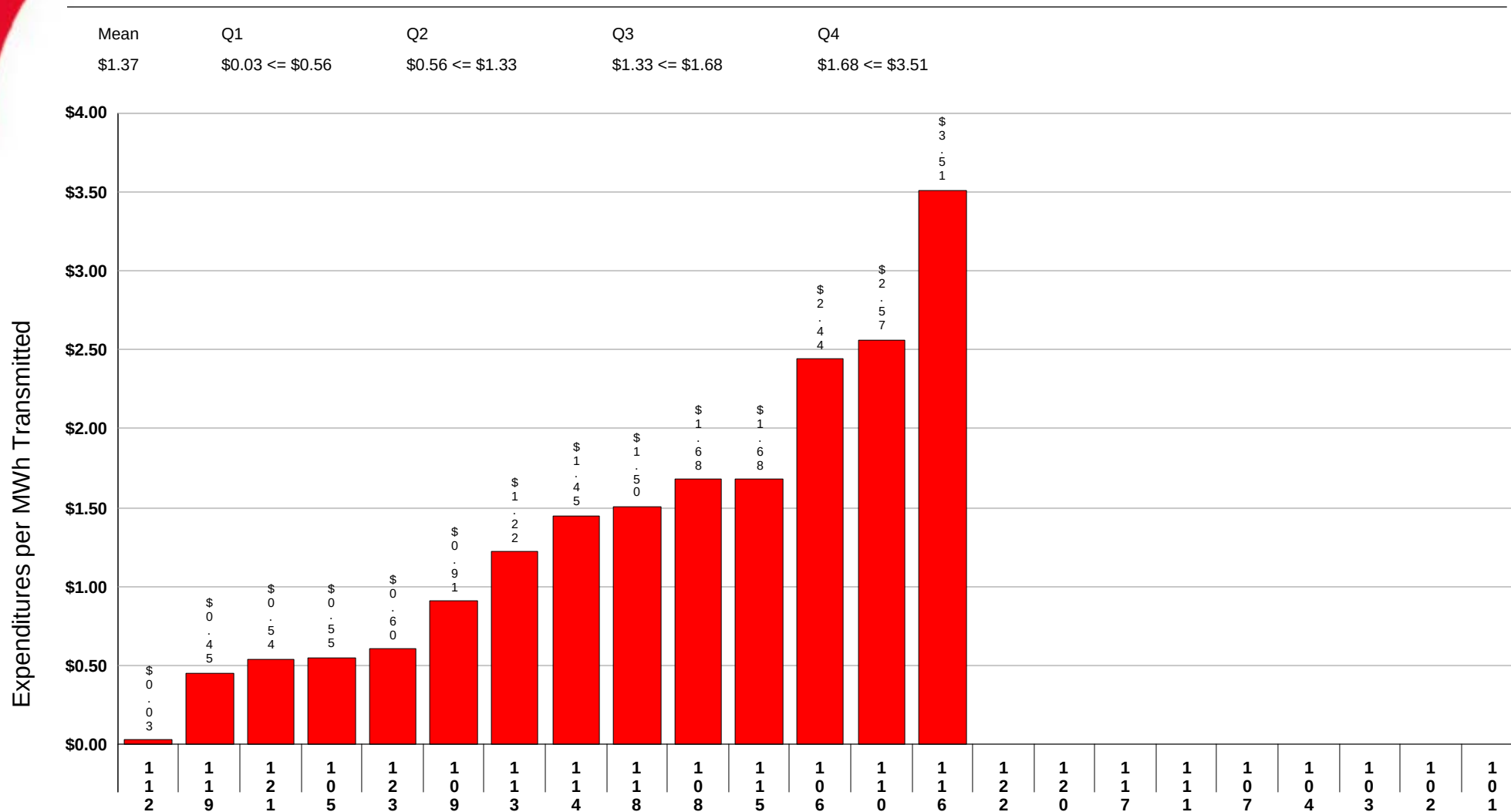
ID Code:8505

Page:1601

Only companies with all the data are shown.

Transmission Line Expenditures

Per MWh Transmitted



Source/Calculation: $(\text{SUM}\{B.2\} + \text{SUM}\{B.20\} - B.20.6 + \text{SUM}\{B.22\} - \text{SUM}\{B.3\} - \text{SUM}\{B.21\} - \text{SUM}\{B.23\}) / A.2.5$

Volume: Transmission Line Statistics, Final Report, 2006

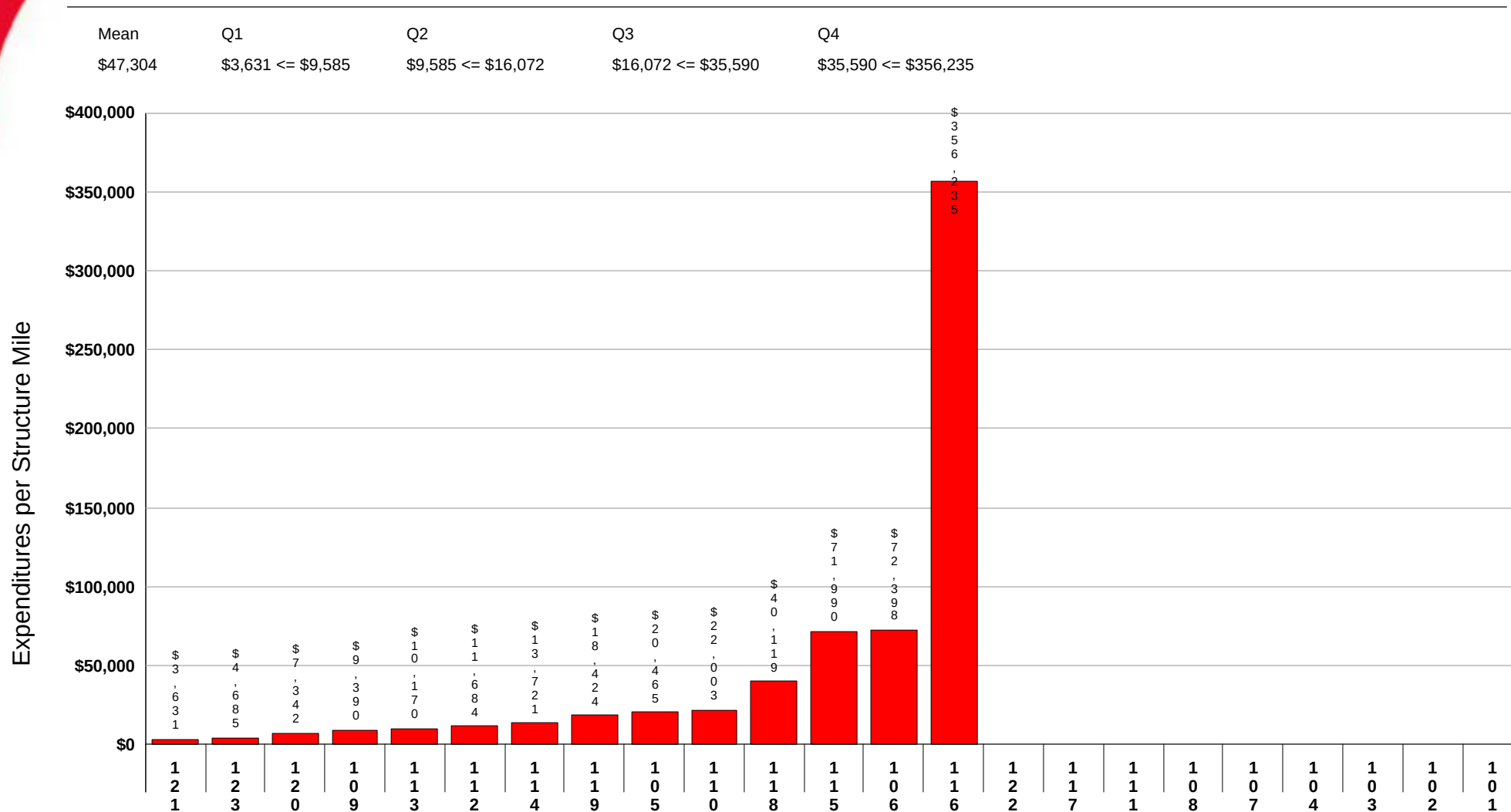
ID Code: 649

Page: 1602

Only companies with all the data are shown.

Transmission Line Expenditures

Per Transmission Structure Mile



Source/Calculation: $(\text{SUM}\{B.2\} + \text{SUM}\{B.20\} - B.20.6 + \text{SUM}\{B.22\} - \text{SUM}\{B.3\} - \text{SUM}\{B.21\} - \text{SUM}\{B.23\}) / (\text{SUM}\{BB.5\} + \text{SUM}\{BB.6\})$

Volume: Transmission Line Statistics, Final Report, 2006

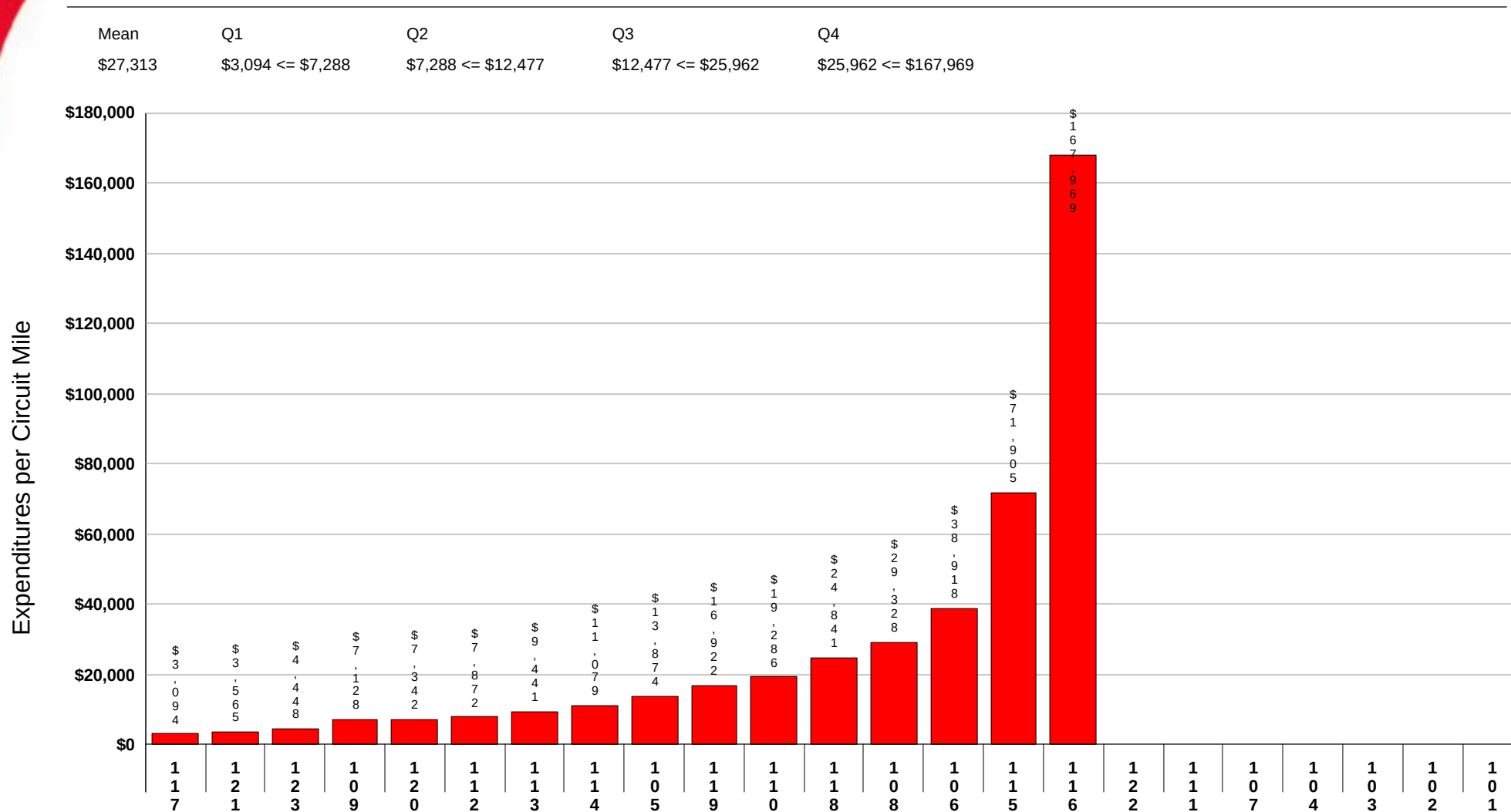
ID Code: 546

Page: 1603

Only companies with all the data are shown.

Transmission Line Expenditures

Per Transmission Circuit Mile



Source/Calculation: (SUM{B.2}+SUM{B.20}-B.20.6+SUM{B.22}-SUM{B.3}-SUM{B.21}-SUM{B.23})/(SUM{BB.3}+SUM{BB.4})

Volume: Transmission Line Statistics, Final Report, 2006

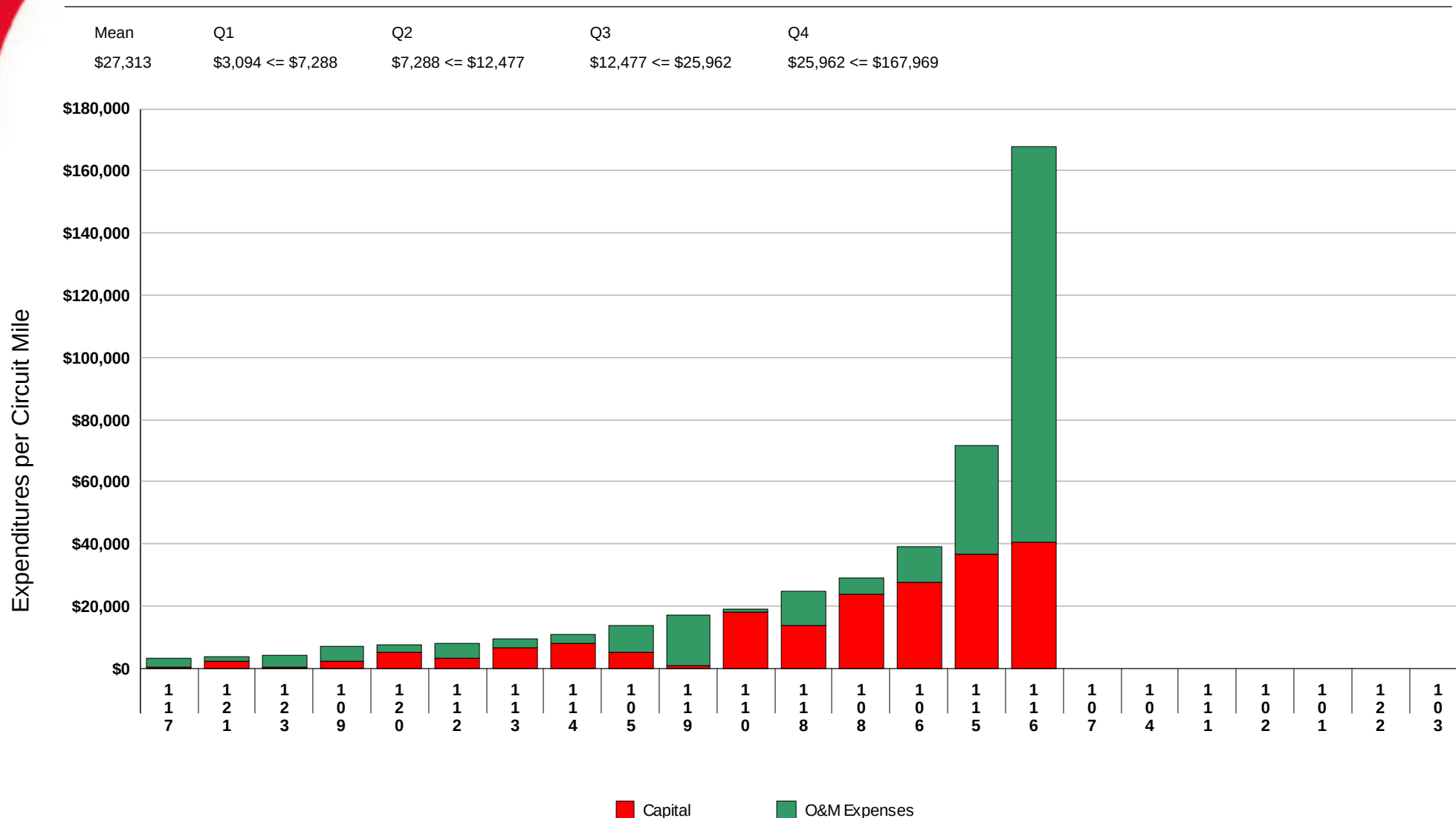
ID Code:2005

Page:1604

Only companies with all the data are shown.

Transmission Line Expenditures

Per Transmission Circuit Mile



Source/Calculation: $(\text{SUM}\{B.2\} - \text{SUM}\{B.3\}) / (\text{SUM}\{BB.3\} + \text{SUM}\{BB.4\})$

Volume: Transmission Line Statistics, Final Report, 2006

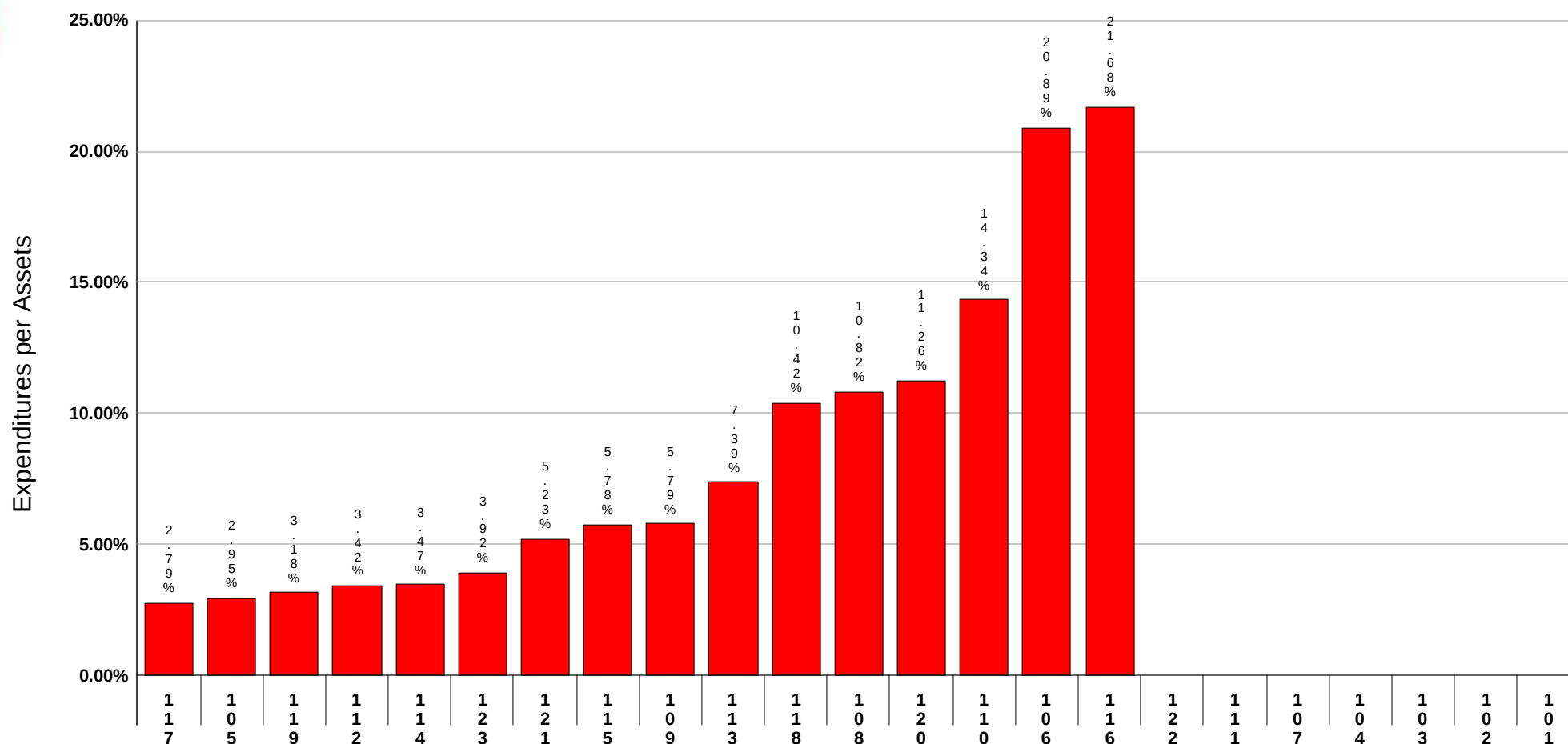
ID Code: 2300529

Page: 1605

Calculation shown is for the first piece of the stacked bar only.

Per Assets

Mean	Q1	Q2	Q3	Q4
8.33%	2.79% <= 3.46%	3.46% <= 5.78%	5.78% <= 10.93%	10.93% <= 21.68%



Source/Calculation: (SUM{B.2}+SUM{B.20}-B.20.6+SUM{B.22}-SUM{B.21}-SUM{B.23}-SUM{B.3})/(B.10.1-B.11.1)

Volume: Transmission Line Statistics, Final Report, 2006

ID Code:2118

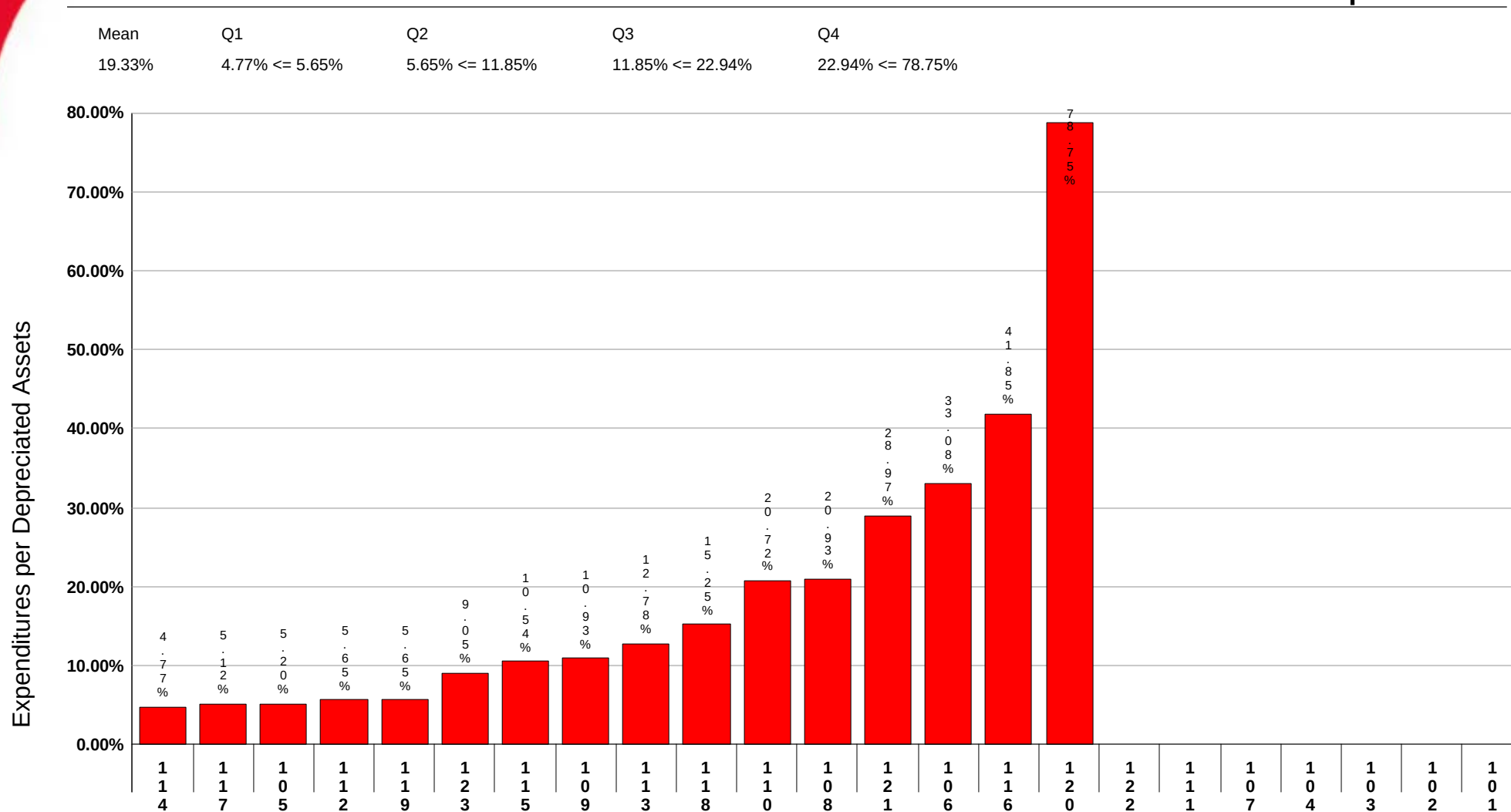
Only companies with all the data are shown.

Page:1606

PA

Transmission Line Expenditures

Per Assets Less Depreciation



Source/Calculation: $(\text{SUM}\{B.2\} + \text{SUM}\{B.20\} - B.20.6 + \text{SUM}\{B.22\} - \text{SUM}\{B.3\} - \text{SUM}\{B.21\} - \text{SUM}\{B.23\}) / (B.10.1 - B.14.2 - (B.11.1 - B.15.2))$

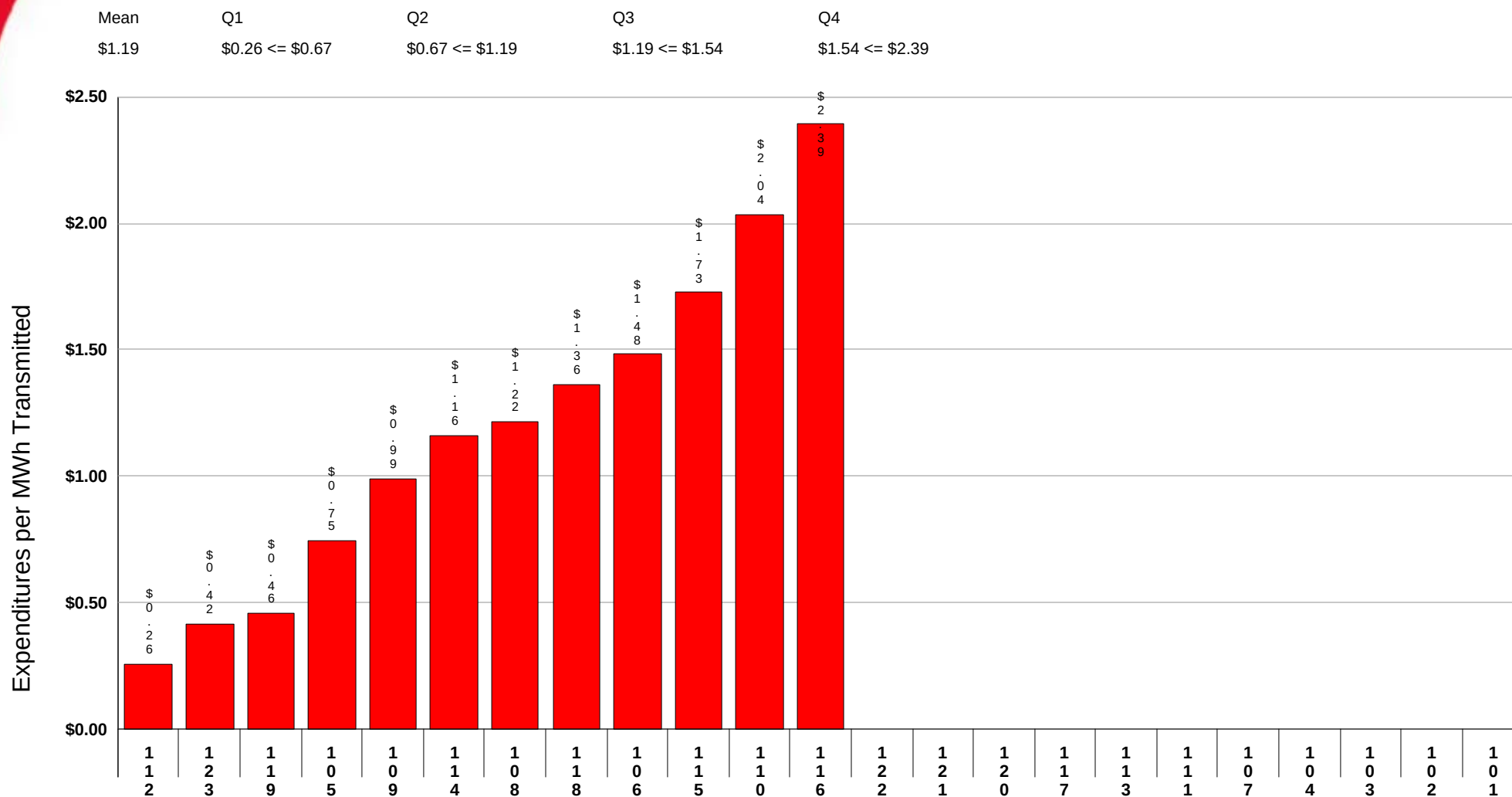
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 6501

Page: 1607

Only companies with all the data are shown.

3-Year Average Transmission Line Expenditures Per MWh Transmitted



$$((\text{SUM}\{B.2\}+\text{SUM}\{B.20\}-B.20.6+\text{SUM}\{B.22\}-\text{SUM}\{B.3\}-\text{SUM}\{B.21\}-\text{SUM}\{B.23\})/(\text{A.2.5})+(B.8.1-B.9.1+B.28.1-B.29.1)/(\text{A.3.5})+(B.8.2-B.9.2+B.28.2-B.29.2)/(\text{A.3.6}))/3$$

Source/Calculation:

Volume: Transmission Line Statistics, Final Report, 2006

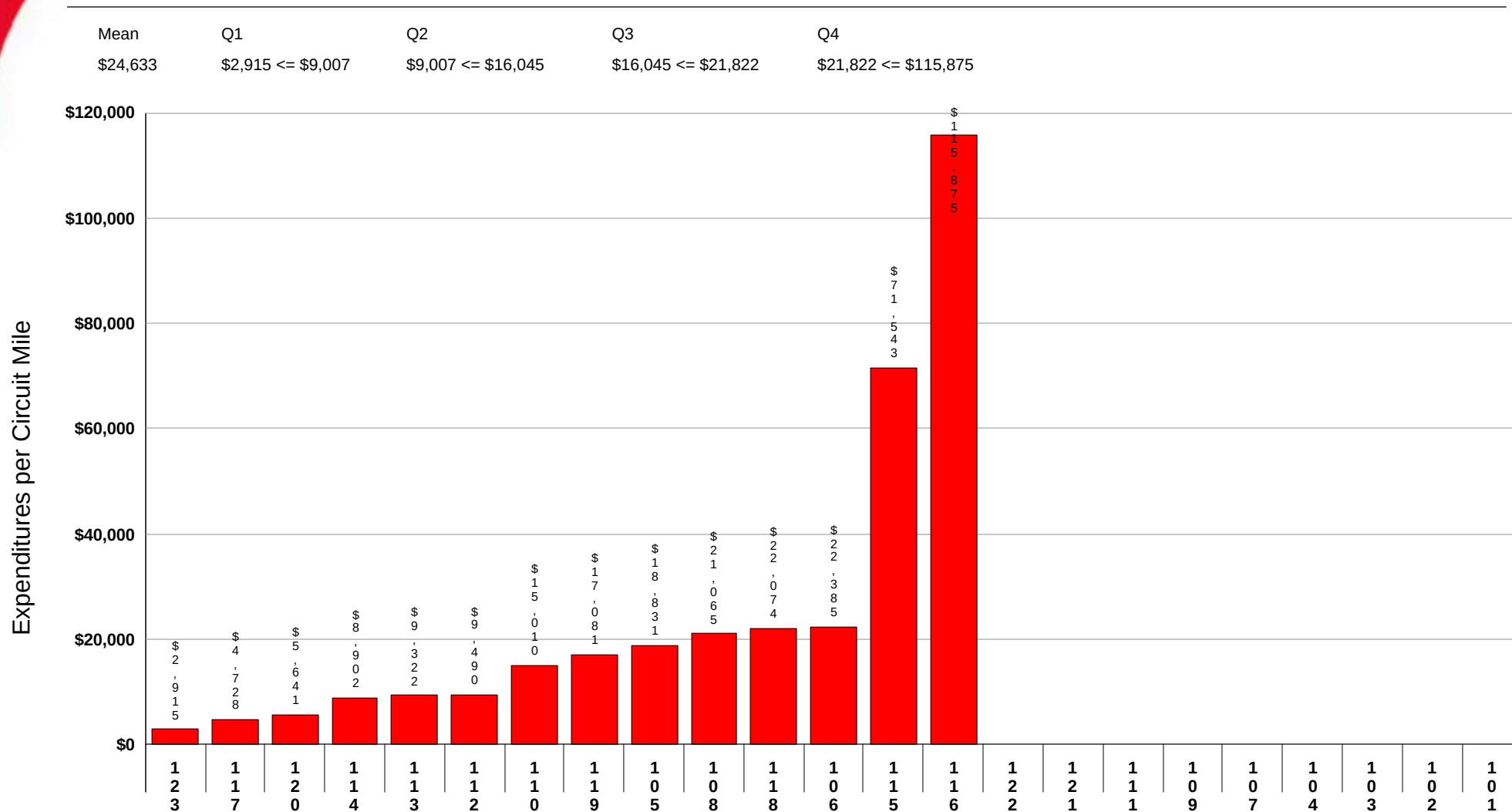
ID Code:27123

Page:1611

Only companies with all the data are shown.

3-Year Average Transmission Line Expenditures

Per Transmission Circuit Mile



$$((\text{SUM}\{B.2\}+\text{SUM}\{B.20\}-B.20.6+\text{SUM}\{B.22\}-\text{SUM}\{B.3\}-\text{SUM}\{B.21\}-\text{SUM}\{B.23\})/(\text{SUM}\{BB.3\}+\text{SUM}\{BB.4\})+(B.8.1-B.9.1+B.28.1-B.29.1)/BB.8.1+(B.8.2-B.9.2+B.28.2-B.29.2)/BB.8.2)/3$$

Source/Calculation:

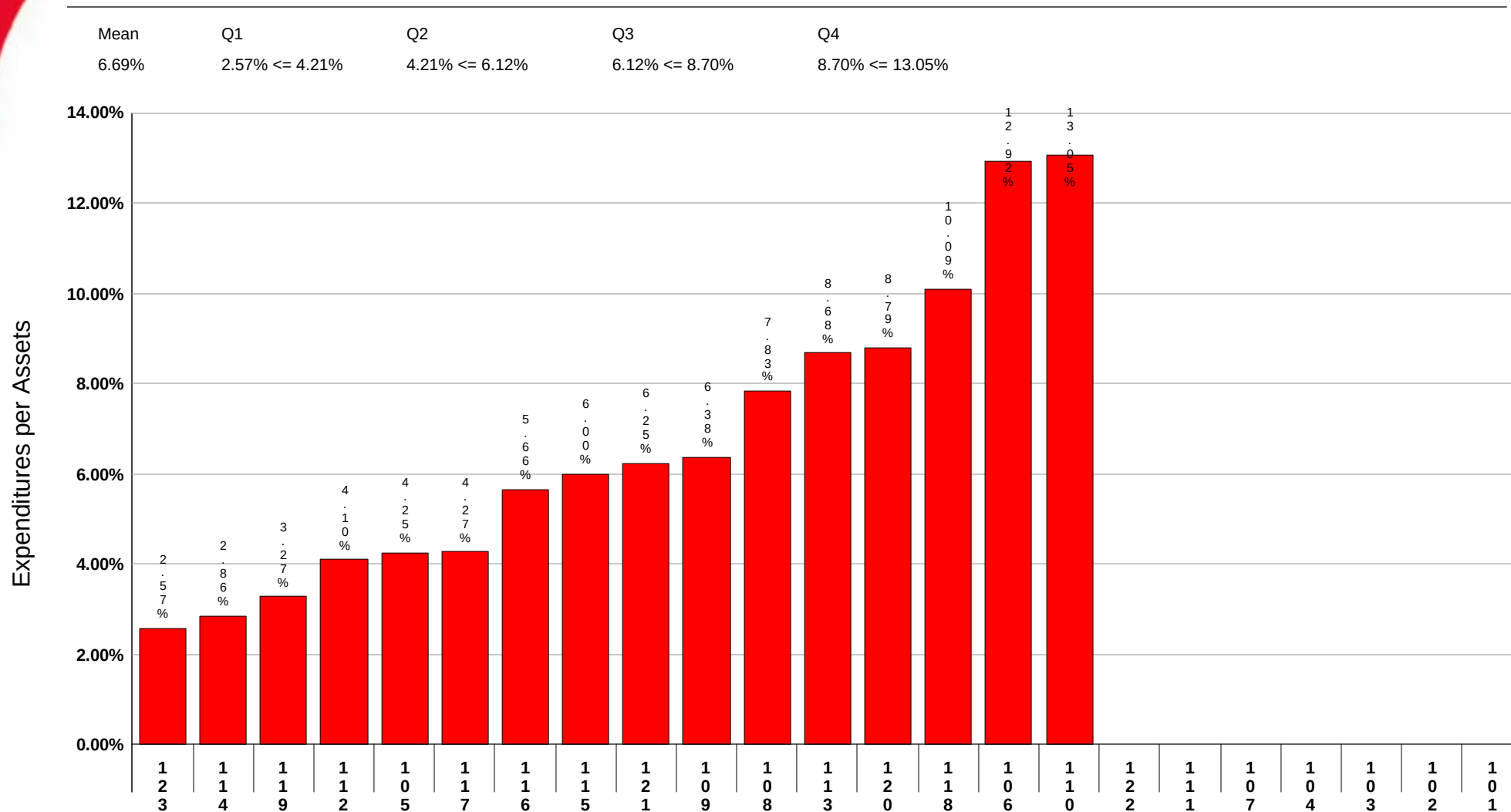
Volume: Transmission Line Statistics, Final Report, 2006

ID Code:27127

Page:1612

Only companies with all the data are shown.

3-Year Average Transmission Line Expenditures Per Assets



((SUM{B.2}+SUM{B.20}-B.20.6+SUM{B.22}-SUM{B.3}-SUM{B.21}-SUM{B.23}))/((B.10.1-B.11.1)+(B.8.1-B.9.1+B.28.1-B.29.1))/((B.12.1-B.13.1)+(B.8.2-B.9.2+B.28.2-B.29.2))/((B.12.2-B.13.2))/3

Source/Calculation:

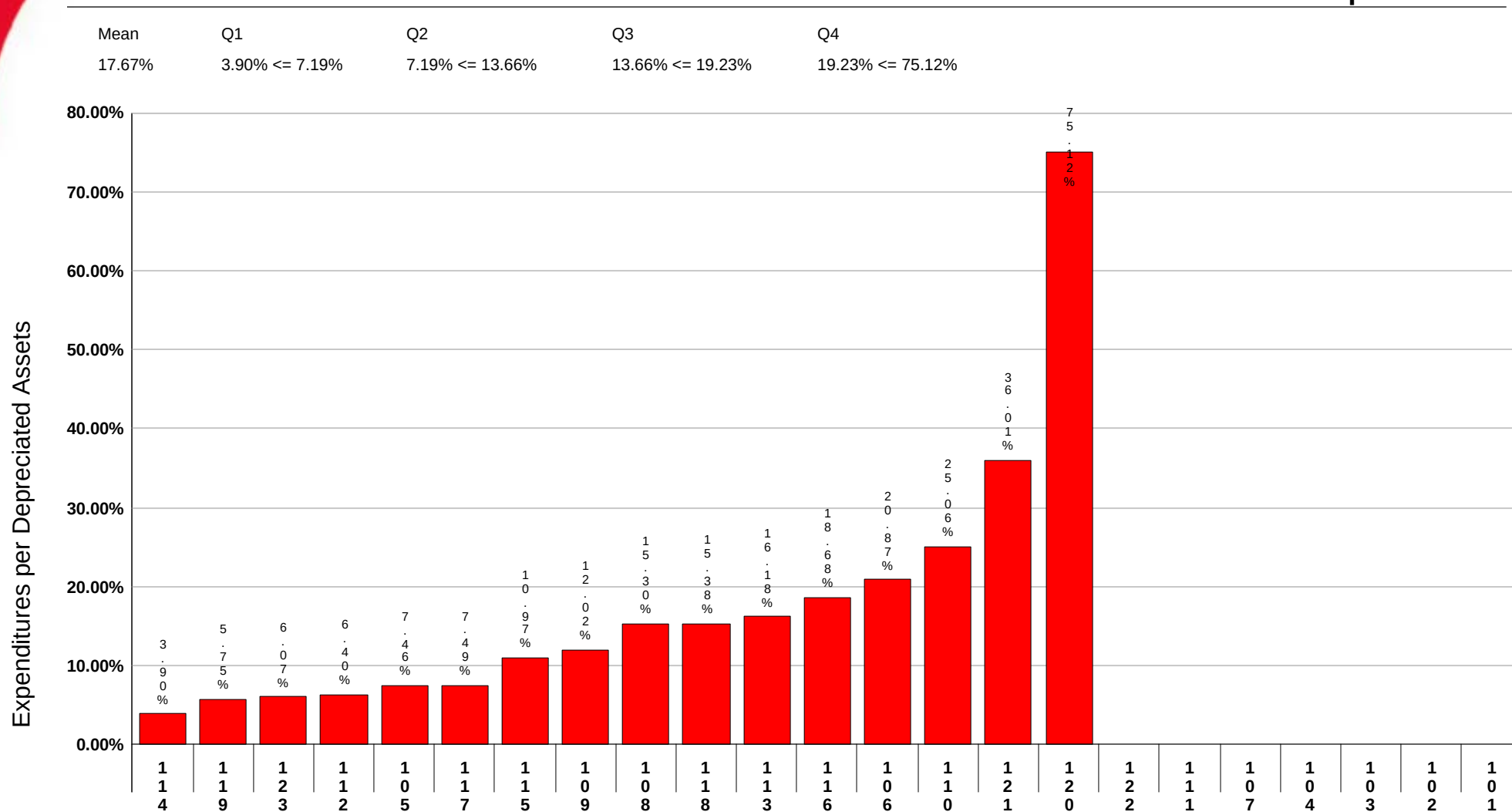
Volume: Transmission Line Statistics, Final Report, 2006

ID Code:27448

Page:1613

Only companies with all the data are shown.

3-Year Average Transmission Line Expenditures Per Assets Less Depreciation



(((SUM{B.2}+SUM{B.20}-B.20.6+SUM{B.22}-SUM{B.3}-SUM{B.21}-SUM{B.23}))/((B.10.1-B.14.2-(B.11.1-B.15.2)))+(B.8.1-B.9.1+B.28.1-B.29.1)/(B.12.1-B.13.1-(B.16.3-B.17.3)))+(B.8.2-B.9.2+B.28.2-B.29.2)/(B.12.2-B.13.2-(B.16.4-B.17.4)))/3

Source/Calculation:

Volume: Transmission Line Statistics, Final Report, 2006

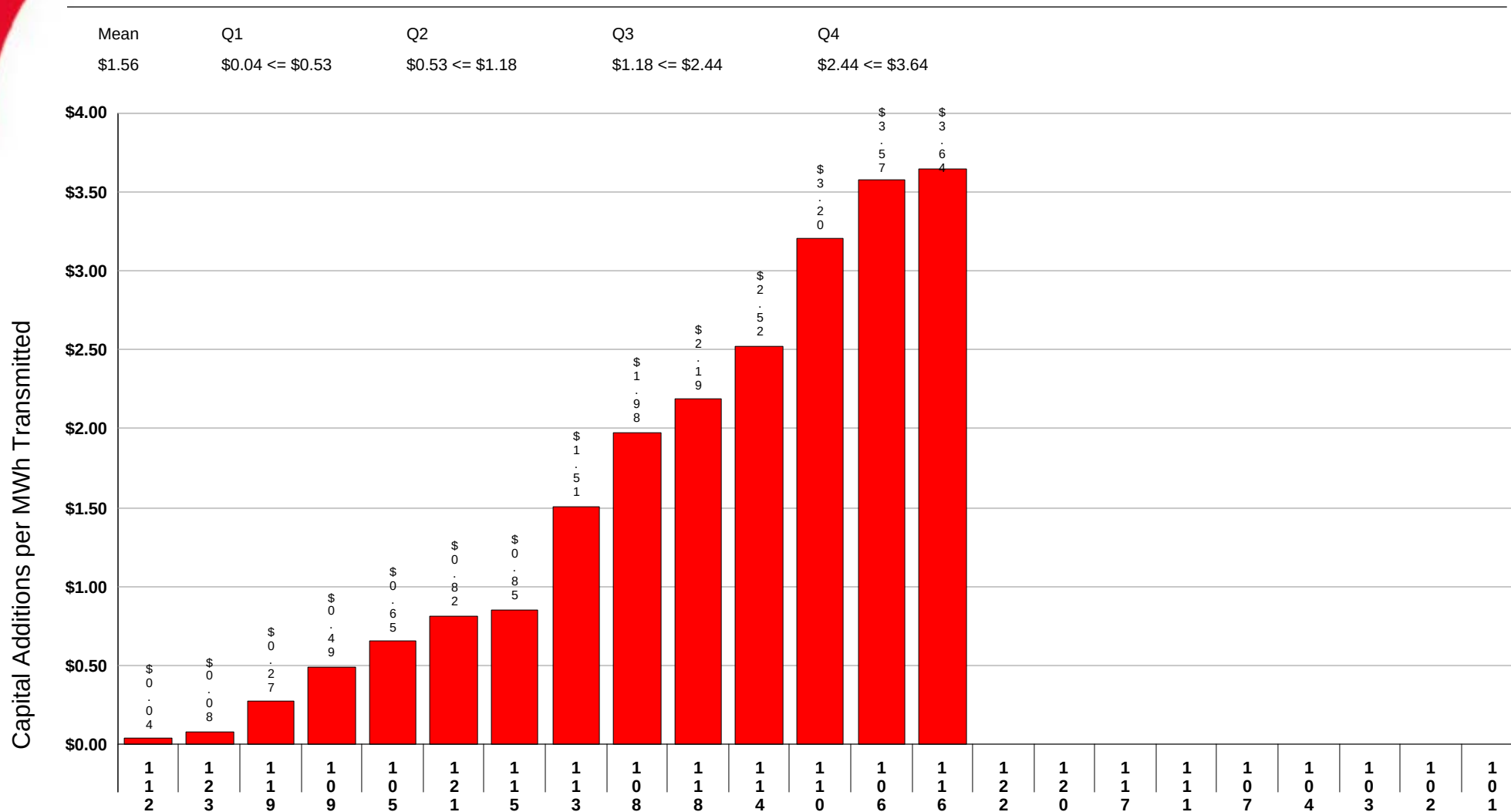
ID Code:27138

Page:1614

Only companies with all the data are shown.

Transmission Capital Additions

Per MWh Transmitted



Source/Calculation: SUM{B.2}/A.2.5

Volume: Transmission Line Statistics, Final Report, 2006

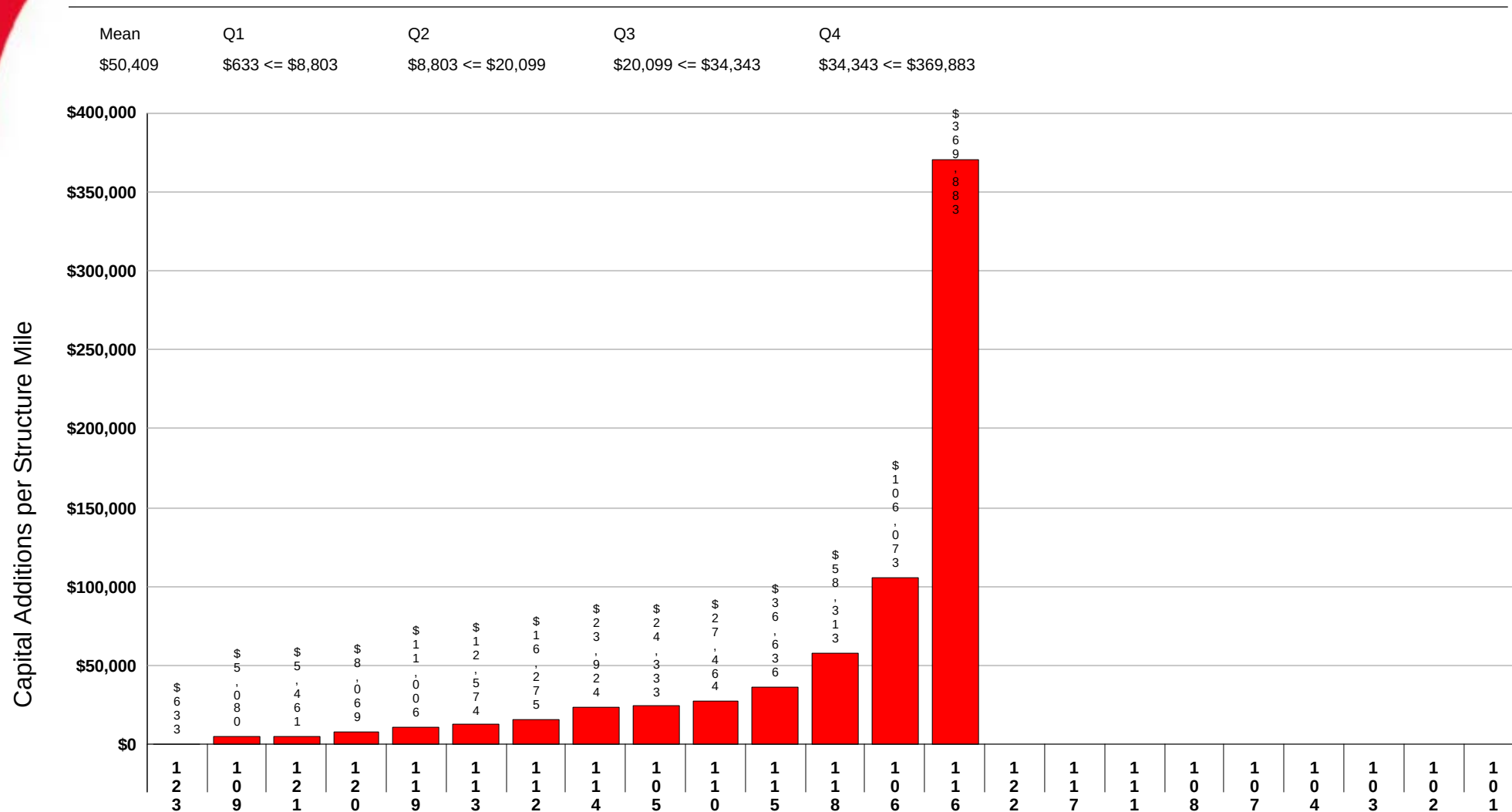
ID Code: 5525

Page: 1616

Only companies with all the data are shown.

Transmission Capital Additions

Per Transmission Structure Mile



Source/Calculation: $\text{SUM}\{B.2\}/(\text{SUM}\{BB.5\}+\text{SUM}\{BB.6\})$

Volume: Transmission Line Statistics, Final Report, 2006

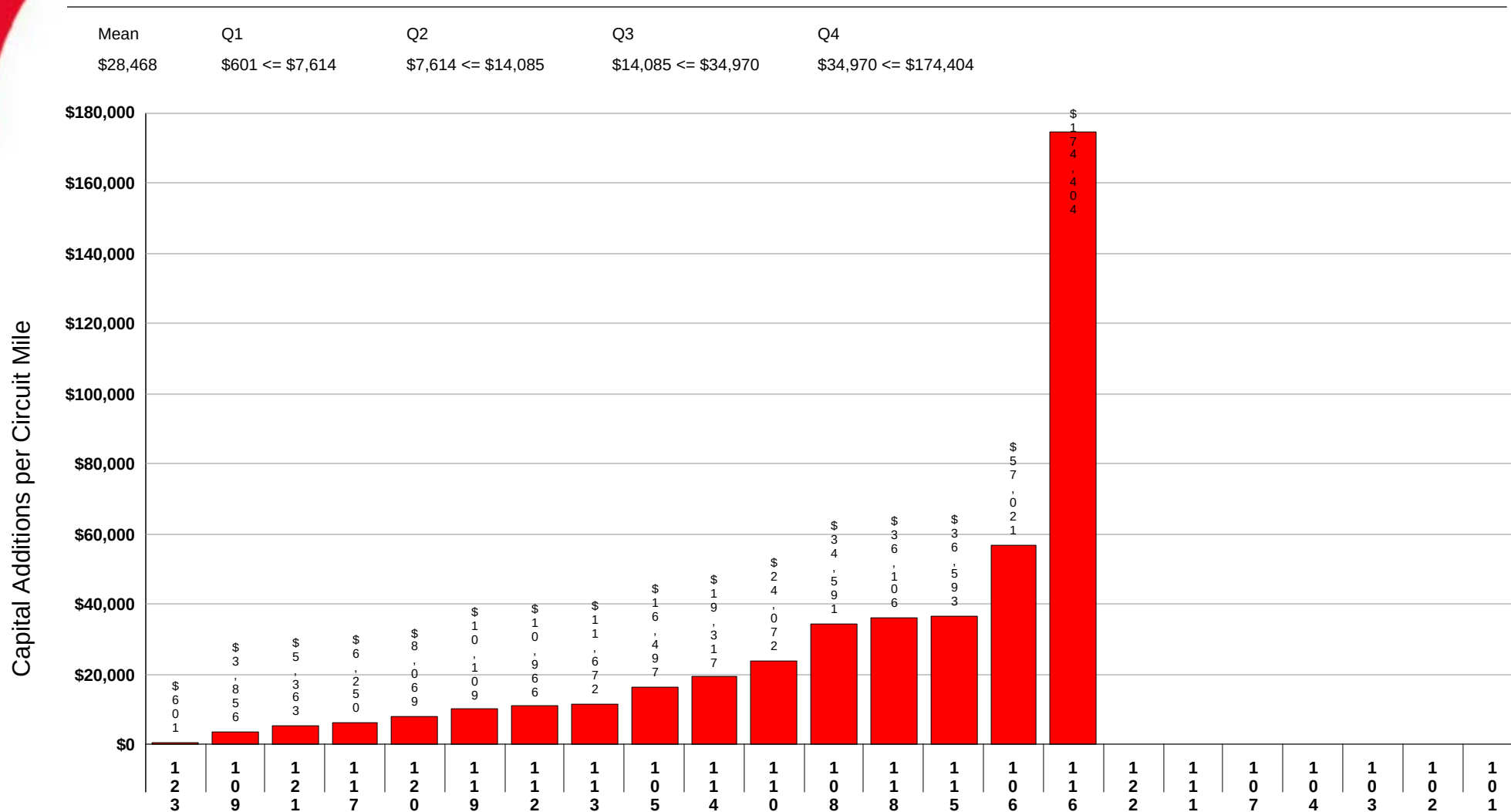
ID Code:645

Page:1617

Only companies with all the data are shown.

Transmission Capital Additions

Per Transmission Circuit Mile



Source/Calculation: SUM{B.2}/(SUM{BB.3}+SUM{BB.4})

Volume: Transmission Line Statistics, Final Report, 2006

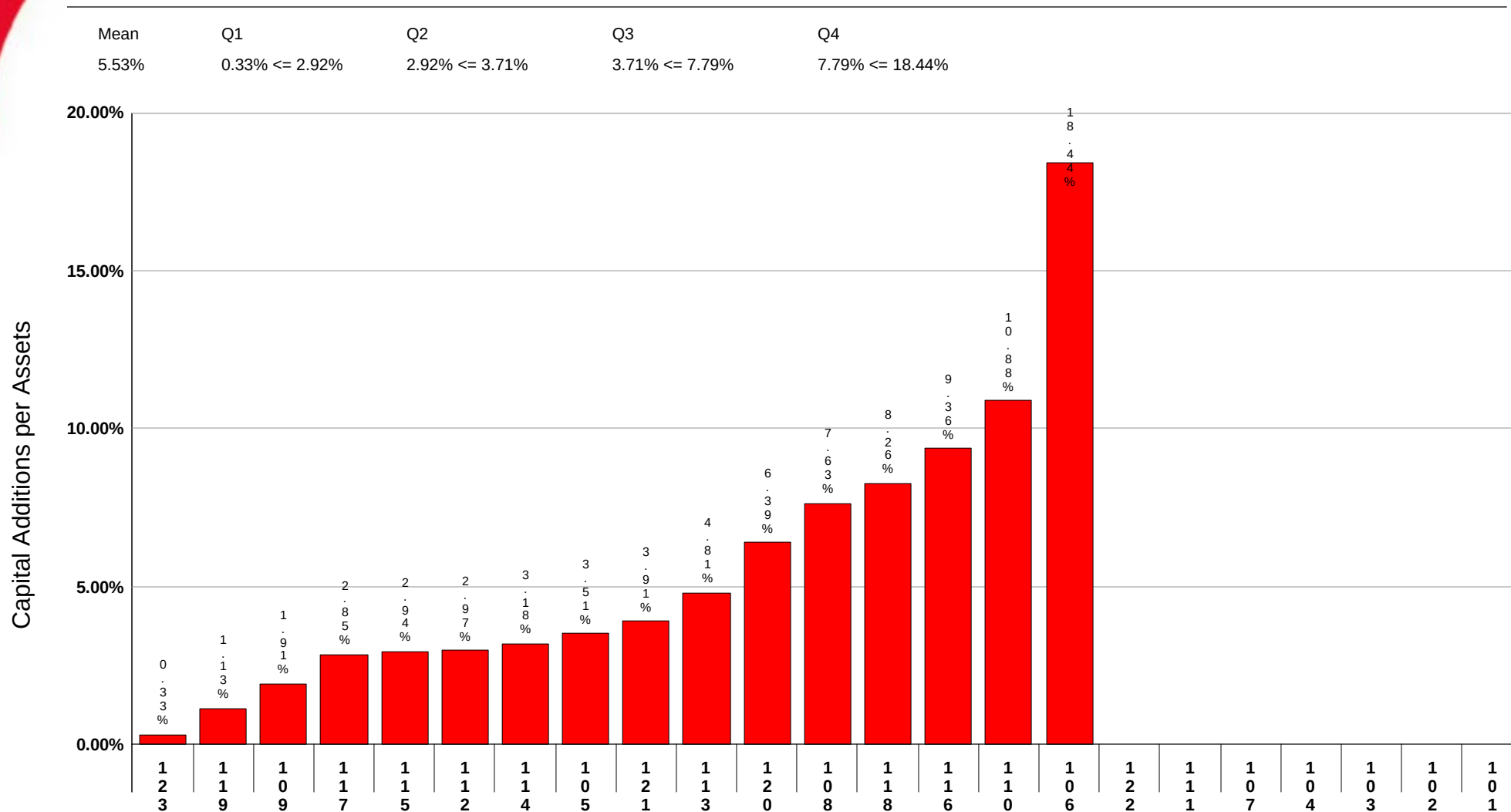
ID Code:2008

Page:1618

Only companies with all the data are shown.

Transmission Capital Additions

Per Assets



Source/Calculation: SUM{B.2}/B.10.1

Volume: Transmission Line Statistics, Final Report, 2006

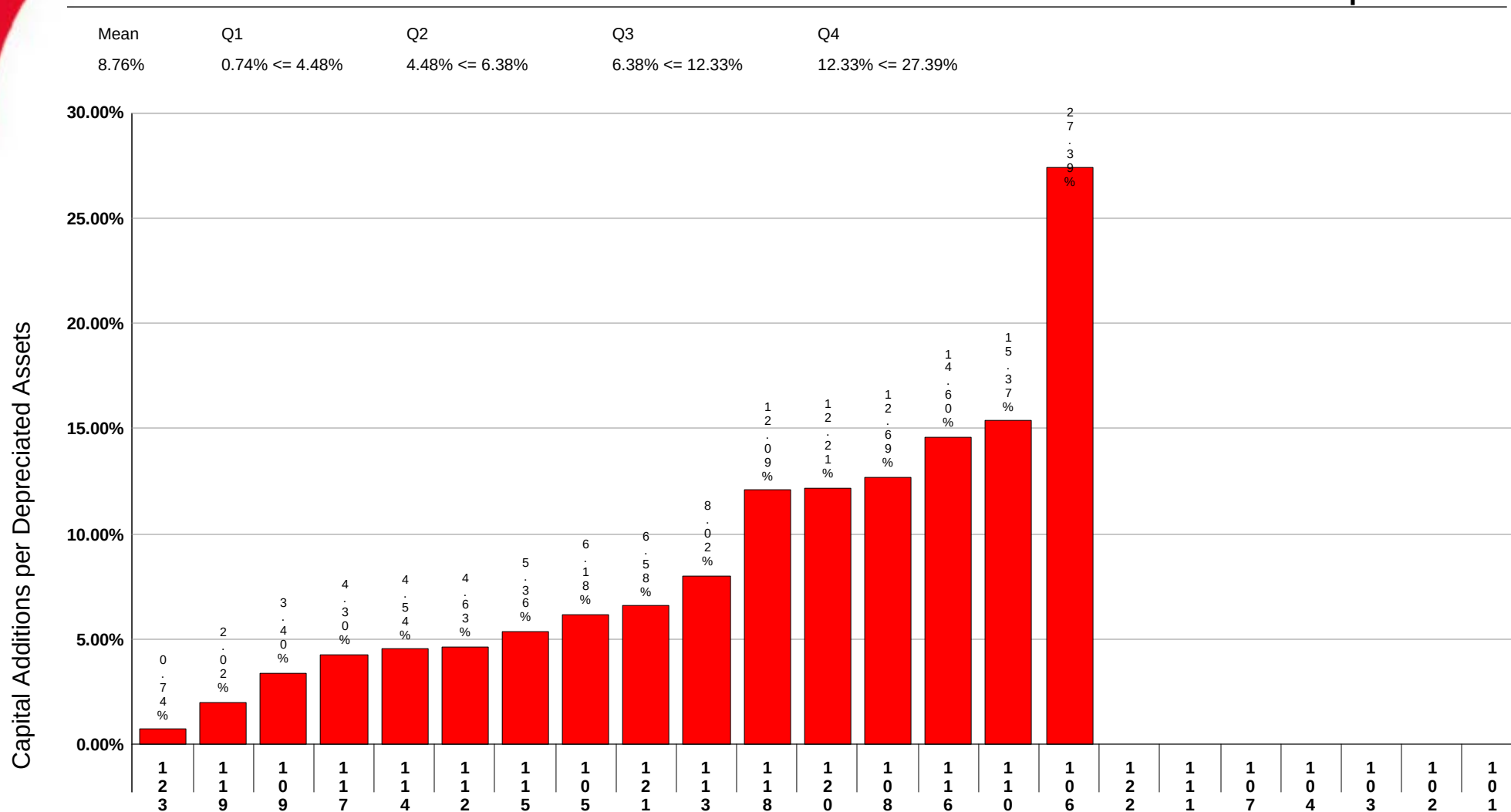
ID Code: 2119

Page: 1620

Only companies with all the data are shown.

Transmission Capital Additions

Per Transmission Assets Less Depreciation



Source/Calculation: (SUM{B.2})/(B.10.1-B.14.2)

Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 7021

Page: 1621

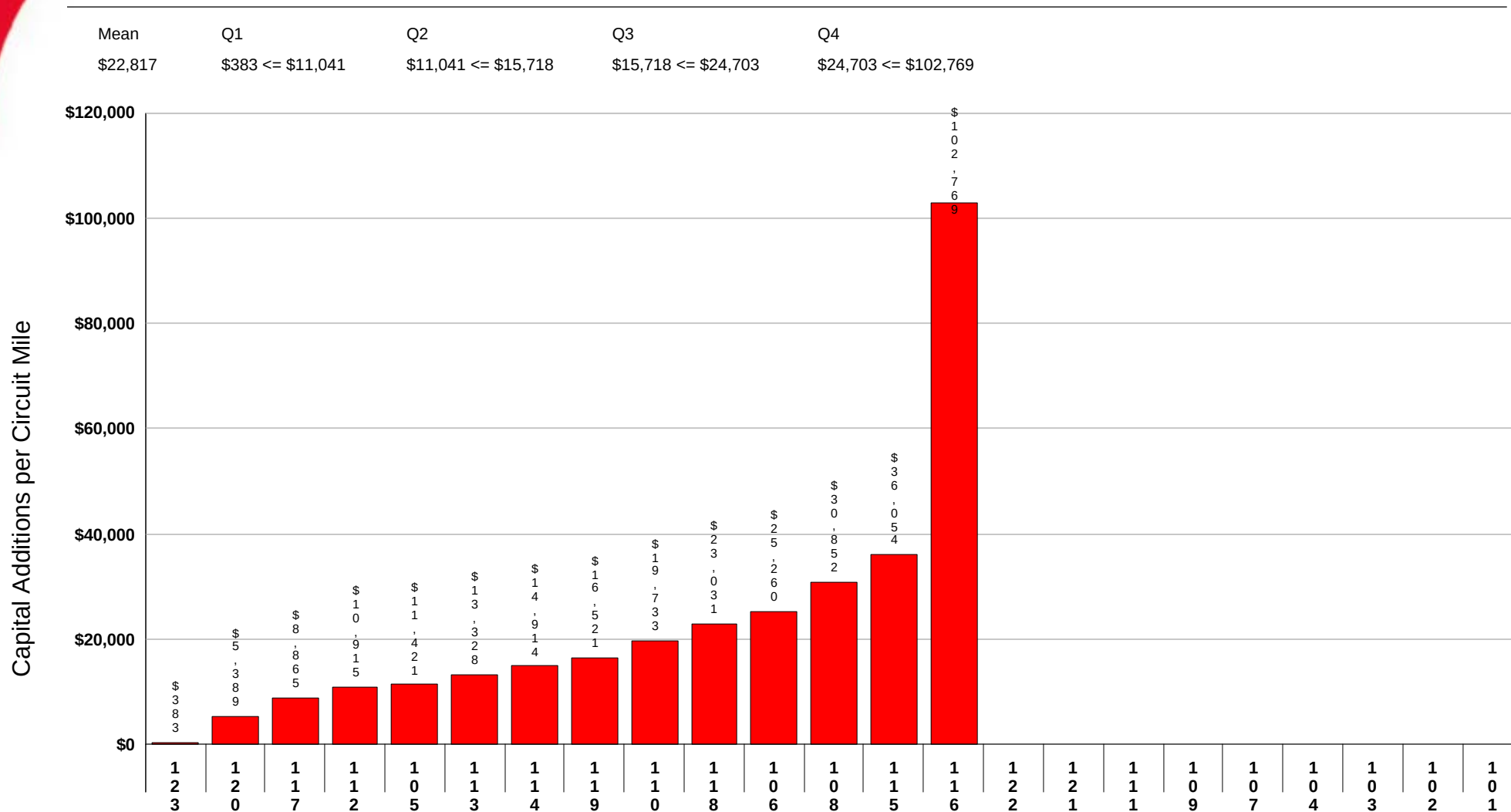
Only companies with all the data are shown.

Per MWh Transmitted

Capital Additions per MWh Transmitted

Page: 1623

3-Year Average Transmission Capital Additions Per Circuit Mile



Source/Calculation: $((\text{SUM}\{B.2\})/(\text{SUM}\{BB.3\}+\text{SUM}\{BB.4\})+B.8.1/BB.8.1+B.8.2/BB.8.2)/3$

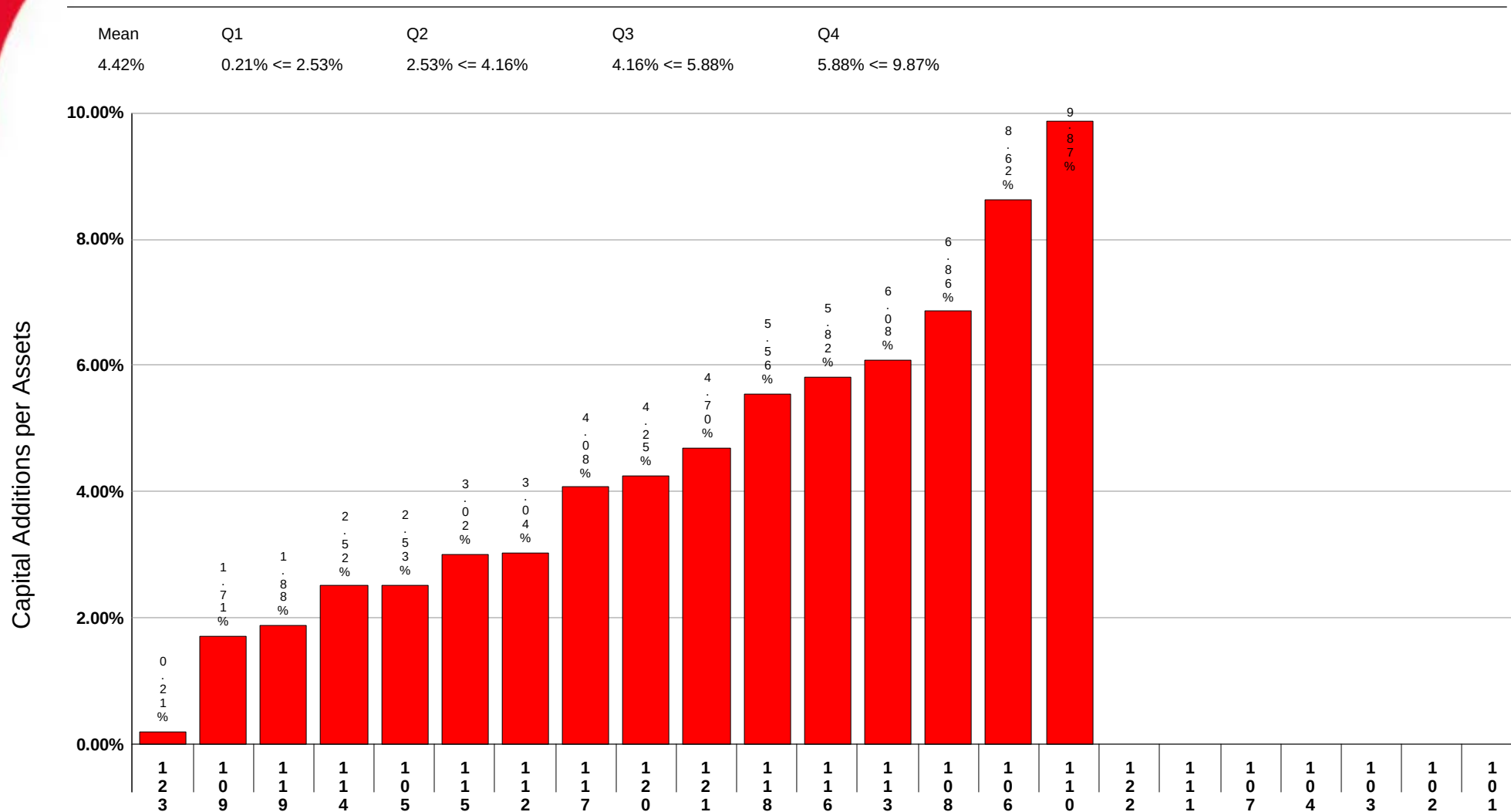
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 6399

Page: 1624

Only companies with all the data are shown.

3-Year Average Transmission Capital Additions Per Assets



Source/Calculation: $((\text{SUM}\{B.2\}/B.10.1) + (B.8.1/B.12.1) + (B.8.2/B.12.2))/3$

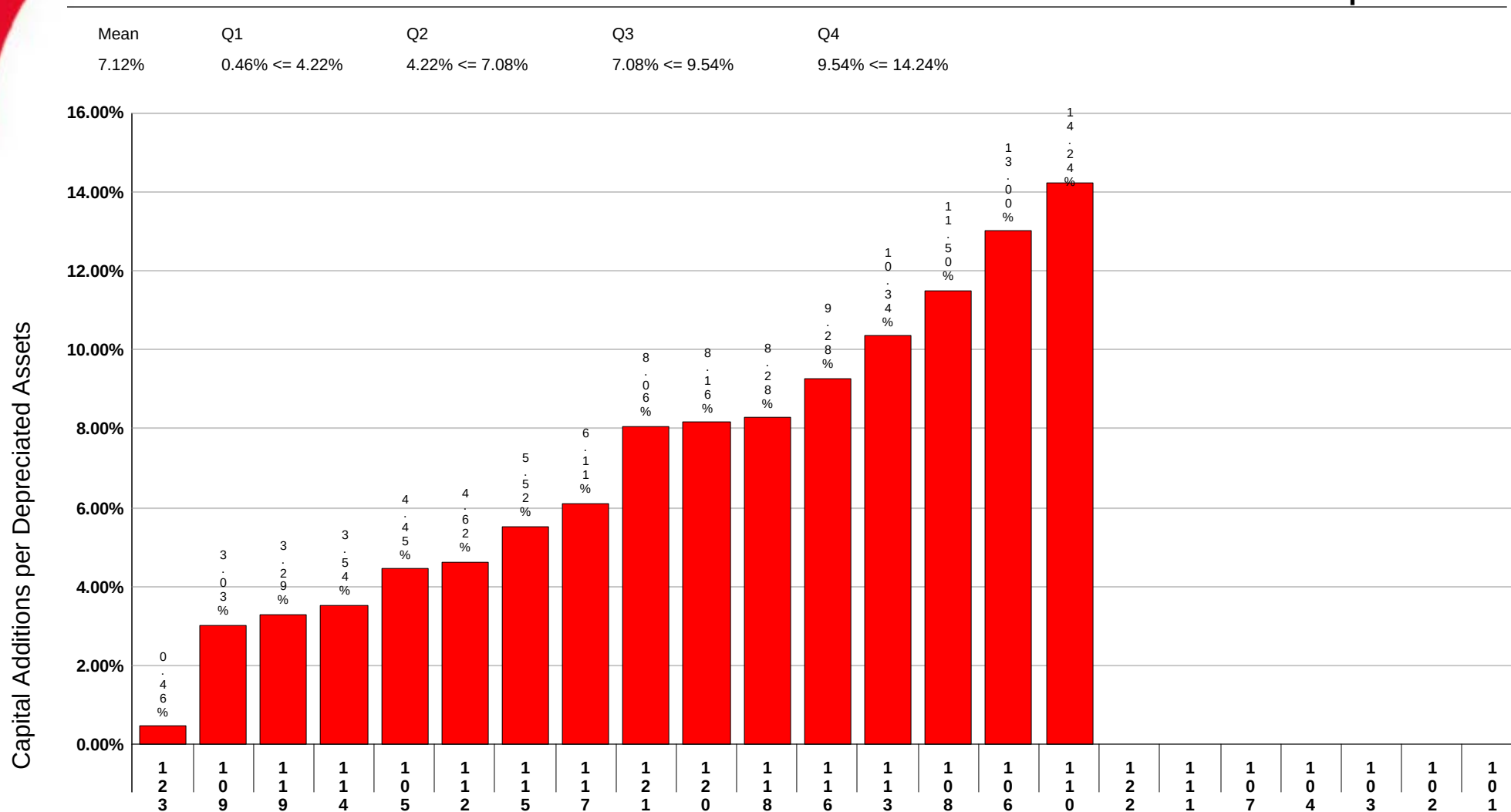
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 6442

Page: 1625

Only companies with all the data are shown.

3-Year Average Transmission Capital Additions Per Assets Less Depreciation



Source/Calculation: $(\text{SUM}\{B.2\}/(B.10.1-B.14.2)+B.8.1/(B.12.1-B.16.3)+B.8.2/(B.12.2-B.16.4))/3$

Volume: Transmission Line Statistics, Final Report, 2006

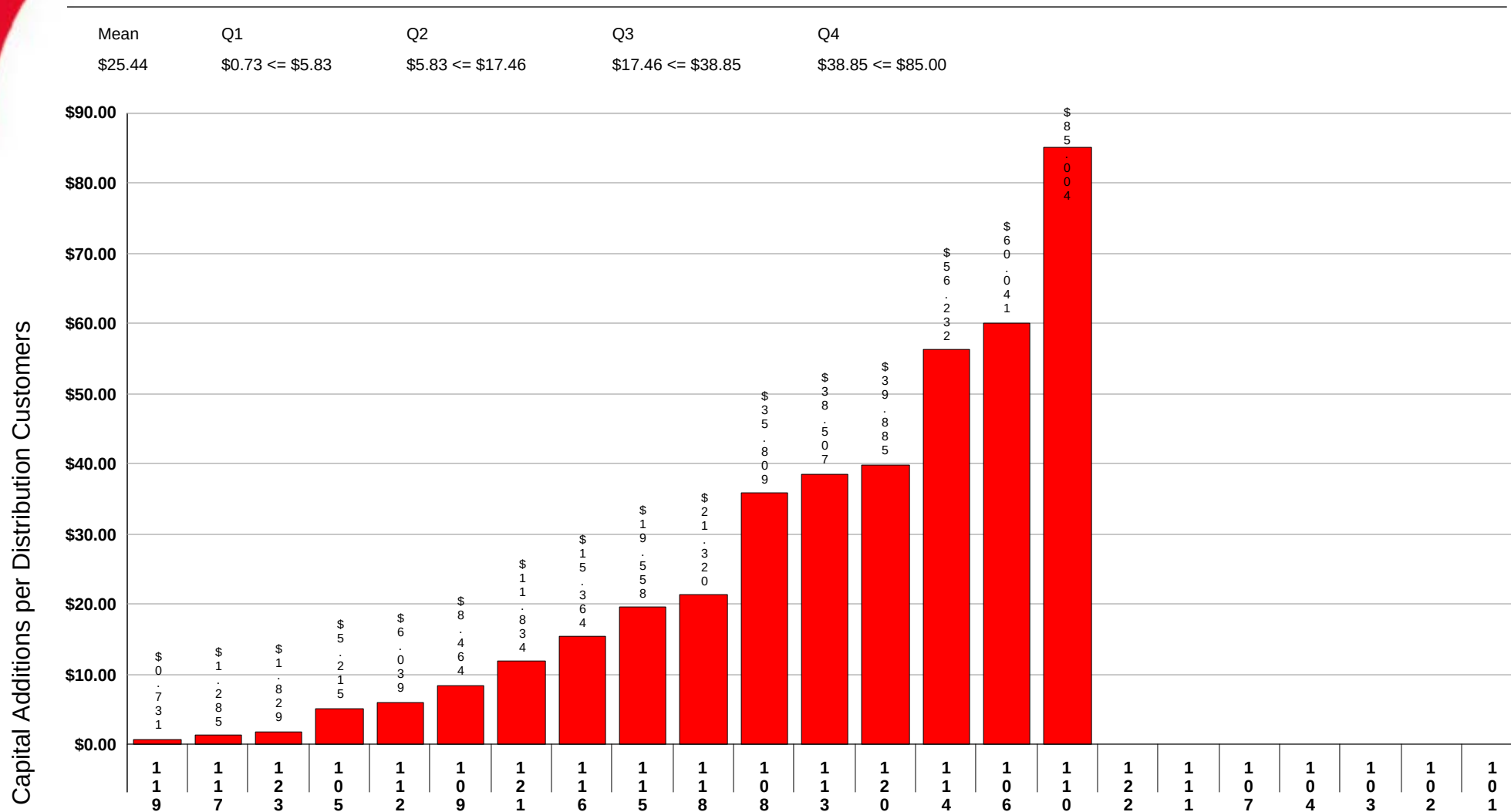
ID Code: 6400

Page: 1626

Only companies with all the data are shown.

Transmission Line Capital Additions

Per Distribution Customers



Source/Calculation: ((SUM{B.2}-SUM{B.3})/A.2.2)

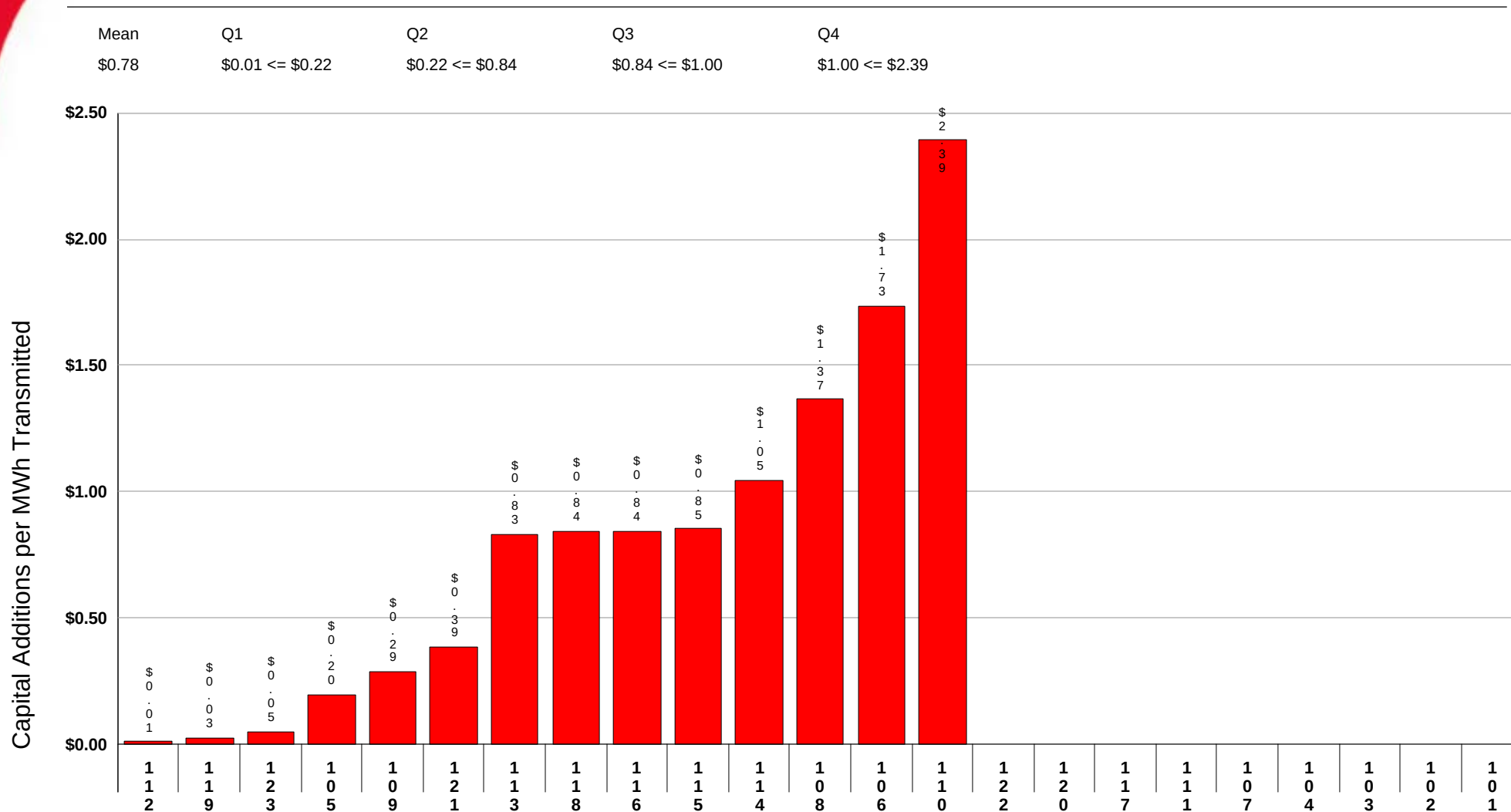
Volume: Transmission Line Statistics, Final Report, 2006

ID Code:653

Page:1627

Only companies with all the data are shown.

Transmission Line Capital Additions Per MWh Transmitted



Source/Calculation: (SUM{B.2}-SUM{B.3})/A.2.5

Volume: Transmission Line Statistics, Final Report, 2006

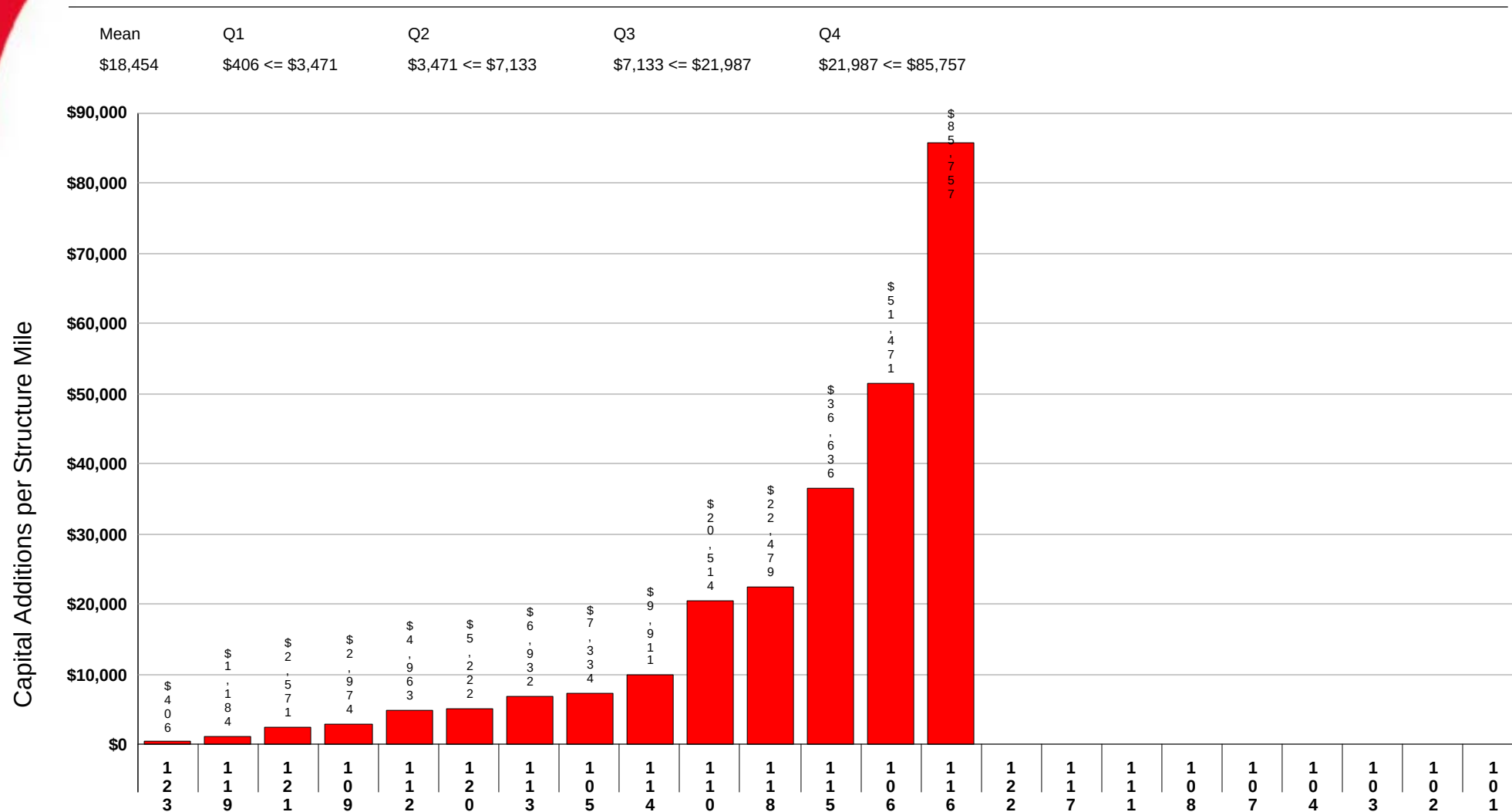
ID Code: 655

Page: 1628

Only companies with all the data are shown.

Transmission Line Capital Additions

Per Transmission Structure Mile



Source/Calculation: $(\text{SUM}\{B.2\} - \text{SUM}\{B.3\}) / (\text{SUM}\{BB.5\} + \text{SUM}\{BB.6\})$

Volume: Transmission Line Statistics, Final Report, 2006

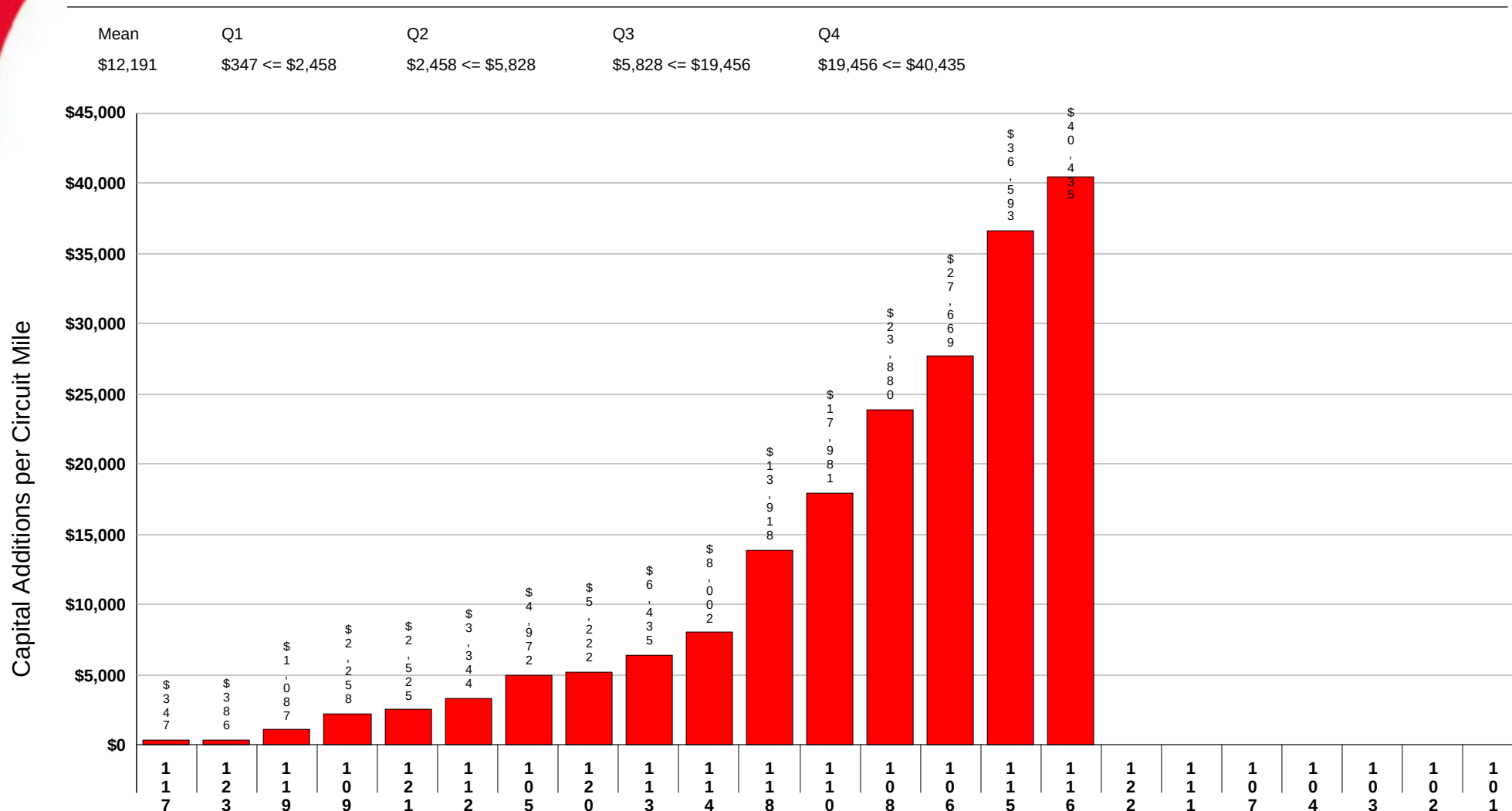
ID Code: 654

Page: 1629

Only companies with all the data are shown.

Transmission Line Capital Additions

Per Transmission Circuit Mile



Source/Calculation: (SUM{B.2}-SUM{B.3})/(SUM{BB.3}+SUM{BB.4})

Volume: Transmission Line Statistics, Final Report, 2006

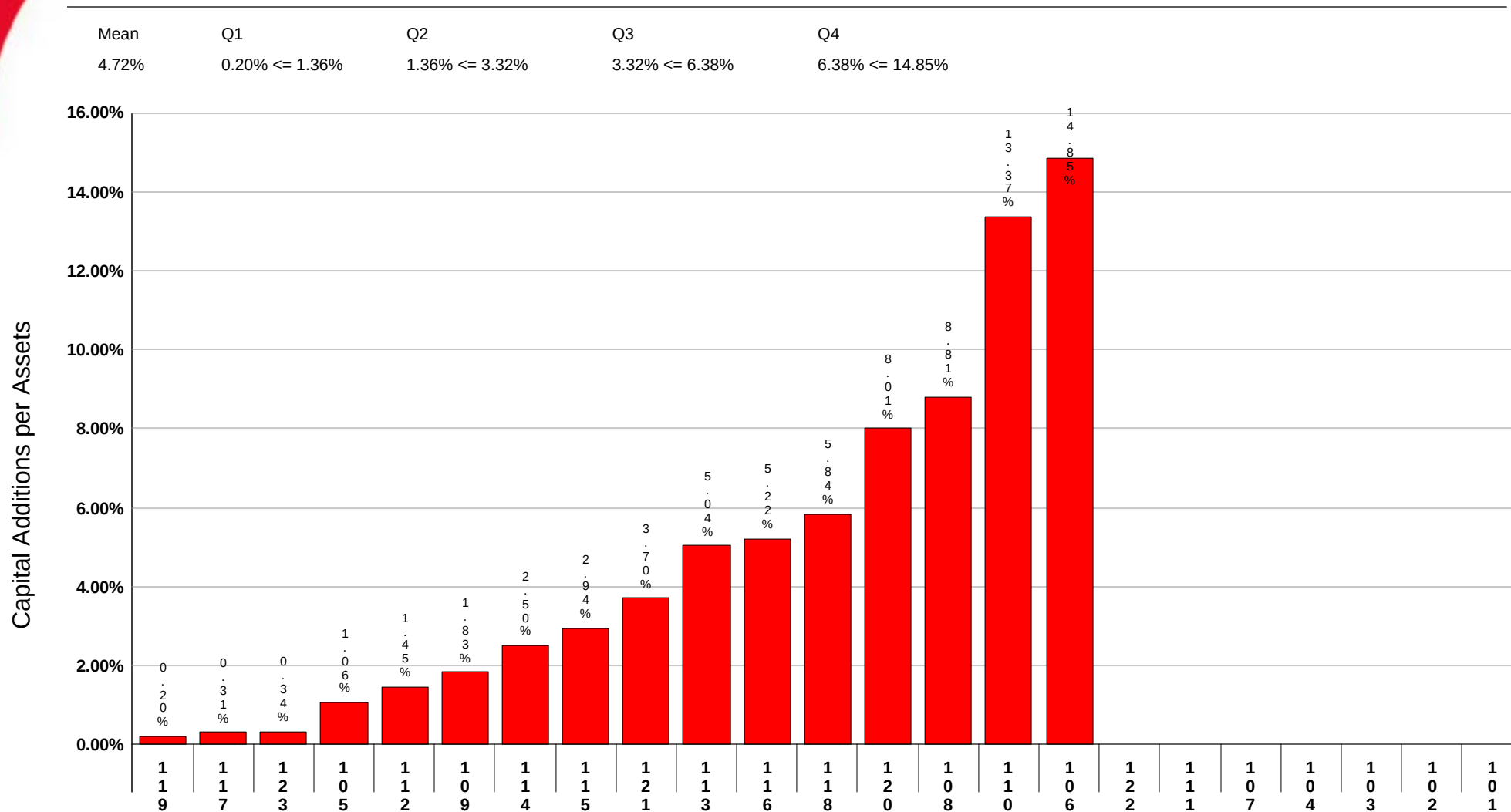
ID Code:2009

Page: 1630

Only companies with all the data are shown.

Transmission Line Capital Additions

Per Assets



Source/Calculation: (SUM{B.2}-SUM{B.3})/(B.10.1-B.11.1)

Volume: Transmission Line Statistics, Final Report, 2006

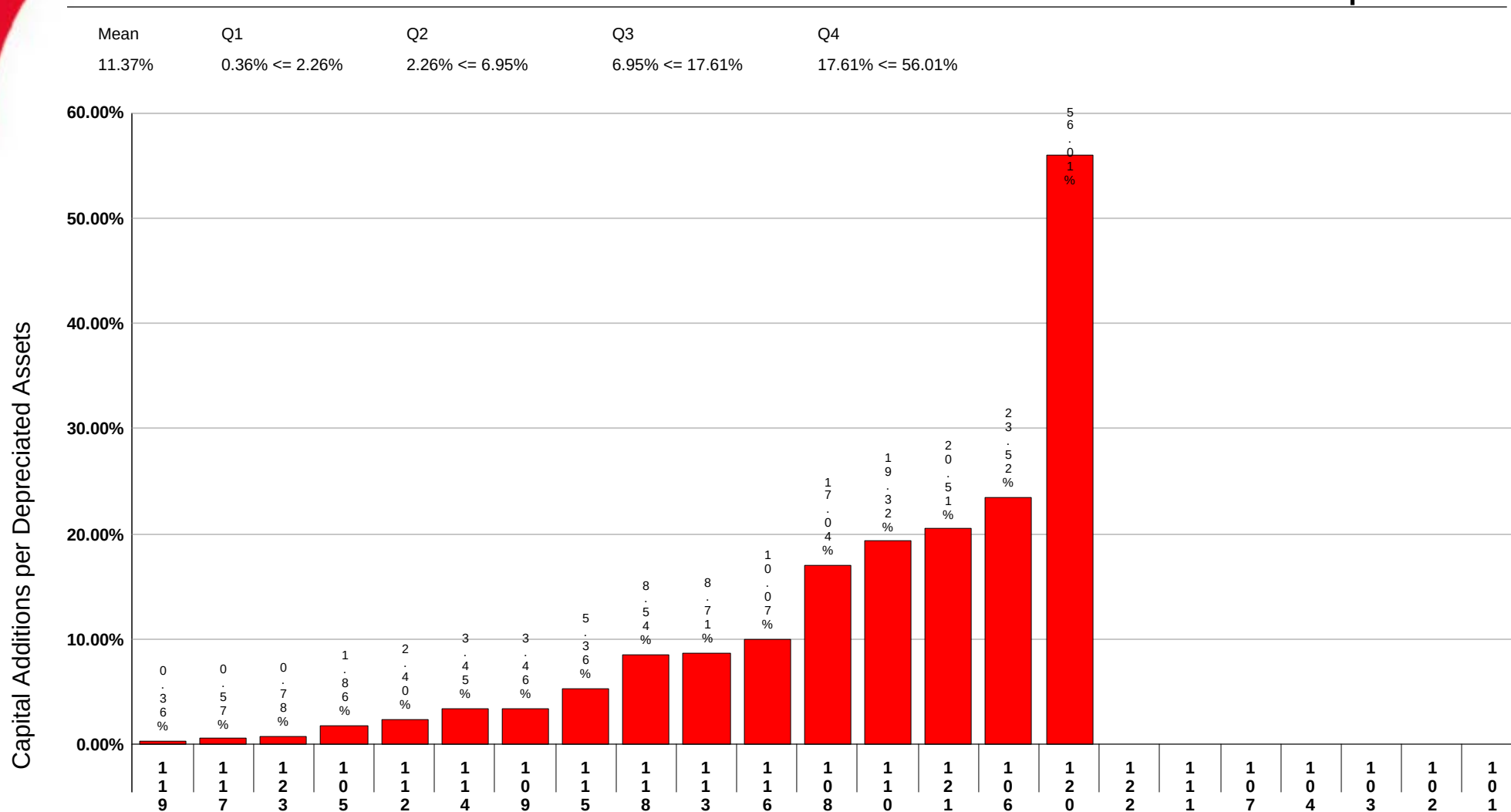
ID Code: 2122

Page: 1631

Only companies with all the data are shown.

Transmission Line Capital Additions

Per Assets Less Depreciation



Source/Calculation: (SUM{B.2}-SUM{B.3})/((B.10.1-B.14.2)-(B.11.1-B.15.2))

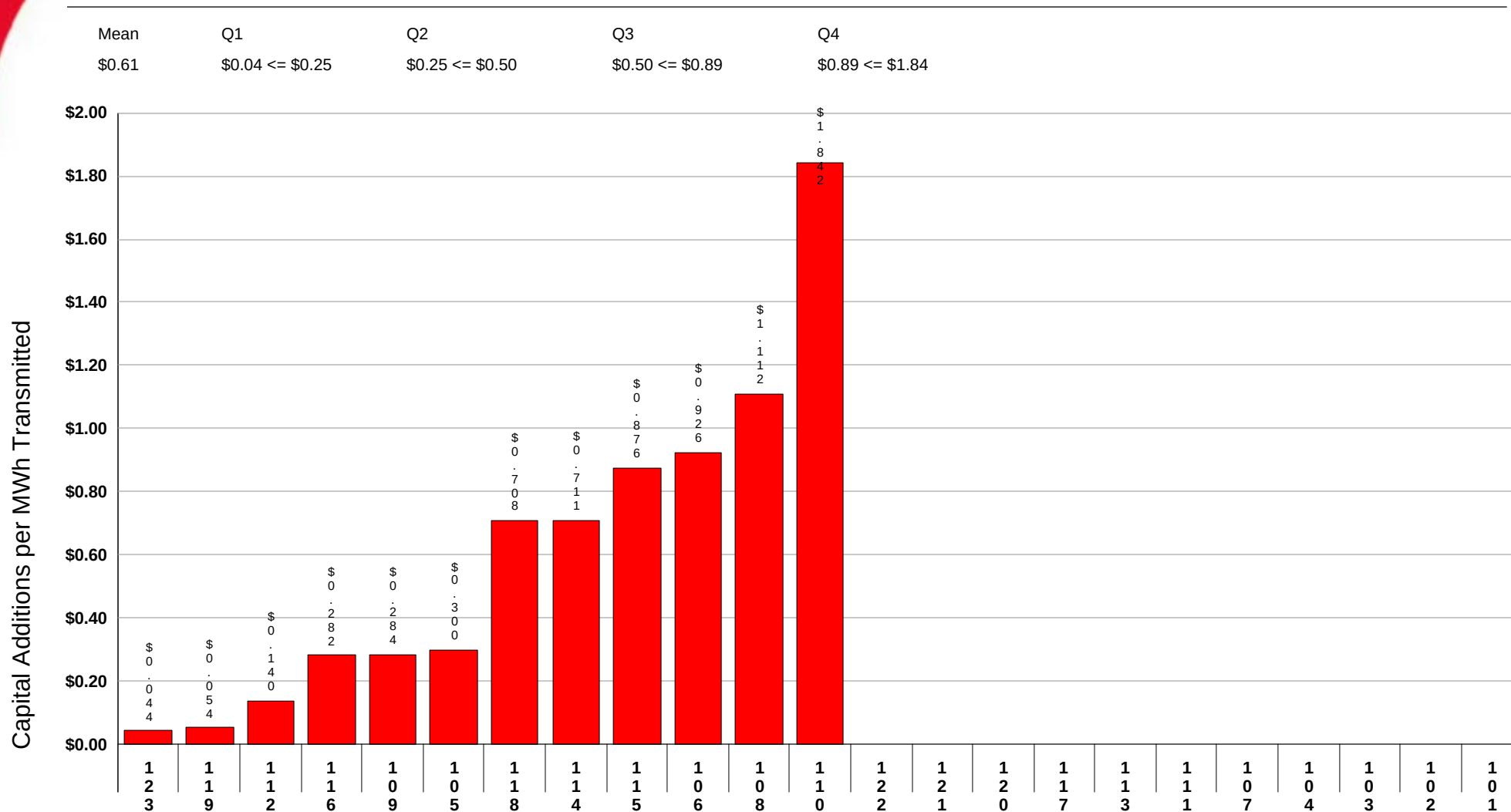
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 27131

Page: 1632

Only companies with all the data are shown.

3-Year Average Transmission Line Capital Additions Per MWh Transmitted



Source/Calculation: $((\text{SUM}\{B.2\} - \text{SUM}\{B.3\}) / A.2.5 + (B.8.1 - B.9.1) / (A.3.5) + (B.8.2 - B.9.2) / (A.3.6)) / 3$

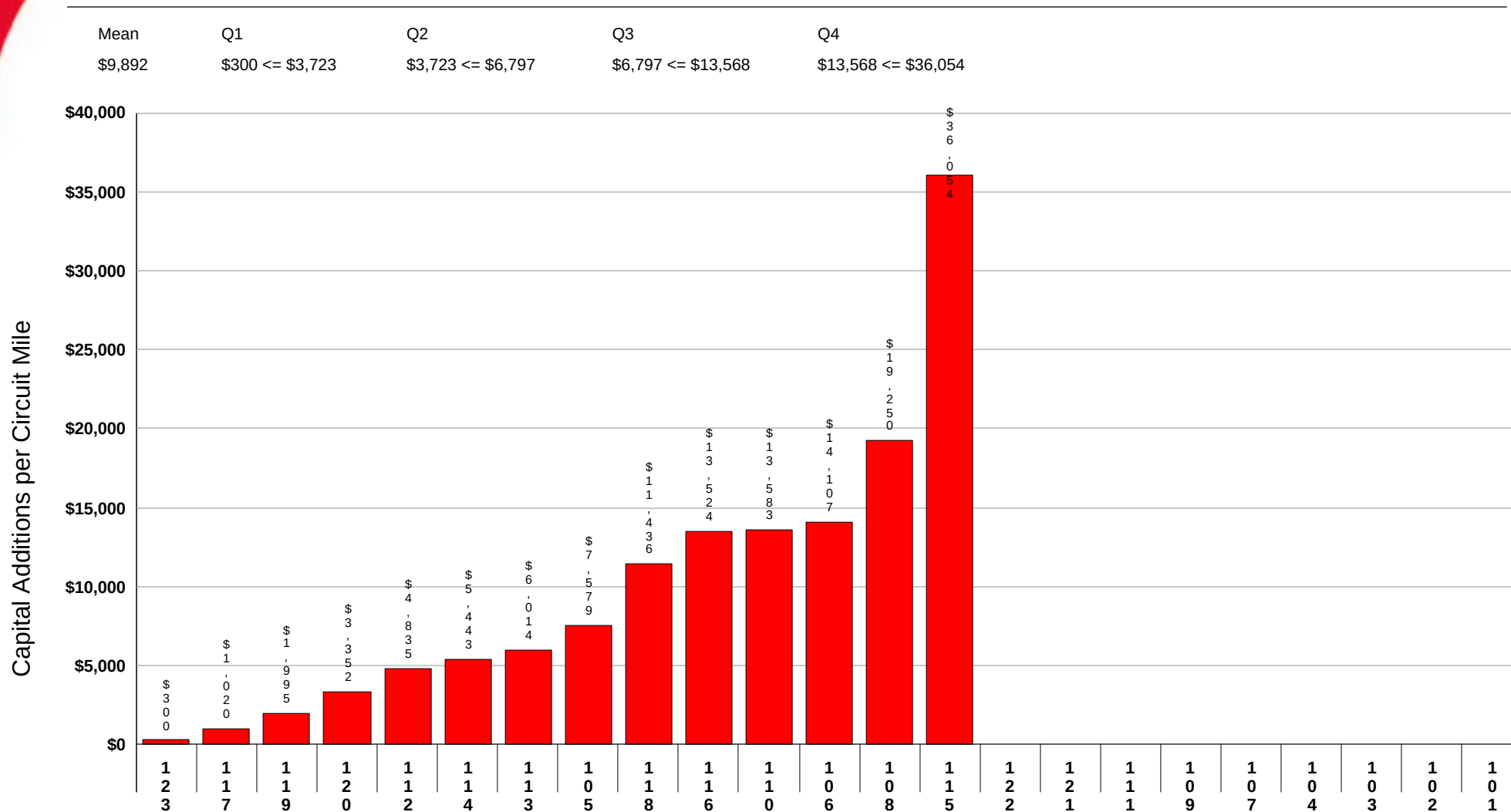
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 6498

Only companies with all the data are shown.

Page: 1634

3-Year Average Transmission Line Capital Additions Per Circuit Mile



Source/Calculation: $((\text{SUM}\{B.2\} - \text{SUM}\{B.3\}) / (\text{SUM}\{BB.3\} + \text{SUM}\{BB.4\}) + (B.8.1 - B.9.1) / BB.8.1 + (B.8.2 - B.9.2) / BB.8.2) / 3$

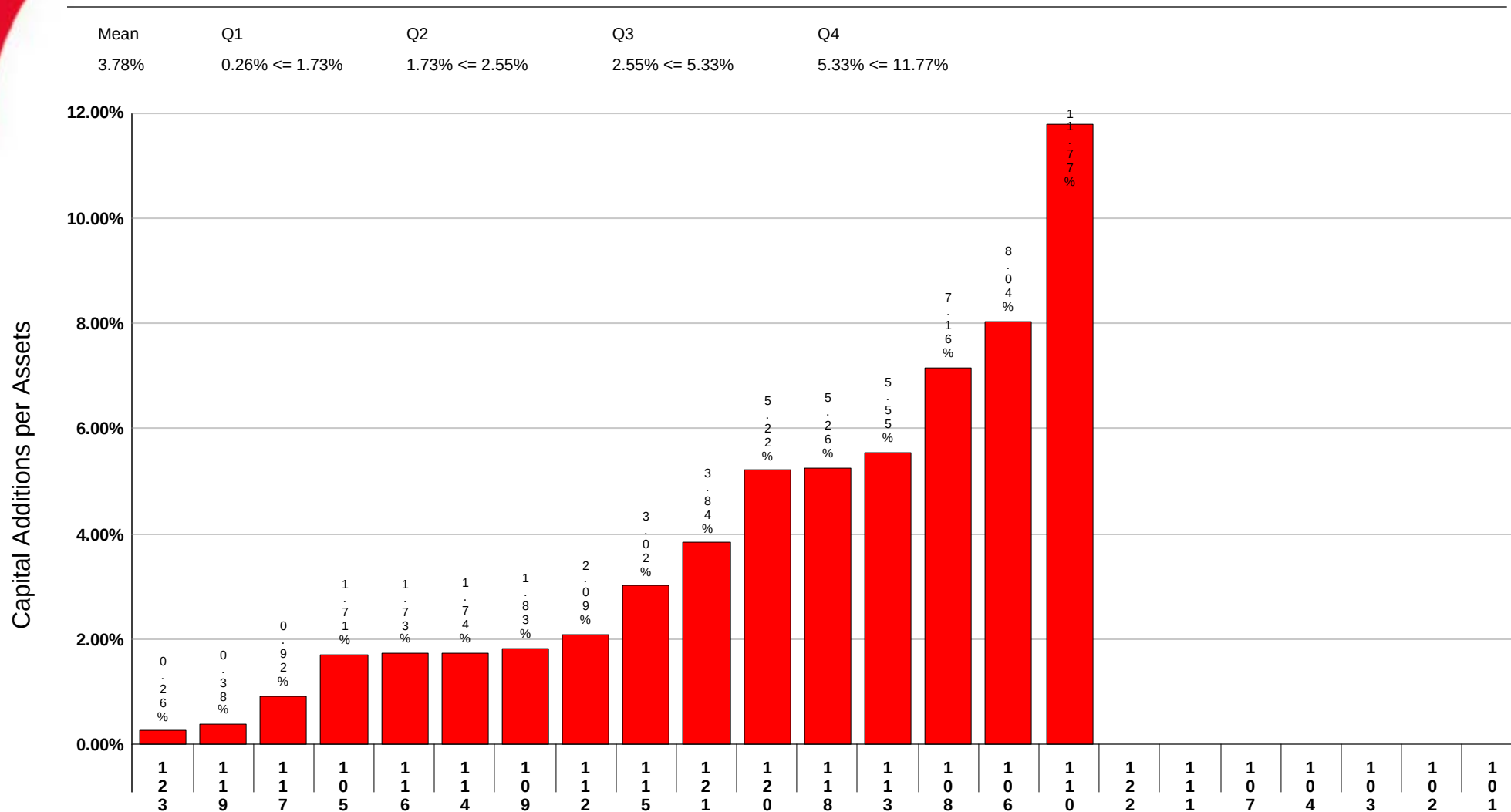
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 6500

Page: 1635

Only companies with all the data are shown.

3-Year Average Transmission Line Capital Additions Per Assets



Source/Calculation: $((\text{SUM}\{B.2\} - \text{SUM}\{B.3\}) / (B.10.1 - B.11.1) + (B.8.1 - B.9.1) / (B.12.1 - B.13.1) + (B.8.2 - B.9.2) / (B.12.2 - B.13.2)) / 3$

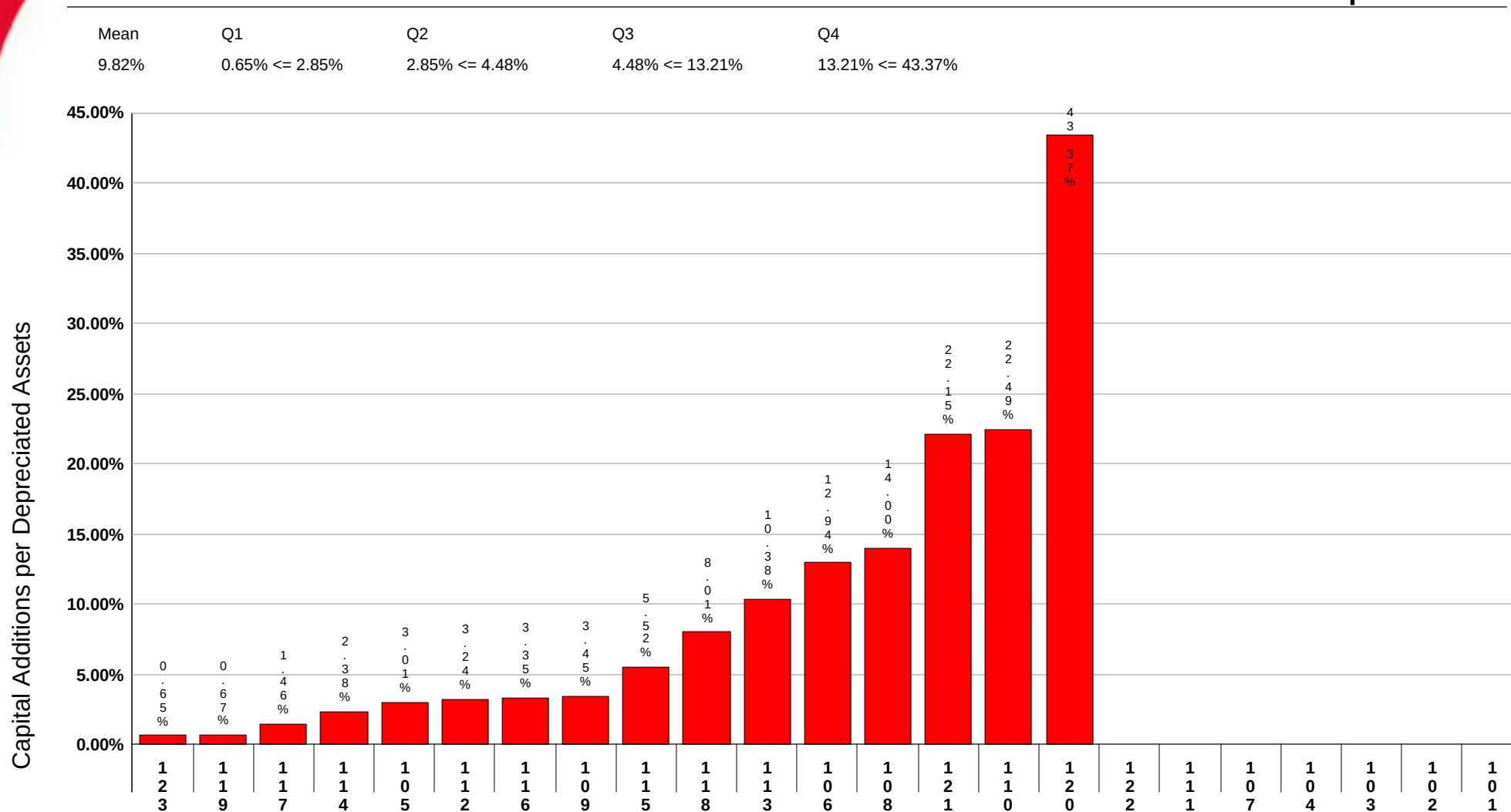
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 65021

Page: 1636

Only companies with all the data are shown.

3-Year Average Transmission Line Capital Additions Per Assets Less Depreciation



Source/Calculation: $((\text{SUM}\{B.2\} - \text{SUM}\{B.3\}) / ((B.10.1 - B.14.2) - (B.11.1 - B.15.2)) + (B.8.1 - B.9.1) / (B.12.1 - B.13.1 - (B.16.3 - B.17.3)) + (B.8.2 - B.9.2) / (B.12.2 - B.13.2 - (B.16.4 - B.17.4)))$

Volume: Transmission Line Statistics, Final Report, 2006

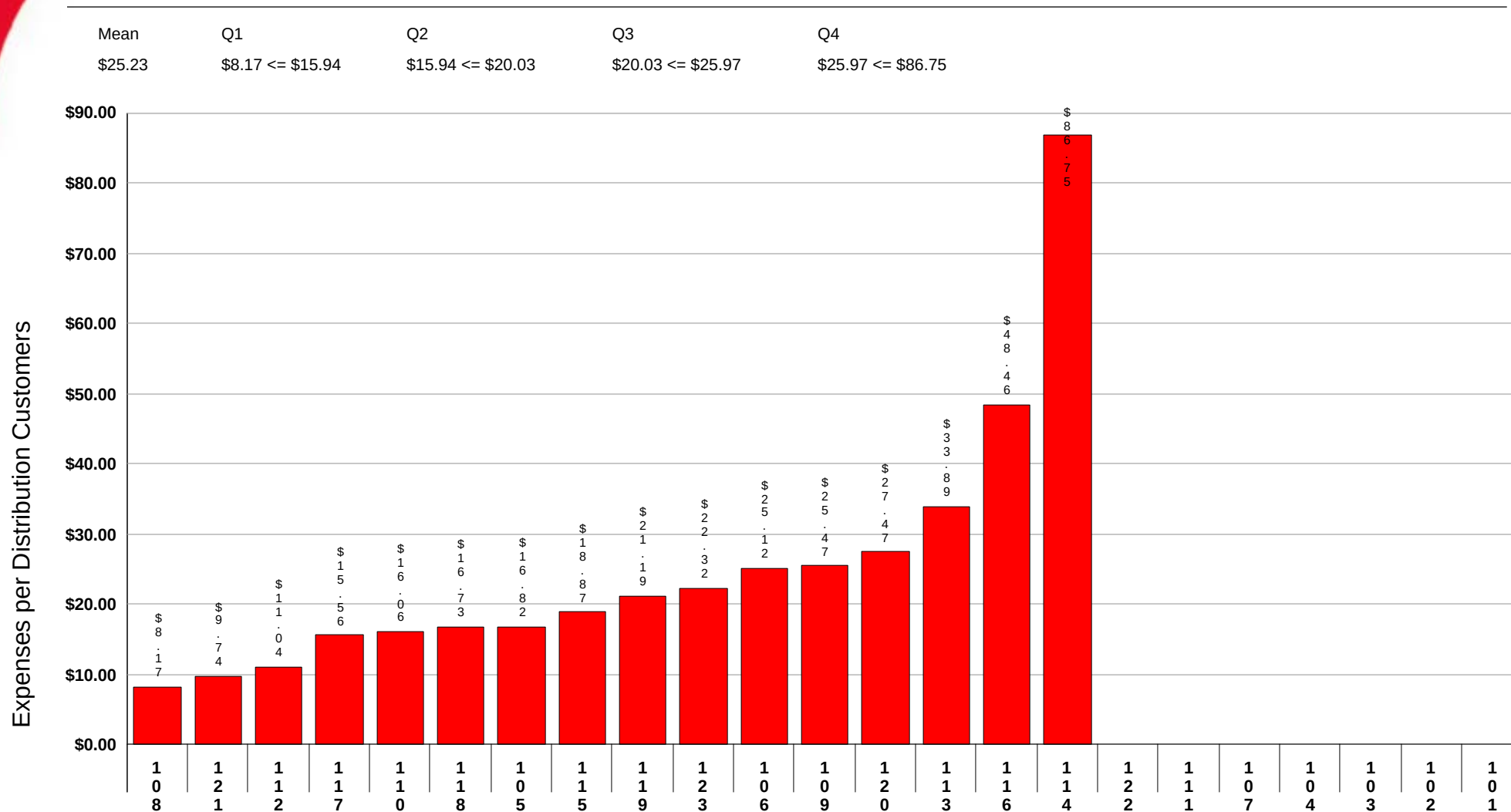
ID Code: 6502

Page: 1637

Only companies with all the data are shown.

Transmission O&M Expenses

Per Distribution Customers



Source/Calculation:((SUM{B.20}-B.20.6+SUM{B.22})/A.2.2)

Volume: Transmission Line Statistics, Final Report, 2006

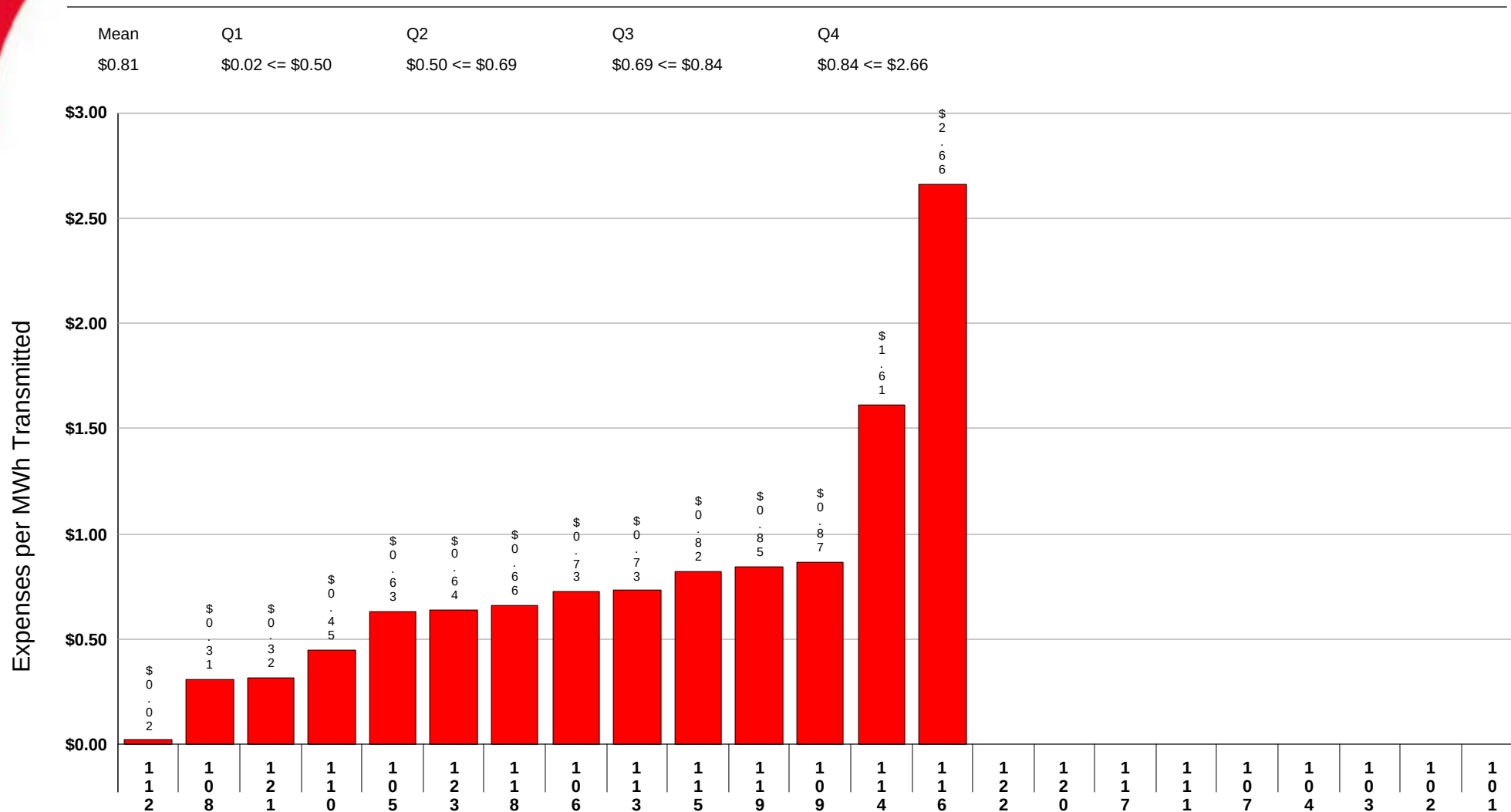
ID Code:8501

Page:1638

Only companies with all the data are shown.

Transmission O&M Expenses

Per MWh Transmitted



Source/Calculation: (SUM{B.20}-B.20.6+SUM{B.22})/A.2.5

Volume: Transmission Line Statistics, Final Report, 2006

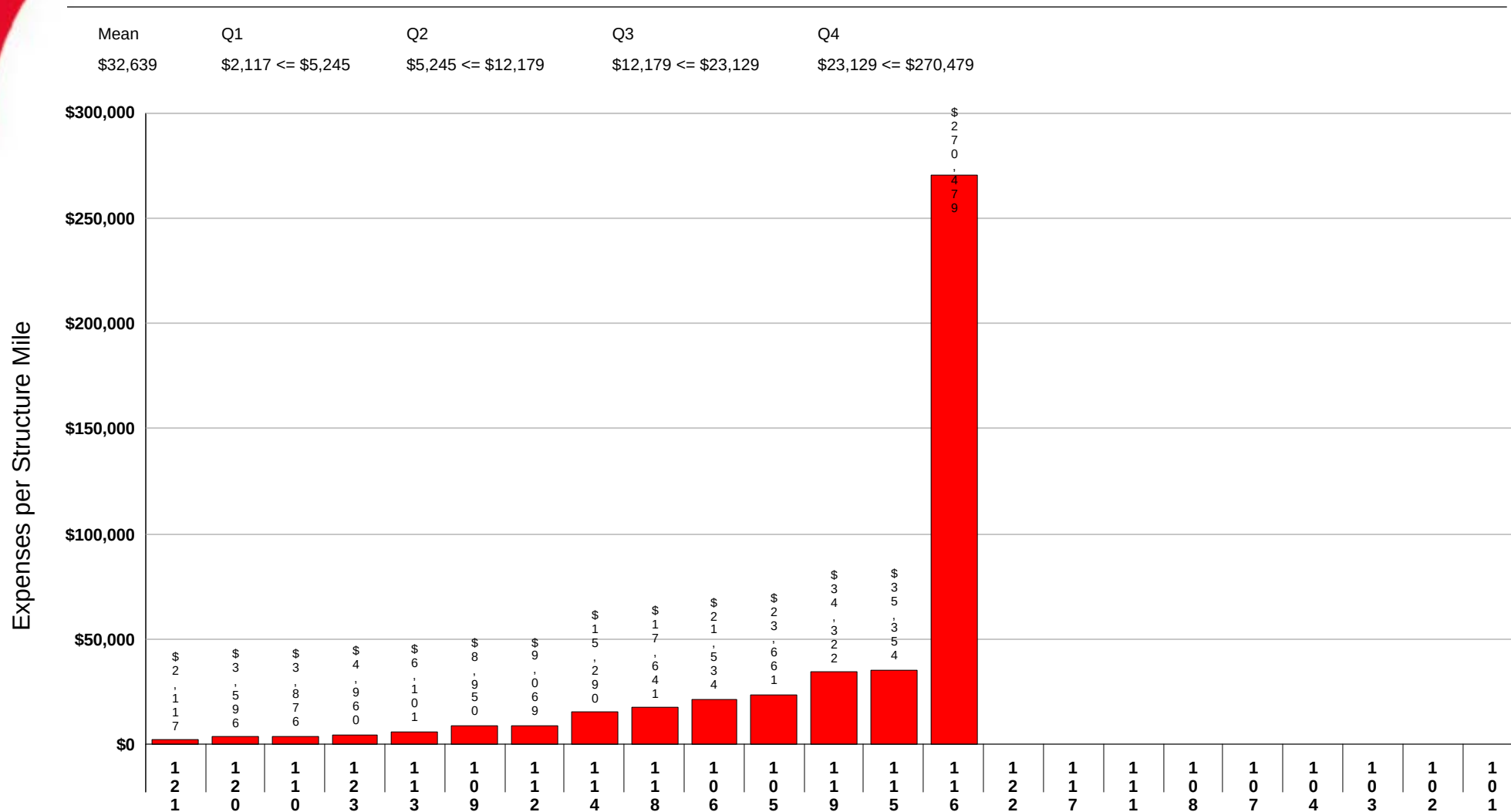
ID Code:642

Page: 1640

Only companies with all the data are shown.

Transmission O&M Expenses

Per Transmission Structure Mile



Source/Calculation: $(\text{SUM}\{B.20\} - B.20.6 + \text{SUM}\{B.22\}) / (\text{SUM}\{BB.5\} + \text{SUM}\{BB.6\})$

Volume: Transmission Line Statistics, Final Report, 2006

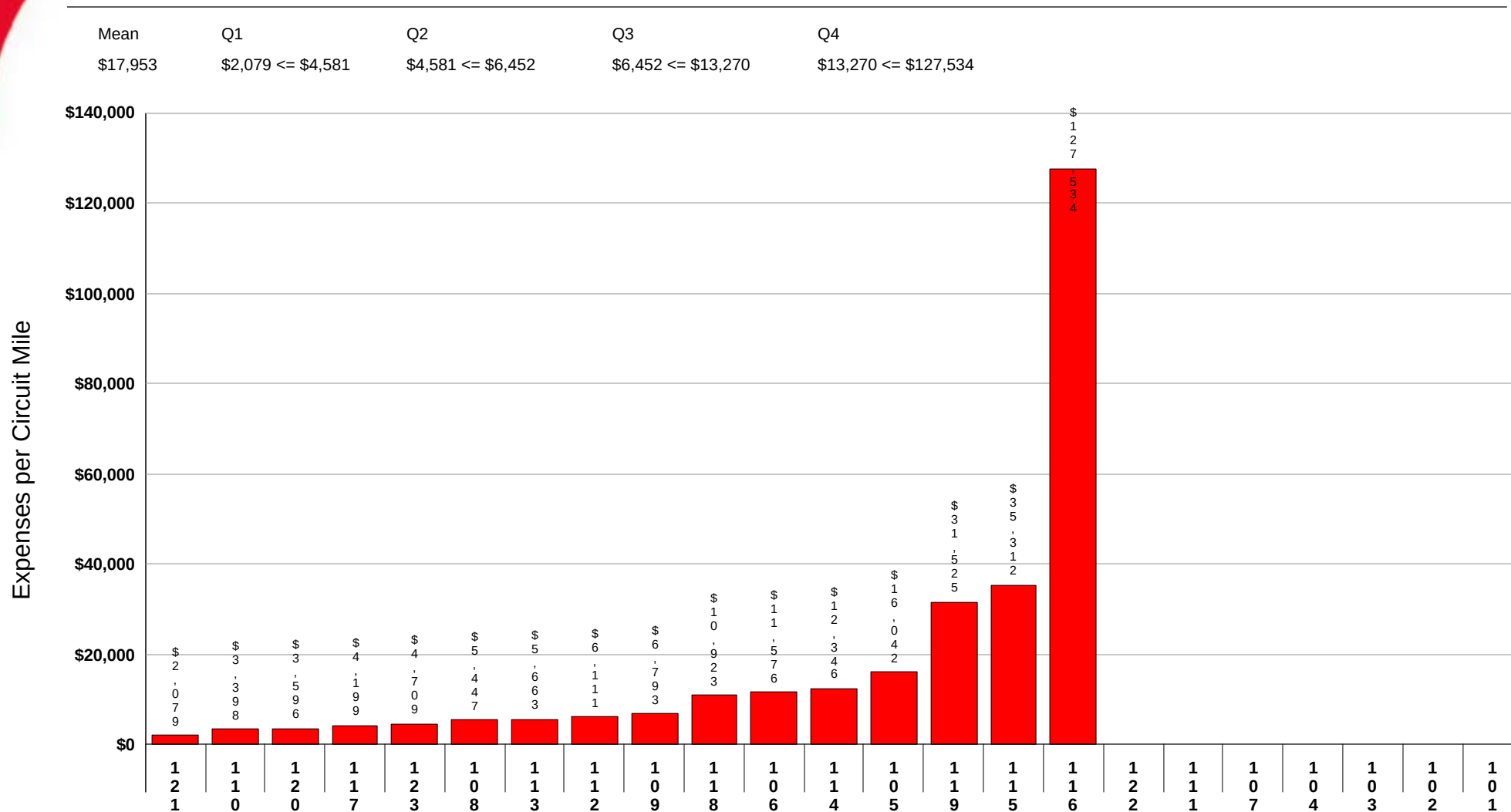
ID Code: 641

Page: 1641

Only companies with all the data are shown.

Transmission O&M Expenses

Per Transmission Circuit Mile



Source/Calculation: $(\text{SUM}\{B.20\} - B.20.6 + \text{SUM}\{B.22\}) / (\text{SUM}\{BB.3\} + \text{SUM}\{BB.4\})$

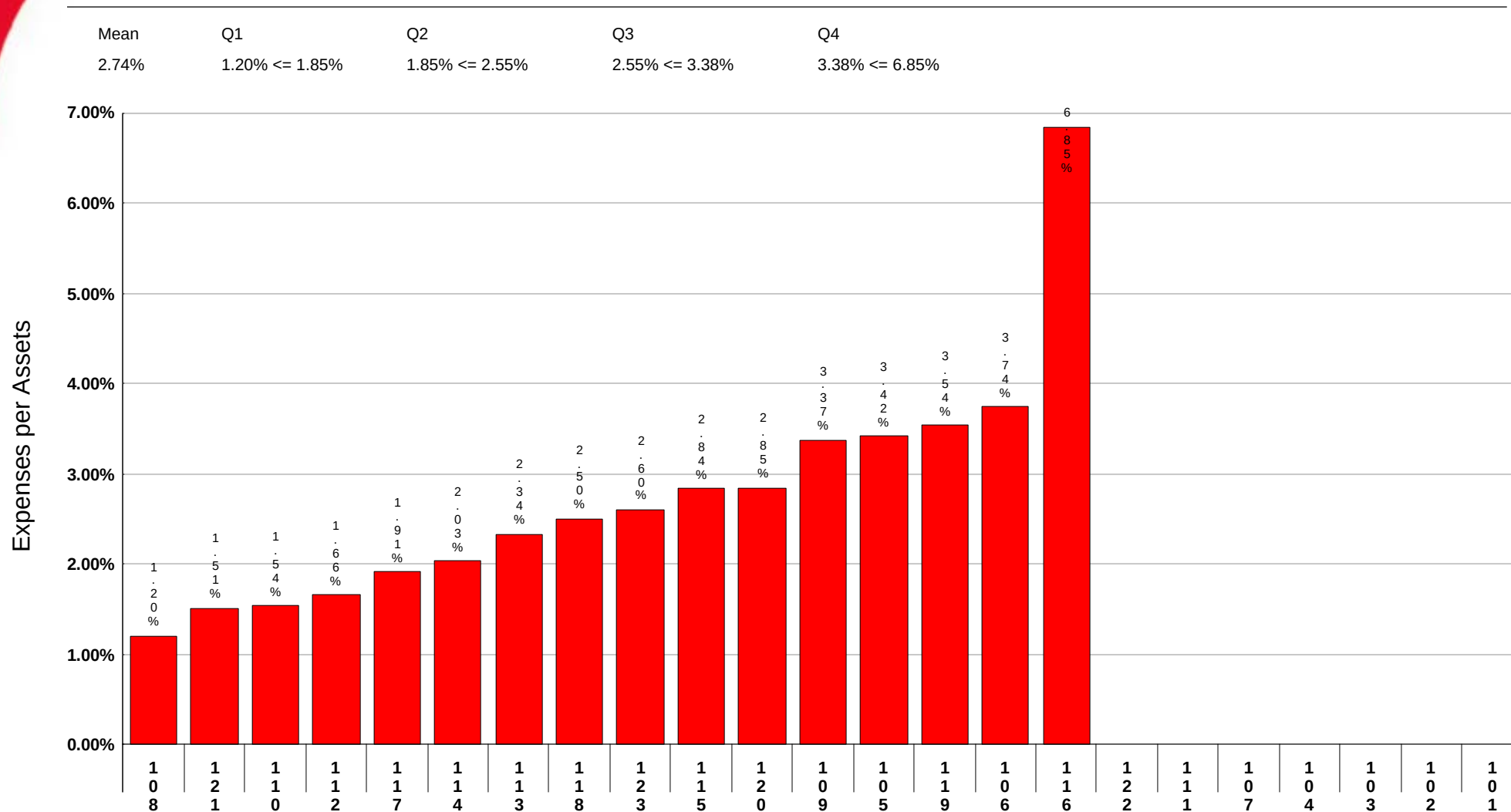
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 2006

Page: 1642

Only companies with all the data are shown.

Transmission O&M Expenses Per Assets



Source/Calculation: (SUM{B.20}+SUM{B.22}-B.20.6)/B.10.1

Volume: Transmission Line Statistics, Final Report, 2006

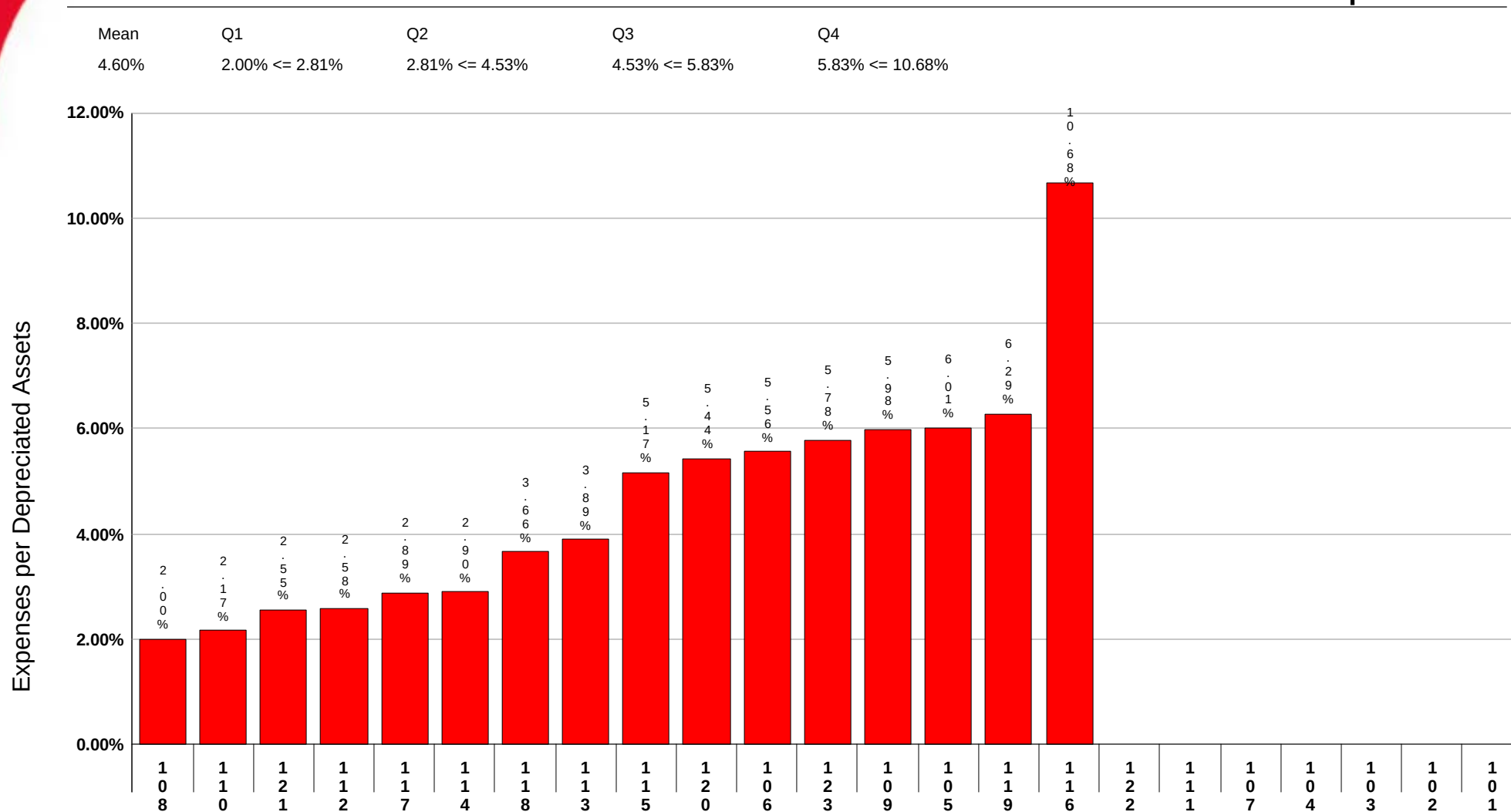
ID Code: 7020

Page: 1643

Only companies with all the data are shown.

Transmission O&M Expenses

Per Assets Less Depreciation



Source/Calculation: (SUM{B.20}-B.20.6+SUM{B.22})/(B.10.1-B.14.2)

Volume: Transmission Line Statistics, Final Report, 2006

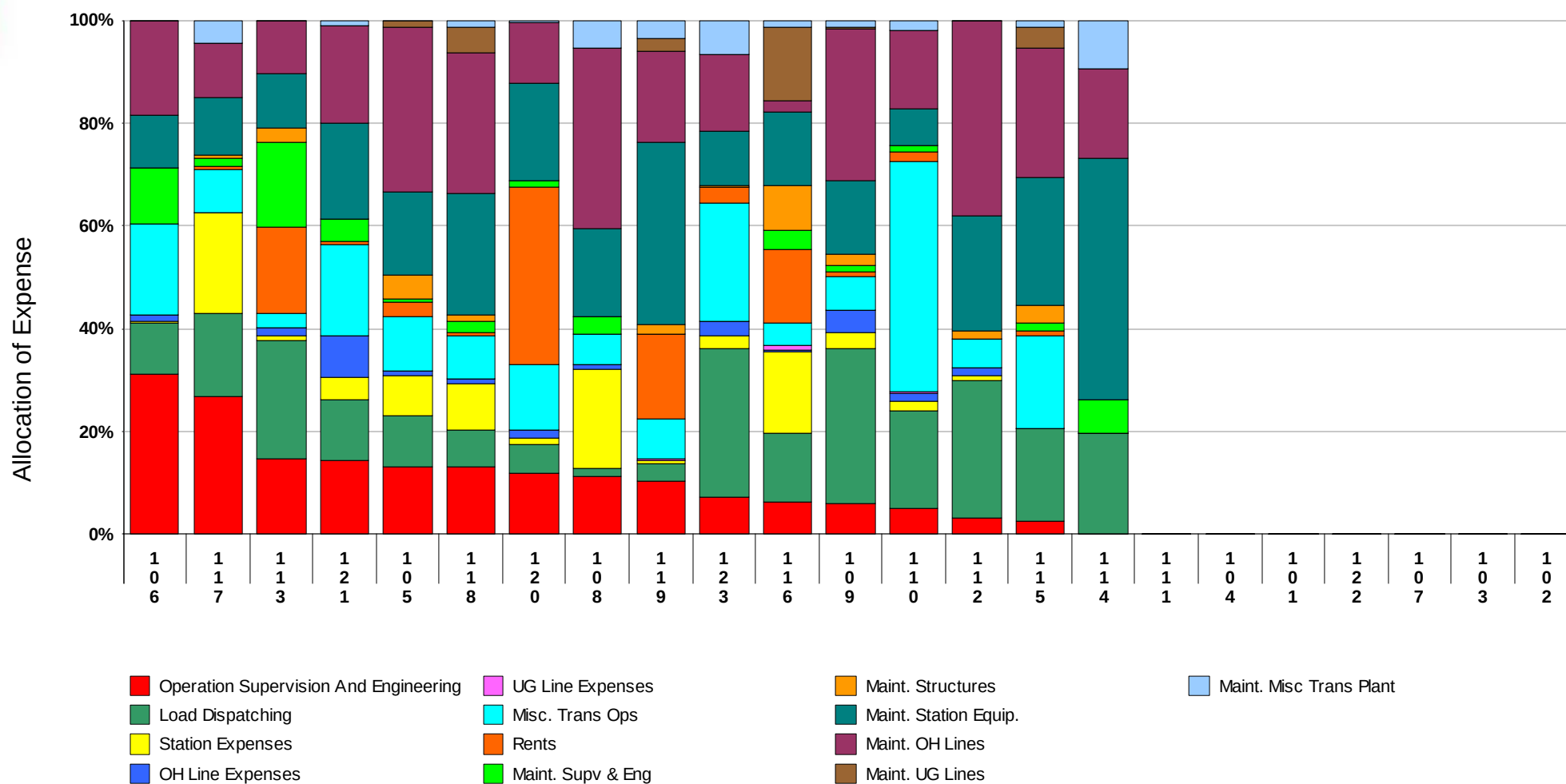
ID Code: 2121

Page: 1644

Only companies with all the data are shown.

Transmission O&M Expense Allocation

Percent of Total



Source/Calculation: B.20.1/(SUM{B.20}+SUM{B.22}-B.20.6-B.20.100-B.22.100)

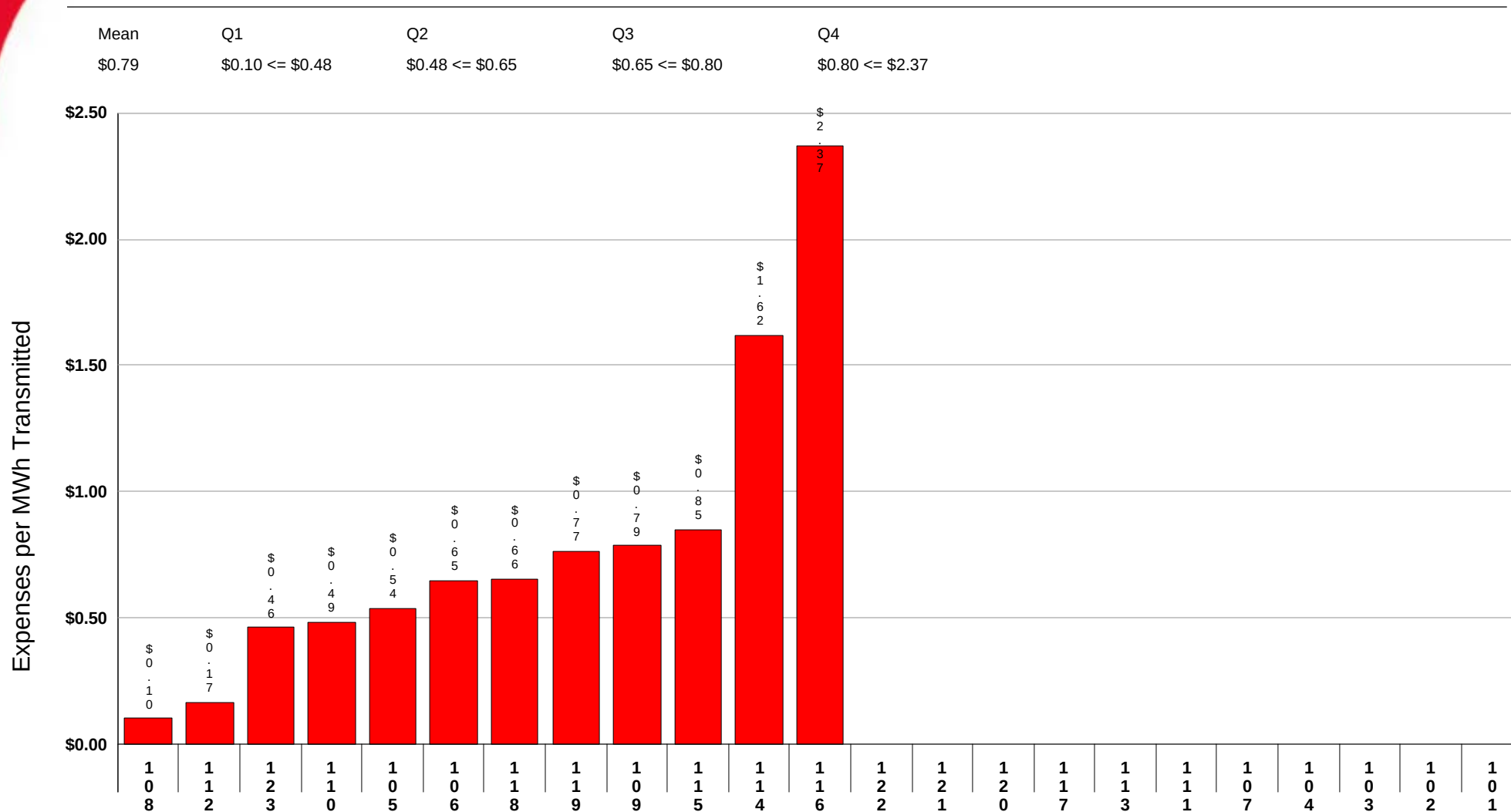
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 8721

Page: 1645

Calculation shown is for the first piece of the stacked bar only.

3-Year Average Transmission O&M Expenses Per MWh Transmitted



Source/Calculation: ((SUM{B.20}-B.20.6+SUM{B.22})/A.2.5+(B.28.1)/(A.3.5)+(B.28.2)/(A.3.6))/3

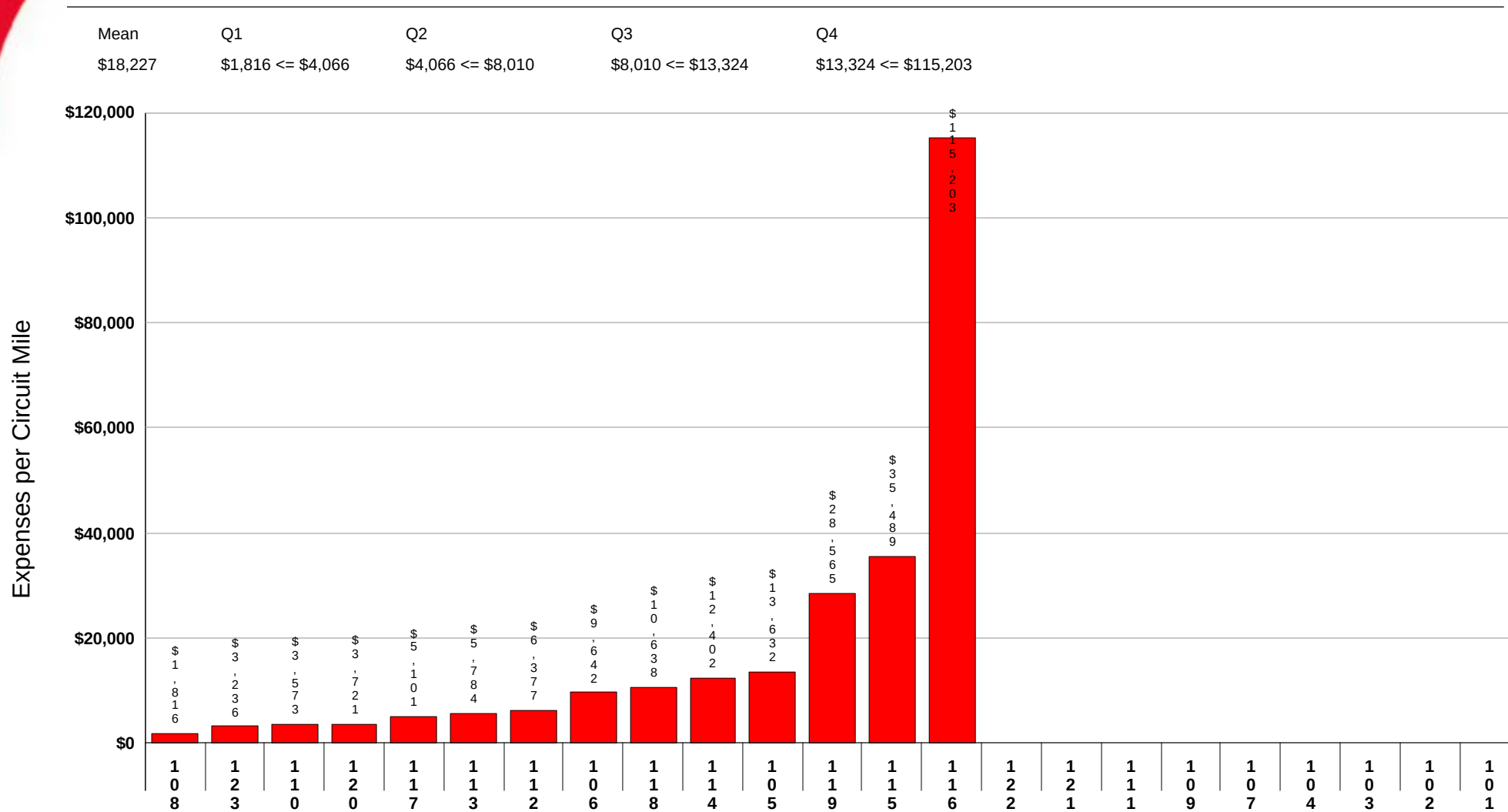
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 27126

Page: 1647

Only companies with all the data are shown.

3-Year Average Transmission O&M Expenses Per Transmission Circuit Mile



Source/Calculation: $((\text{SUM}\{B.20\} - B.20.6 + \text{SUM}\{B.22\}) / (\text{SUM}\{BB.3\} + \text{SUM}\{BB.4\}) + B.28.1 / BB.8.1 + B.28.2 / BB.8.2) / 3$

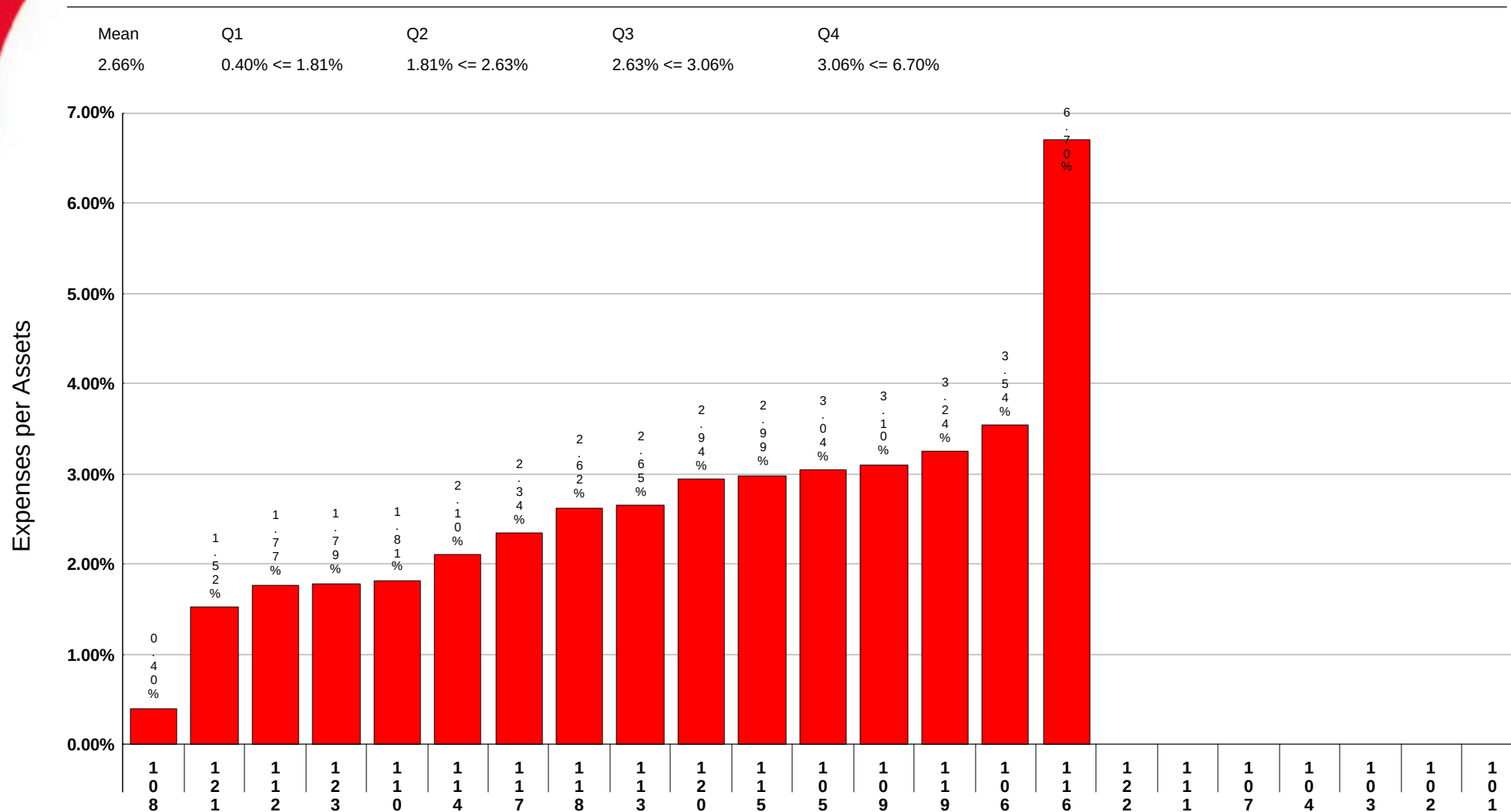
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 27130

Page: 1648

Only companies with all the data are shown.

3-Year Average Transmission O&M Expenses Per Assets



Source/Calculation: $((\text{SUM}\{B.20\} - B.20.6 + \text{SUM}\{B.22\}) / B.10.1 + B.28.1 / B.12.1 + B.28.2 / B.12.2) / 3$

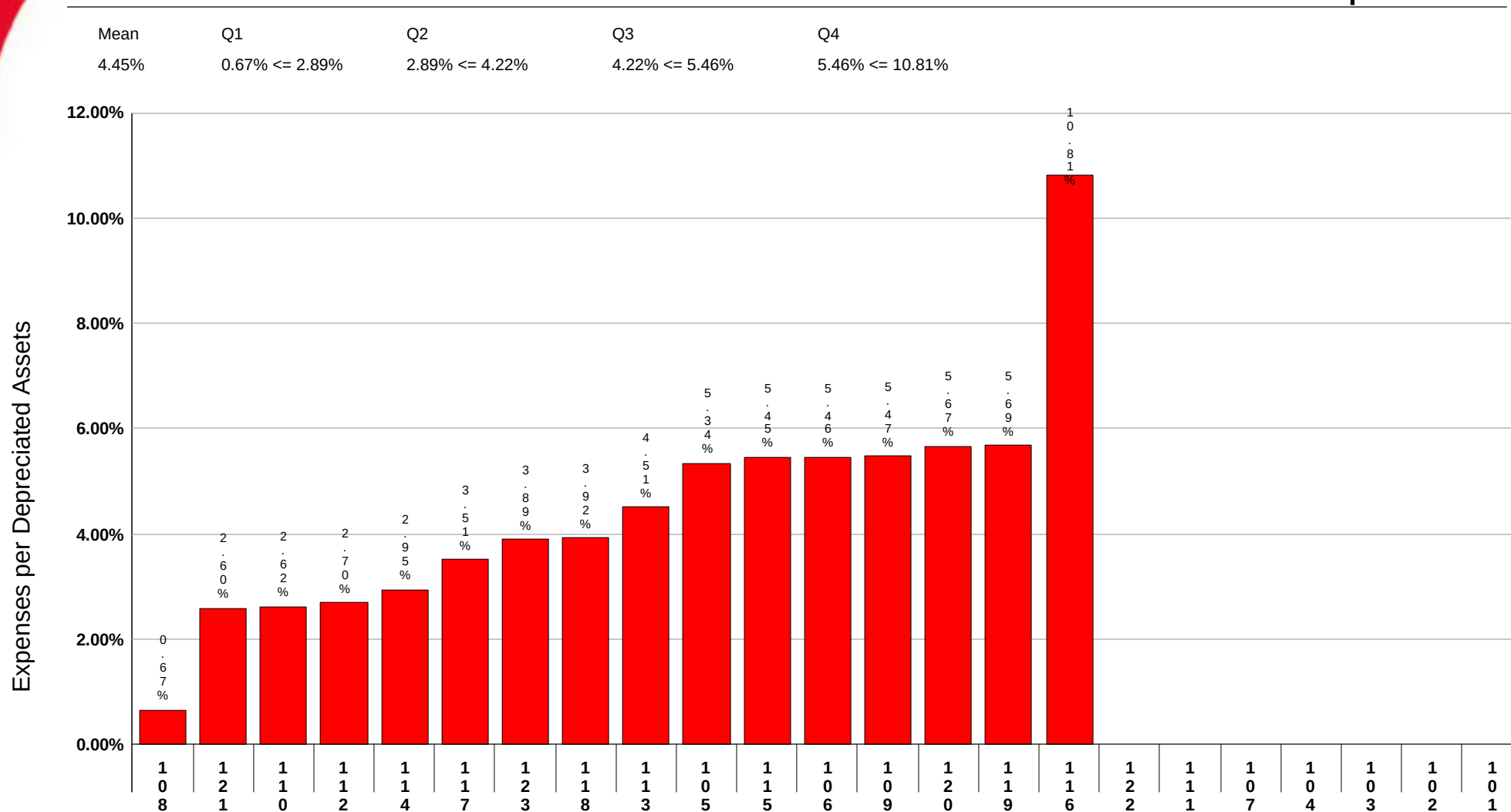
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 27454

Page: 1649

Only companies with all the data are shown.

3-Year Average Transmission O&M Expenses Per Assets Less Depreciation



Source/Calculation: $((SUM\{B.20\}-B.20.6+SUM\{B.22\})/(B.10.1-B.14.2)+B.28.1/(B.12.1-B.16.3)+B.28.2/(B.12.2-B.16.4))/3$

Volume: Transmission Line Statistics, Final Report, 2006

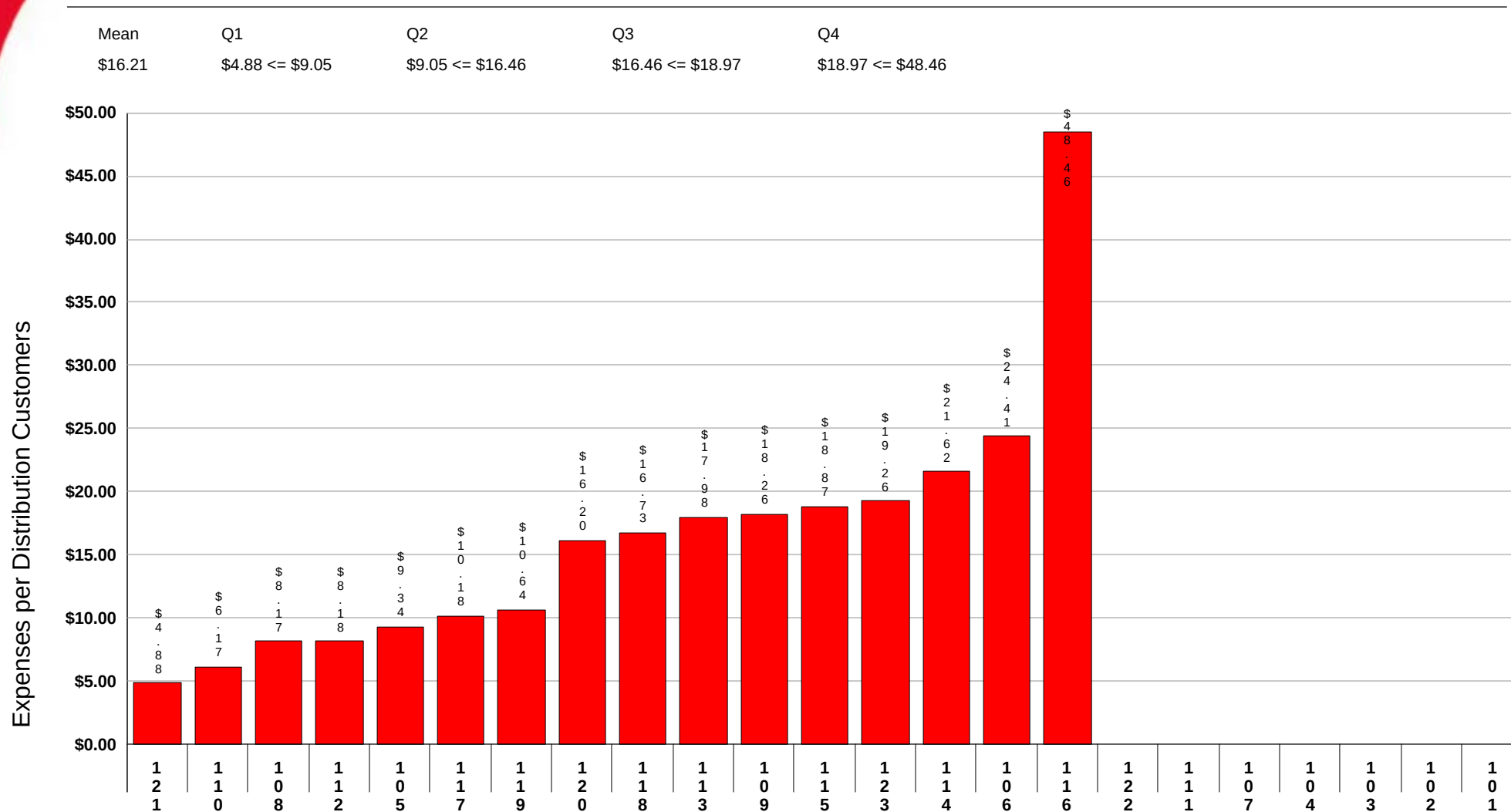
ID Code: 27141

Page: 1650

Only companies with all the data are shown.

Transmission Line O&M Expenses

Per Distribution Customers



Source/Calculation:(((SUM{B.20}-B.20.6+SUM{B.22})-SUM{B.21}-SUM{B.23})/A.2.2)

Volume: Transmission Line Statistics, Final Report, 2006

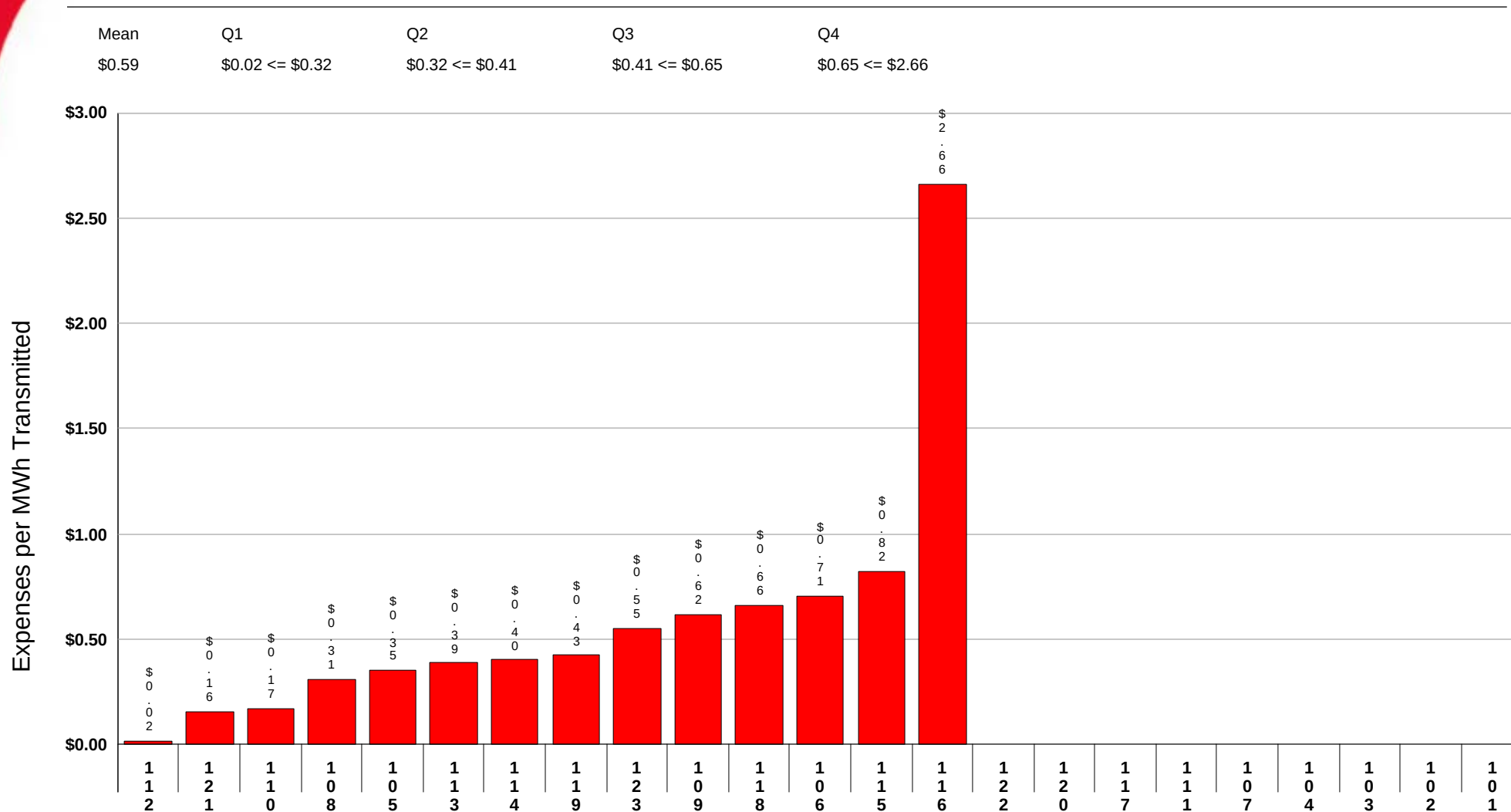
ID Code:8503

Page:1651

Only companies with all the data are shown.

Transmission Line O&M Expenses

Per MWh Transmitted



Source/Calculation: (SUM{B.20}-B.20.6+SUM{B.22}-SUM{B.21}-SUM{B.23})/A.2.5

Volume: Transmission Line Statistics, Final Report, 2006

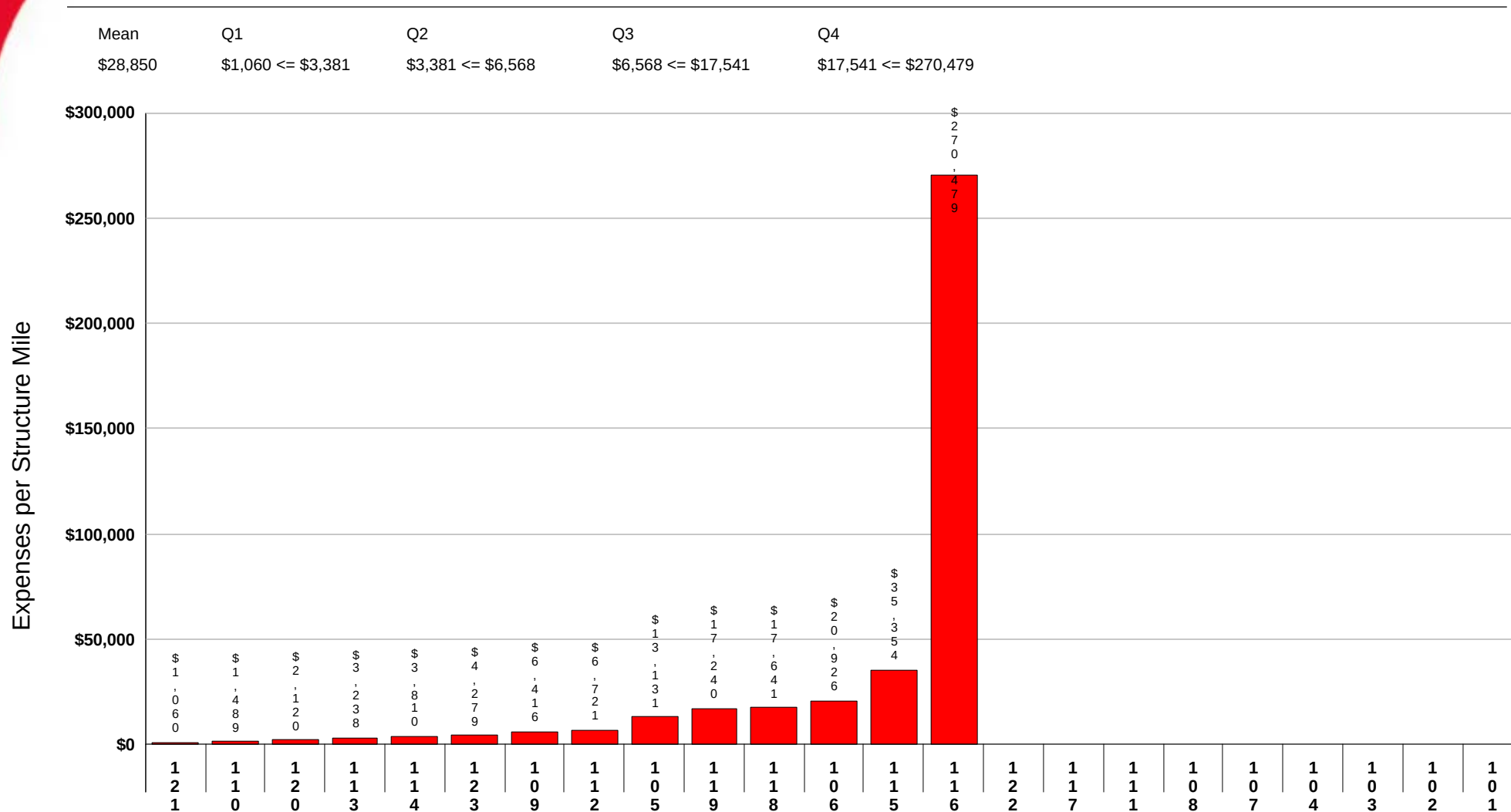
ID Code: 652

Page: 1652

Only companies with all the data are shown.

Transmission Line O&M Expenses

Per Transmission Structure Mile



Source/Calculation: $(\text{SUM}\{B.20\} - B.20.6 + \text{SUM}\{B.22\} - \text{SUM}\{B.21\} - \text{SUM}\{B.23\}) / (\text{SUM}\{BB.5\} + \text{SUM}\{BB.6\})$

Volume: Transmission Line Statistics, Final Report, 2006

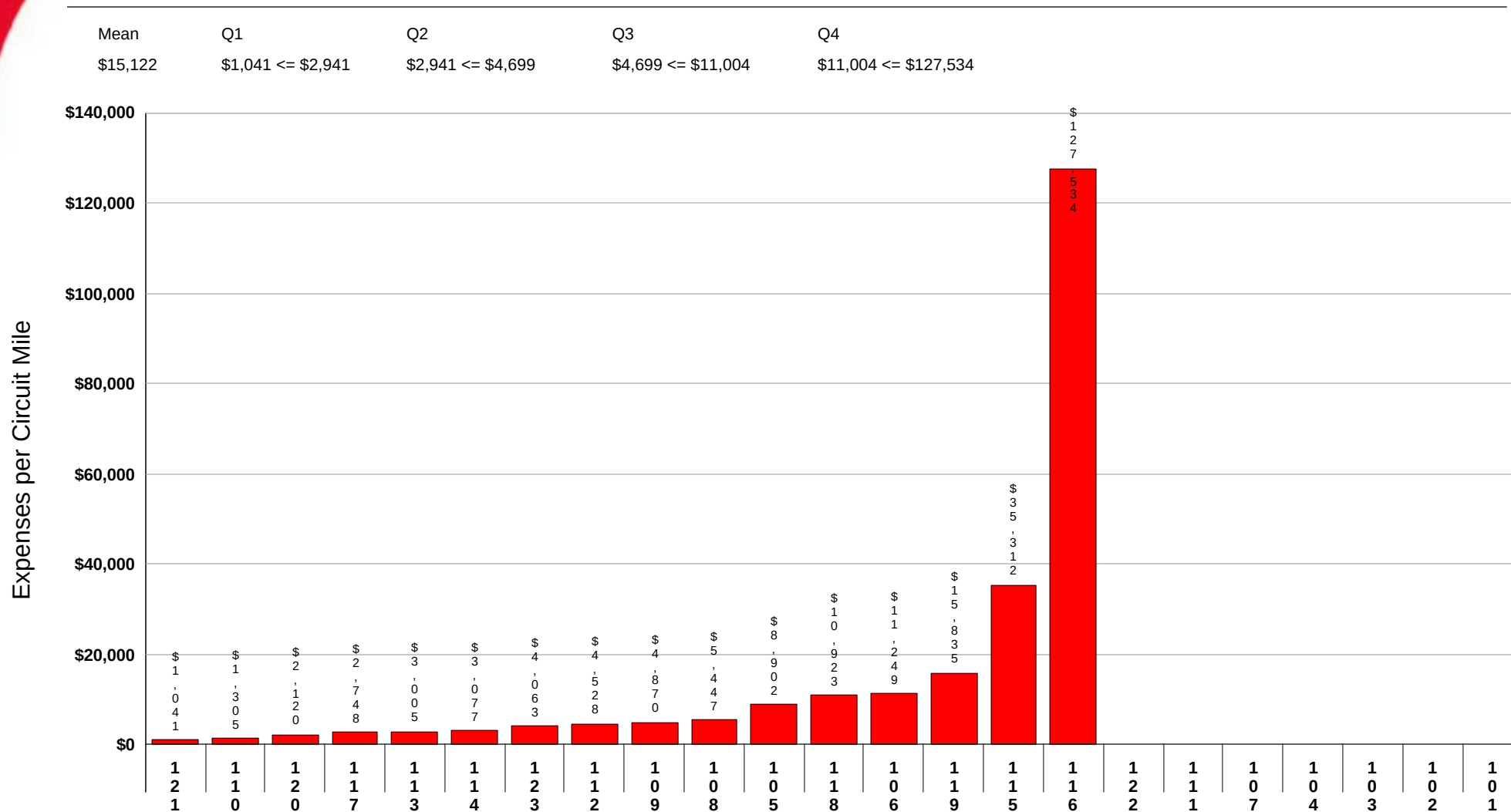
ID Code: 651

Page: 1653

Only companies with all the data are shown.

Transmission Line O&M Expenses

Per Transmission Circuit Mile



Source/Calculation: $(\text{SUM}\{B.20\} - B.20.6 + \text{SUM}\{B.22\} - \text{SUM}\{B.21\} - \text{SUM}\{B.23\}) / (\text{SUM}\{BB.3\} + \text{SUM}\{BB.4\})$

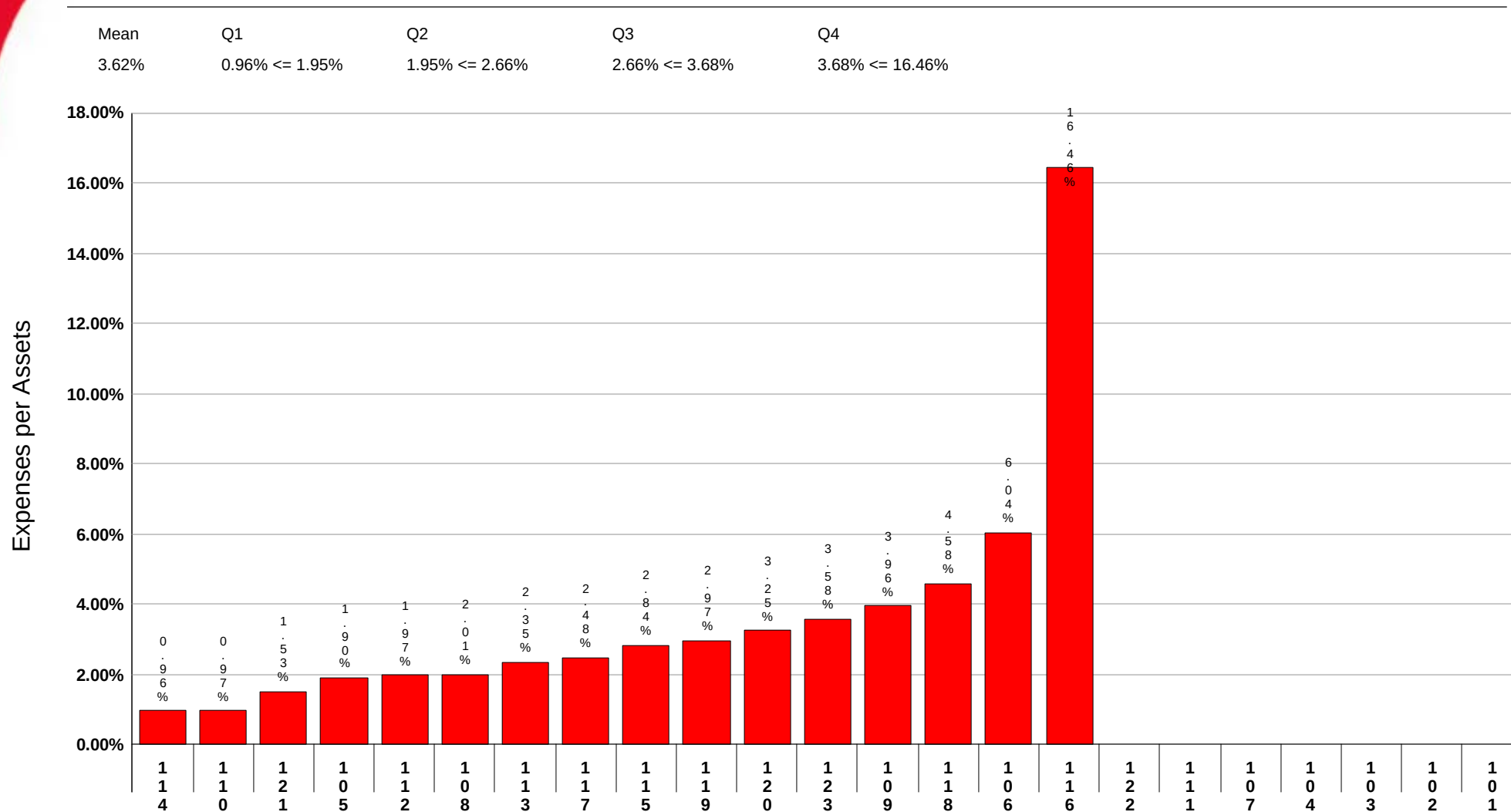
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 2007

Page: 1654

Only companies with all the data are shown.

Transmission Line O&M Expenses Per Assets



Source/Calculation: (SUM{B.20}-B.20.6+SUM{B.22}-SUM{B.21}-SUM{B.23})/(B.10.1-B.11.1)

Volume: Transmission Line Statistics, Final Report, 2006

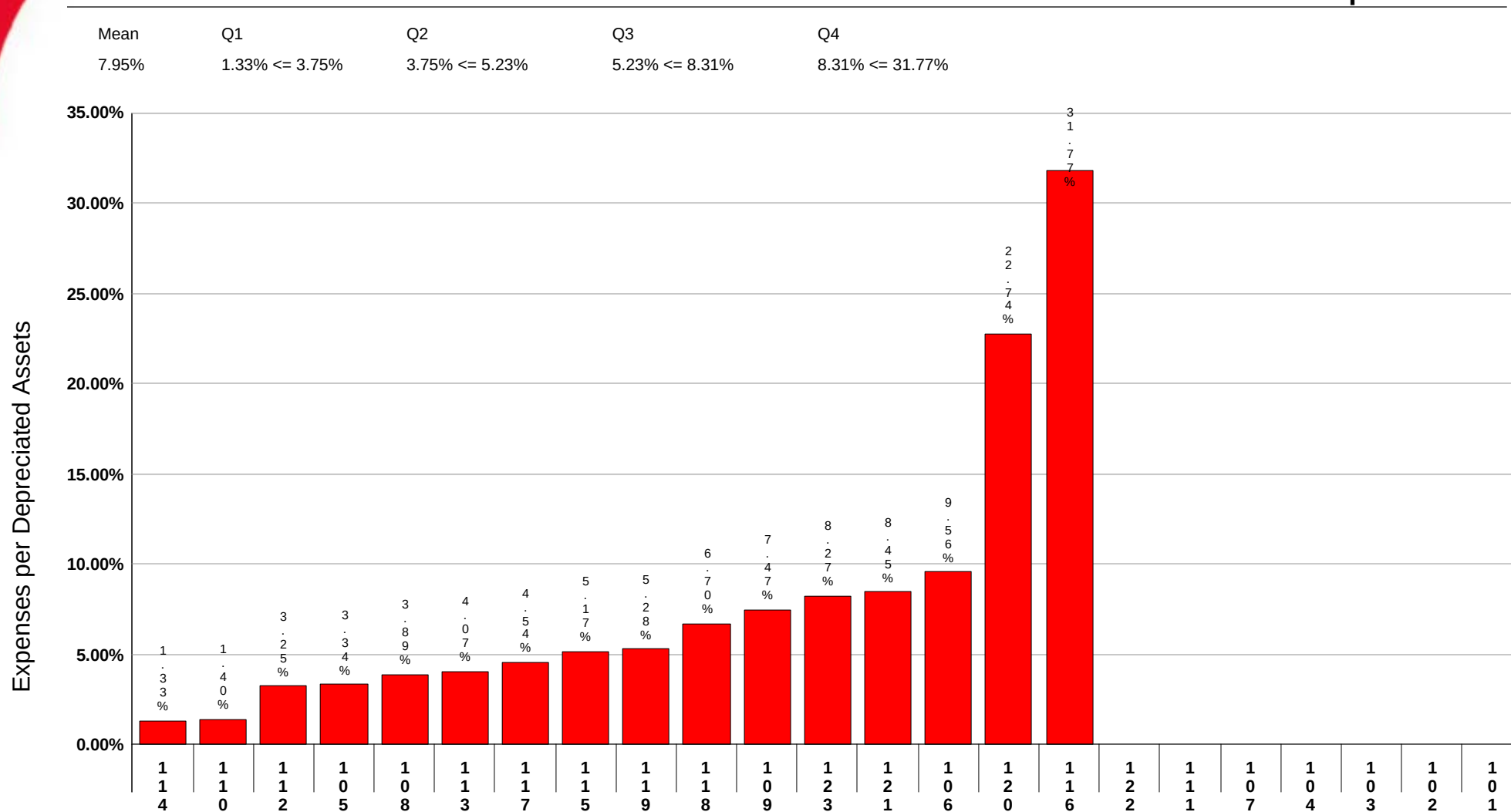
ID Code: 2117

Page: 1655

Only companies with all the data are shown.

Transmission Line O&M Expenses

Per Assets Less Depreciation



Source/Calculation: $(\text{SUM}\{B.20\} - B.20.6 + \text{SUM}\{B.22\} - \text{SUM}\{B.21\} - \text{SUM}\{B.23\}) / ((B.10.1 - B.14.2) - (B.11.1 - B.15.2))$

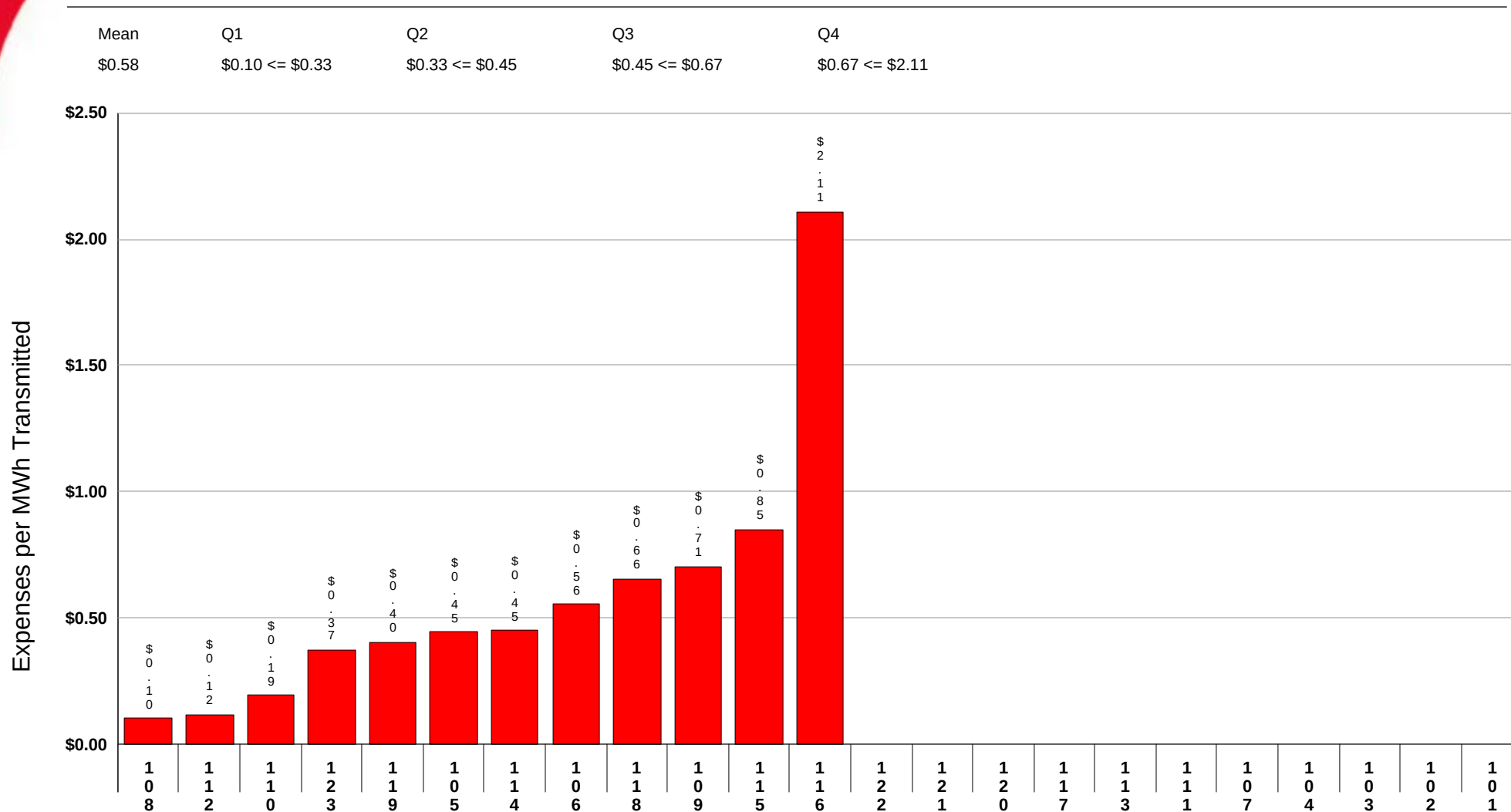
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 6503

Page: 1656

Only companies with all the data are shown.

3-Year Average Transmission Line O&M Expenses Per MWh Transmitted



Source/Calculation: $((\text{SUM}\{B.20\}-B.20.6+\text{SUM}\{B.22\}-\text{SUM}\{B.21\}-\text{SUM}\{B.23\})/A.2.5+(B.28.1-B.29.1)/(A.3.5)+(B.28.2-B.29.2)/(A.3.6))/3$

Volume: Transmission Line Statistics, Final Report, 2006

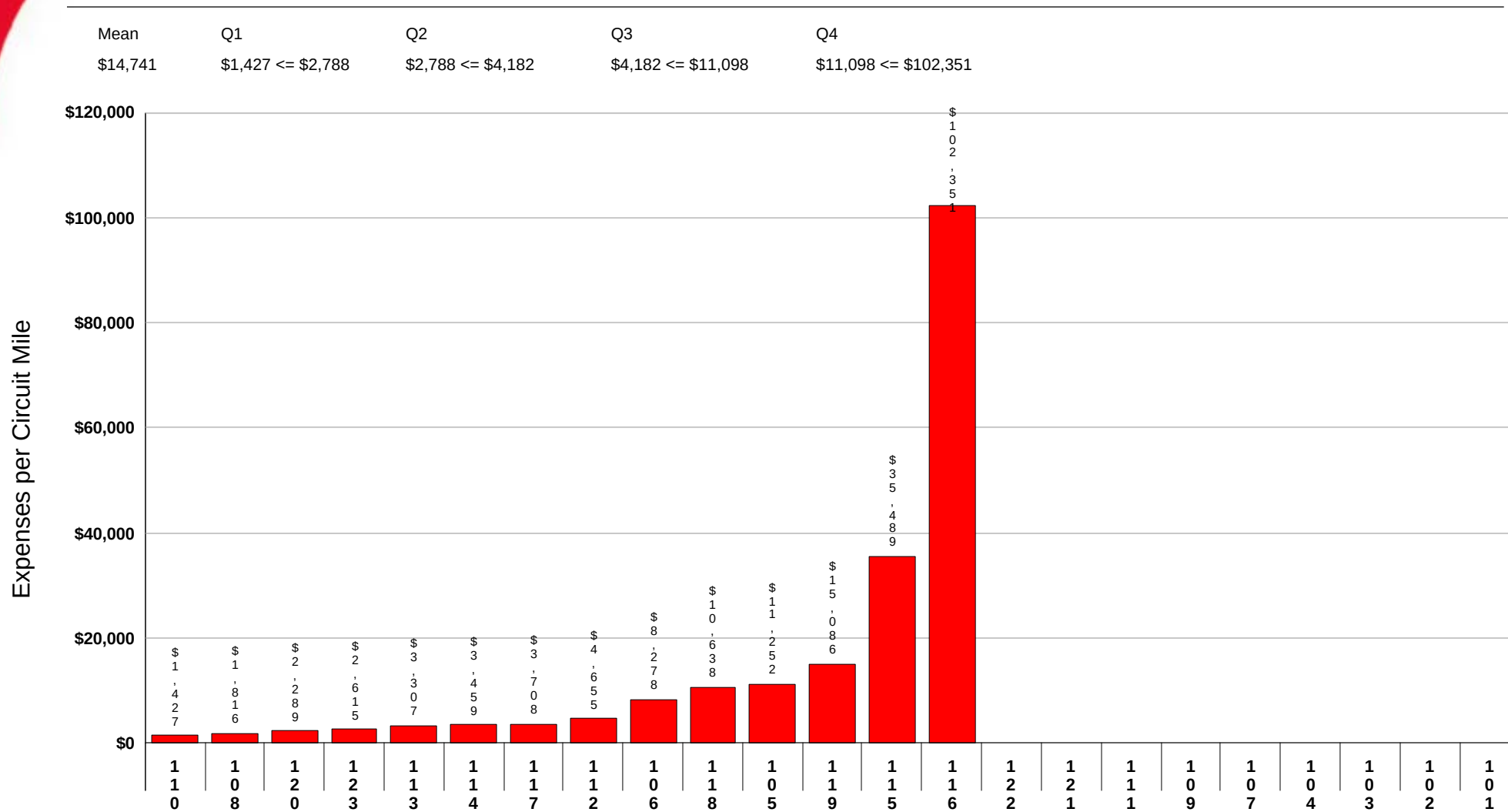
ID Code: 27124

Page: 1658

Only companies with all the data are shown.

3-Year Average Transmission Line O&M Expenses

Per Transmission Circuit Mile



Source/Calculation: $((\text{SUM}\{B.20\}-B.20.6+\text{SUM}\{B.22\}-\text{SUM}\{B.21\}-\text{SUM}\{B.23\})/(\text{SUM}\{BB.3\}+\text{SUM}\{BB.4\})+(B.28.1-B.29.1)/(BB.8.1)+(B.28.2-B.29.2)/(BB.8.2))/3$

Volume: Transmission Line Statistics, Final Report, 2006

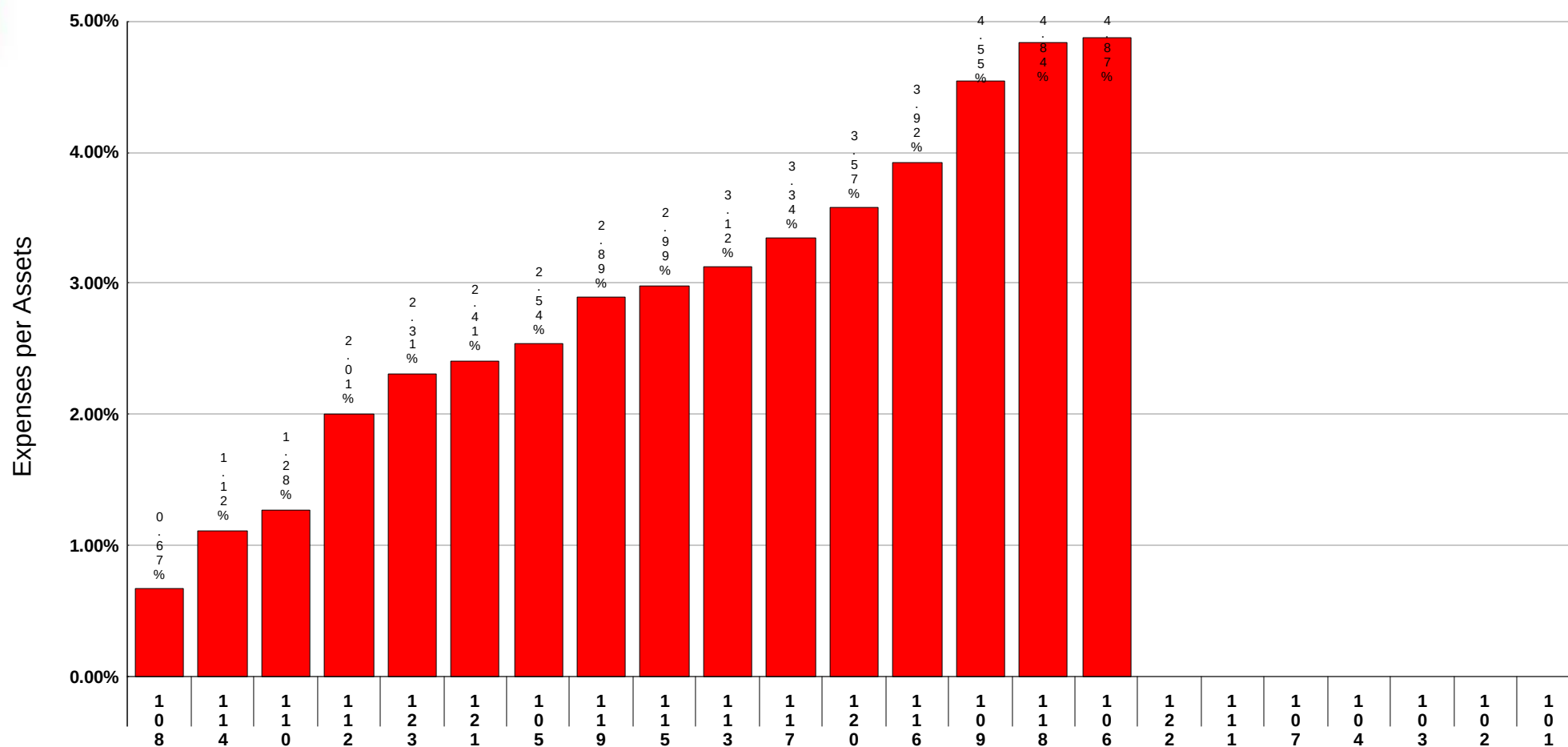
ID Code: 27128

Page: 1659

Only companies with all the data are shown.

Per Assets

Mean	Q1	Q2	Q3	Q4
2.90%	0.67% <= 2.23%	2.23% <= 2.94%	2.94% <= 3.66%	3.66% <= 4.87%



Source/Calculation: $((\text{SUM}\{B.20\}-B.20.6+\text{SUM}\{B.22\}-\text{SUM}\{B.21\}-\text{SUM}\{B.23\})/(B.10.1-B.11.1)+(B.28.1-B.29.1)/(B.12.1-B.13.1)+(B.28.2-B.29.2)/(B.12.2-B.13.2))/3$

Volume: Transmission Line Statistics, Final Report, 2006

ID Code:27449

Only companies with all the data are shown.

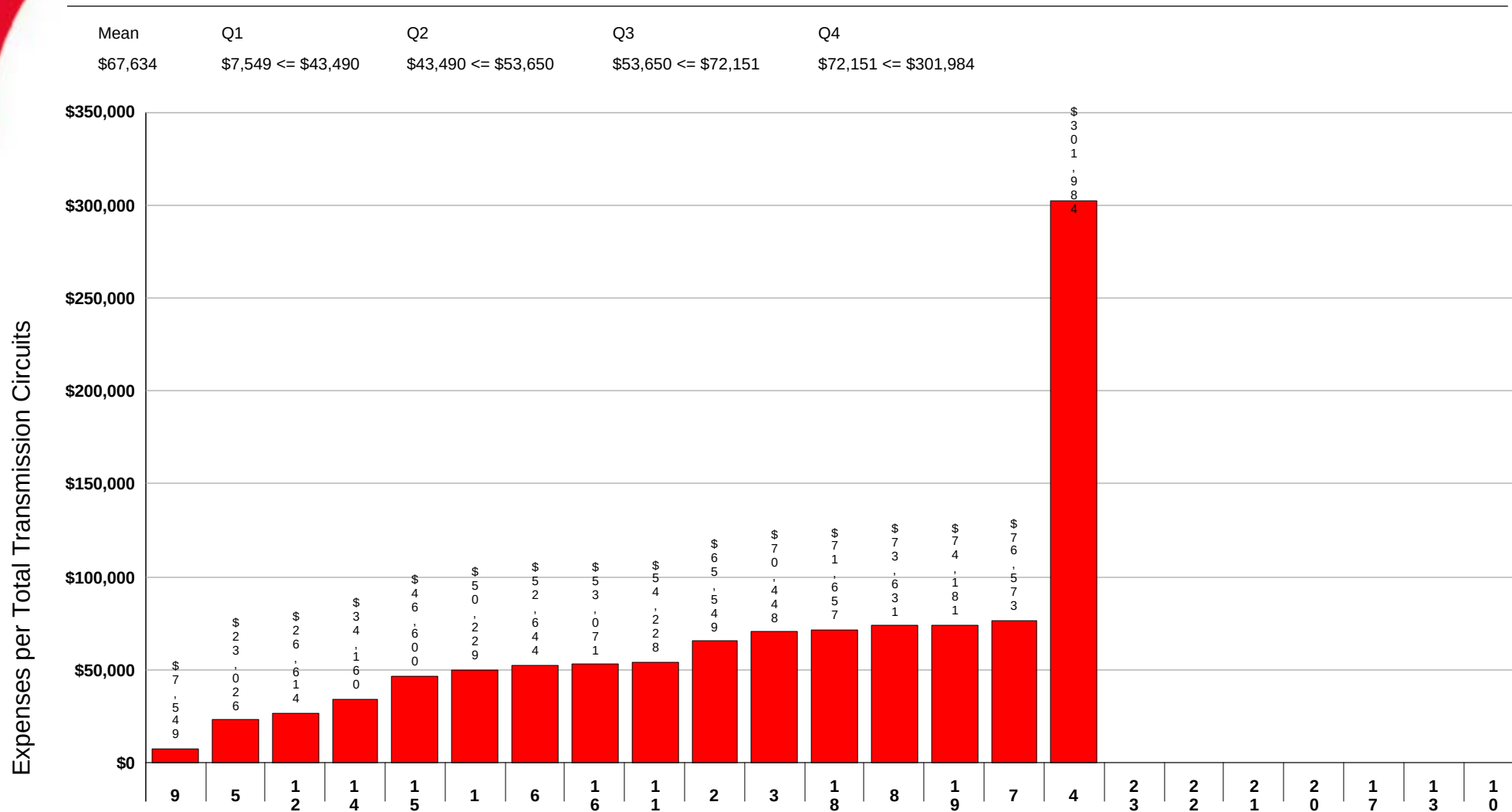
Page:1660

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Transmission Operations Expense

Per Total Transmission Circuits



Source/Calculation: (SUM{B.20}-B.20.6)/SUM{BB.2}

Volume: Transmission Line Statistics, Final Report, 2006

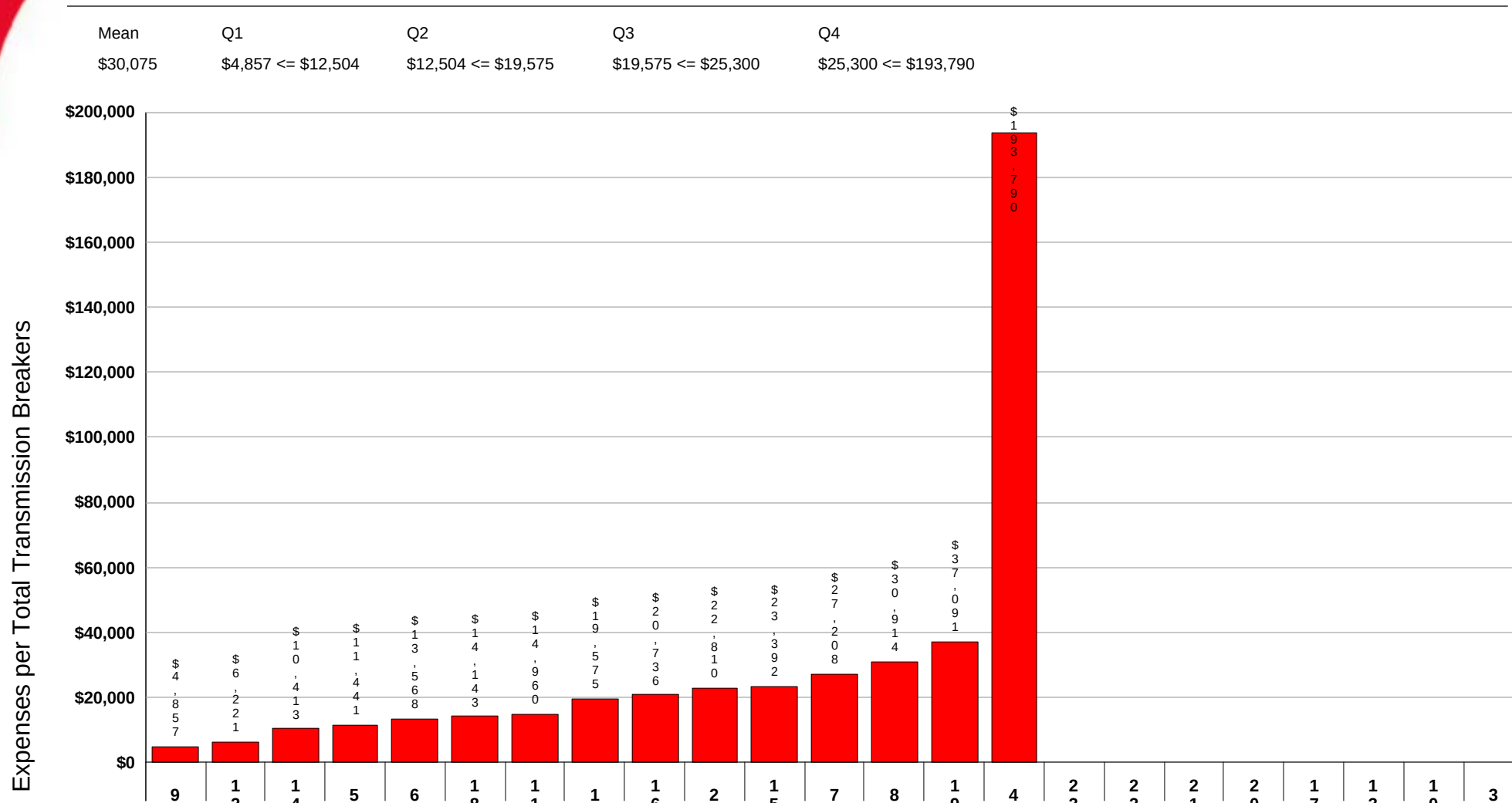
ID Code:2500044

Page:1660.1

Only companies with all the data are shown.

Transmission Operations Expense

Per Total Transmission Breakers



Source/Calculation: (SUM{B.20}-B.20.6)/(AQ.4.1+AQ.4.2+AQ.4.3+AQ.4.4+AQ.4.5+AQ.4.6)

Volume: Transmission Line Statistics, Final Report, 2006

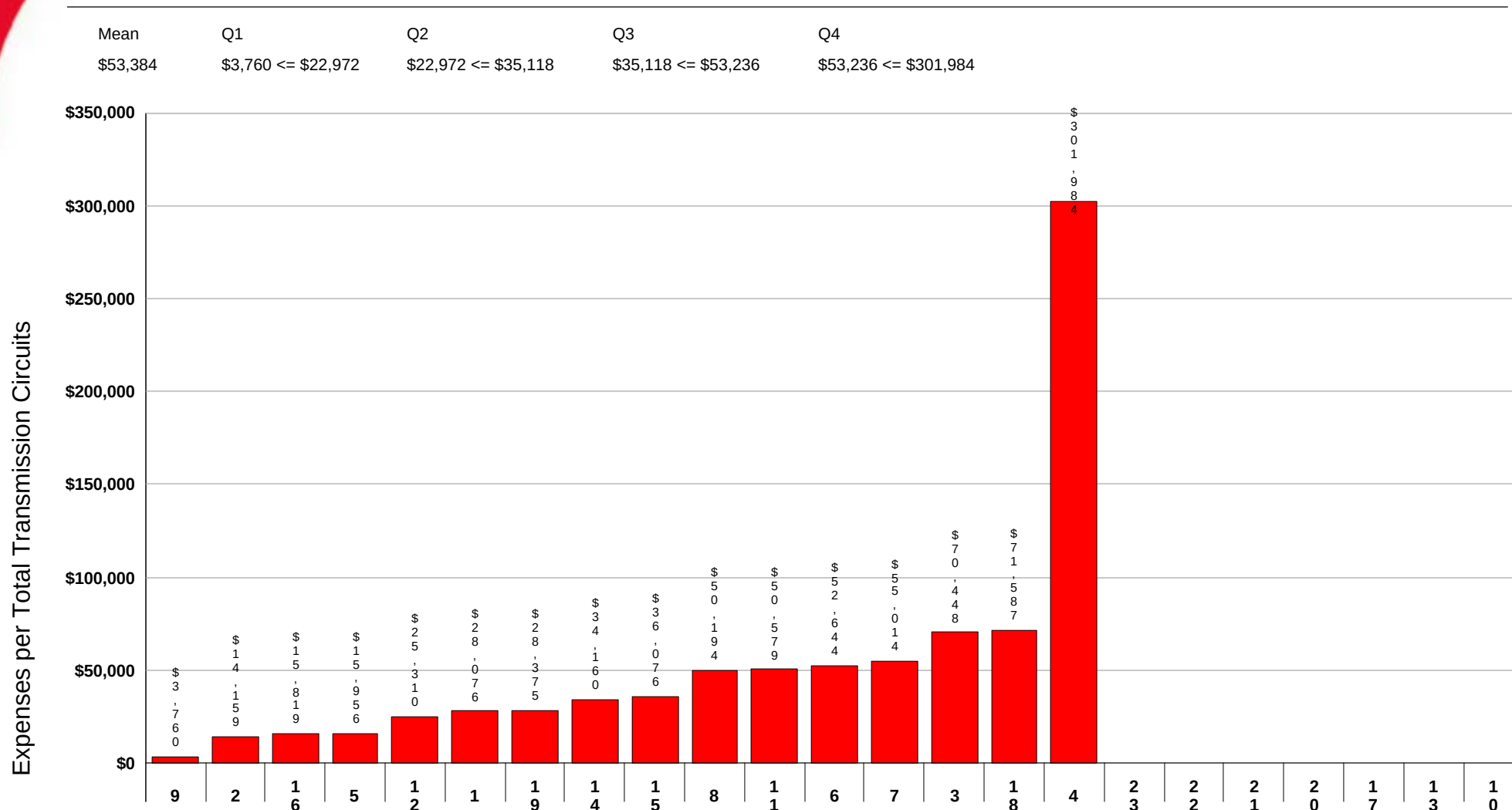
ID Code:2500042

Only companies with all the data are shown.

Page:1660.2

Transmission Line Operations Expense

Per Total Transmission Circuits



Source/Calculation:((SUM{B.20}-B.20.6)-SUM{B.21})/SUM{BB.2}

Volume: Transmission Line Statistics, Final Report, 2006

ID Code:1600022

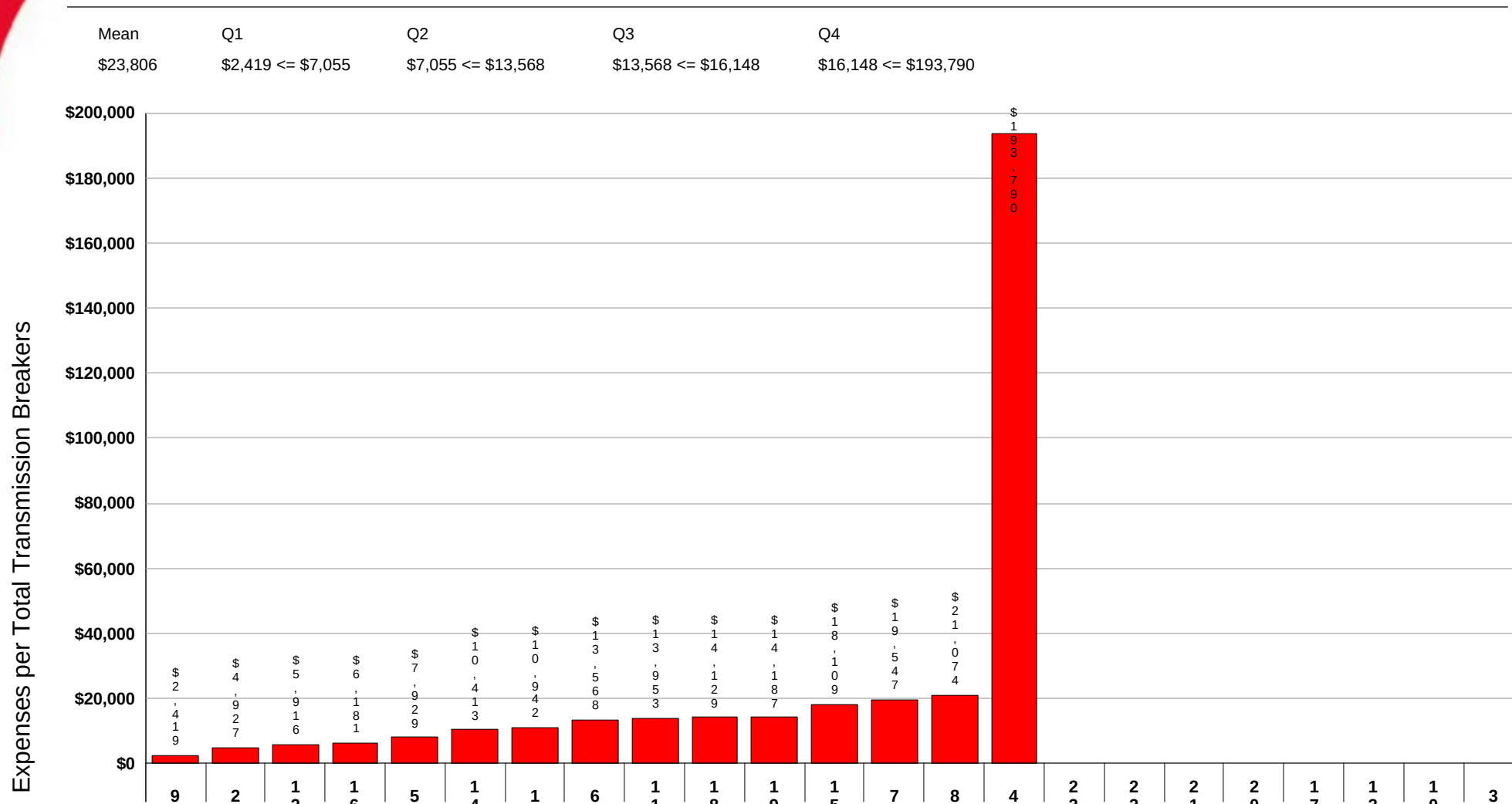
Page:1660.3

Only companies with all the data are shown.



Transmission Line Operations Expense

Per Total Transmission Breakers



Source/Calculation: ((SUM{B.20}-B.20.6)-SUM{B.21})/(AQ.4.1+AQ.4.2+AQ.4.3+AQ.4.4+AQ.4.5+AQ.4.6)

Volume: Transmission Line Statistics, Final Report, 2006

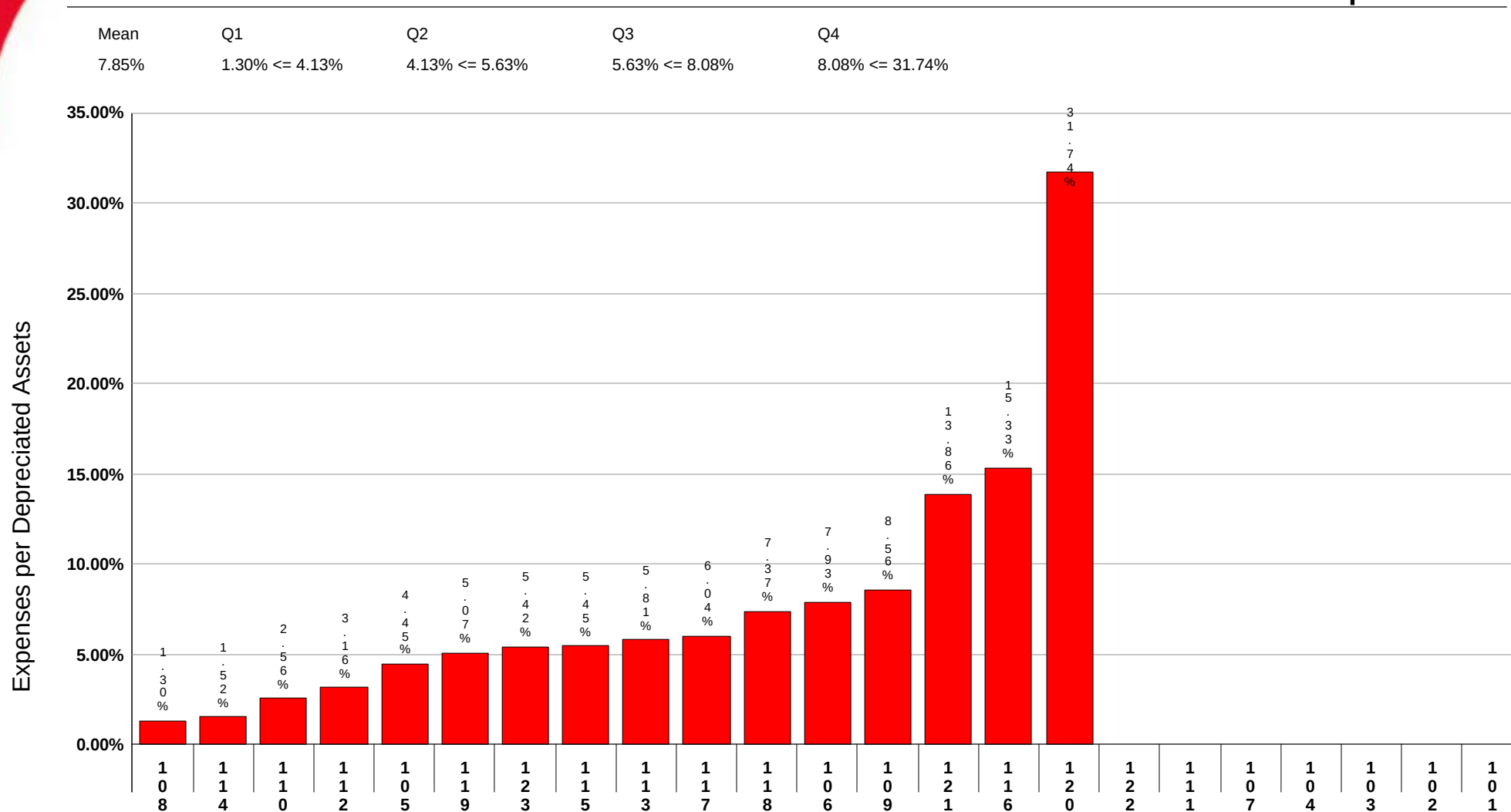
ID Code:1600023

Page:1660.4

Only companies with all the data are shown.

3-Year Average Transmission Line O&M Expenses

Per Assets Less Depreciation



(((SUM{B.20}-B.20.6+SUM{B.22}-SUM{B.21}-SUM{B.23}))/((B.10.1-B.14.2-(B.11.1-B.15.2)))+(B.28.1-B.29.1)/(B.12.1-B.13.1-(B.16.3-B.17.3)))+(B.28.2-B.29.2)/(B.12.2-B.13.2-(B.16.4-B.17.4)))/3

Source/Calculation:

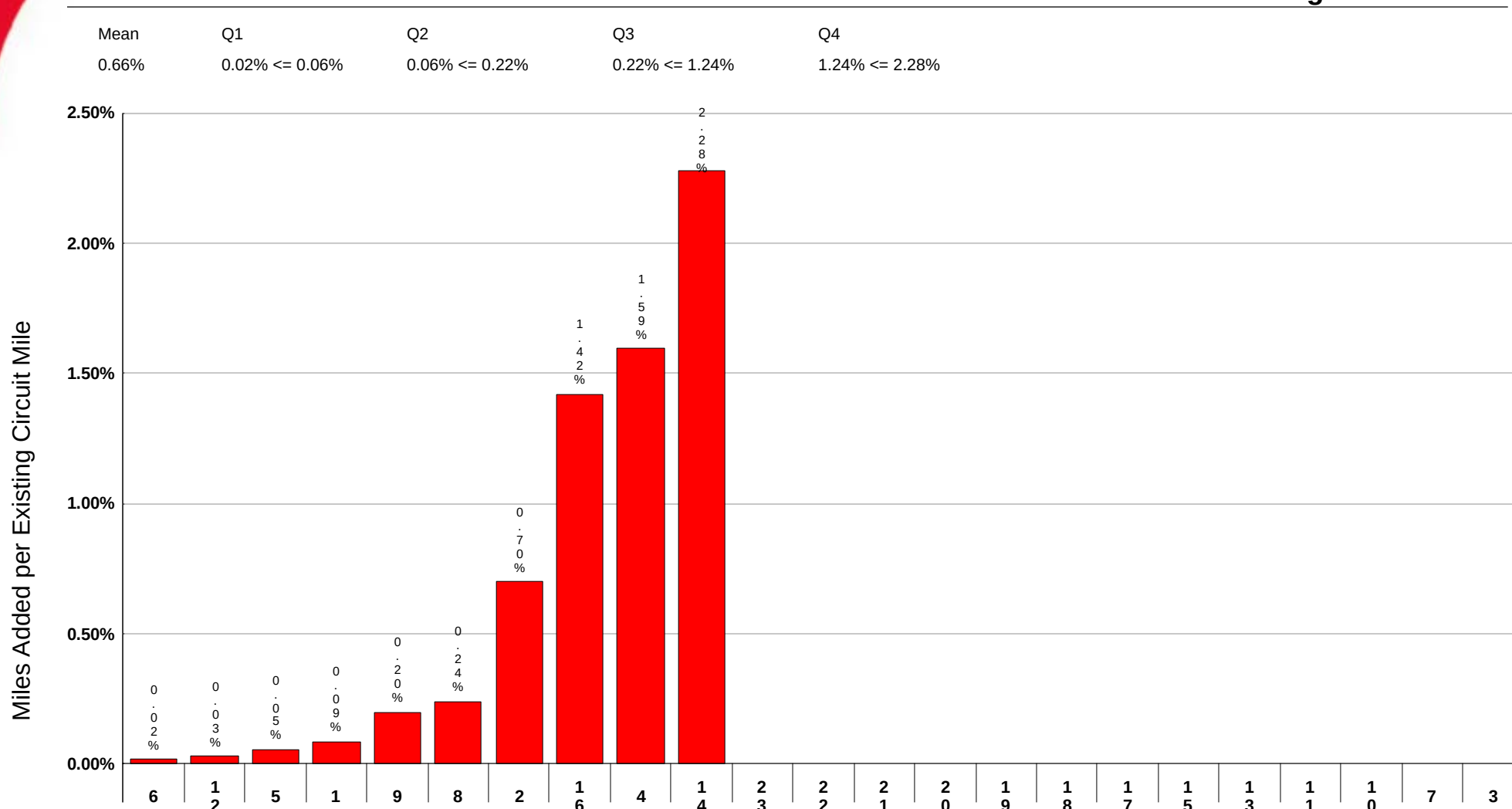
Volume: Transmission Line Statistics, Final Report, 2006

ID Code:27139

Page:1661

Only companies with all the data are shown.

Transmission Circuit Miles Added Per Existing Circuit Mile



Source/Calculation: $\text{SUM}\{\text{BB.10}\} / (\text{SUM}\{\text{BB.3}\} + \text{SUM}\{\text{BB.4}\})$

Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 1600032

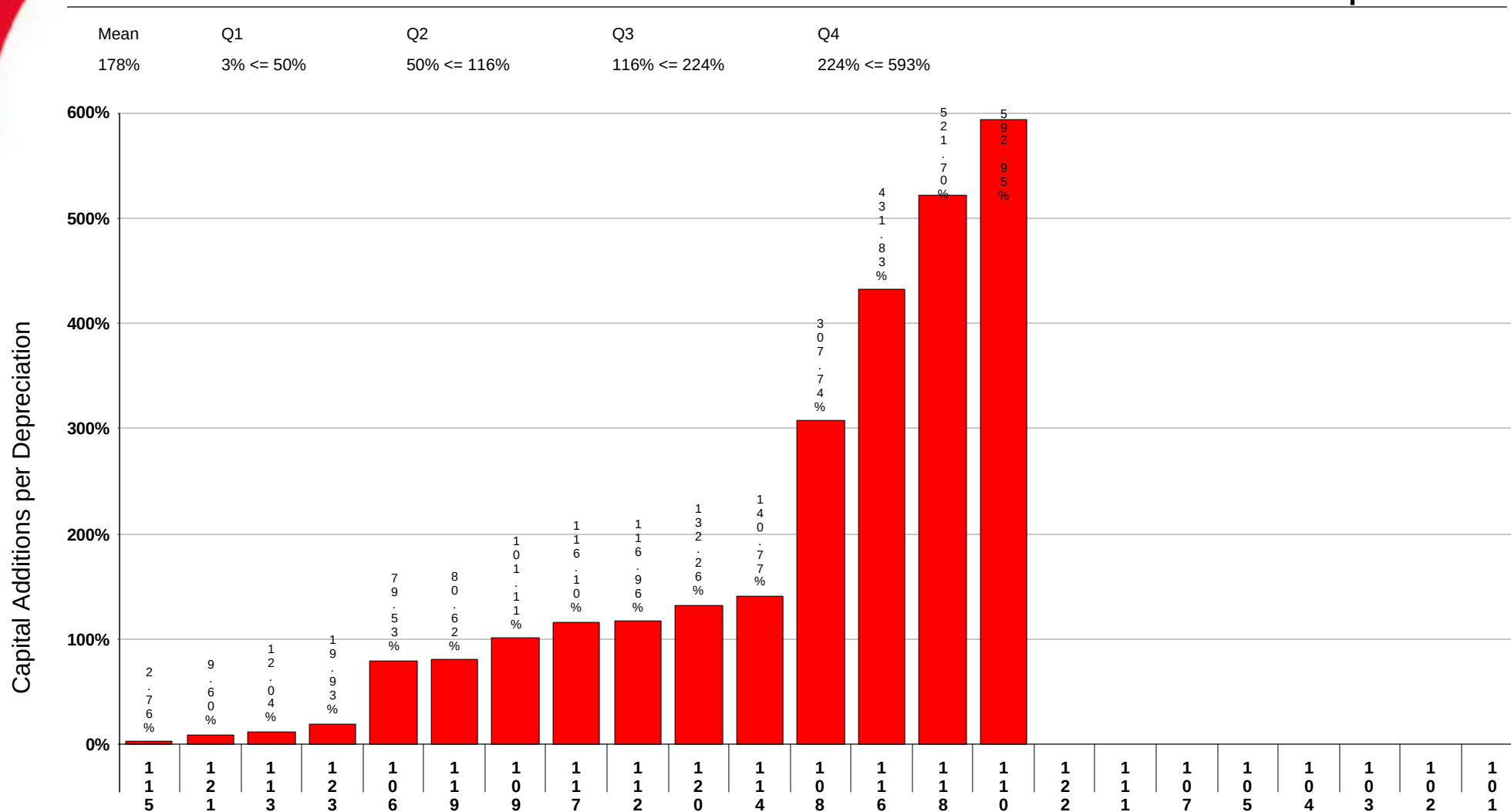
Page: 1661.1

Only companies with all the data are shown.



Current Year Capital Additions - Overall Transmission

Per Current Year Depreciation



Source/Calculation: (SUM{B.2})/B.18.2

Volume: Transmission Line Statistics, Final Report, 2006

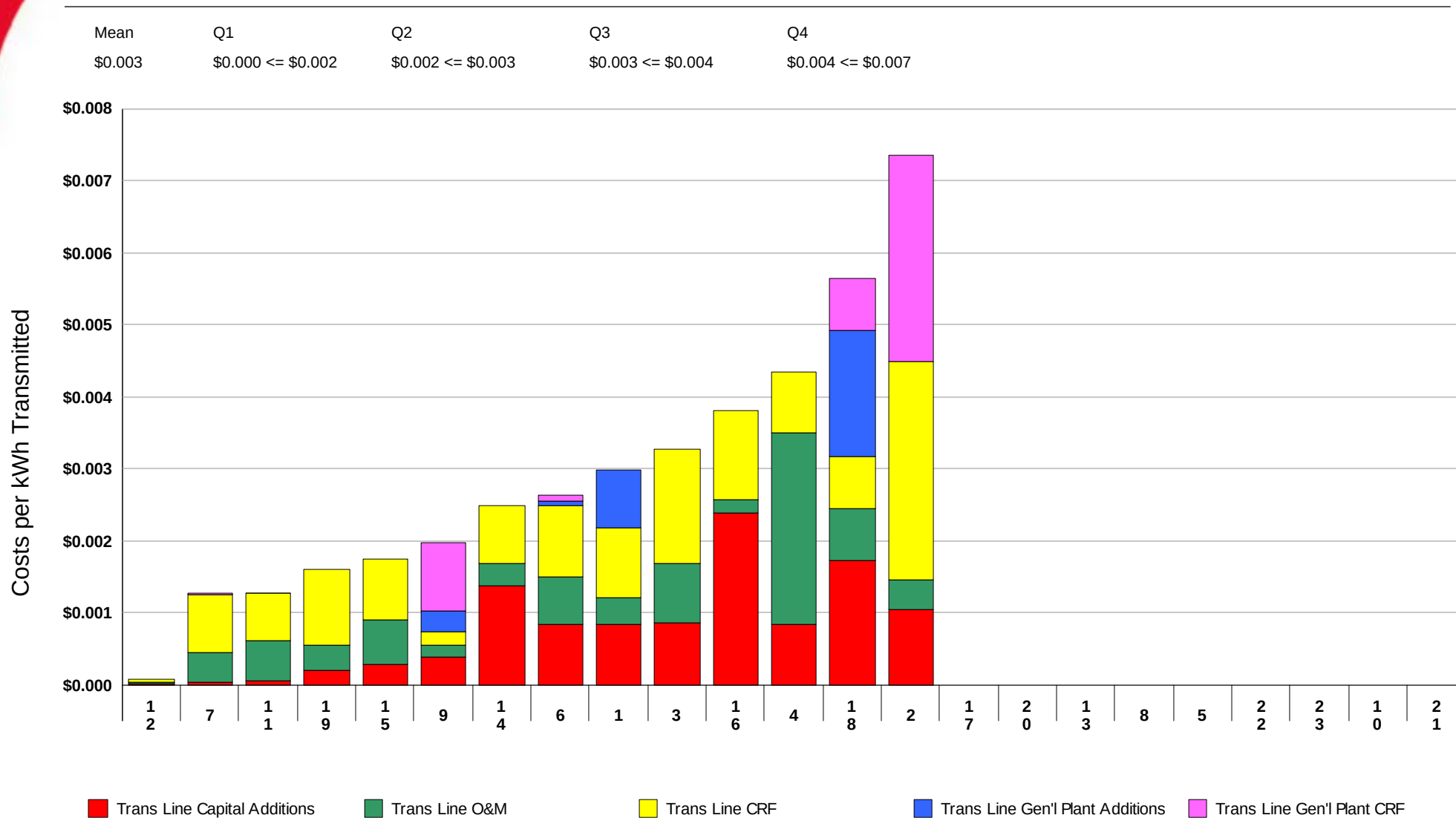
ID Code: 27388

Page: 1662

Only companies with all the data are shown.

Transmission Line Delivery Costs

Per kWh Hour Transmitted



Source/Calculation: $(\text{SUM}\{B.2\} - \text{SUM}\{B.3\}) / (A.2.5 * 1000)$

Volume: Transmission Line Statistics, Final Report, 2006

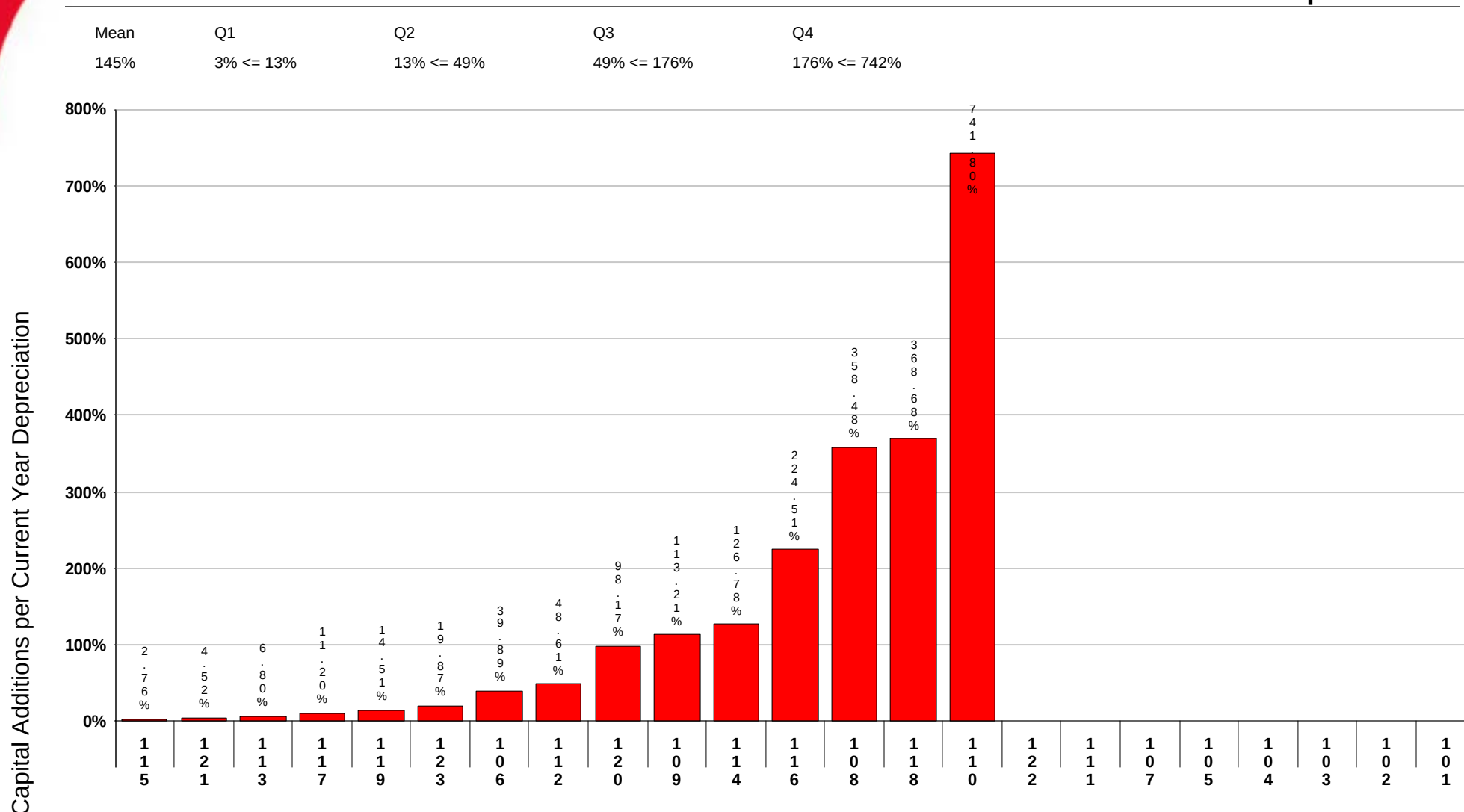
ID Code: 8864

Page: 1663

Calculation shown is for the first piece of the stacked bar only.

Current Year Capital Additions - Transmission Line

Per Current Year Depreciation



Source/Calculation: (SUM{B.2}-SUM{B.3})/(B.18.2-B.19.2)

Volume: Transmission Line Statistics, Final Report, 2006

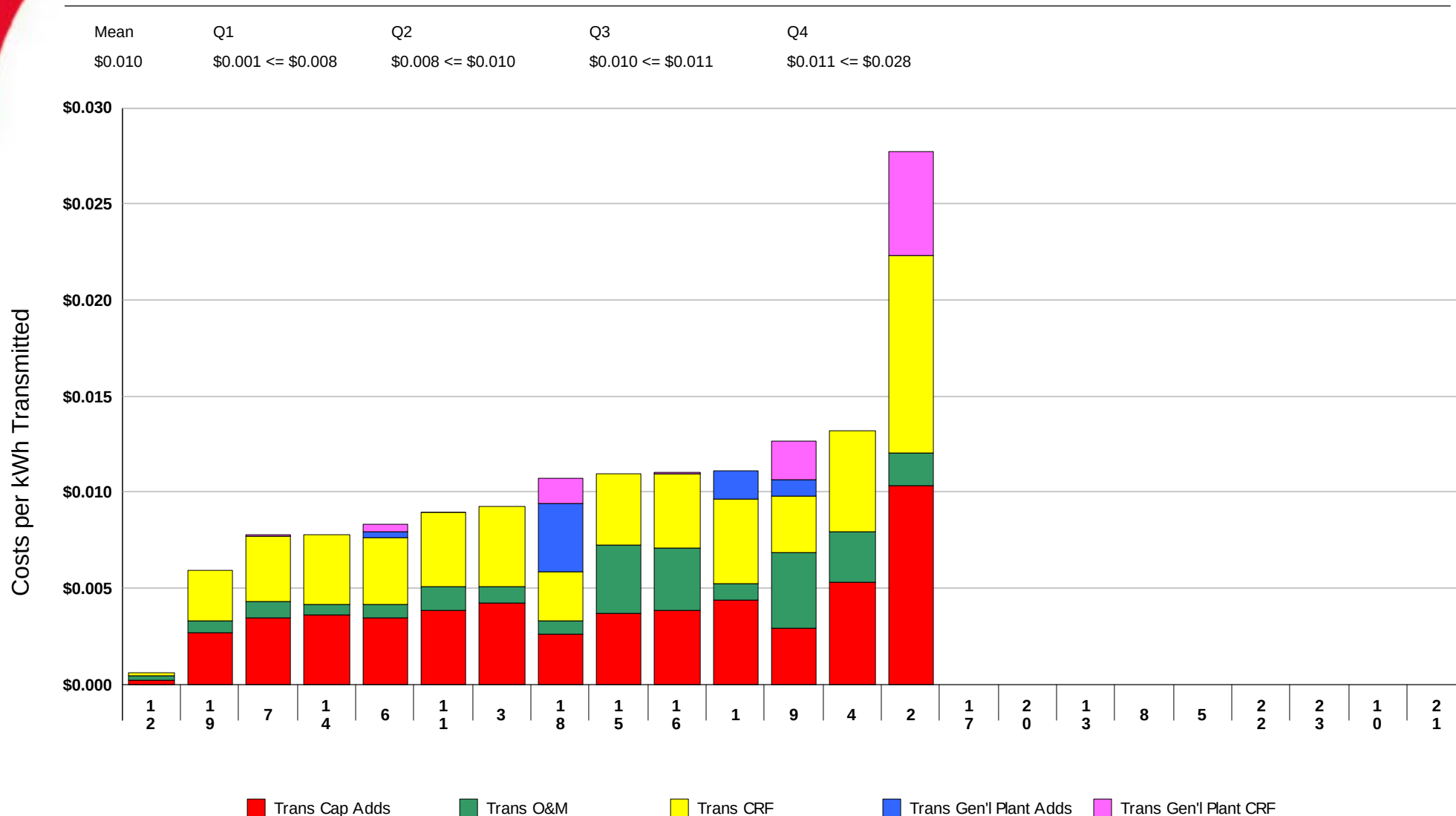
ID Code: 27391

Page: 1664

Only companies with all the data are shown.

Transmission Delivery Costs

Per kWh Transmitted



Source/Calculation: $((B.10.1 + B.14.2) * .10) / (A.2.5 * 1000)$

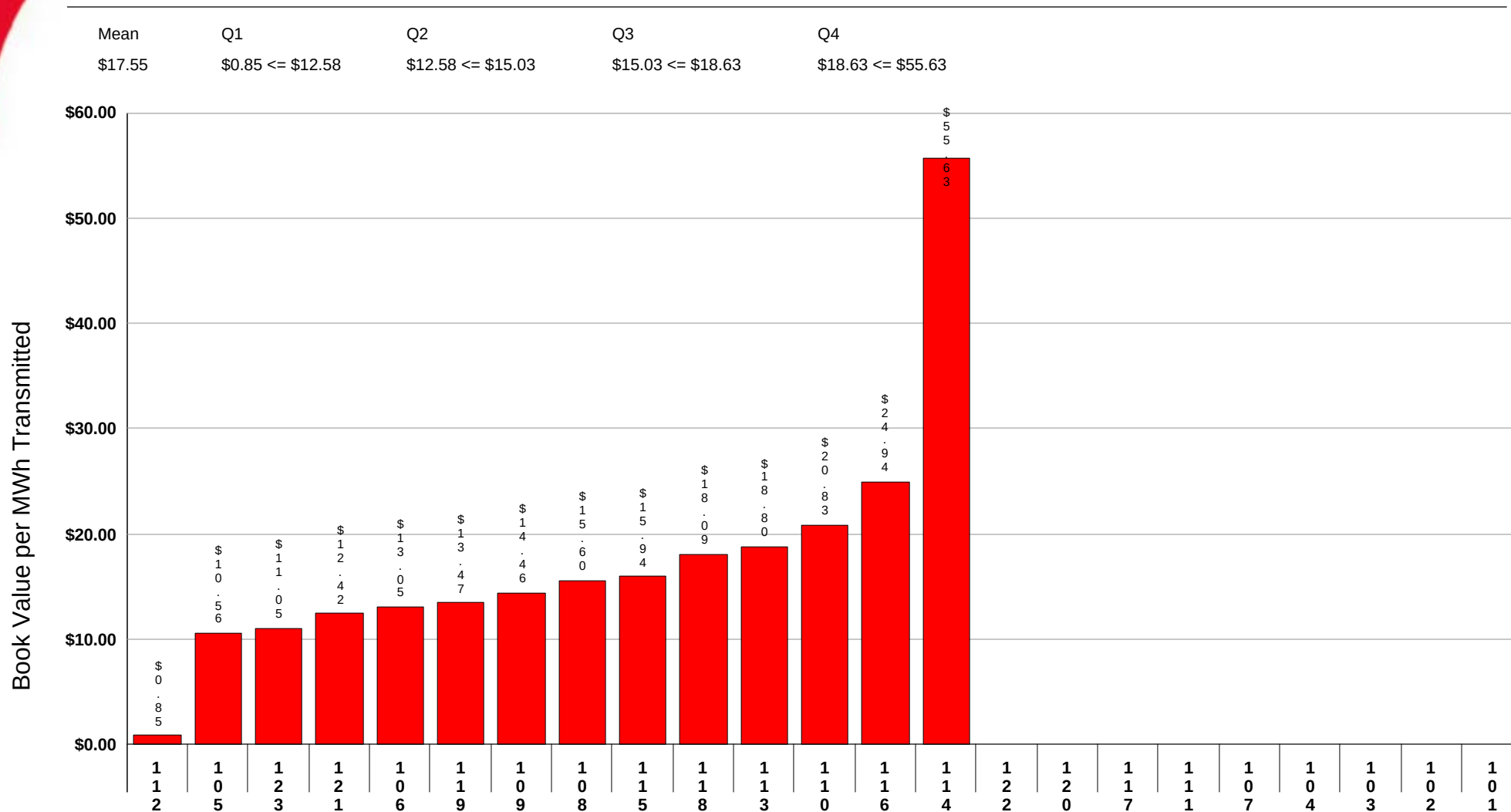
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 8866

Page: 1666

Calculation shown is for the first piece of the stacked bar only.

Transmission Book Value Per MWh Transmitted



Source/Calculation:(B.10.1-B.14.2)/A.2.5

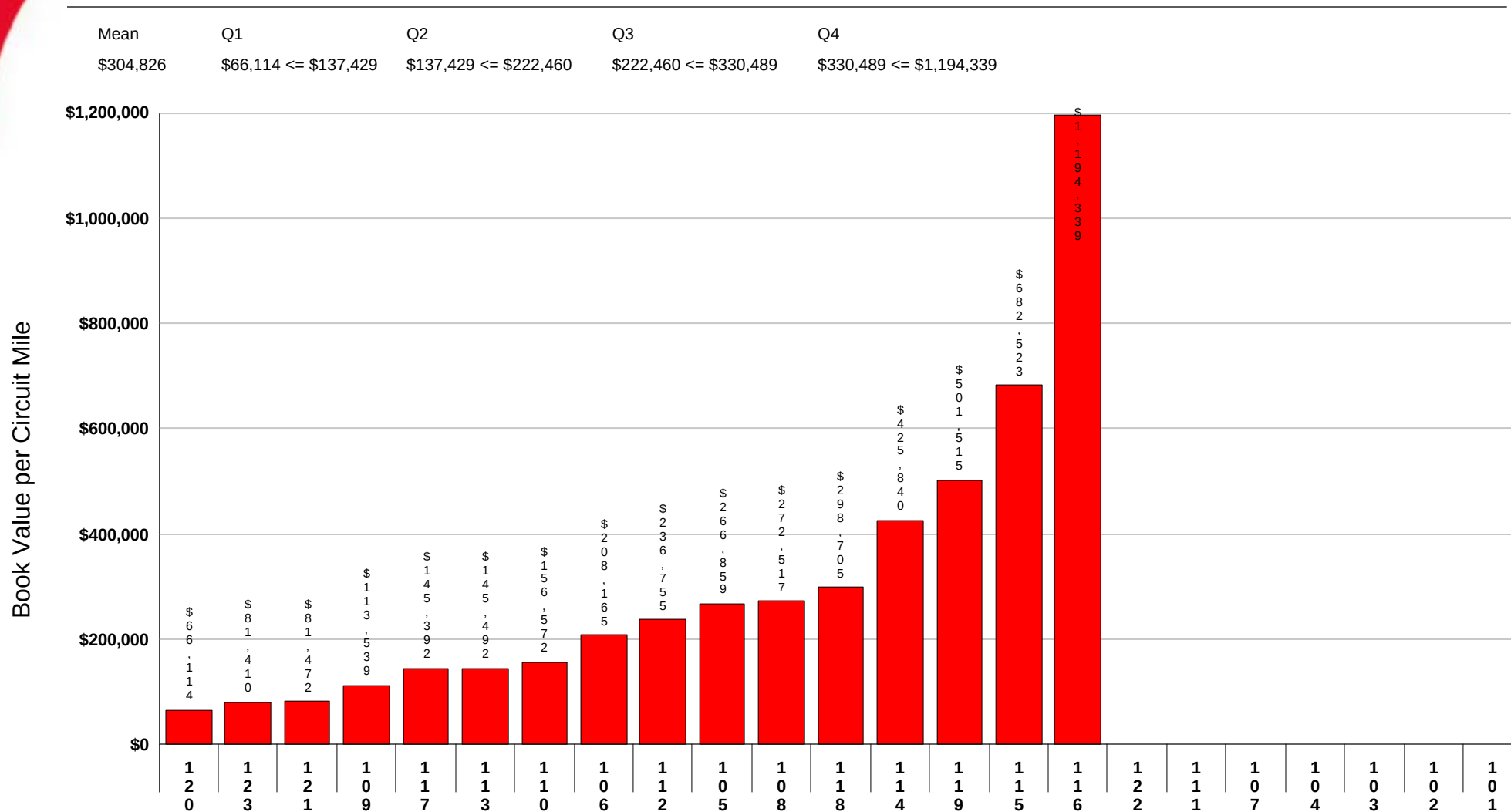
Volume: Transmission Line Statistics, Final Report, 2006

ID Code:2300117

Page:1668

Only companies with all the data are shown.

Transmission Book Value Per Circuit Mile



Source/Calculation: (B.10.1-B.14.2)/(SUM{BB.3}+SUM{BB.4})

Volume: Transmission Line Statistics, Final Report, 2006

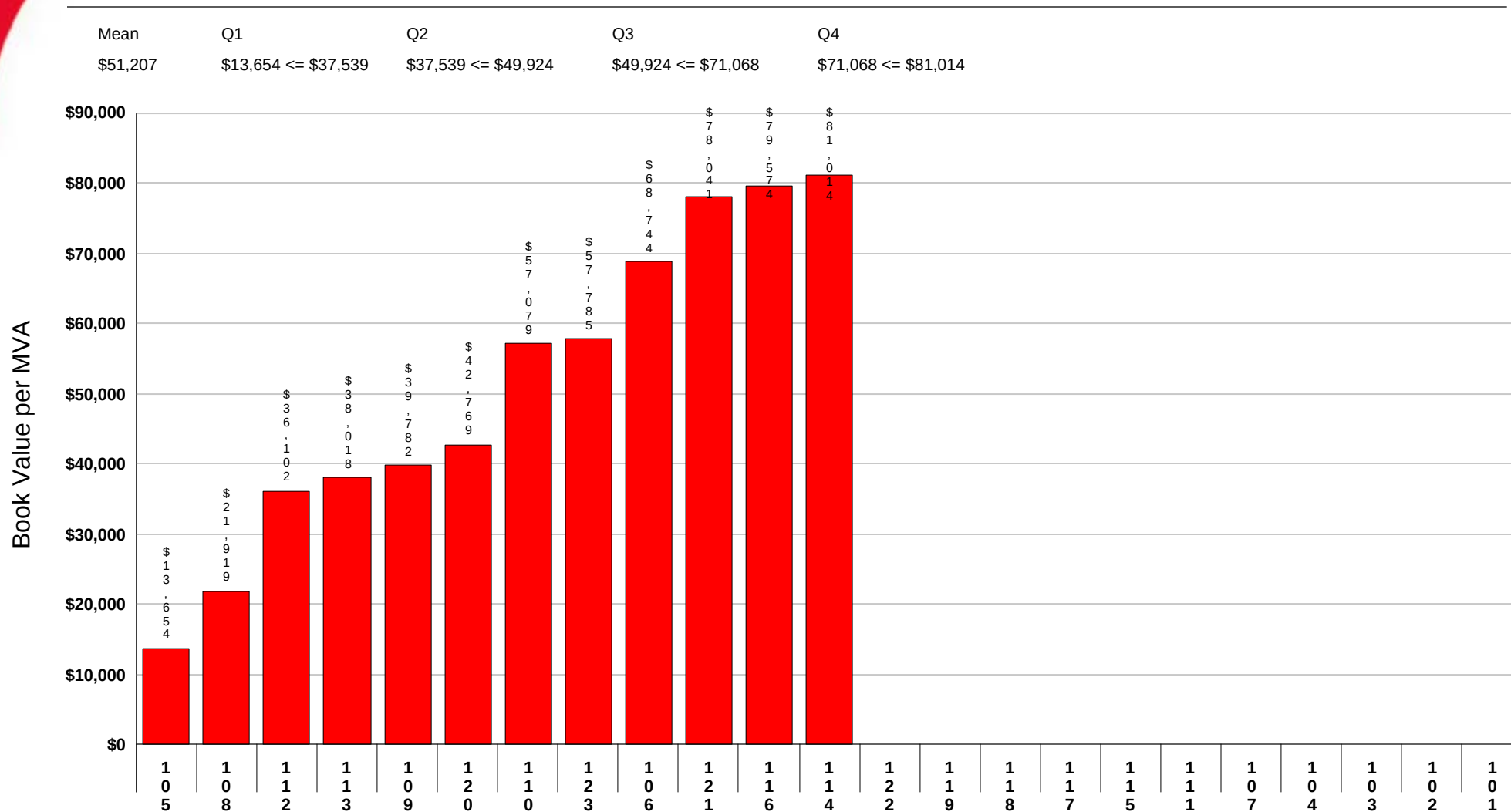
ID Code: 8748

Page: 1669

Only companies with all the data are shown.

Transmission Book Value

Per MVA



Source/Calculation: (B.10.1-B.14.2)/SUM{AQ.12}

Volume: Transmission Line Statistics, Final Report, 2006

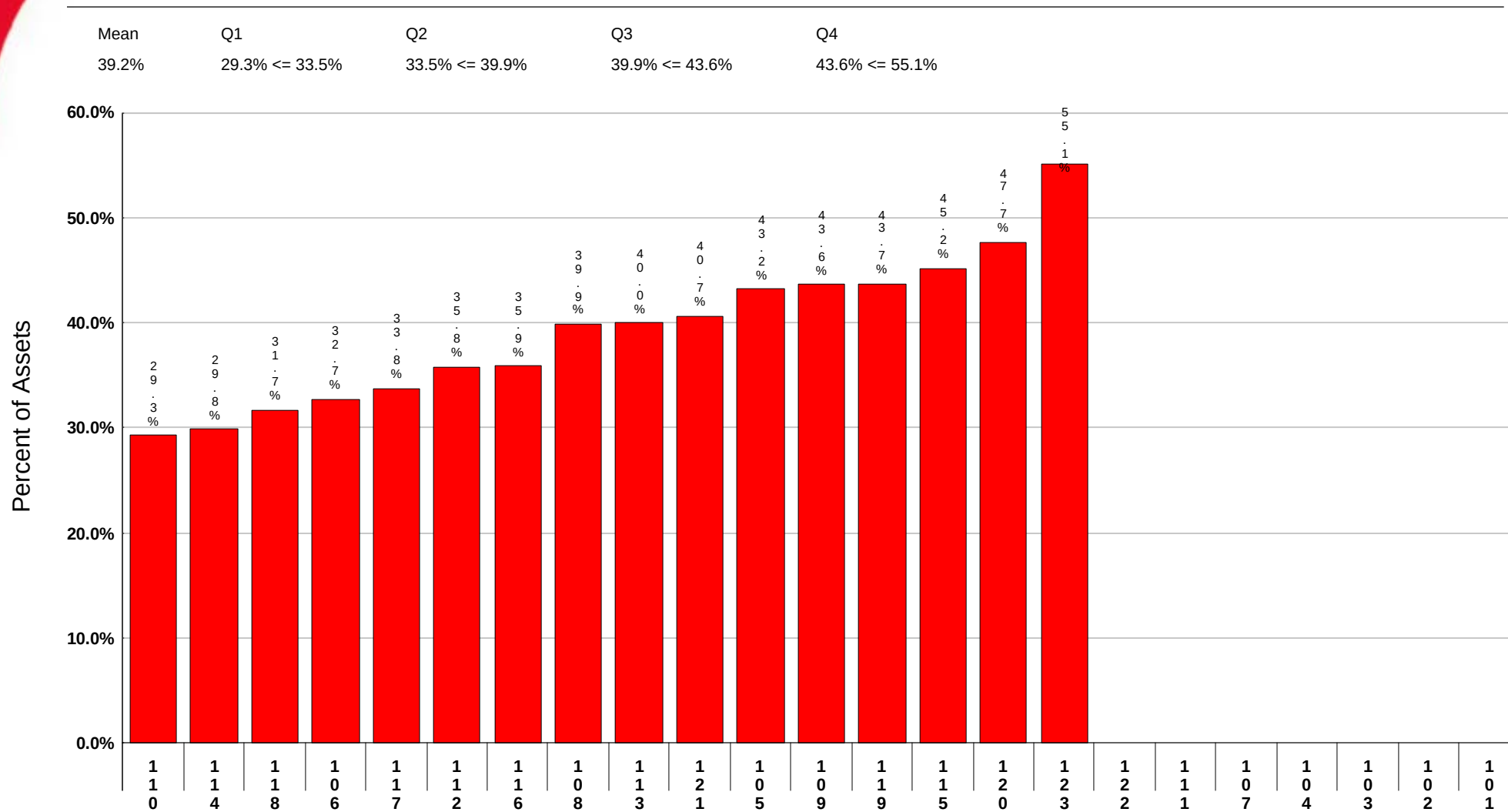
ID Code: 2300116

Page: 1670

Only companies with all the data are shown.

Transmission Depreciation

As a Percent of Assets



Source/Calculation: B.14.2/B.10.1

Volume: Transmission Line Statistics, Final Report, 2006

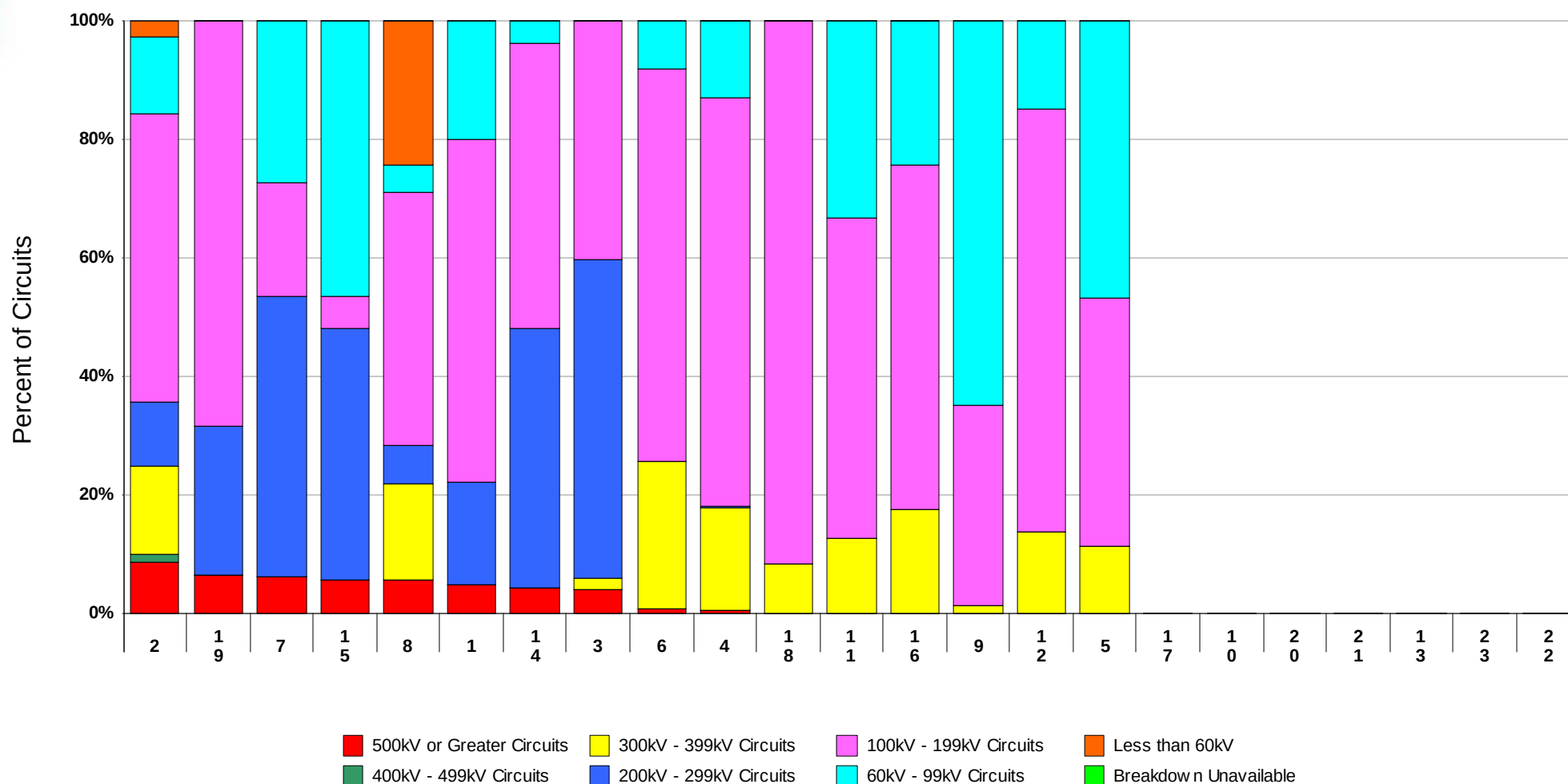
ID Code: 8750

Page: 1671

Only companies with all the data are shown.

Transmission Circuits

By Voltage Class



Source/Calculation:BB.2.1/SUM{BB.2}

Volume: Transmission Line Statistics, Final Report, 2006

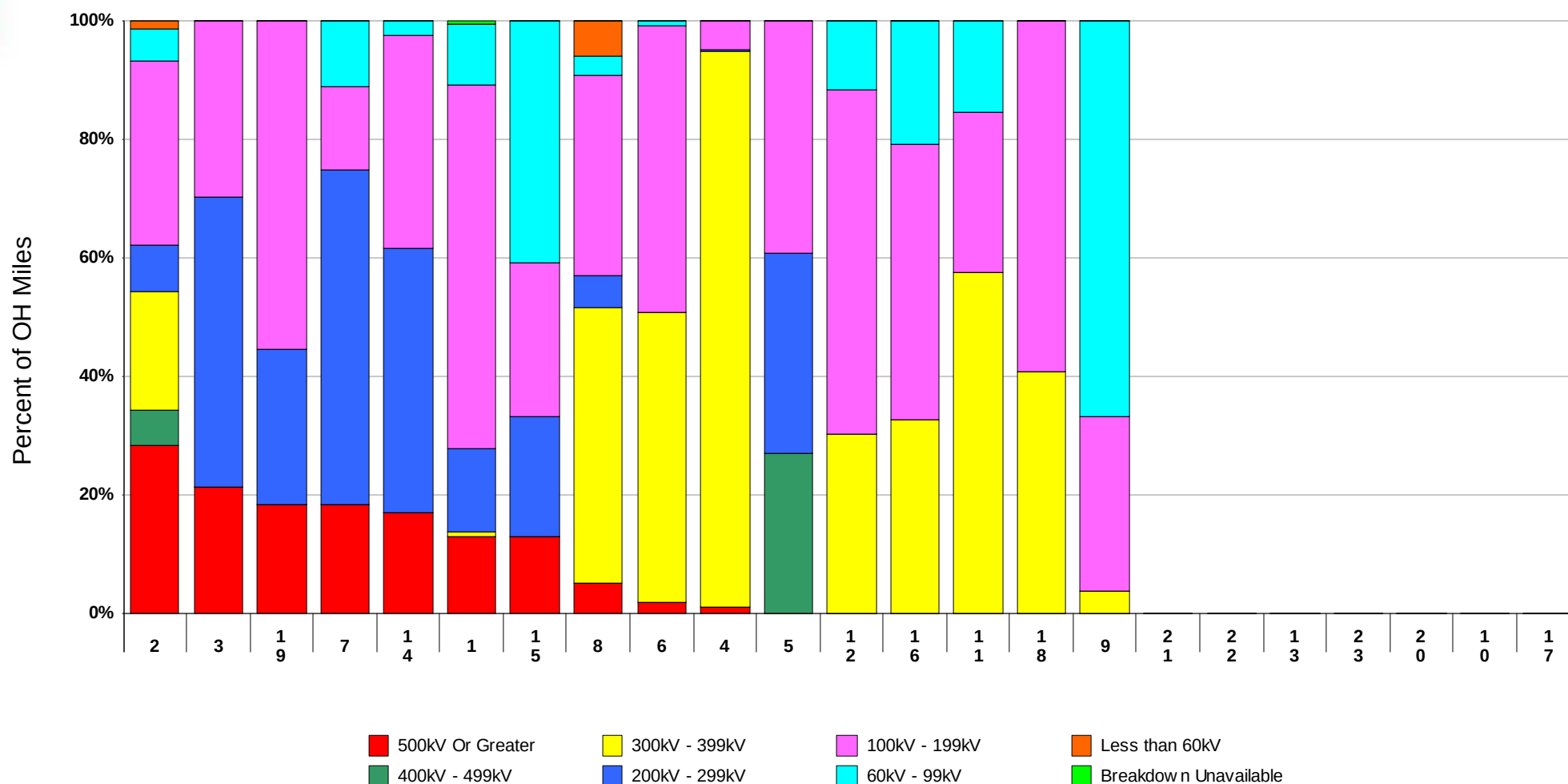
ID Code:8759

Page:1672

Calculation shown is for the first piece of the stacked bar only.

Transmission OH Circuit Miles

By Voltage Class



Source/Calculation:BB.3.1/SUM{BB.3}

Volume: Transmission Line Statistics, Final Report, 2006

ID Code:8756

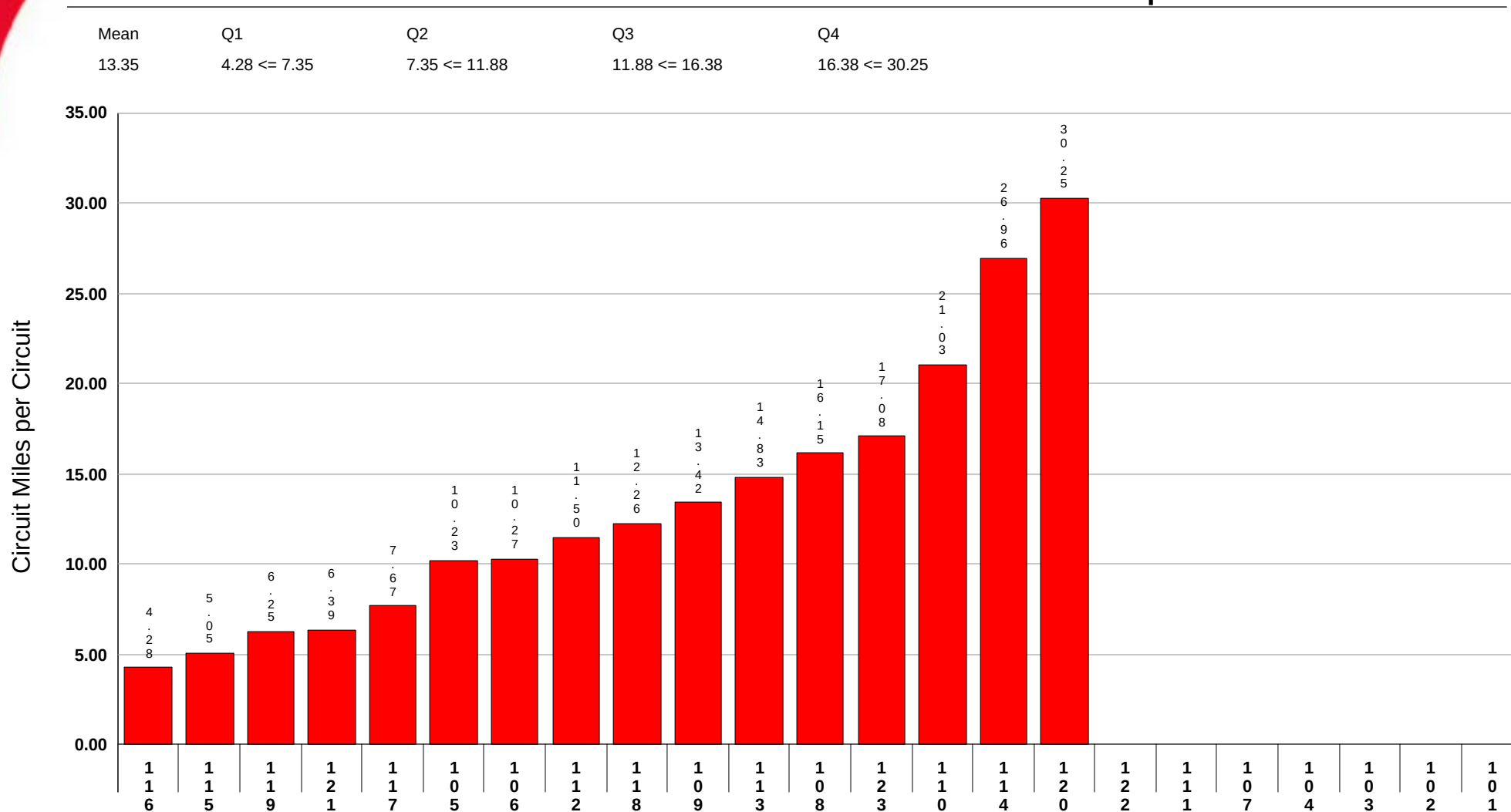
Page:1673

Calculation shown is for the first piece of the stacked bar only.



Average Transmission Circuit Length

Transmission Circuit Miles per Transmission Circuit



Source/Calculation: (SUM{BB.3}+SUM{BB.4})/SUM{BB.2}

Volume: Transmission Line Statistics, Final Report, 2006

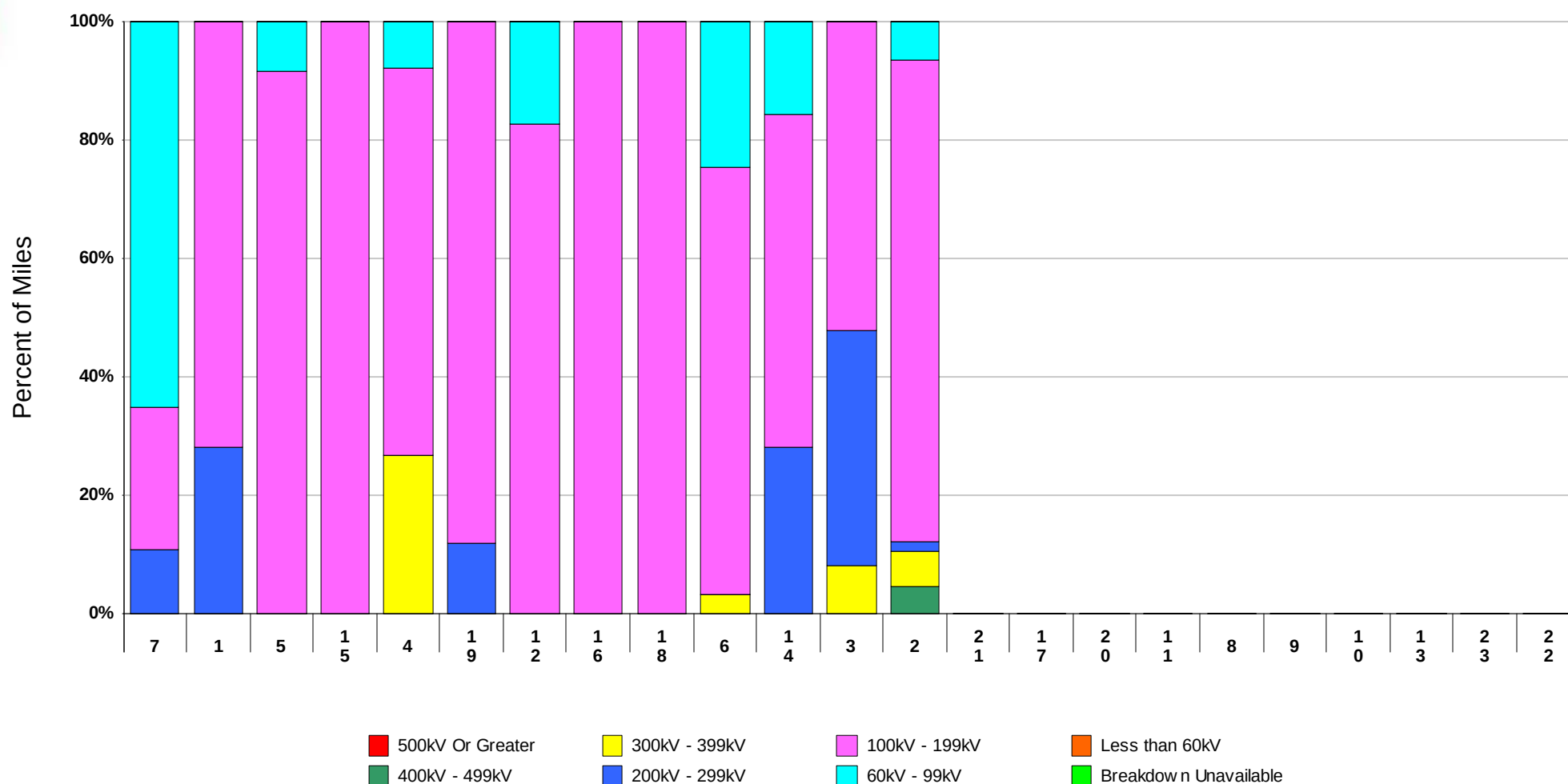
ID Code: 27362

Page: 1674

Only companies with all the data are shown.

Transmission UG Circuit Miles

By Voltage Class



Source/Calculation:BB.4.1/SUM{BB.4}

Volume: Transmission Line Statistics, Final Report, 2006

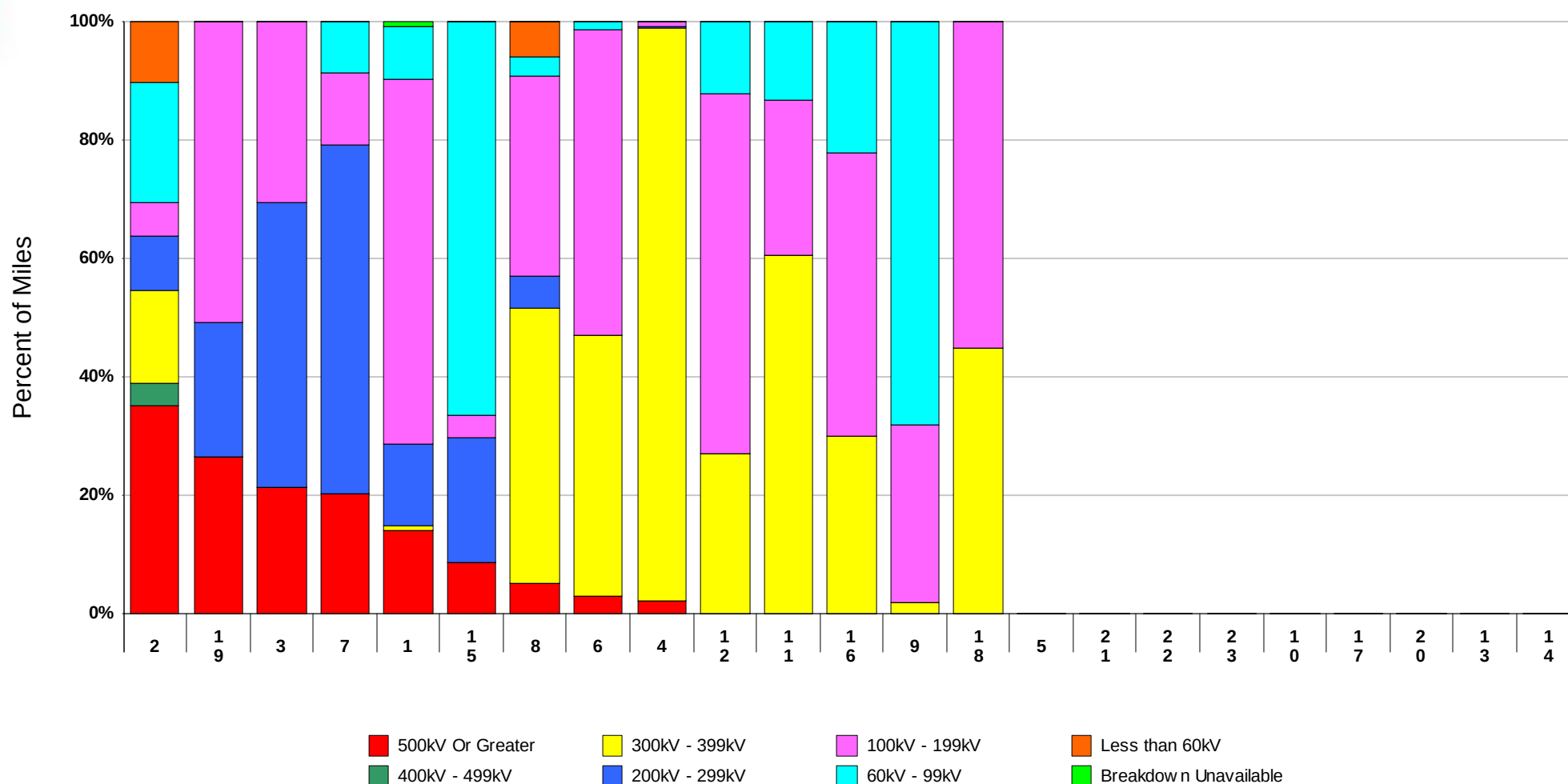
ID Code:8768

Page:1675

Calculation shown is for the first piece of the stacked bar only.

Transmission OH Structure Miles

By Voltage Class



Source/Calculation:BB.5.1/SUM{BB.5}

Volume: Transmission Line Statistics, Final Report, 2006

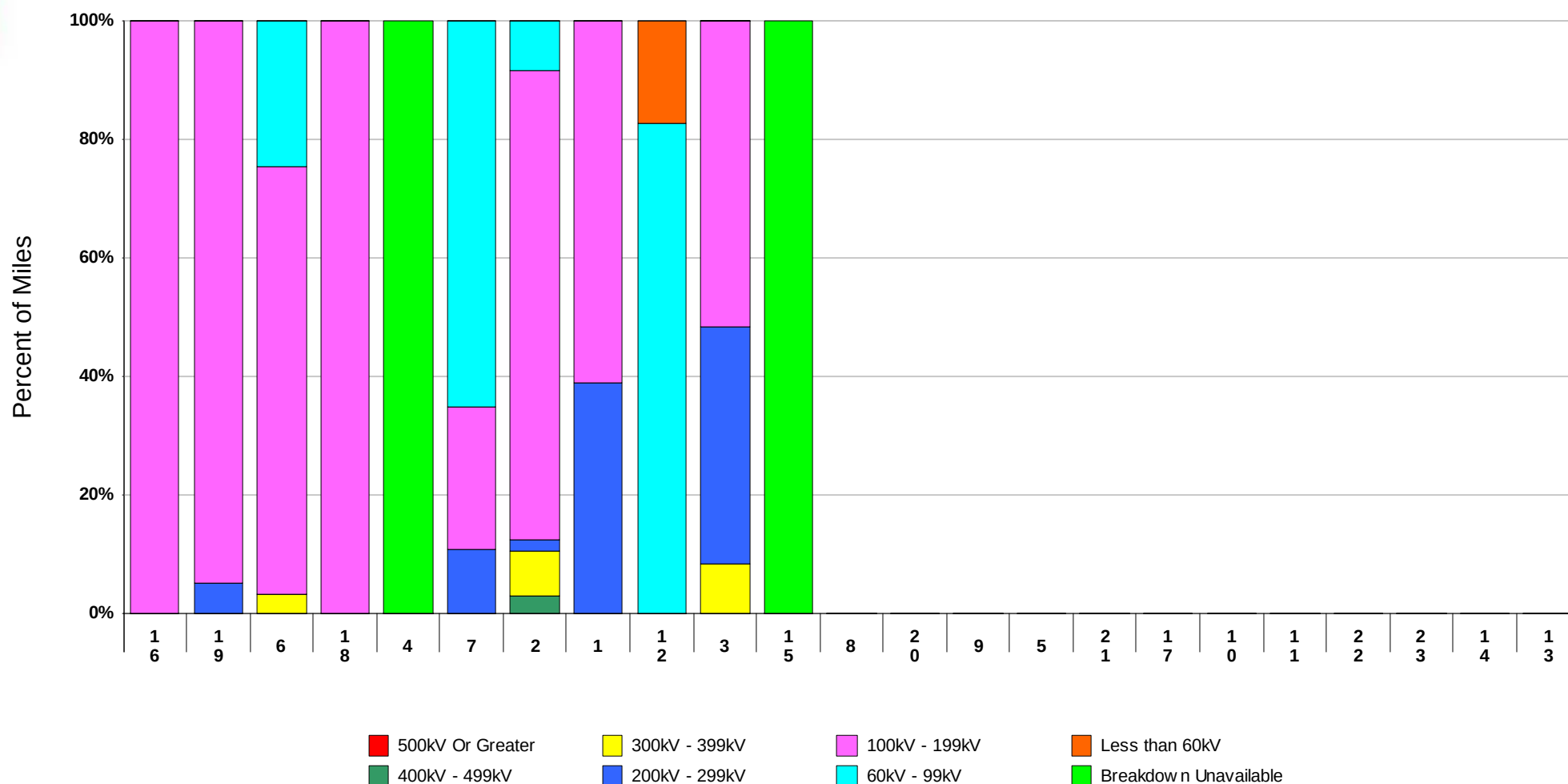
ID Code:8767

Page:1676

Calculation shown is for the first piece of the stacked bar only.

Transmission UG Trench Miles

By Voltage Class



Source/Calculation:BB.6.1/SUM{BB.6}

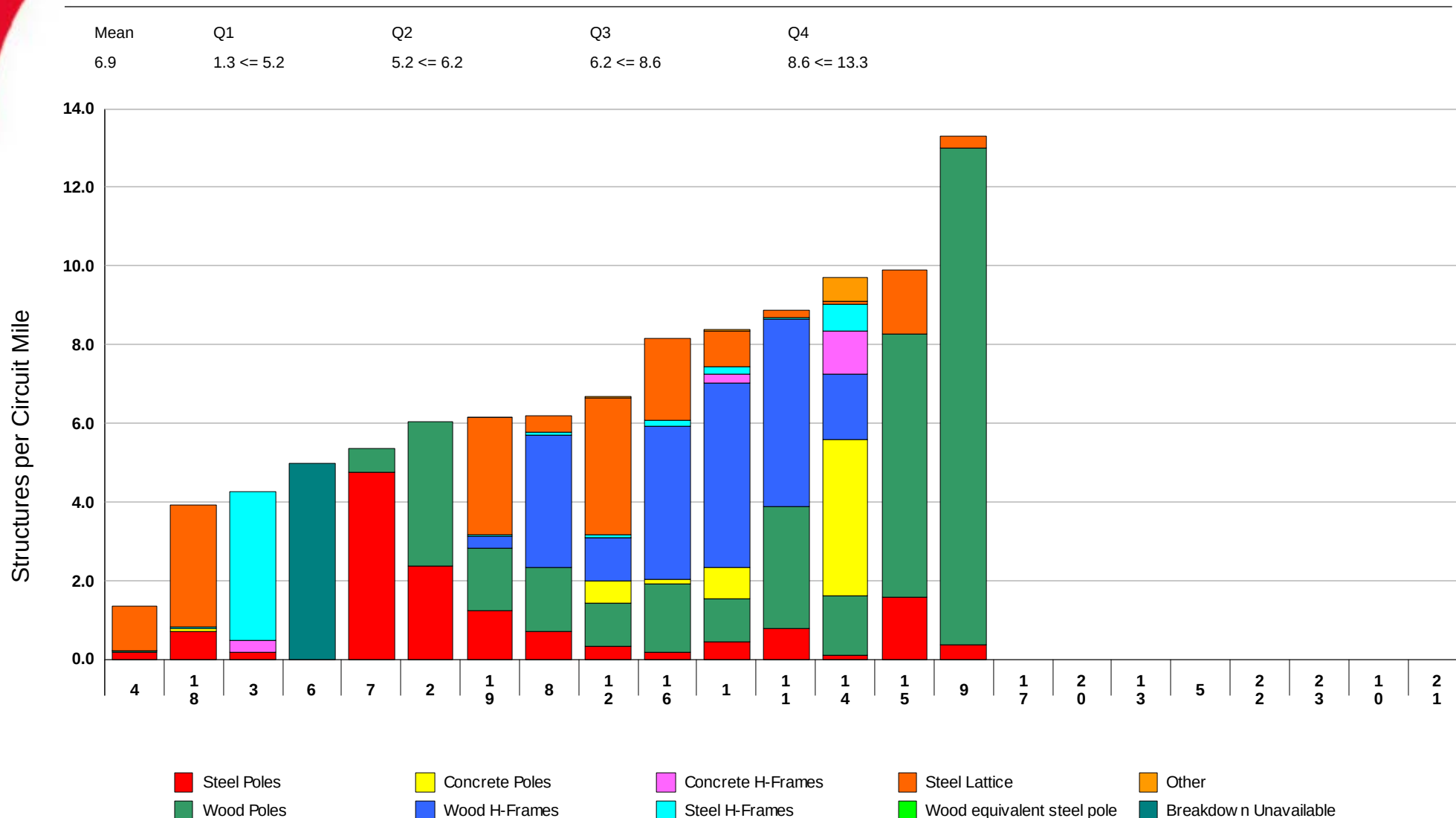
Volume: Transmission Line Statistics, Final Report, 2006

ID Code:8766

Page:1677

Calculation shown is for the first piece of the stacked bar only.

Transmission OH Structures Per Circuit Mile



Source/Calculation: BB.7.1/(SUM{BB.3}+SUM{BB.4})

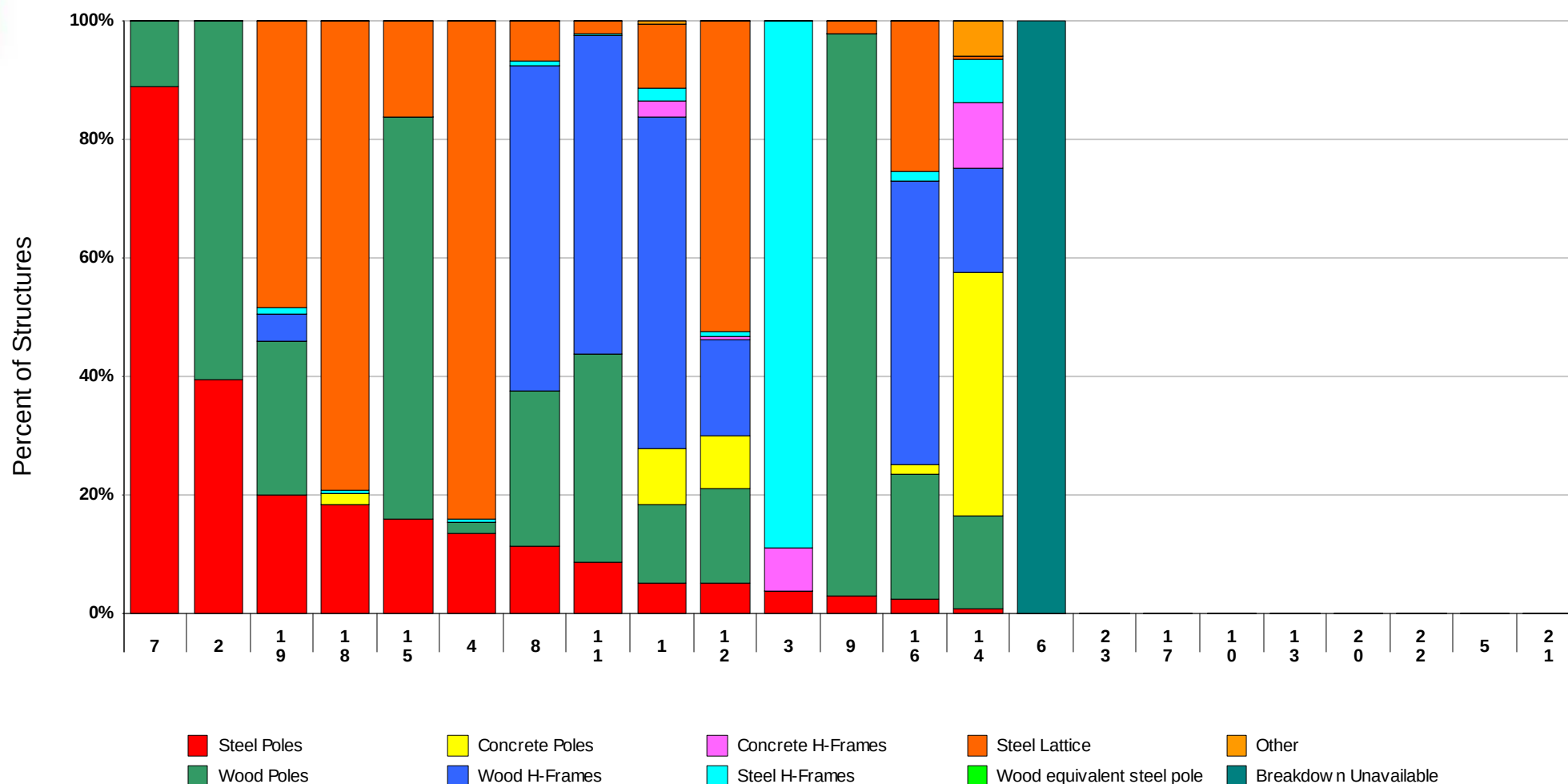
Volume: Transmission Line Statistics, Final Report, 2006

ID Code: 8762

Page: 1678

Calculation shown is for the first piece of the stacked bar only.

Transmission OH Structure Types



Source/Calculation:BB.7.1/SUM{BB.7}

Volume: Transmission Line Statistics, Final Report, 2006

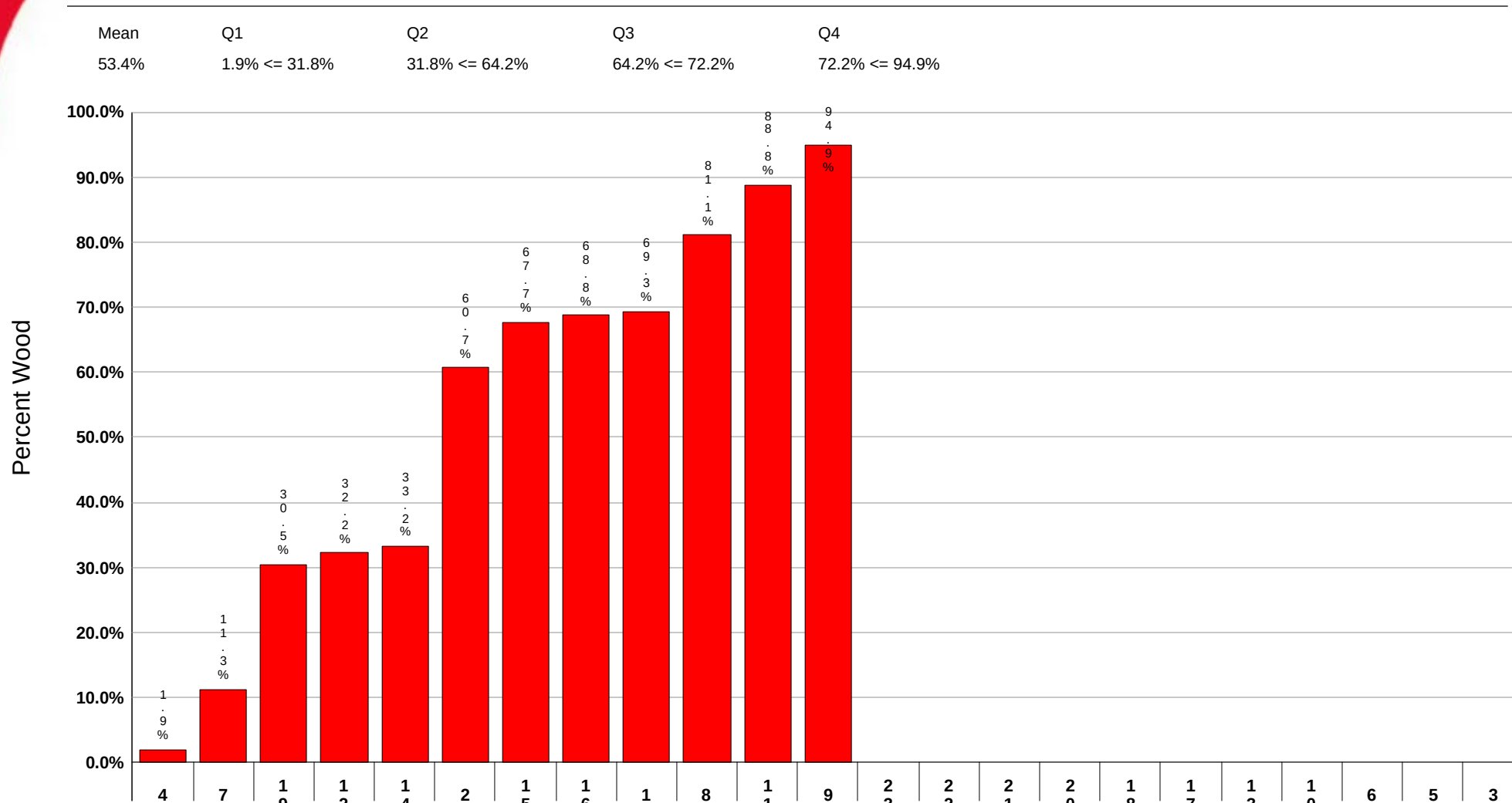
ID Code:27329

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Calculation shown is for the first piece of the stacked bar only.

Wood Overhead Transmission Structures

Per Total Overhead Transmission Structures



Source/Calculation:(BB.7.2+BB.7.4)/SUM{BB.7}

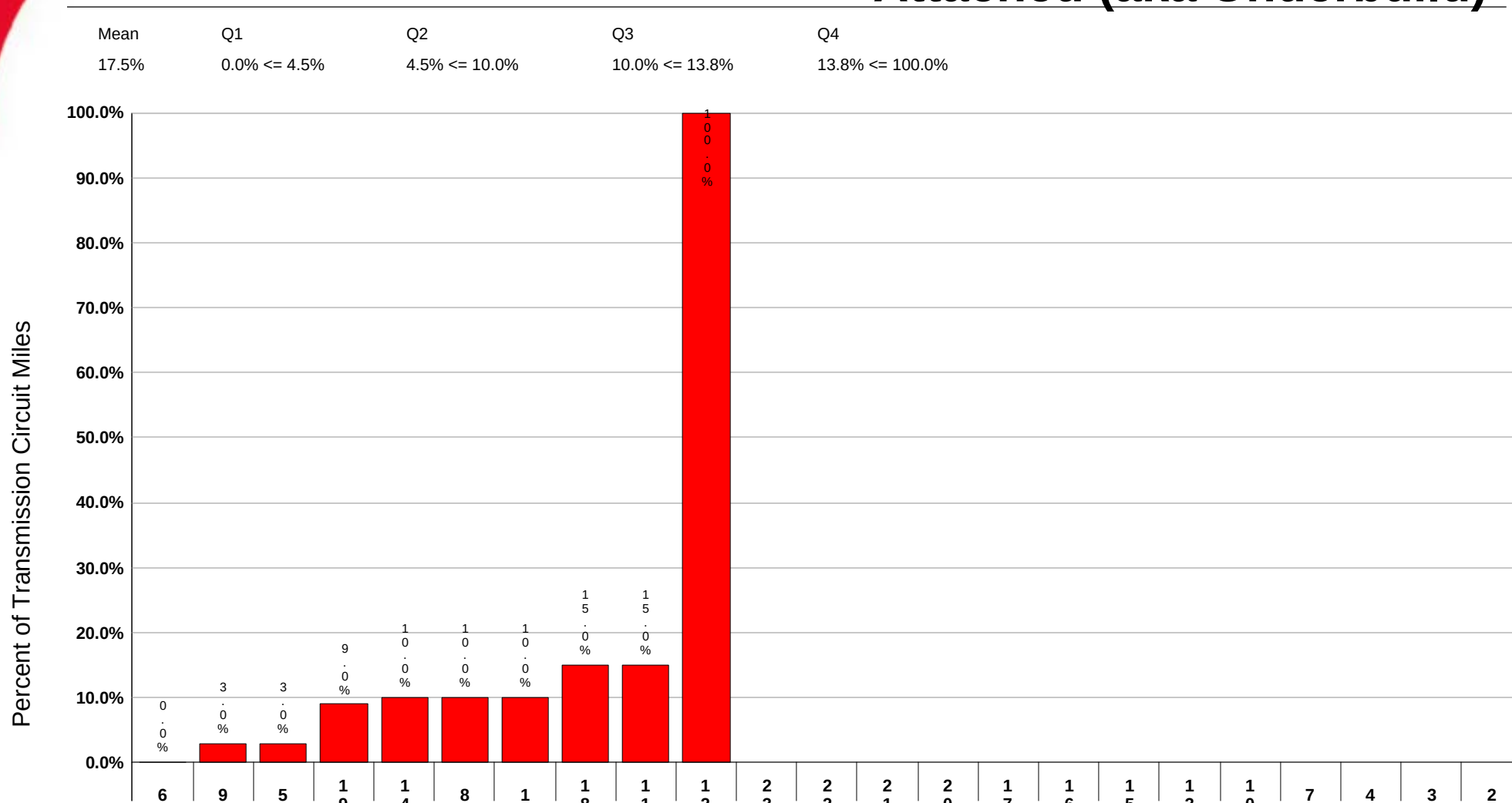
Volume: Transmission Line Statistics, Final Report, 2006

ID Code:8700

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Only companies with all the data are shown.

Percent of Transmission Circuit Miles with Distribution Attached (aka Underbuild)



Source/Calculation:BB.9.1

Volume: Transmission Line Statistics, Final Report, 2006

ID Code:2300511

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Only companies with all the data are shown.

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-  ● Pg. 1682 Project Management Technique Usage
-  ● Pg. 1683 Project Management Technique Usage (cont.)
-  # Pg. 1684 Most Successful Design Improvement Initiatives for Reducing Costs - 1 = Lowest, 3 = Highest
-  ● Pg. 1685 Most Successful Design Improvement Initiatives for Reducing Costs (cont.)
-  ● Pg. 1686 Method Used for Measuring Design/Engineering Efficiency
-  ● Pg. 1686.1 Method Used for Measuring Design/Engineering Efficiency (cont.)
-  ● Pg. 1687 Measuring Effectiveness of Formal/Systematic Project Management Organization
-  ● Pg. 1688 Measuring Effectiveness of Formal/Systematic Project Management Organization (cont.)

Project Management Technique Usage

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. No Formal Project Management:																								0.0%
2. Assign A Project Manager To Large Jobs:		✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓		✓	✓					100.0%
3. Develop A Work Breakdown Structure:		✓	✓			✓	✓	✓				✓				✓		✓	✓					64.3%
4. Assign Responsibilities For Each Task:		✓	✓	✓		✓	✓	✓	✓			✓		✓				✓	✓					78.6%
5. Identify Interdependencies:			✓	✓	✓	✓	✓	✓				✓		✓		✓		✓	✓					78.6%
6. Calculate Resource Loading:			✓			✓	✓					✓			✓			✓	✓					50.0%
7. Use Software:		✓	✓	✓	✓	✓	✓		✓			✓		✓				✓	✓					78.6%
8. Establish Milestones:		✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓		✓	✓					100.0%
9. Require Progress Reporting:		✓	✓	✓		✓	✓		✓			✓		✓	✓	✓		✓	✓					85.7%
10. Enforce Change Orders:		✓	✓			✓	✓		✓			✓			✓	✓		✓						64.3%
11. Site visits:		✓	✓	✓		✓	✓		✓			✓		✓	✓	✓		✓	✓					85.7%
12. Monthly Meetings:		✓	✓	✓	✓	✓	✓	✓	✓			✓		✓		✓		✓	✓					92.9%
99. Other:																✓								7.1%

Source/Calculation:BC.2.1

Volume: Transmission Line Engineering & Design, Final Report, 2006

ID Code:1166

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Project Management Technique Usage (cont.)

Which project management techniques are used?

- Assign portfolio's of projects to Project Manager.

Most Successful Design Improvement Initiatives for Reducing Costs

1 = Lowest, 3 = Highest

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:
1. Design Criteria:	-	3	-	1	2	3	3	-	-	-	-	-	-	-	1	2	-	3	-	-	-	-	-	2.3
2. Types of Material:	-	-	1	2	3	1	2	-	1	-	-	-	-	-	2	1	-	2	-	-	-	-	-	1.7
3. Types of Static Wire:	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-	-	1.3
4. Use of Polymer Insulators:	-	-	-	-	-	-	2	2	2	-	-	-	-	-	3	-	-	1	1	-	-	-	-	1.8
5. Operating Temperature Guidelines:	-	2	-	-	1	-	1	1	-	-	-	1	-	1	-	-	-	2	3	-	-	-	-	1.5
6. New inspection and line condition assessment standards:	-	3	-	-	-	-	1	3	-	-	-	2	-	-	-	-	-	2	-	-	-	-	-	2.2
7. Low surge impedance grounding:	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1.0
8. Use of high temperature conductor:	-	-	-	-	-	-	2	-	3	-	-	3	-	-	-	3	-	1	-	-	-	-	-	2.4
99. Other:	-	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.5

Source/Calculation: BC.3.1

Volume: Transmission Line Engineering & Design, Final Report, 2006

ID Code: 7061

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Most Successful Design Improvement Initiatives for Reducing Costs (cont.)

Which design improvement initiatives have been most successful in reducing costs?

- Computer design techniques
- Individual initiatives not specifically tracked

Method Used for Measuring Design/Engineering Efficiency

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Not Measured:								✓																7.1%
2. Actual vs. Estimated Budget:			✓		✓	✓	✓		✓			✓		✓		✓		✓	✓					71.4%
3. Actual vs. Estimated Hours:		✓					✓					✓			✓			✓						35.7%
4. Utilization of Personnel:					✓										✓			✓	✓					28.6%
5. Billing Rates vs. A&E Firms:																								0.0%
6. Bids vs. A&E Firms:				✓																				7.1%
7. Design As Percent of Total Cost:												✓				✓		✓						21.4%
8. Cost Per New MVA:																								0.0%
9. Cost Per Installed MVA:																								0.0%
10. Rate of Return - Revenues Expected vs. Costs:																								0.0%
11. Equipment Utilization:																								0.0%
99. Other:														✓										7.1%

Source/Calculation:BC.4.1

Volume: Transmission Line Engineering & Design, Final Report, 2006

ID Code:27471

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Method Used for Measuring Design/Engineering Efficiency (cont.)

How do you measure design/engineering efficiency?

- Schedules + cost per mile

Source/Calculation: BC.4.99

Volume: Transmission Line Engineering & Design, Final Report, 2006

ID Code: 1600126

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Measuring Effectiveness of Formal/Systematic Project Management Organization

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Not Measured:																								0.0%
2. Within Budget:		✓	✓	✓	✓	✓	✓		✓			✓		✓	✓	✓		✓	✓					92.9%
3. Completed On Time:		✓	✓	✓	✓	✓	✓		✓			✓		✓	✓	✓		✓	✓					92.9%
4. Actual vs Estimated Cost:		✓	✓			✓	✓	✓	✓			✓		✓	✓	✓		✓	✓					85.7%
5. Actual vs Estimated Hours:						✓	✓					✓			✓			✓						35.7%
6. Change Management:												✓						✓						14.3%
7. Compliance:				✓								✓		✓				✓						28.6%
8. Forecasting Accuracy:		✓				✓	✓					✓							✓					35.7%
99. Other:												✓				✓								14.3%

Source/Calculation:BC.5.1

Volume: Transmission Line Engineering & Design, Final Report, 2006

ID Code:27472

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Measuring Effectiveness of Formal/Systematic Project Management Organization (cont.)

How do you measure the effectiveness of the formal/systematic project management organization?

- Communication of status and budget.
- Internal Audits, Self Assessments, Process Improvement

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- Pg. 1691 Methods Used to Determine Aging Transmission Line Equipment in the System
- Pg. 1692 Refurbishment and/or Replacement Policies for Major Transmission Line Equipment Currently Used
- Pg. 1693 Methods Used to Detect Transmission Line Equipment Deterioration Failures
- Pg. 1694 Methods Used to Detect Transmission Line Equipment Deterioration Failures (cont.)
- Pg. 1695 Preventive Maintenance Period Much Longer Than the Average Duration of the Optimal Preventive Replacement Interval - For Major Transmission Line Equipment
- Pg. 1696 Definition of "Refurbishment" of Transmission Line Equipment
- Pg. 1697 Distinction Between Refurbishment, Maintenance, and Capital Expenditures
- Pg. 1698 Identifying Need for Refurbishment of Aging Transmission Line Infrastructure
- Pg. 1699 Determining Which Type of Structures to Use When Refurbishing a Transmission Line
- Pg. 1700 Handling of Grounding Issues When Installing Transmission Line Structures
- Pg. 1701 Criteria Used to Decide How to Proceed After Initial "Reasonable" Efforts to Achieve a Grounding Target Fail
- Pg. 1710 Use "Fleet" Studies of Transmission Lines by Outside Consultants to Determine Need for Refurbishment/Replacement

Methods Used to Determine Aging Transmission Line Equipment in the System

What methods are utilized to determine aging Transmission Line equipment in the system?

- Aerial patrol, GLIT
- Age of components and inspections
- climbing inspection/condition assessments
- Climbing inspections and aerial inspections
- Close visual inspections from helicopter using gyro-stabilized telephoto lens camera; infrared inspections; foot patrols; wood pole inspections.
- Engineering Decision
- Failure Rates & Industry Trends
- Ground line inspections
- Ground line testing, visual damage do to aging.
- In some cases both installed dates or asset age records which are maintained at the grid locations. Manufactures life expectancy information is also useful.
- Lab and engineering analysis is performed on failure specimens.
- Outage data; Inspection data
- Review and analysis of outage data and inspection data
- Routine patrols and inspections
- Visual Inspection
- We have a 5 year inspection and rehab cycle for our transmission system. All components are inspected for conditions and replaced, if needed. We have a GLT program on a 10 year cycle. We have a tower painting program for our corrosive areas.

Source/Calculation:BD.6.1

Volume: Focus Area: Transmission Line Refurbishment, Final Report, 2006

ID Code:2300674

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Refurbishment and/or Replacement Policies for Major Transmission Line Equipment Currently Used

What are the refurbishment and/or replacement policies for major transmission line equipment currently used in your company?

- As required only
- Engineering provides this information
- Equipment obsolescence and overall transmission line outage performance
- Equipment obsolescence and overall transmission line outage performance.
- In general, replacement used over repair/reinforce
- Inspections, outage statistics, age
- Keep ahead with rigorous inspection programs
- No formal policies. Xonditions often determine type of fix (replace or maintain).
- Refurbishment vs. Replacement is based on good Engineering practices and analysis.
- See Notes
- Usually needs upgrade in capacity before end of life
- We have a selective replacement guideline that is part of the inspection and rehab program. It contains the criteria for replacement or repair of the transmission facilities. We repair or replace any item that will not provide reliable operation.

Source/Calculation:BD.12.1

Volume: Focus Area: Transmission Line Refurbishment, Final Report, 2006

ID Code:2300675

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Methods Used to Detect Transmission Line Equipment Deterioration Failures

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent	
1. Increased inspection frequency:	✓		✓					✓	✓					✓	✓										42.9%
2. Outage management statistics:	✓					✓	✓	✓	✓			✓		✓	✓	✓		✓							71.4%
99. Other:		✓		✓								✓						✓	✓						35.7%

Source/Calculation:BD.8.1

Volume: Focus Area: Transmission Line Refurbishment, Final Report, 2006

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Methods Used to Detect Transmission Line Equipment Deterioration Failures (cont.)

What methods are utilized to detect transmission line equipment deterioration failures?

- Established 5 year inspection cycle and 10 year GLT program. We employ ground based inspections with high power stabilized binoculars and spotting scopes. We use OHM meters to test grounding systems. We use IR on switches.
- Routine inspections
- Special inspection (i.e., infrared and comprehensive helicopter inspection).
- Standard routine inspection /failure analysis
- Visual Inspection

Preventive Maintenance Period Much Longer Than the Average Duration of the Optimal Preventive Replacement Interval

For Major Transmission Line Equipment

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent:
1. Yes:															✓	✓		✓						27.3%
2. No:		✓		✓		✓	✓		✓		✓	✓								✓				72.7%

Source/Calculation:BD.14.1

Volume: Focus Area: Transmission Line Refurbishment, Final Report, 2006

ID Code:2300578

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Definition of "Refurbishment" of Transmission Line Equipment

How is "refurbishment" of a transmission line equipment defined?

- Any significant maintenance or improvement to existing line components.
- climbing inspection / condition assessment
- Complete replacement of towers, conductors, insulator strings and/or hardware end-to-end. This may or may not be associated with an increase in transmission capacity.
- Everything short of total rebuild
- New structures
- Refurbishment is the replacement of degraded components on a proactive basis.
- Refurbishment is the replacement of degraded components on a proactive basis.
- Repair or replacement of deteriorated line components to ensure optimal performance of a transmission line between inspection cycles.
- Repair, rebuild
- Replacing like/or polymer to replace porcelain
- Thermal upgrade, life extension, refurbishment.
- We don't use that term. We maintain or replace.
- When a major component (poles, timbers, insulators) are replaced throughout the line.
- Wire and associated hardware replaced
- Works of a non repetitive nature when important costs are added to one or several units of existing properties with the aim of prolonging the life expectancy in a substantial way

Distinction Between Refurbishment, Maintenance, and Capital Expenditures

Where is the line drawn between refurbishment, maintenance, and capital expenditures?

- 70% of replacement cost.
- Age of line, cost to repair, outage statistics; Maintenance is performed until no longer effective
- Each major expenditure is handled on a case by case basis.
- If line is totally rebuilt or anything that adds life is capital
- In general, replacement used over refurbishment or maintenance
- Refurbishment is the replacement of degraded components that have not failed. A refurbishment is typically a capital expenditure because of the extent of the work completed. Maintenance is the replacement of failed components.
- Refurbishment is the replacement of degraded components that have not failed. A refurbishment is typically a capital expenditure. Maintenance is replacement of failed components
- Renewal of assets
- See notes
- Sometimes depends on outage availability, updoming projects, and or budgets.
- That is determined on the spot in the field by the inspection team. The selective replacement guidelines are the resource for decision making to repair or replace. If an item can be economically repaired, then that decision is made.
- The works of refurbishment have to restor in the unit of existing property at least 50% of its original life expentancy, and put back the asset to the state of nine by restoring the original life expentancy

Identifying Need for Refurbishment of Aging Transmission Line Infrastructure

How is the need for refurbishment of aging transmission line infrastructure identified? Is it an outgrowth of "normal" survey activity, or are focused surveys specific to refurbishment conducted?

- An outgrowth of normal survey activity
- Analysis of normal inspection and survey results
- Both -outgrowth of normal surveys plus focused surveys
- Engineering and Planning Decision
- focused surveys specific to refurbishment
- Ground normal line inspections
- It is an outgrowth of the normal survey activity.
- No specific surveys are conducted.
- Normal
- Normal Survey
- Normal survey activity
- Normal Survey Activity
- Outgrowth of "normal" survey activity.
- Patrols are focused on identifying maintenance items
- We employ a normal inspection on a 5 year cycle for all transmission circuits. We are on our 3rd round of the system. If a circuit is not performing well or has repeat outages, then special off cycle inspections are made to determine the problem.

Source/Calculation:BD.7.1

Volume: Focus Area: Transmission Line Refurbishment, Final Report, 2006

ID Code:2300678

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Determining Which Type of Structures to Use When Refurbishing a Transmission Line

How do you decide what type of structures to use when you refurbish a transmission line? Are wood poles perceived as more aesthetically acceptable than steel towers?

- Depends on location. We use "cor-ten" weathering steel for most new installations
- Economics & delivery
- Engineering Decision
- engineering design, cost analysis
- Generally replace-in-kind. No preference on wood or steel.
- It depends on location.
- No wood poles used, primarily steel poles
- No, depends on structural loads
- See Notes
- Steel lattice towers are replaced with steel poles. Wood poles are replaced with steel poles. Wood poles are not perceived as more aesthetically acceptable than steel towers or poles.
- This is determined during the engineering design phase on a line-by-line basis.
- Upgrade to current design standards
- We use the most efficient structure for the specific location. It is typical to replace wooden H frames with single pole concrete or steel poles. Wood is still used to replace smaller class wood poles such as in multi-pole structure.
- When refurbishing, steel towers are replaced with steel poles. Wood poles are replaced with steel poles. Wood poles are not perceived as more aesthetically acceptable than steel towers.
- Wood/Steel for 115kv single circuit. Steel poles for everything else. Wood not perceived more acceptable than steel towers.

Source/Calculation:BD.13.1

Volume: Focus Area: Transmission Line Refurbishment, Final Report, 2006

ID Code:2300679

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Handling of Grounding Issues When Installing Transmission Line Structures

How do you handle grounding issues when installing transmission line structures?

- Con Edison has a standard specification that requires a grounding grid to be installed with an impedance of 10 ohms or lower.
- Design Standards require 10 ohms or less
- Do Not Ground / Only Ground for Lightning
- Every structure is grounded using ground rods and counterpoise
- Follow grounding procedures and practices
- Ground rods and counterpoise for H/K frame; also depends on construction type (steel, wood, lattice, etc.)
- Grounding is always done plus counterpoise
- lightning performance and code requirements
- safe operating procedures/installation standards
- See Notes.
- Structures are grounded by approved engineering standards
- The maximum grounding target footing resistance for 69 kV - 230 kV is 25 ohms; for 345 kV - 500 kV is 15 ohms.
- The maximum grounding target footing resistance for 69kV - 500kV is 10 ohms
- We have a construction standard of 5 OHMs for new installations and a maintenance standard of $\leq$ 5 OHMs. We design for a withstand of 40 KA lightning strokes on all of our transmission lines.

Source/Calculation: BD.9.1

Volume: Focus Area: Transmission Line Refurbishment, Final Report, 2006

ID Code: 2300680

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Criteria Used to Decide How to Proceed After Initial "Reasonable" Efforts to Achieve a Grounding Target Fail

If initial "reasonable" efforts to achieve a grounding target (measured in ohms) fail, what criteria do you use to decide how to proceed?

- 3 point measurement if high additional ground rods are added until resistance is acceptable
- add more counterpoise and ground rods until target is achieved
- additional ground rods. sometimes, counterpoise is installed.
- Engineering Decision
- Engineering is contacted for further evaluation and guidance.
- If problems occur then we improve grounding
- Install G.E.M. with grd rod & re-measure
- minimum ground resistance criteria
- See Notes
- The best you can. If the structures are within the first 2 miles of a substation we put in more effort.
- We achieve target most often. Every structure is grounded.
- We install a maximum of five 8' ground rods in a series no matter what the final reading is. Our OHM standard can usually be met with three 8' ground rods in a series. We have very good soil in our area.
- Will first attempt to add additional ground rods at the base of the structure. If still unable to achieve the desired target, then we will install counterpoise.
- Will install counterpoise until the desired ground target is achieved.

Source/Calculation:BD.10.1

Volume: Focus Area: Transmission Line Refurbishment, Final Report, 2006

ID Code:2300681

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Use "Fleet" Studies of Transmission Lines by Outside Consultants to Determine Need for Refurbishment/Replacement

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent:
1. Yes:									✓															7.1%
2. No:		✓	✓	✓		✓	✓	✓			✓	✓		✓	✓	✓		✓	✓					92.9%

Source/Calculation:BD.11.1

Volume: Focus Area: Transmission Line Refurbishment, Final Report, 2006

ID Code:2300582

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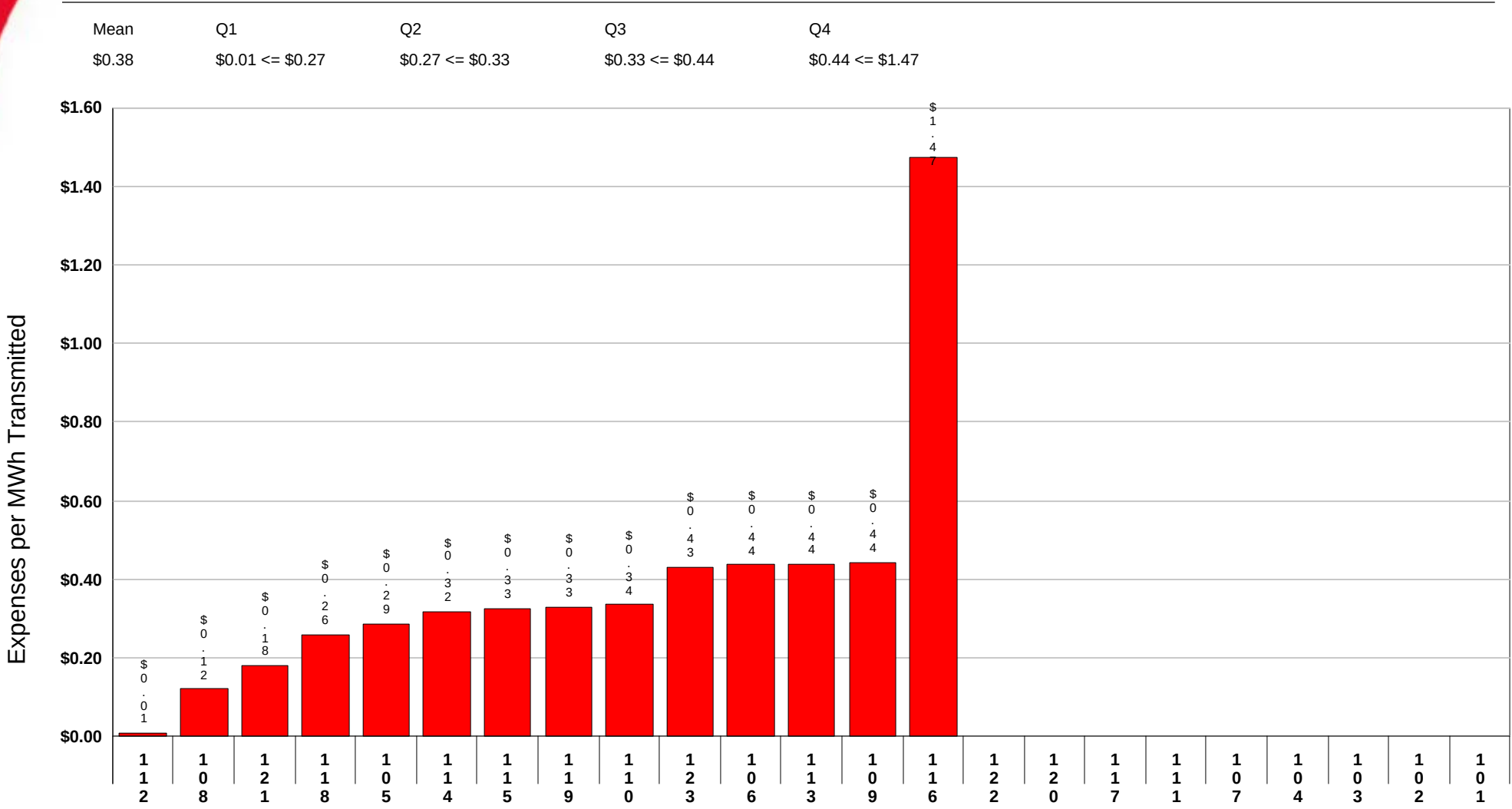
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	Pg. 1717	Transmission Operations Expenses - Per Transmission Structure Mile
	Pg. 1718	Transmission Operations Expenses - Per Transmission Circuit Mile
	Pg. 1718.1	Transmission Operations Expenses - Per Total Transmission Circuits
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	Pg. 1719	Transmission Operations Expenses - Per Transmission Assets
	Pg. 1721	Transmission Line Operations Expenses - Per MWh Transmitted
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	Pg. 1726	Transmission Maintenance Expenses - Per Transmission Structure Mile
	Pg. 1728	Transmission Maintenance Expenses - Per Transmission Circuit Mile
	Pg. 1729	Transmission Maintenance Expenses - Per Transmission Assets
	Pg. 1731	Transmission Line Maintenance Expenses - Per MWh Transmitted
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	Pg. 1733	Transmission Line Maintenance Expenses - Per Transmission Circuit Mile
	Pg. 1734	Transmission Line Maintenance Expenses - Per Transmission Line Assets
	Pg. 1735	Frequency of Aerial Patrol of Transmission Lines - Months Between Patrols (Helicopters, Fixed-Wing Fly-By)
	Pg. 1742	Authority of Inspection Personnel to Make Correction Decisions
	Pg. 1742.1	Authority of Inspection Personnel to Make Correction Decisions (cont.)
	Pg. 1746	Percent of Transmission System Maintained Last Year - Preventive Maintenance
	Pg. 1747	Percent of Maintenance Done with Energized Lines - Per Voltage Class

Transmission Operations Expenses

Per MWh Transmitted

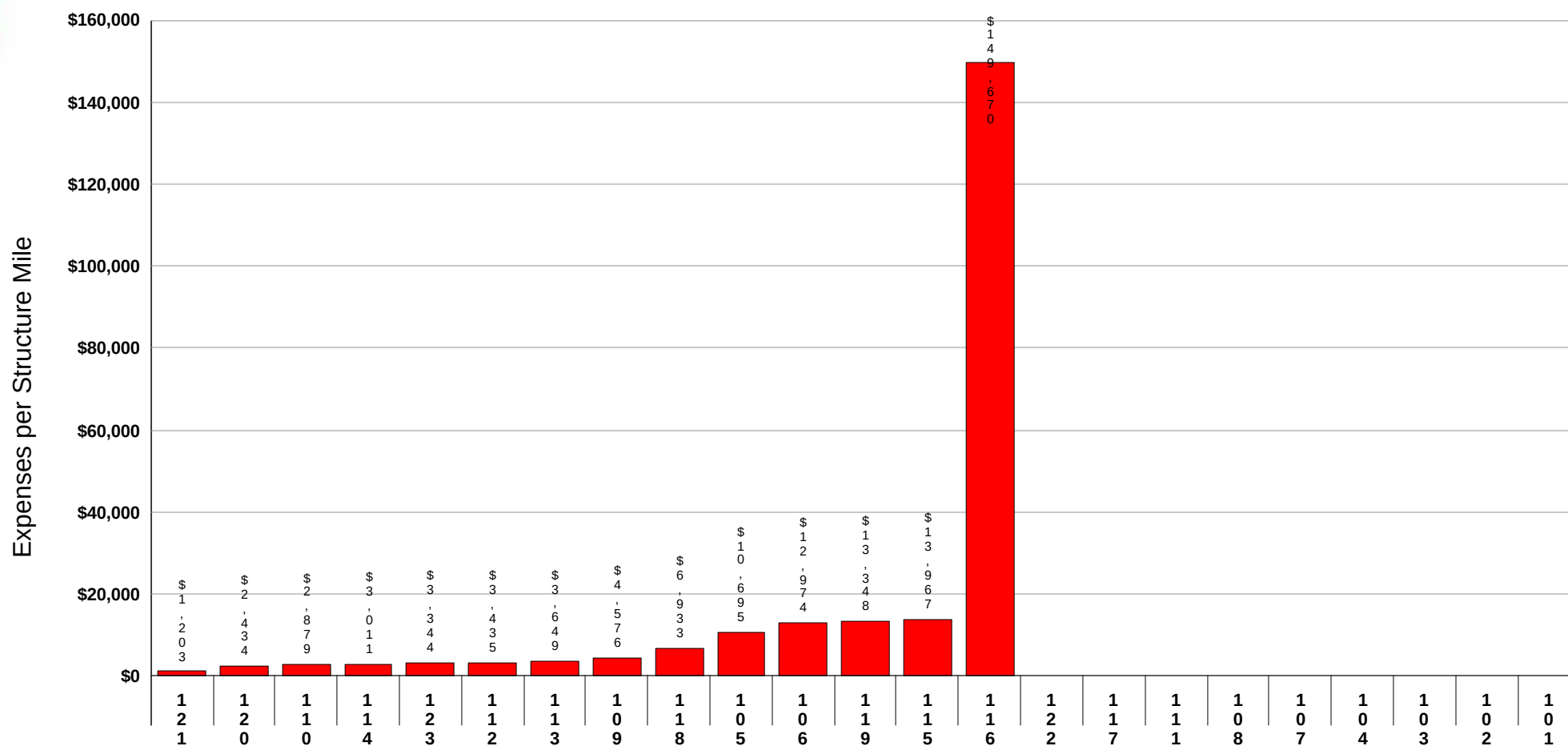


Source/Calculation:(SUM{B.20}-B.20.6)/A.2.5
Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006
ID Code:659
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Only companies with all the data are shown.

Per Transmission Structure Mile

Mean	Q1	Q2	Q3	Q4
\$16,580	\$1,203 <= \$3,094	\$3,094 <= \$4,112	\$4,112 <= \$12,404	\$12,404 <= \$149,670



Source/Calculation: (SUM{B.20}-B.20.6)/(SUM{BB.5}+SUM{BB.6})

Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006

ID Code:658

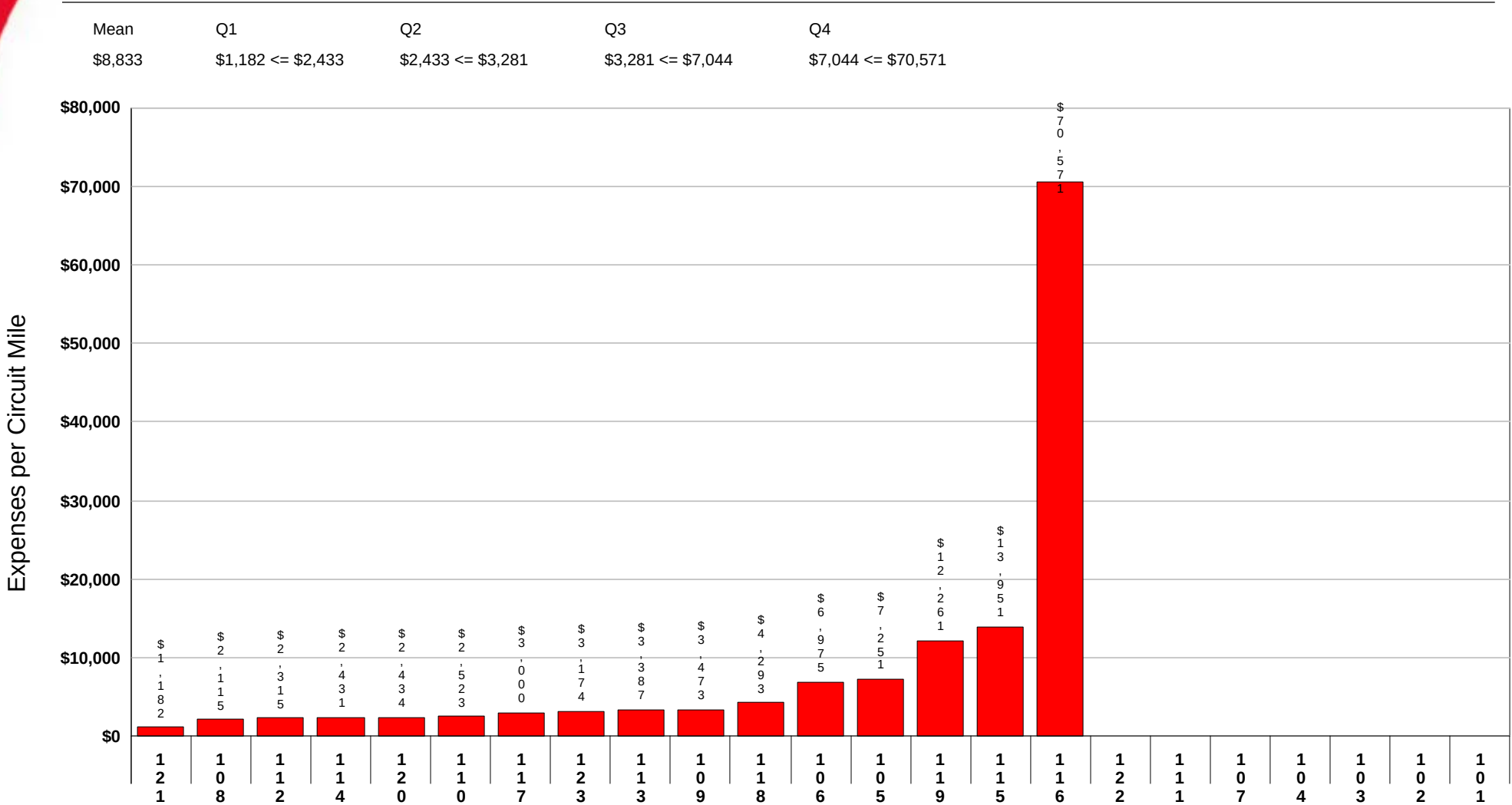
Only companies with all the data are shown.

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PA

Transmission Operations Expenses

Per Transmission Circuit Mile



Source/Calculation: (SUM{B.20}-B.20.6)/(SUM{BB.3}+SUM{BB.4})

Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006

ID Code:2010

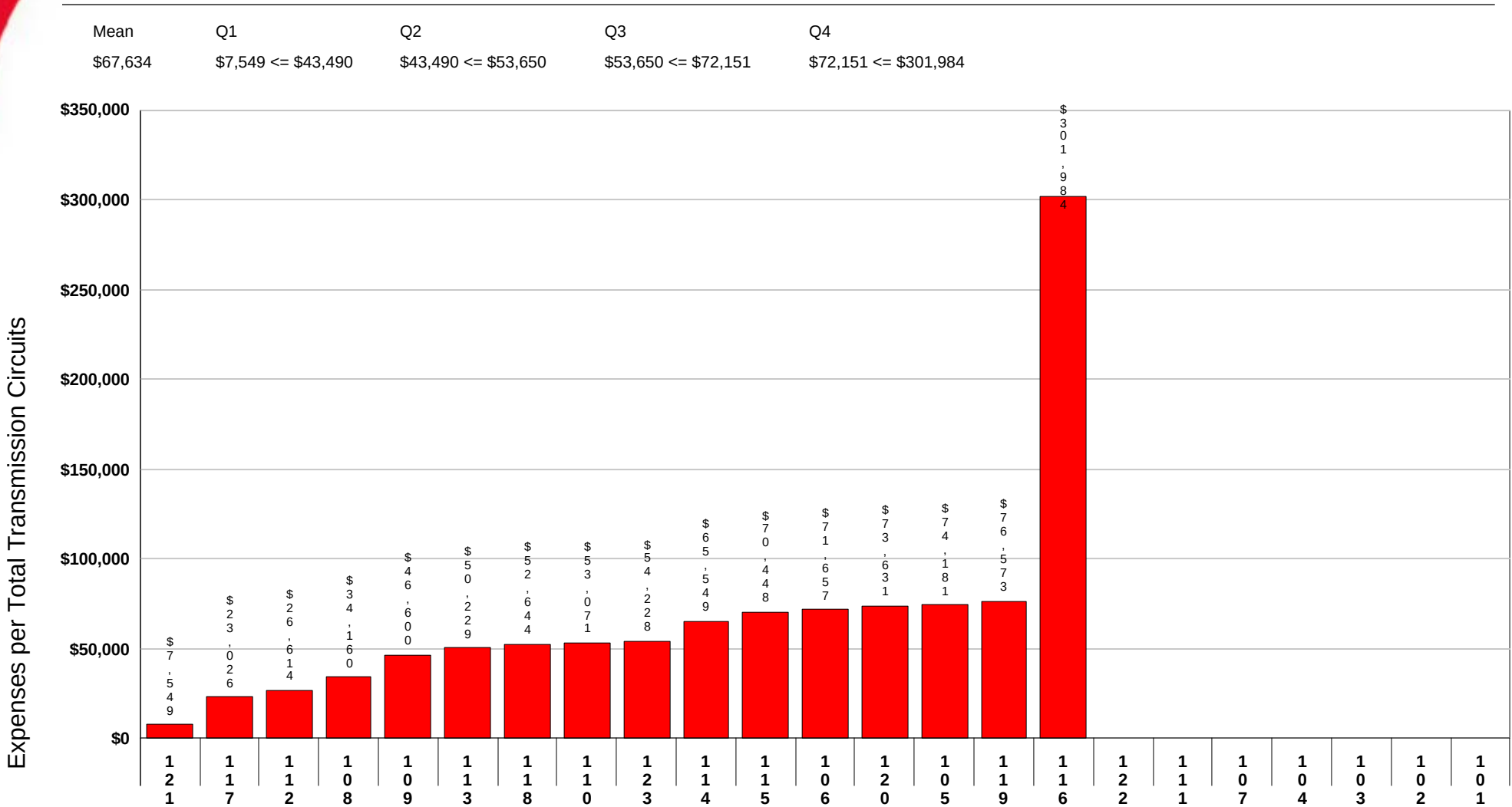
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Only companies with all the data are shown.



Transmission Operations Expenses

Per Total Transmission Circuits



Source/Calculation:(SUM{B.20}-B.20.6)/SUM{BB.2}

Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006

ID Code:1600107

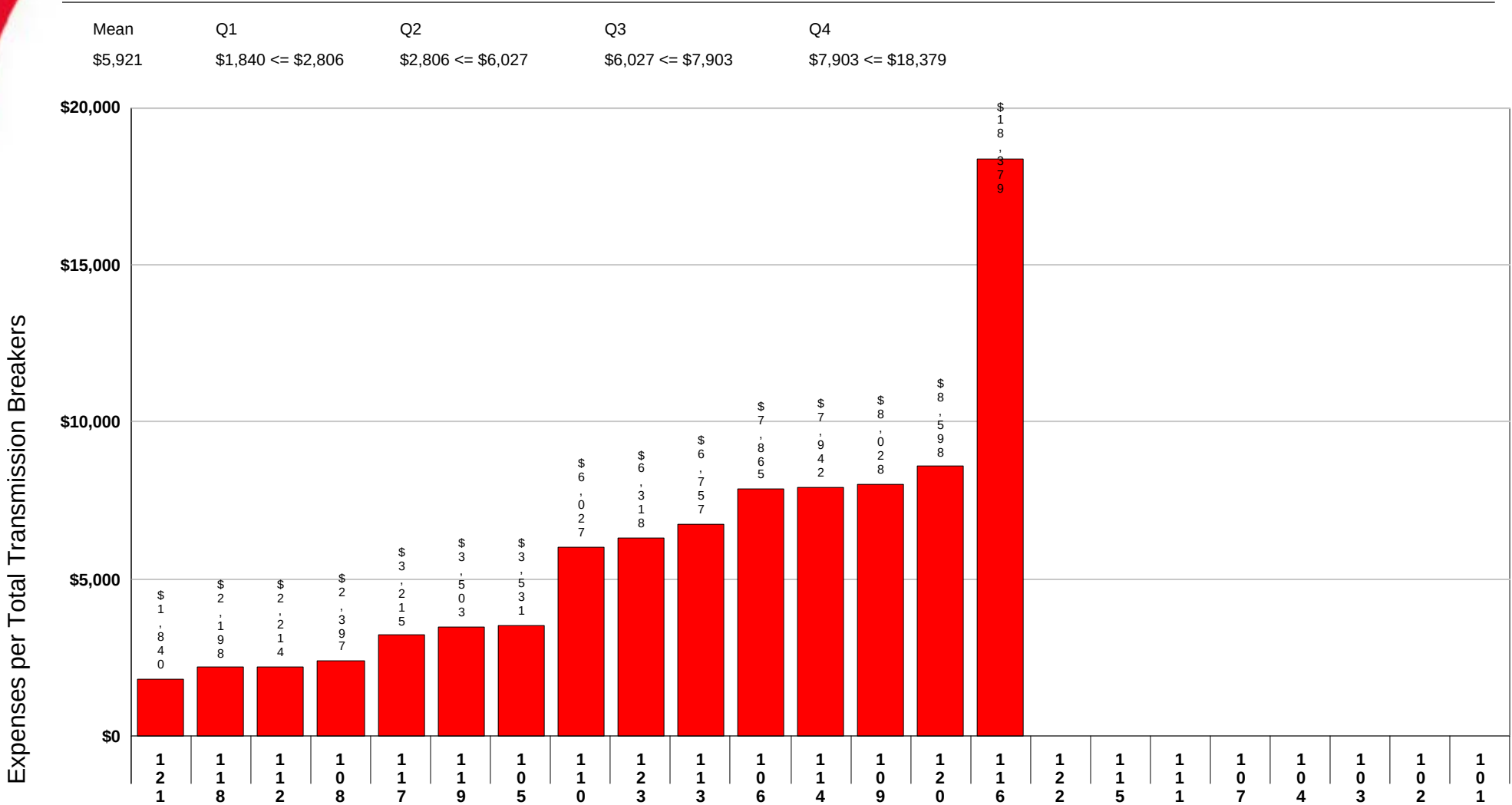
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Only companies with all the data are shown.



Transmission Operations Expenses

Per Total Transmission Breakers



Source/Calculation:(SUM{B.20}-B.20.6)/SUM{AQ.4}

Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006

ID Code:1600108

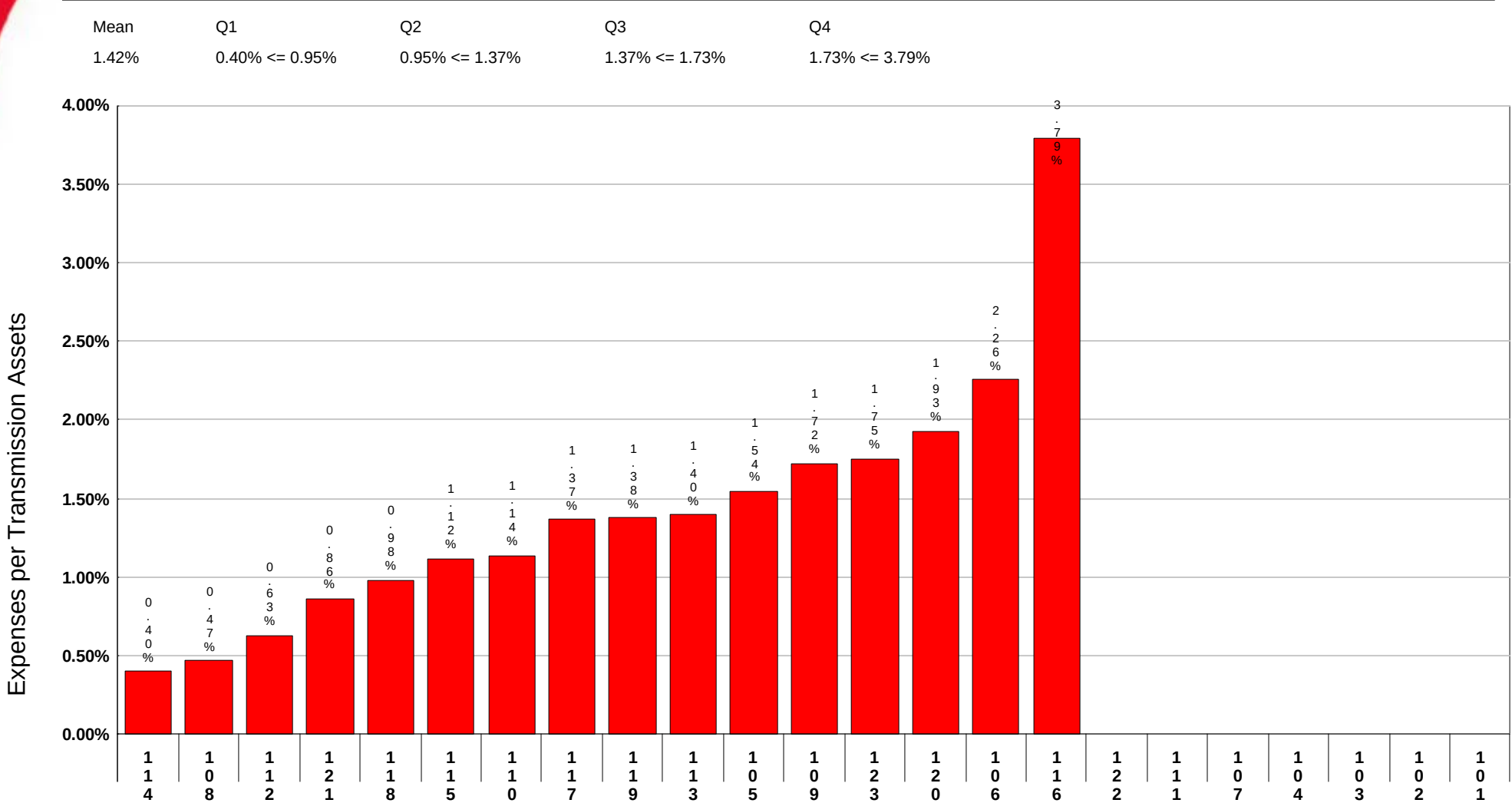
Page:1718.2

Only companies with all the data are shown.



Transmission Operations Expenses

Per Transmission Assets



Source/Calculation:(SUM{B.20}-B.20.6)/B.10.1

Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006

ID Code:2116

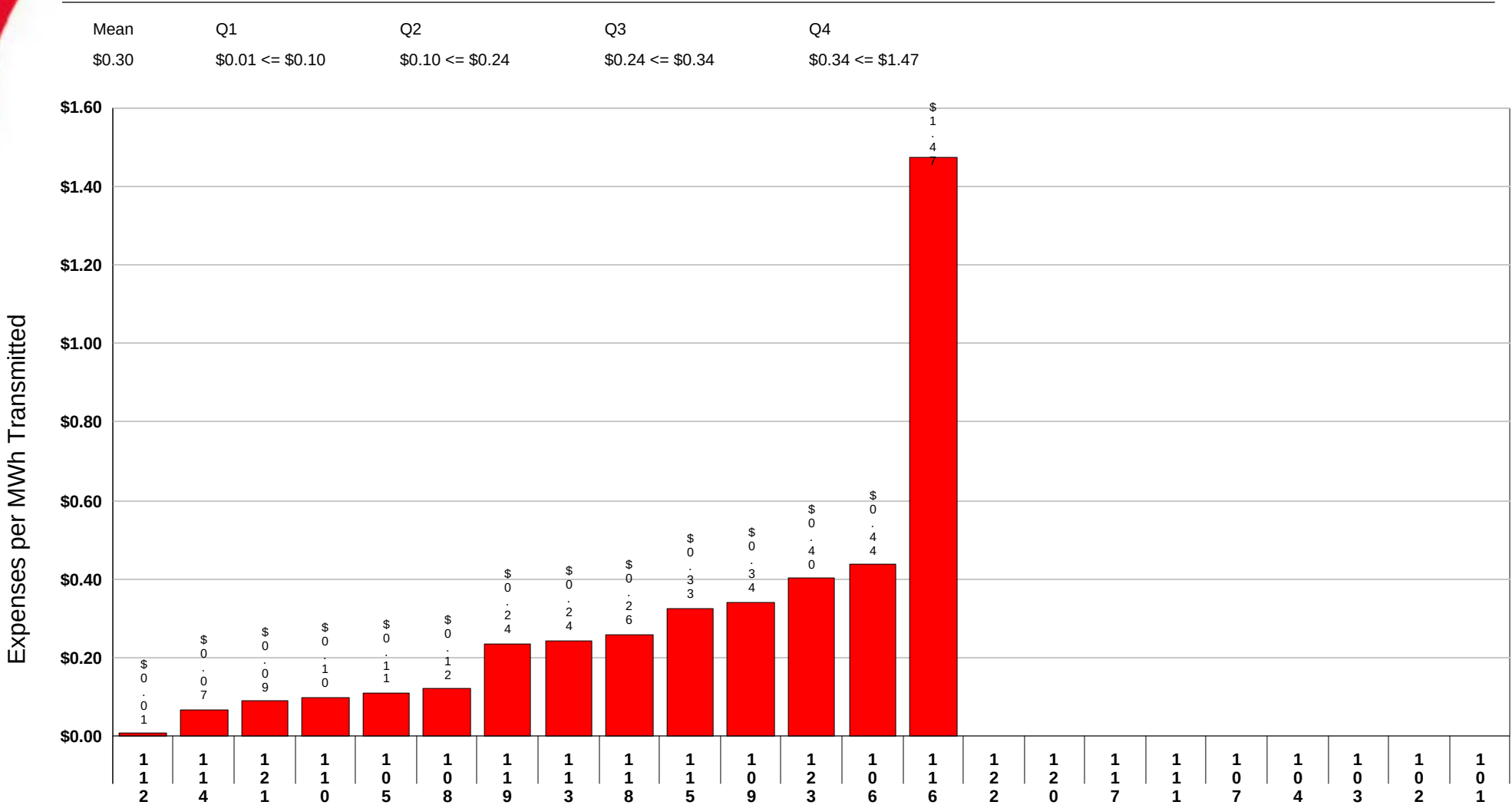
Page:1719

Only companies with all the data are shown.



Transmission Line Operations Expenses

Per MWh Transmitted



Source/Calculation:(SUM{B.20}-B.20.6-SUM{B.21})/A.2.5

Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006

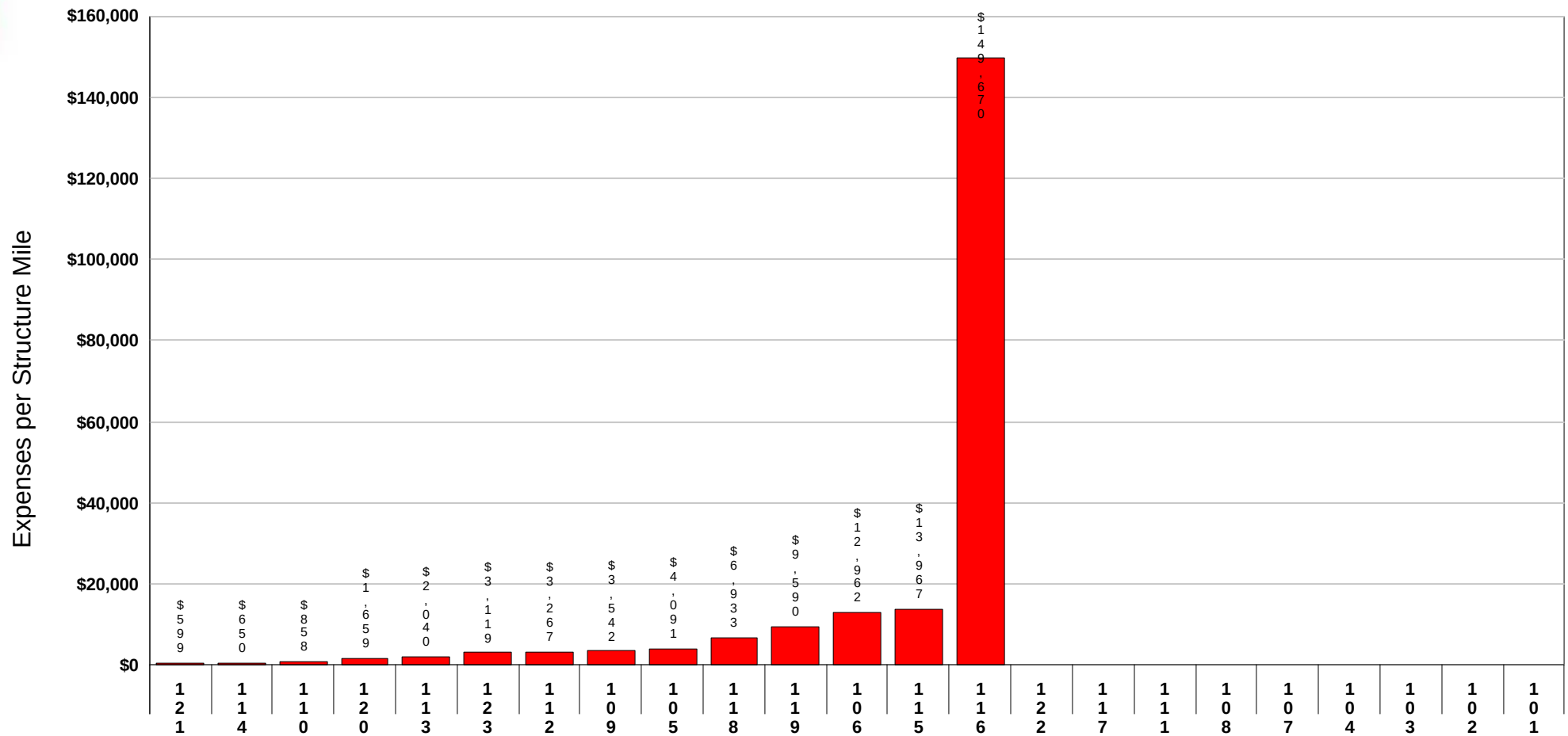
ID Code:662

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Only companies with all the data are shown.

Per Transmission Structure Mile

Mean	Q1	Q2	Q3	Q4
\$15,211	\$599 <= \$1,754	\$1,754 <= \$3,405	\$3,405 <= \$8,926	\$8,926 <= \$149,670



Source/Calculation:=(SUM{B.20}-B.20.6-SUM{B.21})/(SUM{BB.5}+SUM{BB.6})

Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006

ID Code:661

Only companies with all the data are shown.

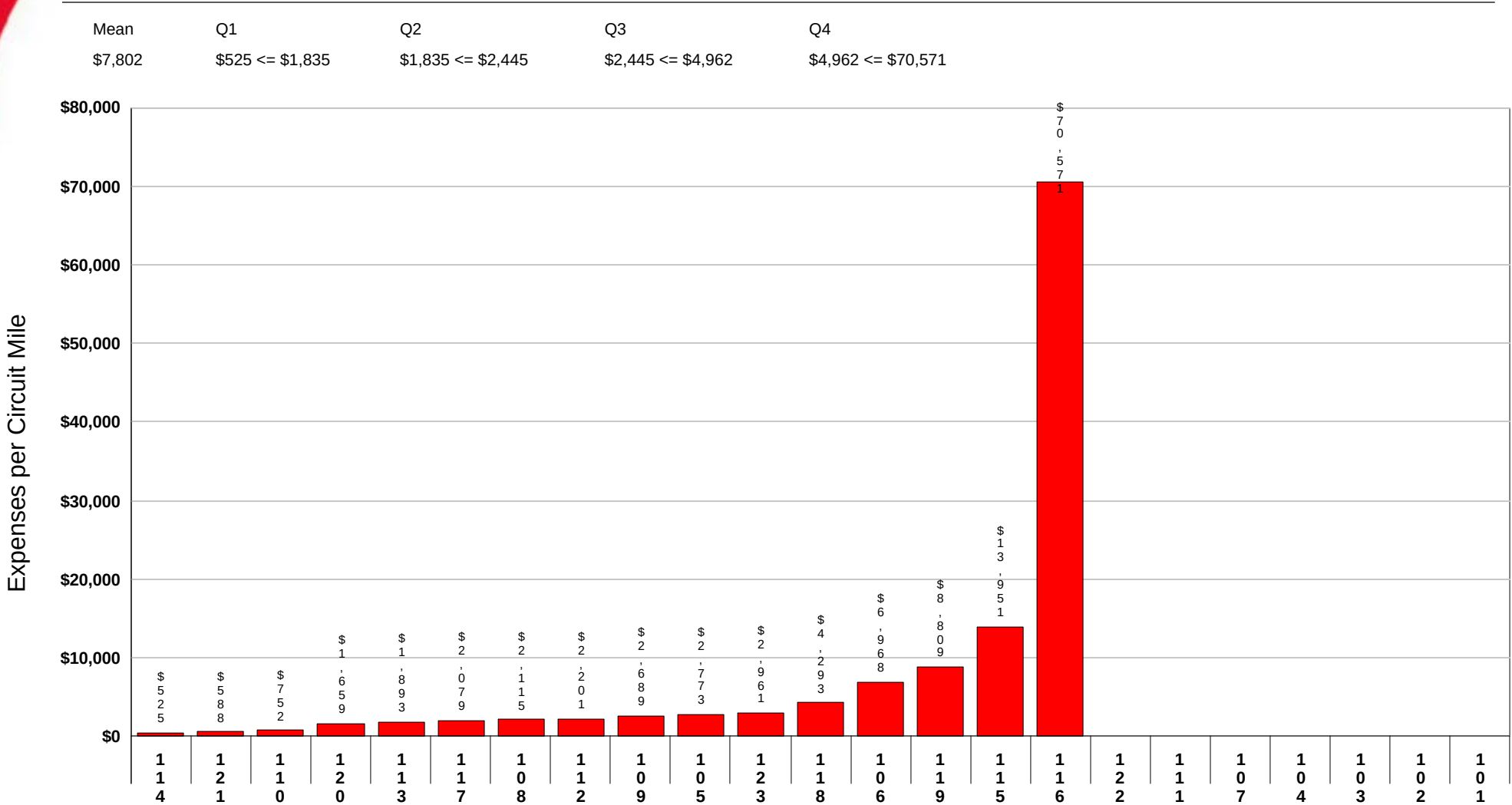
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Transmission Line Operations Expenses

Per Transmission Circuit Mile

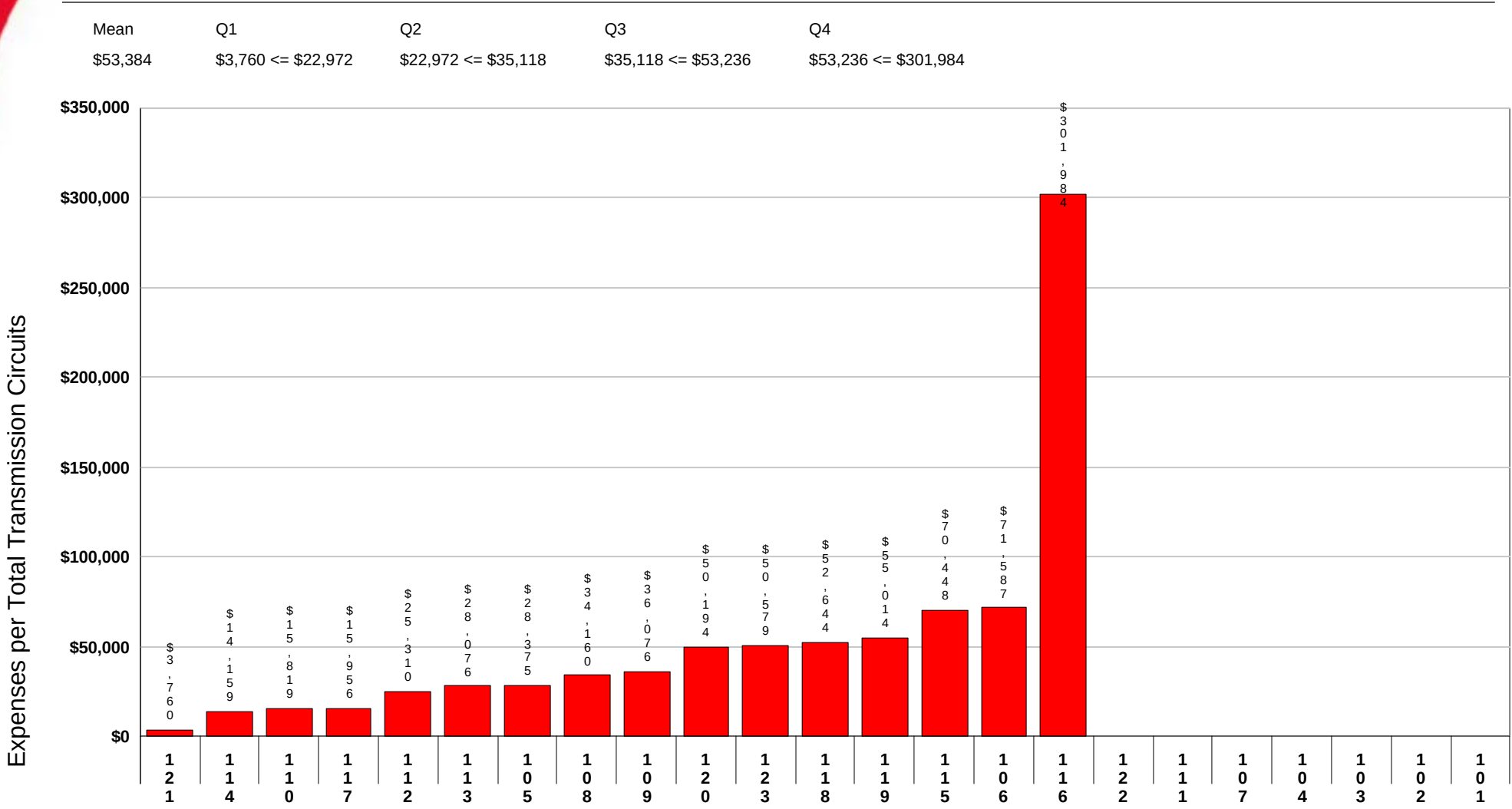


Source/Calculation: ((SUM{B.20}-B.20.6)-SUM{B.21})/(SUM{BB.3}+SUM{BB.4})
Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006
ID Code:2013
Page:1723

Only companies with all the data are shown.

Transmission Line Operations Expenses

Per Total Transmission Circuits



Source/Calculation:((SUM{B.20}-B.20.6)-SUM{B.21})/SUM{BB.2}

Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006

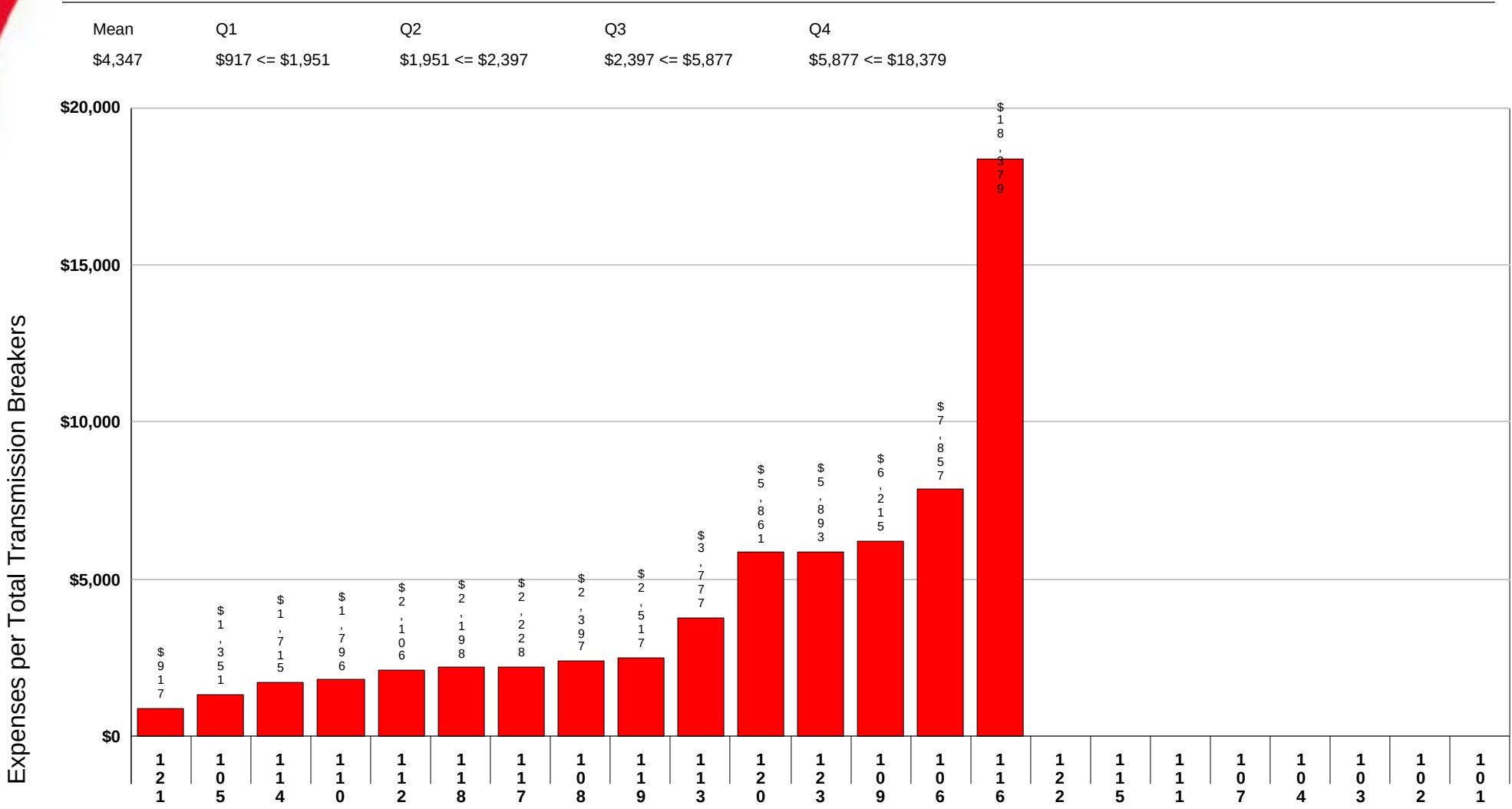
ID Code:1600109

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Only companies with all the data are shown.

Transmission Line Operations Expenses

Per Total Transmission Breakers



Source/Calculation:((SUM{B.20}-B.20.6)-SUM{B.21})/SUM{AQ.4}

Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006

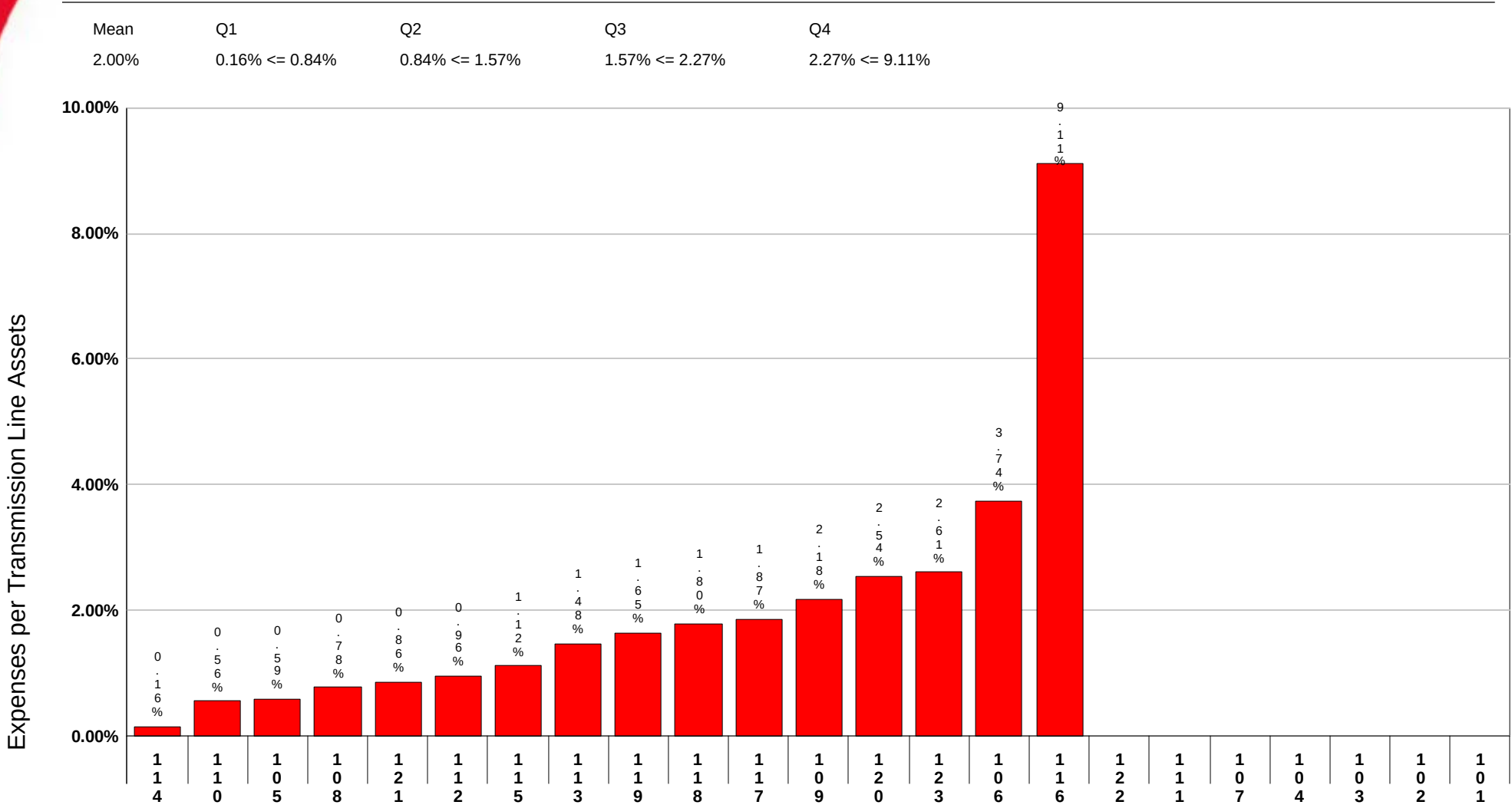
ID Code:1600110

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Only companies with all the data are shown.

Transmission Line Operations Expenses

Per Transmission Line Assets



Source/Calculation:(SUM{B.20}-B.20.6-SUM{B.21})/(B.10.1-B.11.1)

Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006

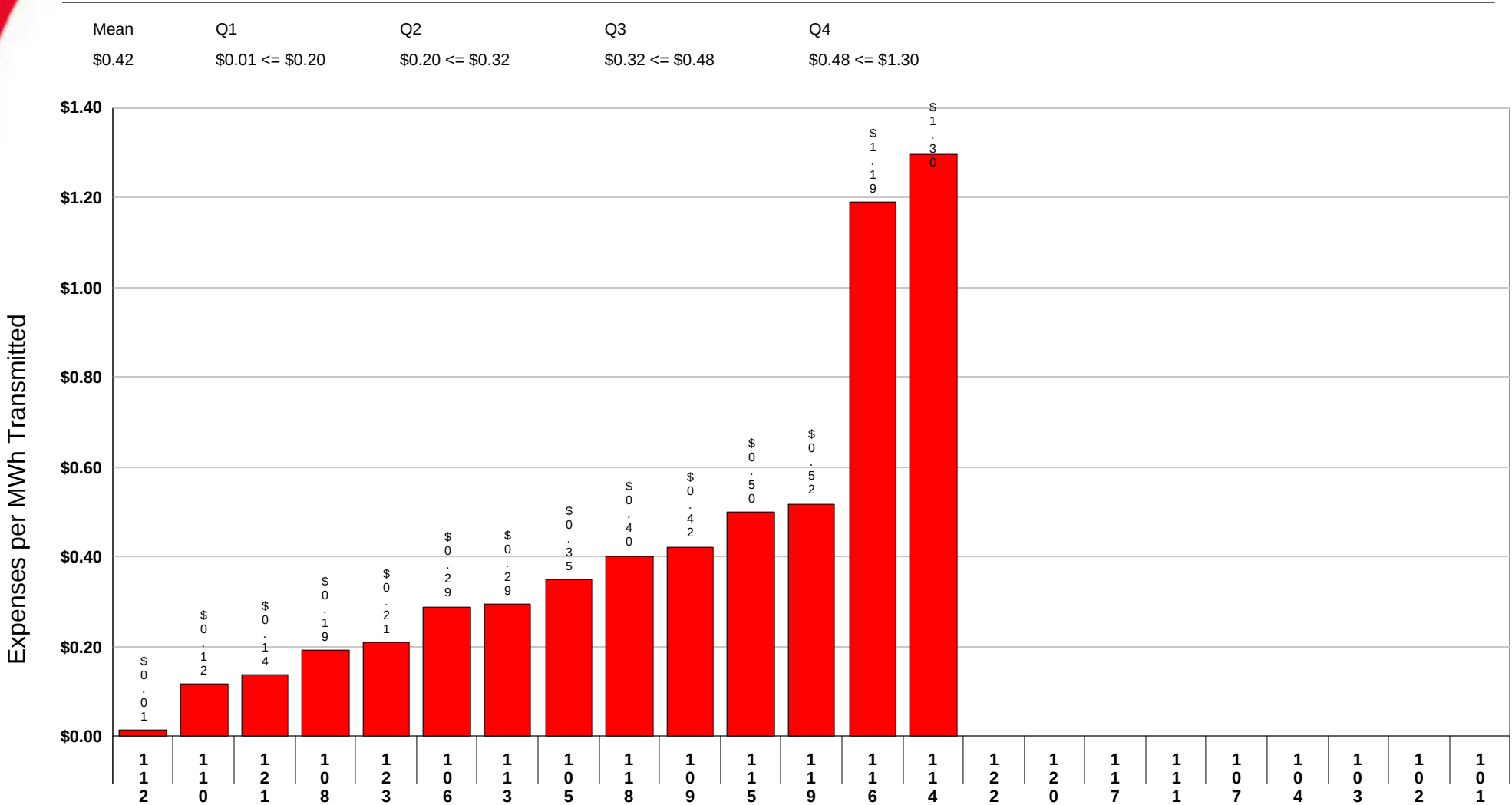
ID Code:2123

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Only companies with all the data are shown.

Transmission Maintenance Expenses

Per MWh Transmitted



Source/Calculation:SUM{B.22}/A.2.5

Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006

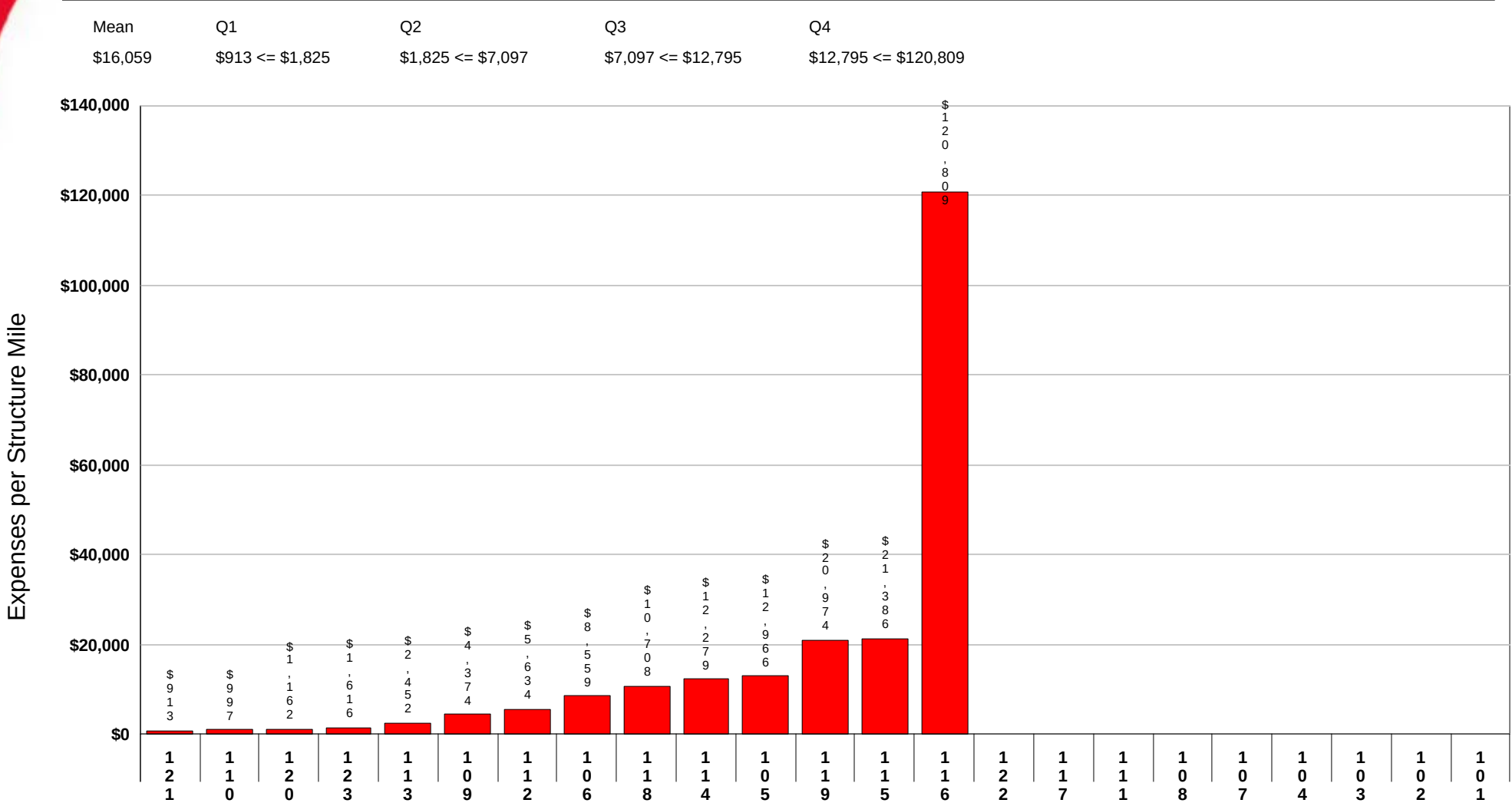
ID Code:665

Page:1725

Only companies with all the data are shown.

Transmission Maintenance Expenses

Per Transmission Structure Mile



Source/Calculation:SUM{B.22}/(SUM{BB.5}+SUM{BB.6})

Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006

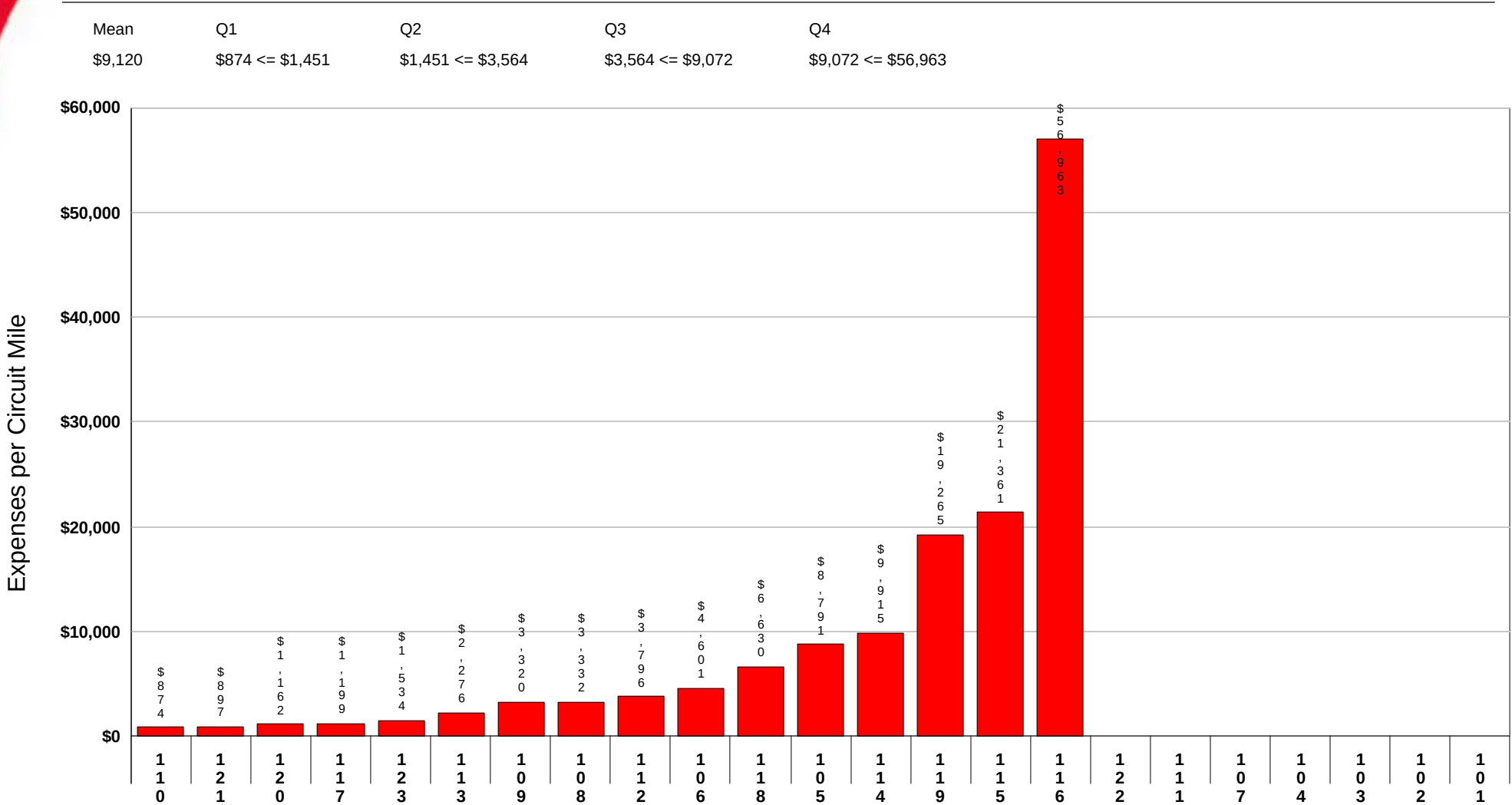
ID Code:664

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Only companies with all the data are shown.

Transmission Maintenance Expenses

Per Transmission Circuit Mile



Source/Calculation:SUM{B.22}/(SUM{BB.3}+SUM{BB.4})

Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006

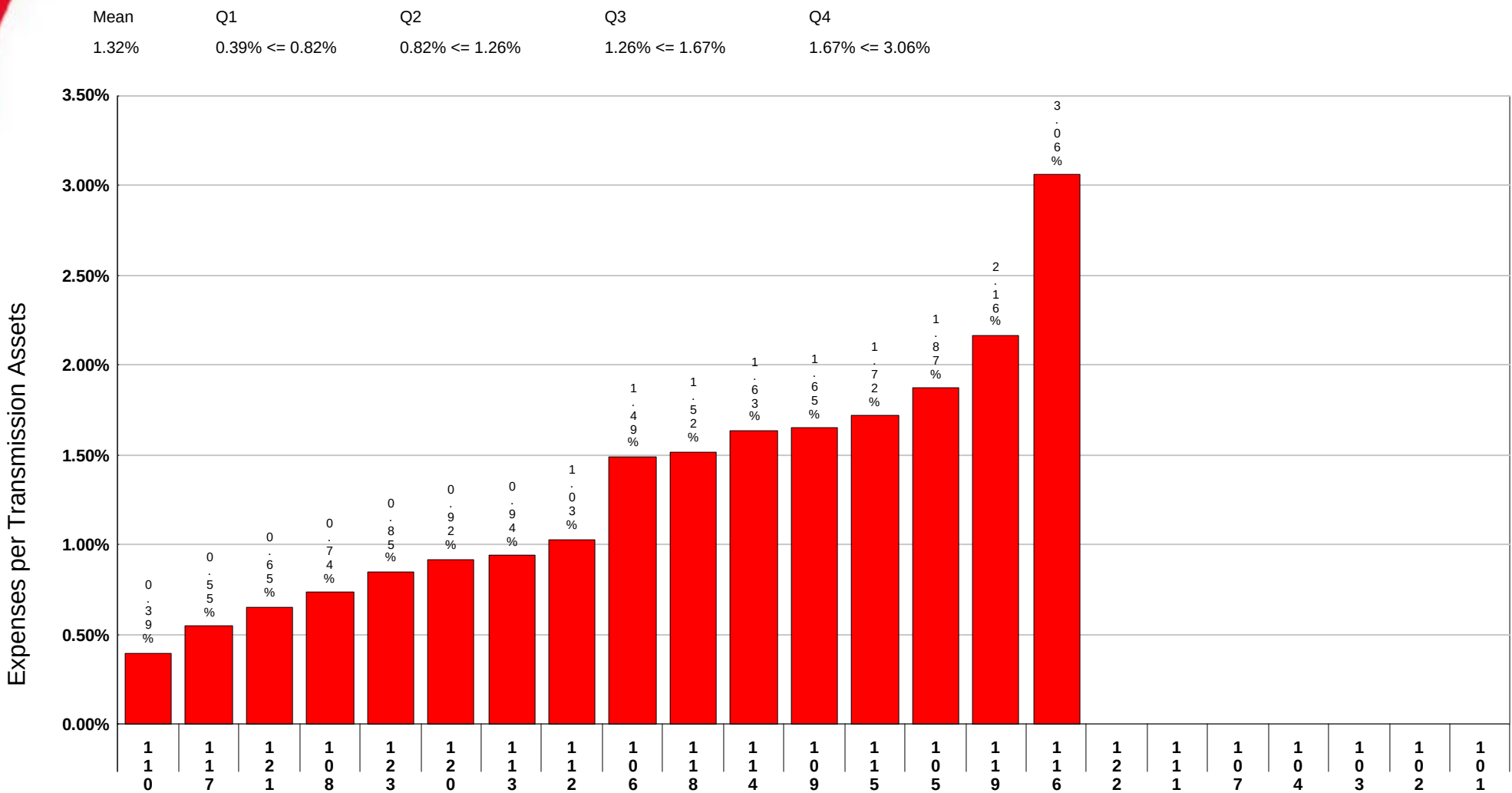
ID Code:2011

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Only companies with all the data are shown.

Transmission Maintenance Expenses

Per Transmission Assets



Source/Calculation:SUM{B.22}/B.10.1

Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006

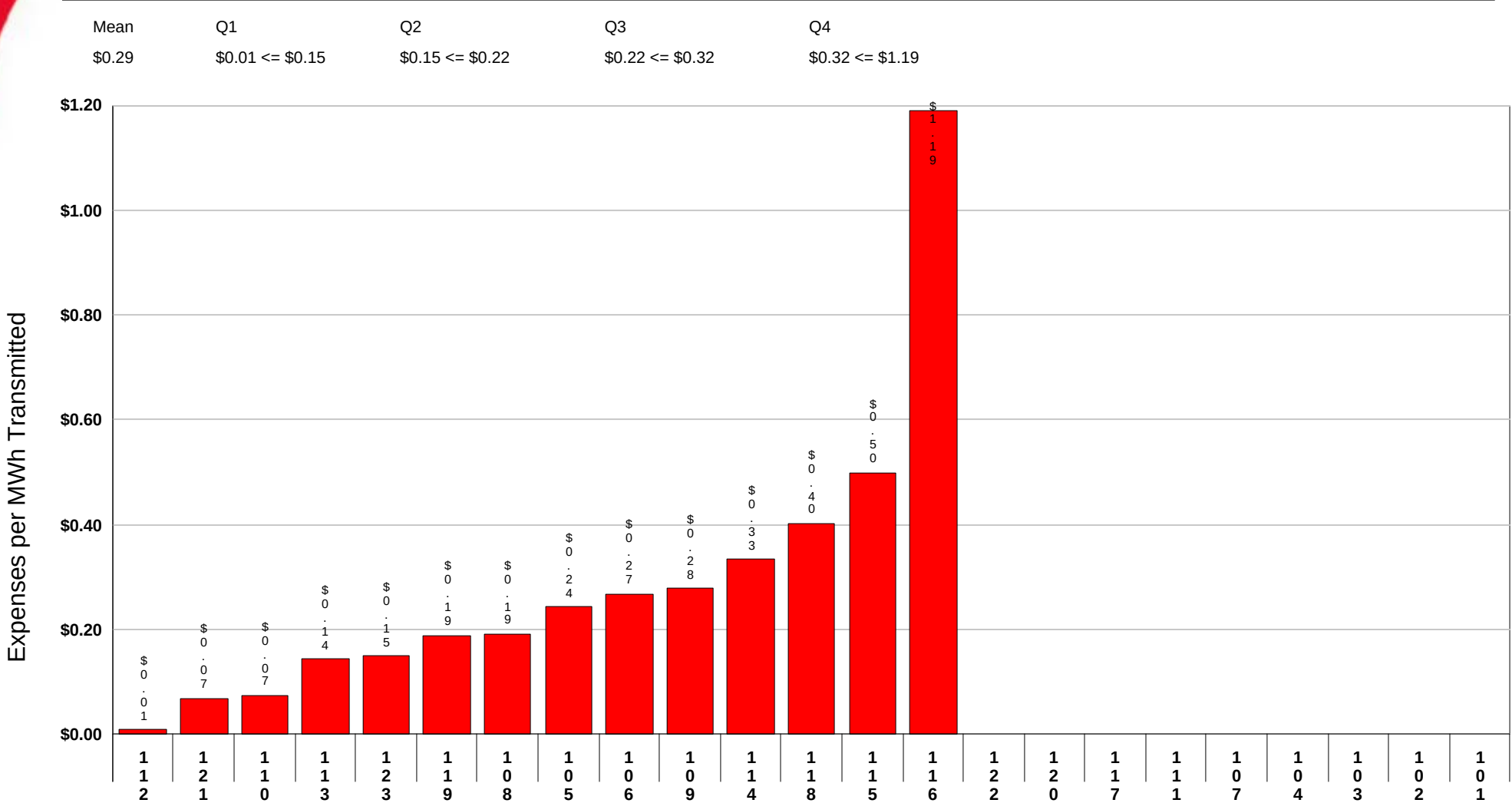
ID Code:2125

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Only companies with all the data are shown.

Transmission Line Maintenance Expenses

Per MWh Transmitted



Source/Calculation:(SUM{B.22}-SUM{B.23})/A.2.5

Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006

ID Code:671

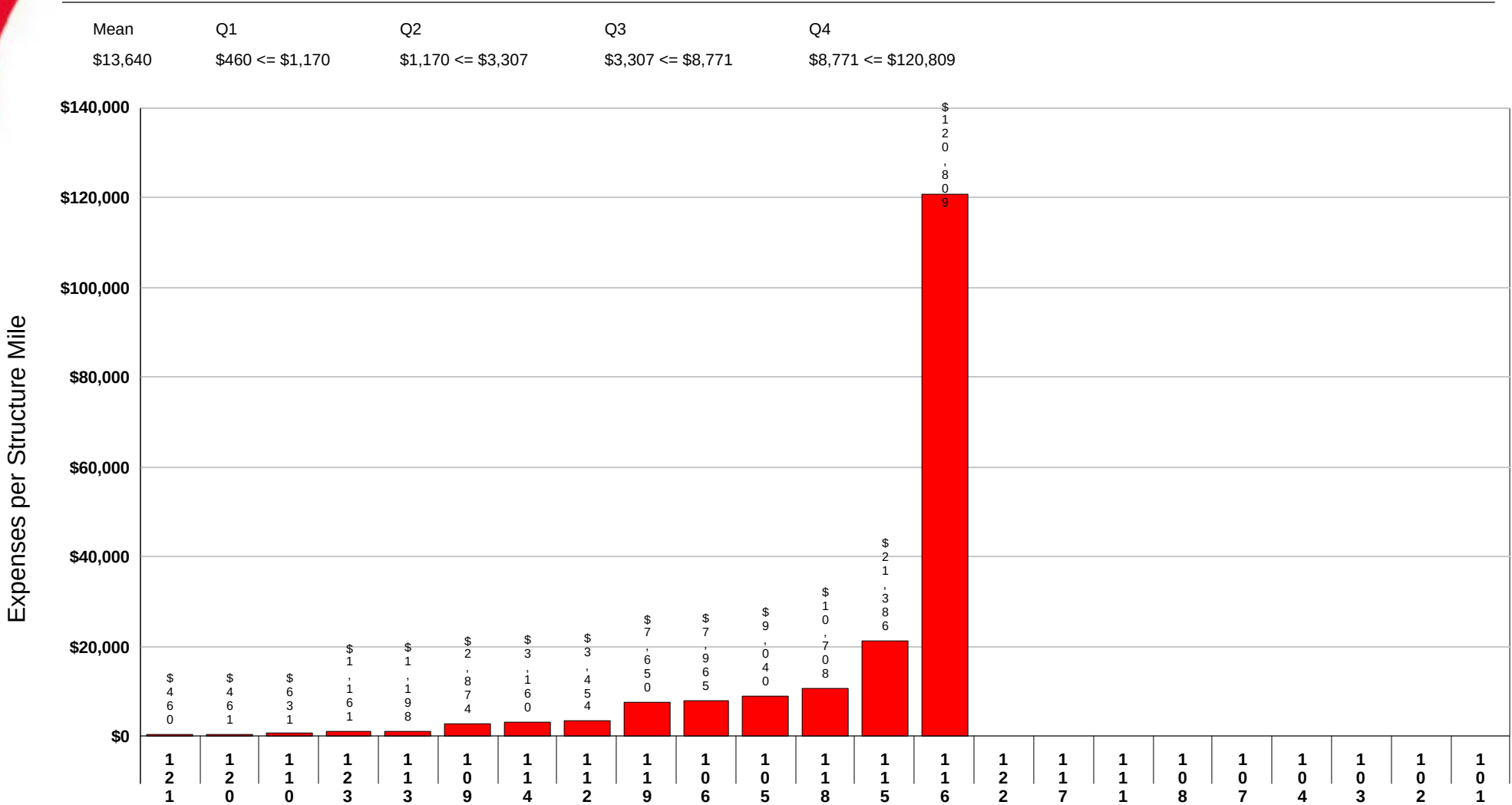
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Only companies with all the data are shown.



Transmission Line Maintenance Expenses

Per Transmission Structure Mile

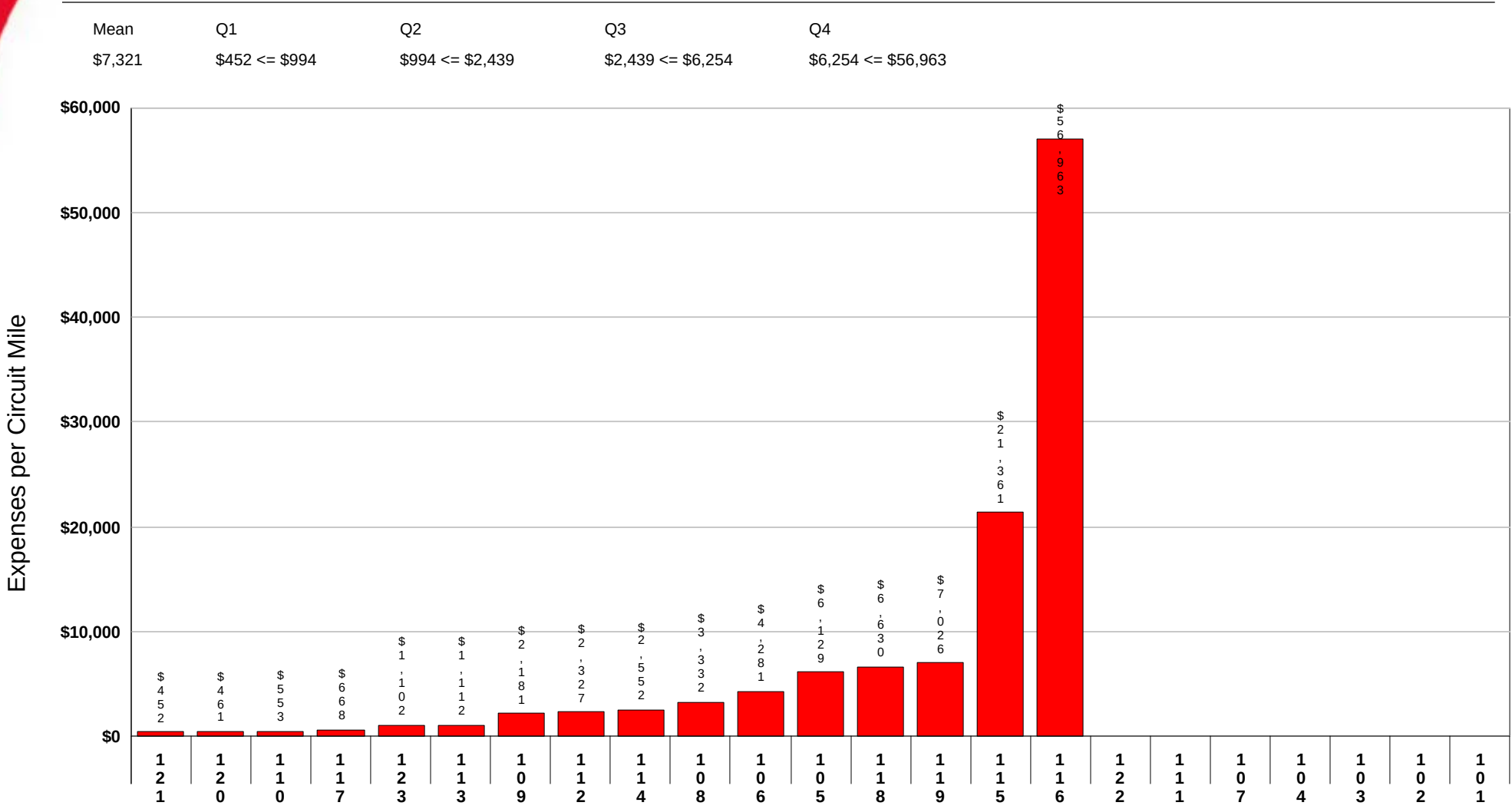


Source/Calculation: (SUM{B.22}-SUM{B.23})/(SUM{BB.5}+SUM{BB.6})
Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006
ID Code:670
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Only companies with all the data are shown.

Transmission Line Maintenance Expenses

Per Transmission Circuit Mile

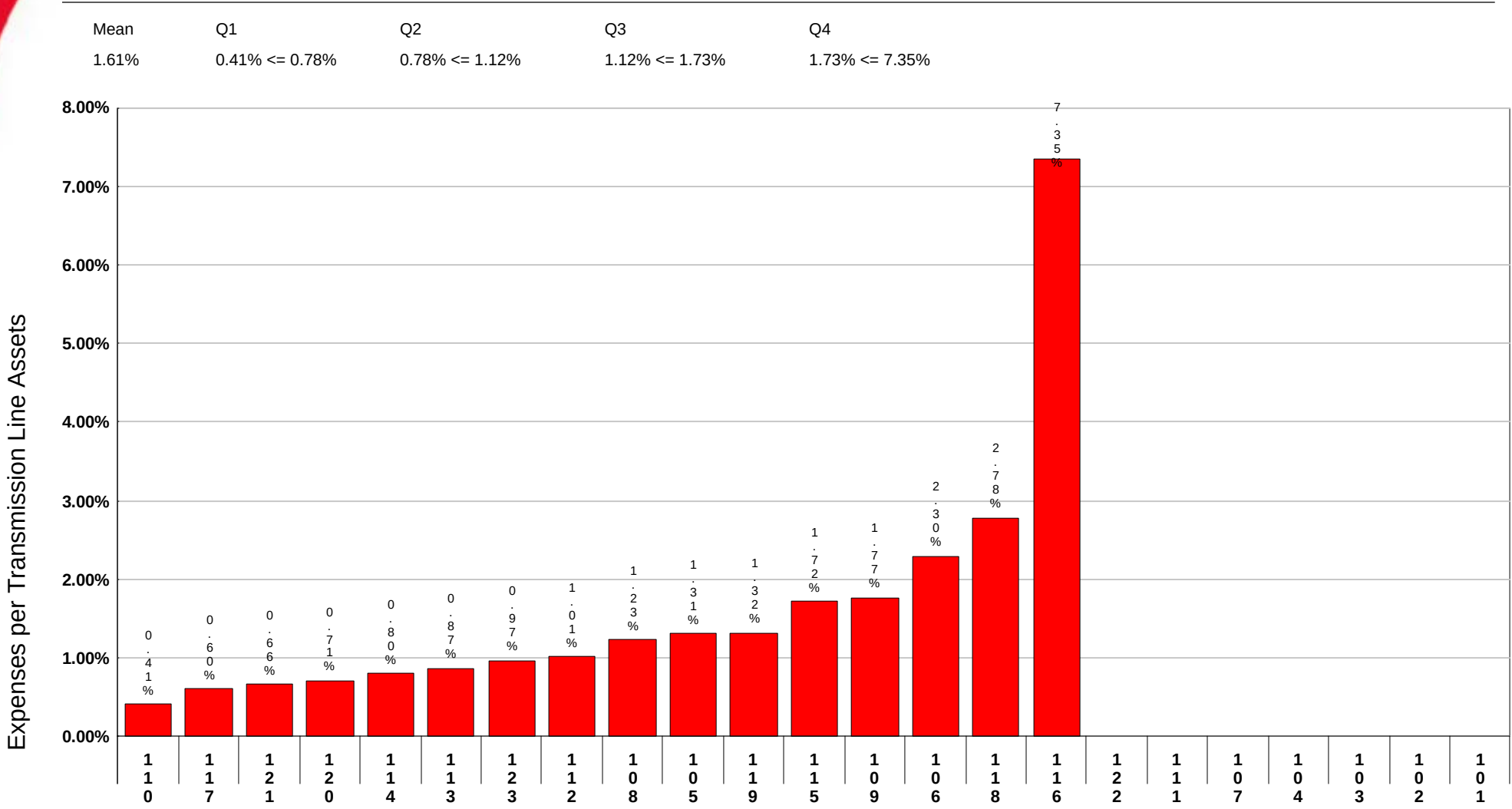


Source/Calculation: (SUM{B.22}-SUM{B.23})/(SUM{BB.3}+SUM{BB.4})
Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006
ID Code: 2012
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Only companies with all the data are shown.

Transmission Line Maintenance Expenses

Per Transmission Line Assets

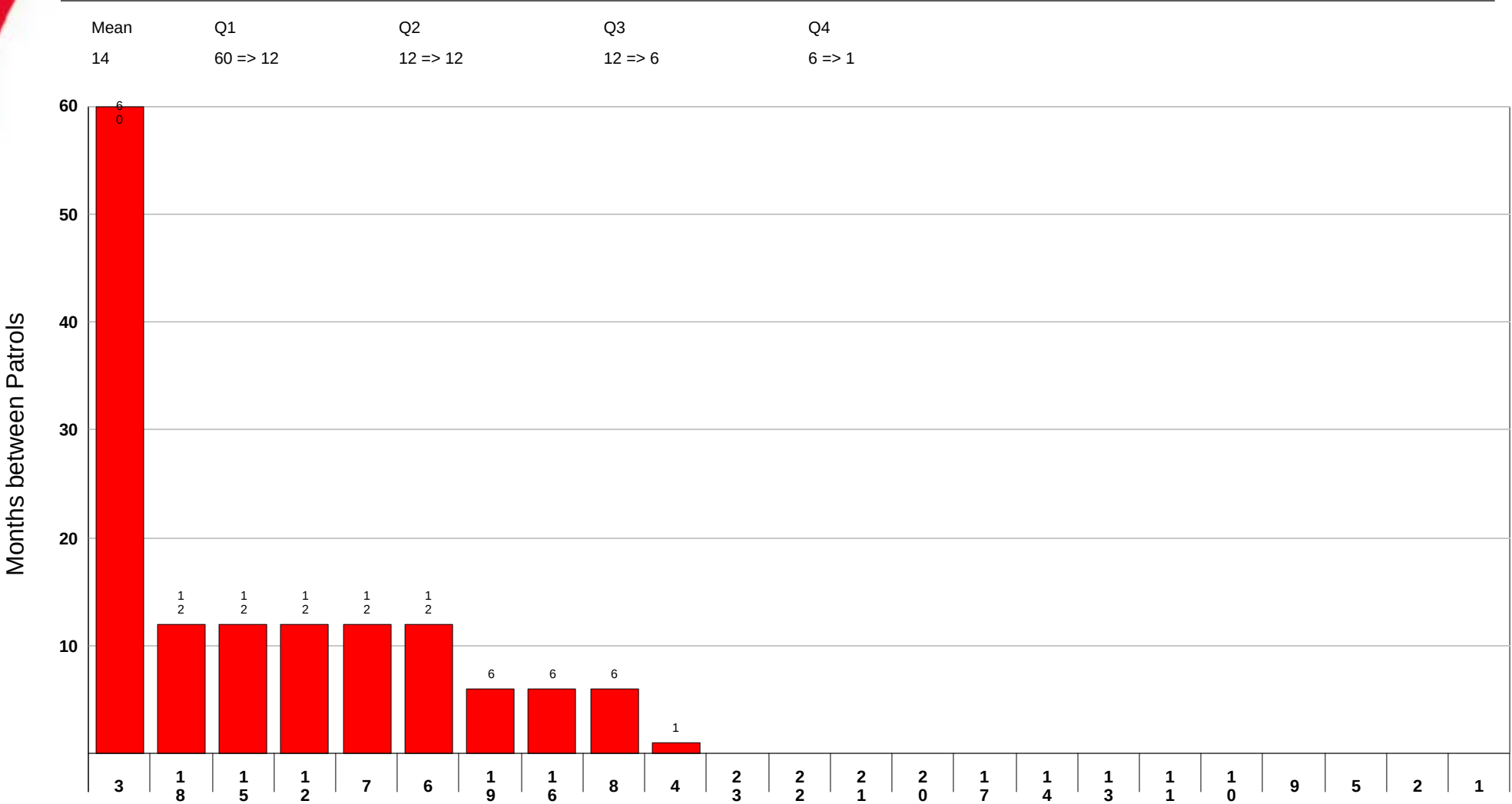


Source/Calculation: (SUM{B.22}-SUM{B.23})/(B.10.1-B.11.1)
Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006
ID Code: 2124
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Only companies with all the data are shown.

Frequency of Aerial Patrol of Transmission Lines

Months Between Patrols (Helicopters, Fixed-Wing Fly-By)



Authority of Inspection Personnel to Make Correction Decisions

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Full (can make on-site decisions):											✓	✓							✓					18.8%
2. Limited (e.g. budget restriction):	✓	✓						✓																18.8%
3. Report Back Only:			✓	✓	✓	✓	✓							✓	✓	✓		✓						56.3%
99. Other:									✓															6.3%

Source/Calculation:BD.3.1

Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006

ID Code:9625

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Authority of Inspection Personnel to Make Correction Decisions (cont.)

To what extent do inspection personnel have authority to make correction decisions?

- The need to prevent outage or protect life/property

Percent of Transmission System Maintained Last Year

Preventive Maintenance

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:
1. Percent of Circuits:	-	100%	20%	-	14%	100%	100%	60%	100%	-	100%	20%	-	-	25%	10%	-	20%	25%	-	-	-	-	53.4%
2. Percent of Circuit miles:	-	100%	20%	-	-	100%	100%	-	30%	-	100%	20%	-	-	25%	10%	-	10%	25%	-	-	-	-	49.1%
3. Percent of Structures:	-	100%	20%	35%	5%	100%	100%	3%	10%	-	100%	20%	-	20%	25%	5%	-	10%	25%	-	-	-	-	38.5%

Source/Calculation:BD.4.1

Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006

ID Code:40232

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Percent of Maintenance Done with Energized Lines

Per Voltage Class

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:	
1. 500kV Or Greater:	-	60%	5%	-	-	0%	0%	0%	0%	-	-	-	-	1%	50%	0%	-	-	0%	-	-	-	-	-	11.6%
2. 230kV Class (200kV - 499kV):	-	60%	5%	-	5%	0%	0%	75%	0%	-	80%	2%	-	1%	50%	10%	-	5%	0%	-	-	-	-	-	20.9%
3. 100kV Class (100kV - 199kV):	-	60%	5%	-	5%	0%	0%	50%	0%	-	50%	5%	-	0%	50%	0%	-	10%	0%	-	-	-	-	-	16.8%
4. 60kV Class (60kV - 99kV):	-	60%	-	-	5%	0%	0%	0%	10%	-	30%	5%	-	0%	50%	0%	-	-	-	-	-	-	-	-	14.5%
5. Less than 60kV:	-	60%	-	-	-	0%	-	5%	10%	-	-	-	-	0%	100%	0%	-	-	-	-	-	-	-	-	25.0%

Source/Calculation:BD.5.1

Volume: Transmission Line Field Maintenance/Operations, Final Report, 2006

ID Code:9626

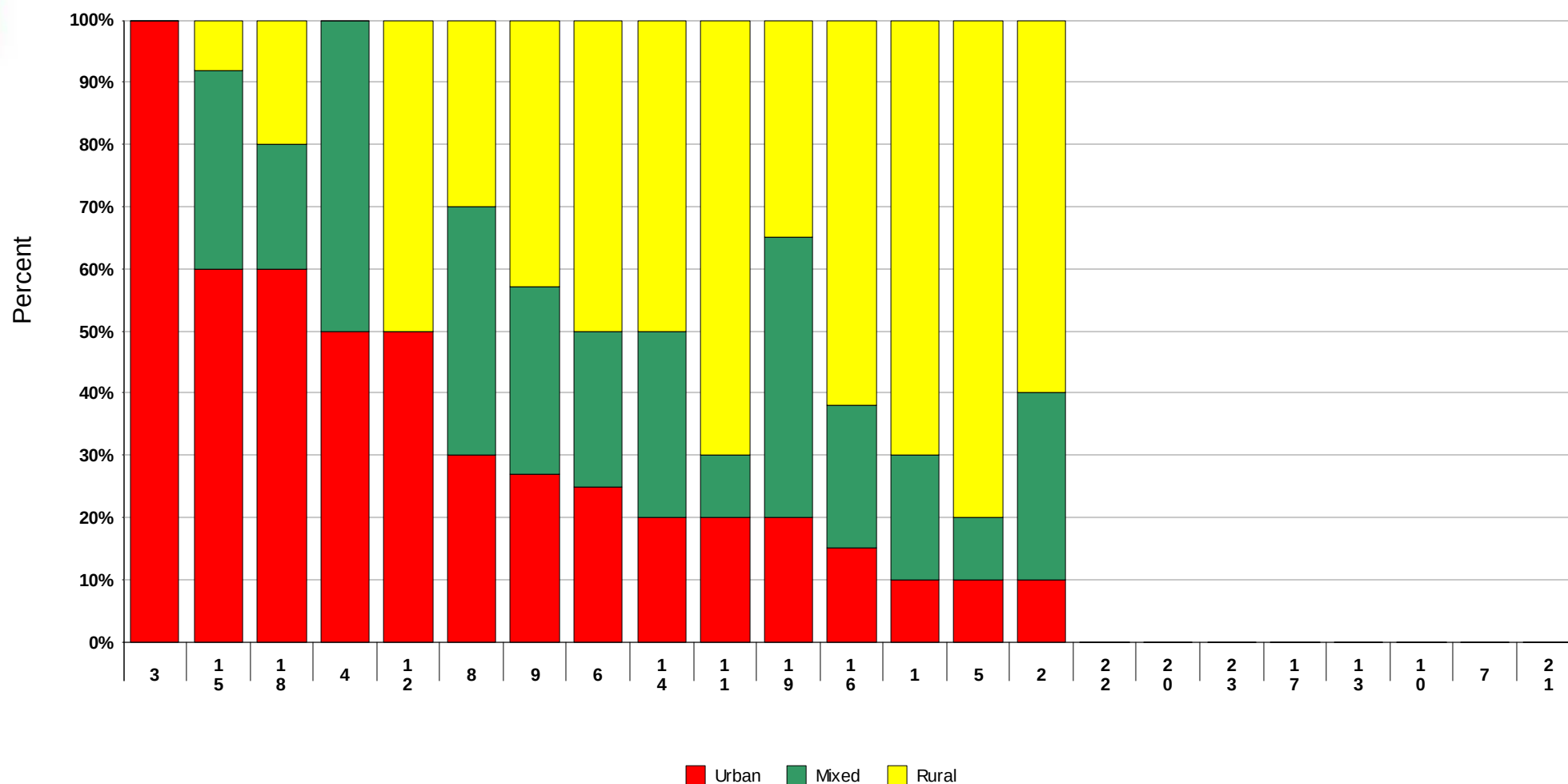
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	Pg. 1755	Transmission Vegetation Management O&M Expense for the Past Four Years - Per Transmission Service Territory - Square Miles
	Pg. 1762	Percent of Transmission Vegetation Management Budget Used
	Pg. 1763	Percent Transmission Vegetation Management Budget Used (cont.)
	Pg. 1764	Methods Used to Measure Effectiveness Transmission Vegetation Program
	Pg. 1765	Methods Used to Measure Effectiveness Transmission Vegetation Program (cont.)
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	Pg. 1770	Number of Tree Contracting Companies Used on Transmission System
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	Pg. 1778.1	Frequency of Transmission Rights-Of-Way Management Activities (cont.) - Number of Years
	Pg. 1779	Typical Unit Costs - For the Following Activities

Percent of Service Territory That Is Urban, Mixed, or Rural Density



Source/Calculation: BE.3.1

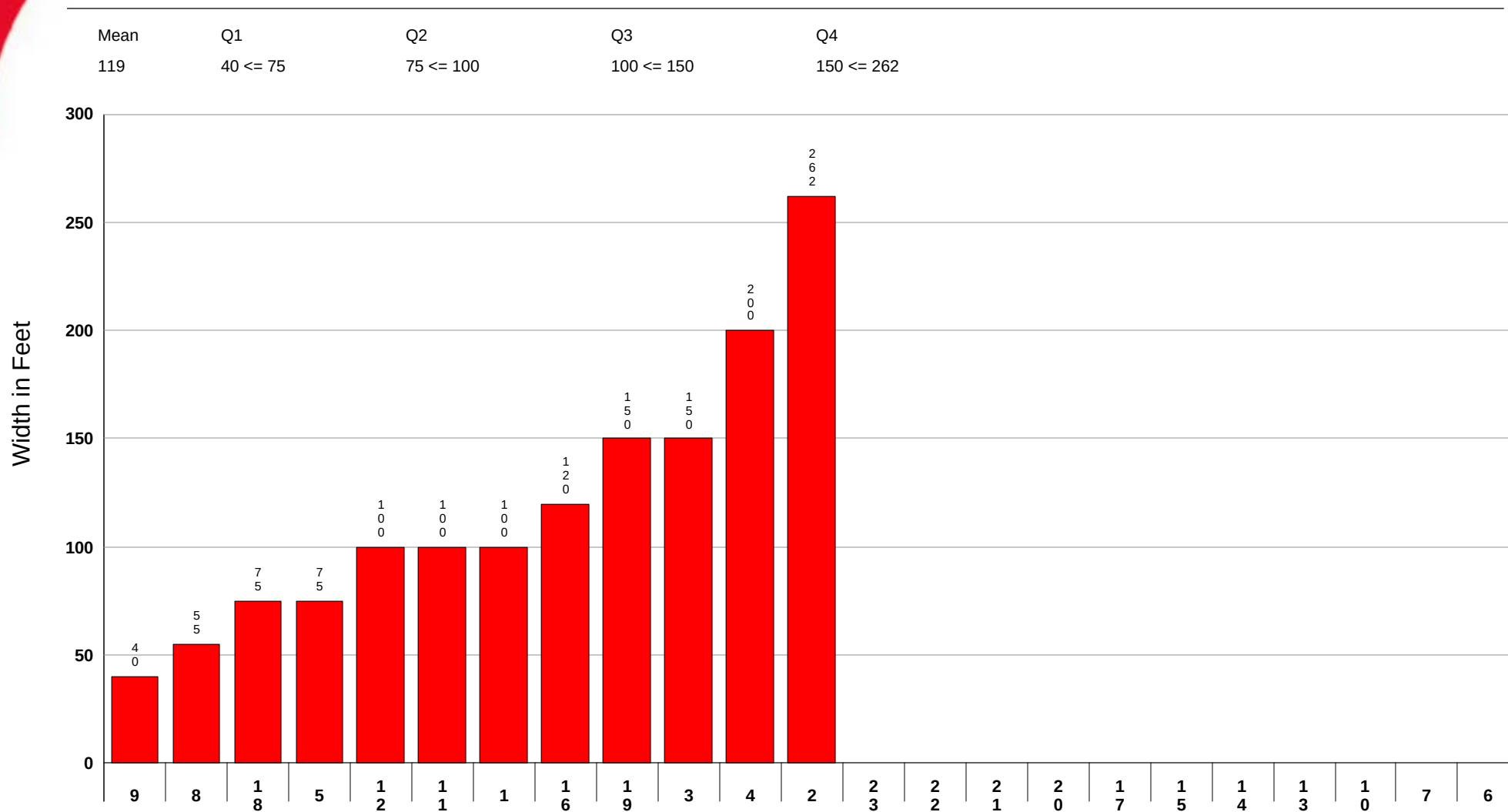
Volume: Transmission Vegetation Management, Final Report, 2006

ID Code: 40255

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Calculation shown is for the first piece of the stacked bar only.

Average ROW Width



Source/Calculation: BE.4.1

Volume: Transmission Vegetation Management, Final Report, 2006

ID Code: 40257

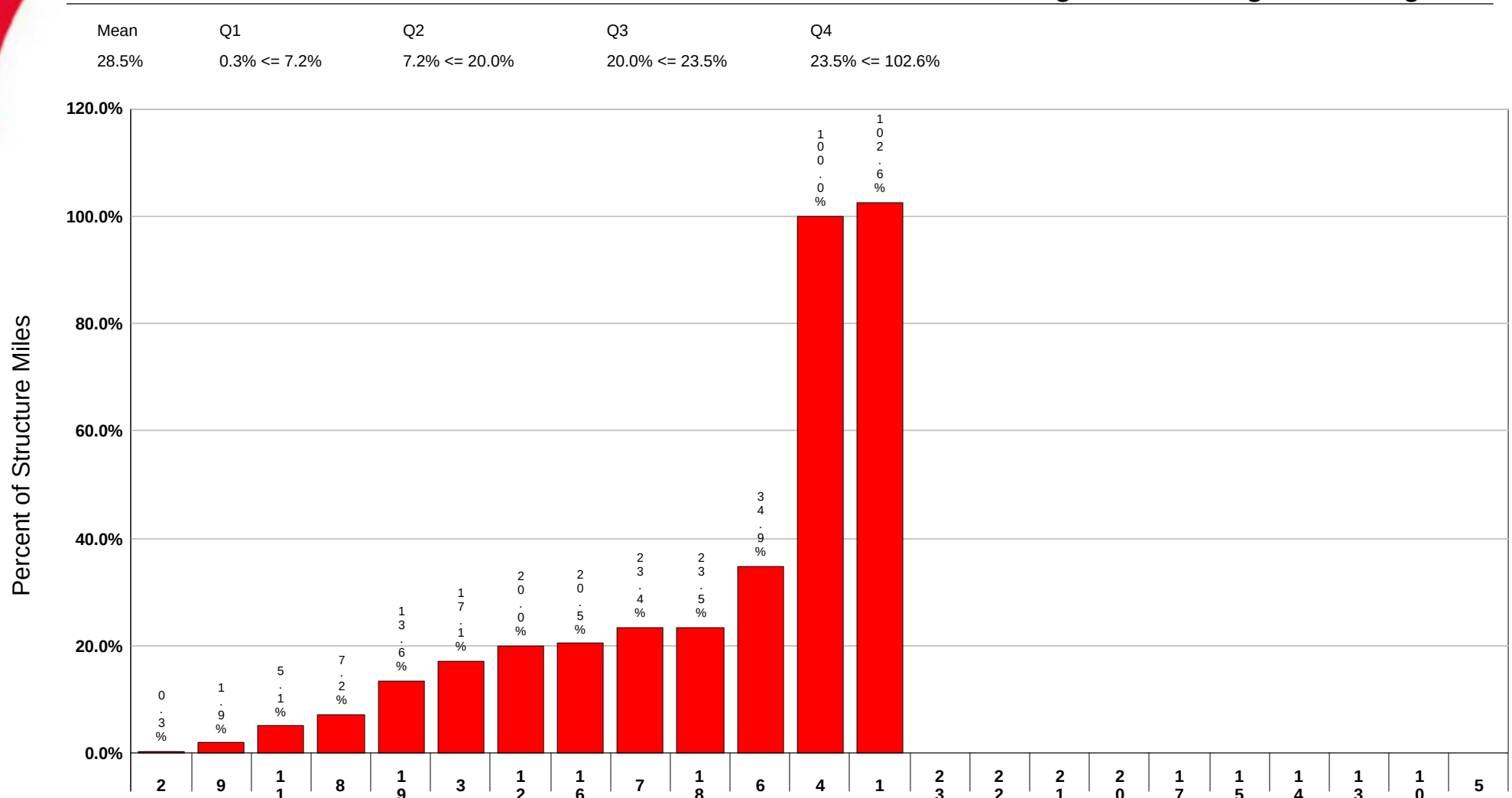
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Only companies with all the data are shown.



Structure Miles Maintained Last Year per OH Structure Mile

As Part of Vegetation Management Program



Source/Calculation: BE.5.1/SUM{BB.5}

Volume: Transmission Vegetation Management, Final Report, 2006

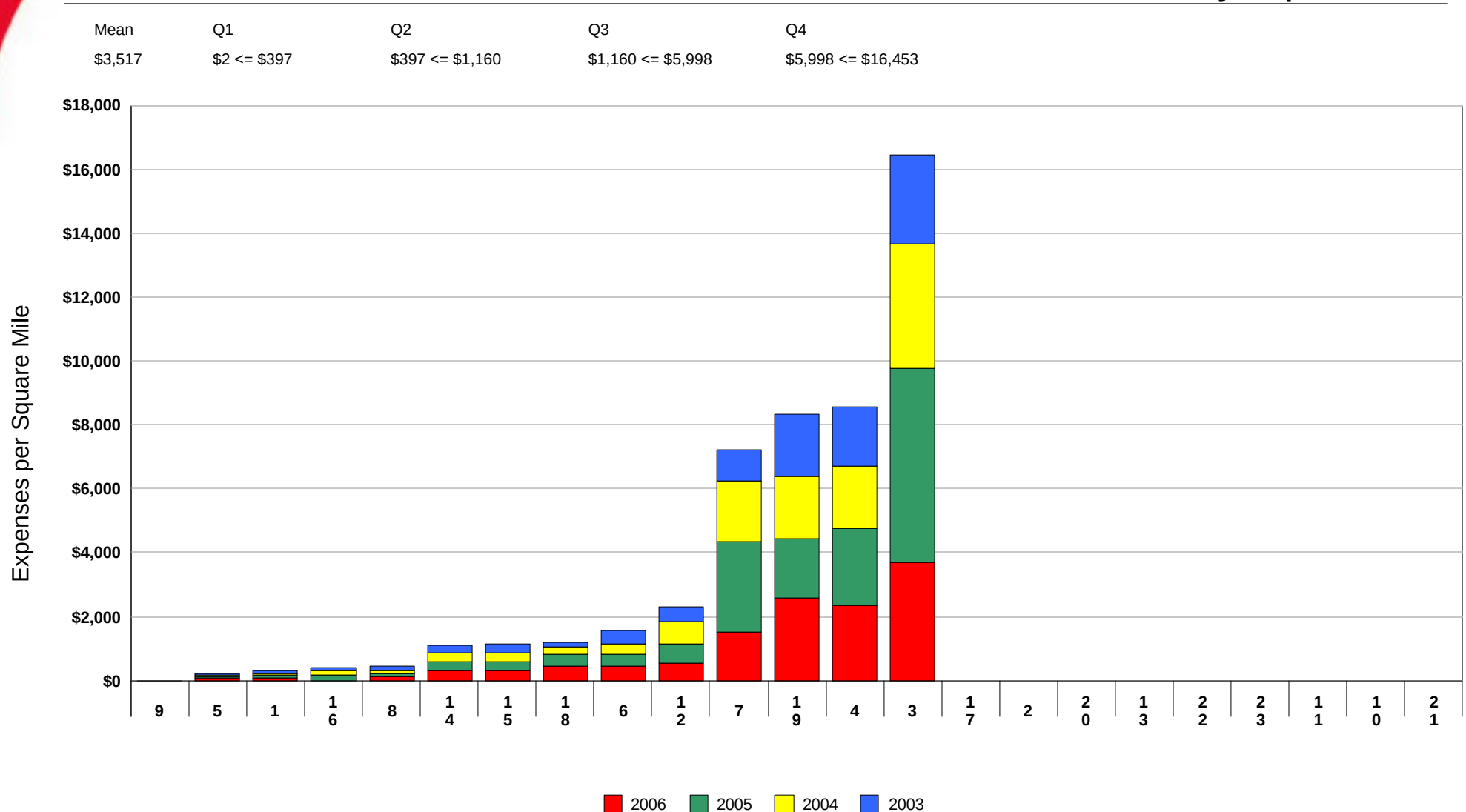
ID Code: 40259

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Only companies with all the data are shown.

Transmission Vegetation Management O&M Expense for the Past Four Years

Per Transmission Service Territory - Square Miles



Source/Calculation: BE.6.1/BE.2.1

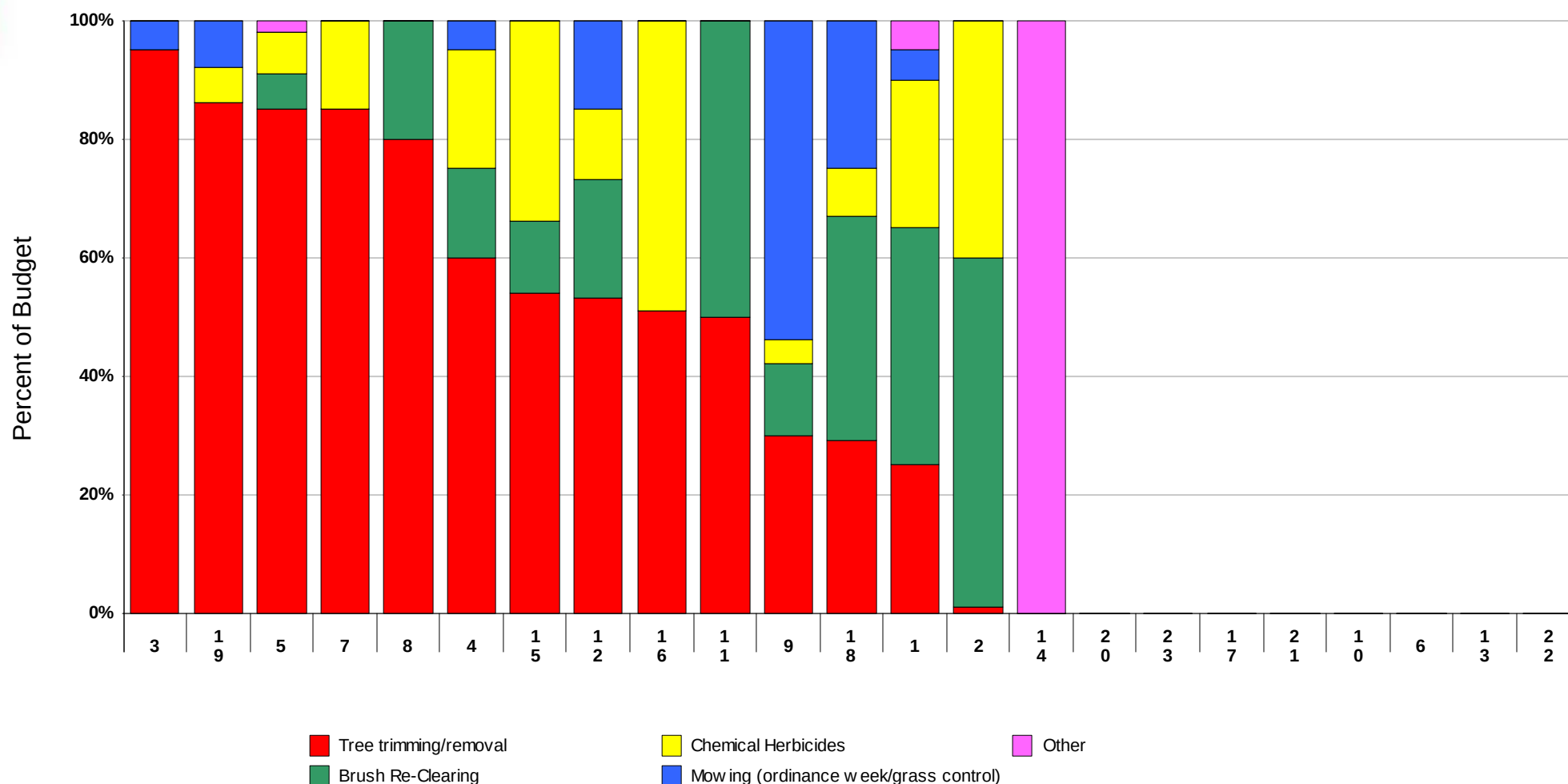
Volume: Transmission Vegetation Management, Final Report, 2006

ID Code: 27330

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Calculation shown is for the first piece of the stacked bar only.

Percent of Transmission Vegetation Management Budget Used



Source/Calculation: BE.7.1

Volume: Transmission Vegetation Management, Final Report, 2006

ID Code: 40263

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Calculation shown is for the first piece of the stacked bar only.

Percent Transmission Vegetation Management Budget Used (cont.)

What percent of your Transmission Vegetation management budget is spent on the following?

- Patrolling
- Prescriptions based on an arborist assessment

Source/Calculation: BE.7.99

Volume: Transmission Vegetation Management, Final Report, 2006

ID Code: 40412

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Methods Used to Measure Effectiveness Transmission Vegetation Program

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. None:																								0.0%
2. Miles of Circuit cleared vs. planned:	✓	✓		✓			✓		✓			✓						✓	✓					50.0%
3. Cost per mile cleared:	✓			✓			✓		✓			✓							✓					37.5%
4. Cost per brush acre cleared:		✓							✓															12.5%
5. Vegetation related outages:	✓	✓		✓	✓			✓	✓		✓	✓		✓	✓	✓								68.8%
6. Vegetation related SAIFI:	✓					✓	✓	✓	✓					✓		✓			✓					50.0%
7. Vegetation related SAIDI:	✓							✓	✓					✓		✓								31.3%
99. Other :			✓		✓							✓		✓				✓						31.3%

Source/Calculation: BE.8.1

Volume: Transmission Vegetation Management, Final Report, 2006

ID Code: 40265

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Methods Used to Measure Effectiveness Transmission Vegetation Program (cont.)

What performance measures do you use to measure effectiveness of your Transmission Vegetation program?

- Contractor QA, Cost variance, Inspected on time
- cost per span
- cost per system mile
- Cost per unit
- Line Dept. complaints

Source/Calculation: BE.8.99

Volume: Transmission Vegetation Management, Final Report, 2006

ID Code: 40413

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Transmission Vegetation Management Department Organization Structure

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Transmission Operations Area:	✓	✓	✓	✓	✓									✓		✓								43.8%
2. Transmission Support Area:		✓																						6.3%
3. Support Services - System:						✓	✓					✓												18.8%
4. Distribution Operations Area:					✓				✓							✓		✓	✓					31.3%
5. Distribution Support Area:																								0.0%
99. Other:								✓			✓			✓										18.8%

Source/Calculation: BE.9.1

Volume: Transmission Vegetation Management, Final Report, 2006

ID Code: 40267

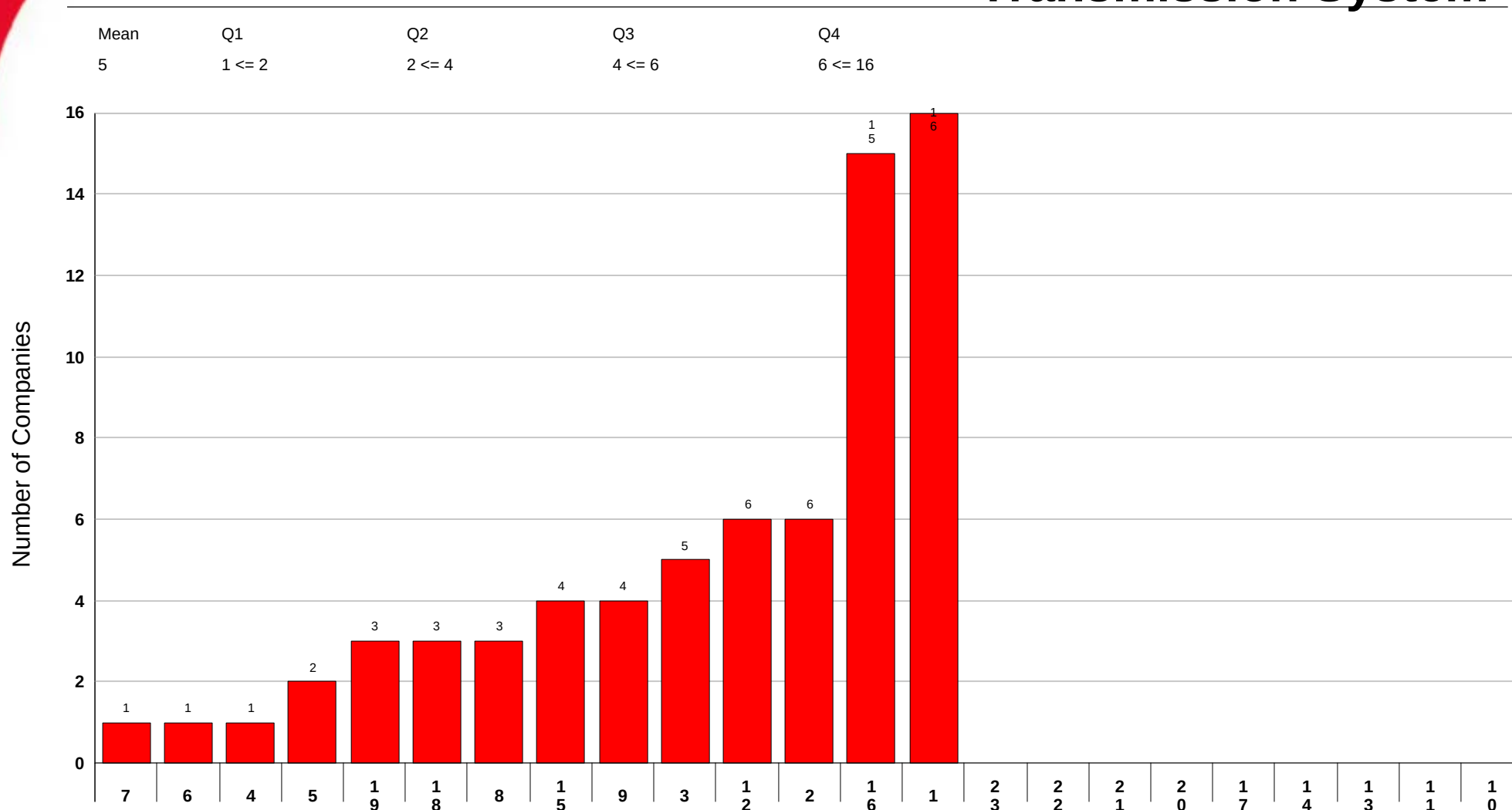
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Transmission Vegetation Management Department Organization Structure (cont.)

Where does the Transmission vegetation management department fall into the company organization structure?

- T&D Engineering & Ops
- Technical Services
- Transmission maintenance

Number of Tree Contracting Companies Used on Transmission System



Source/Calculation: BE.10.1

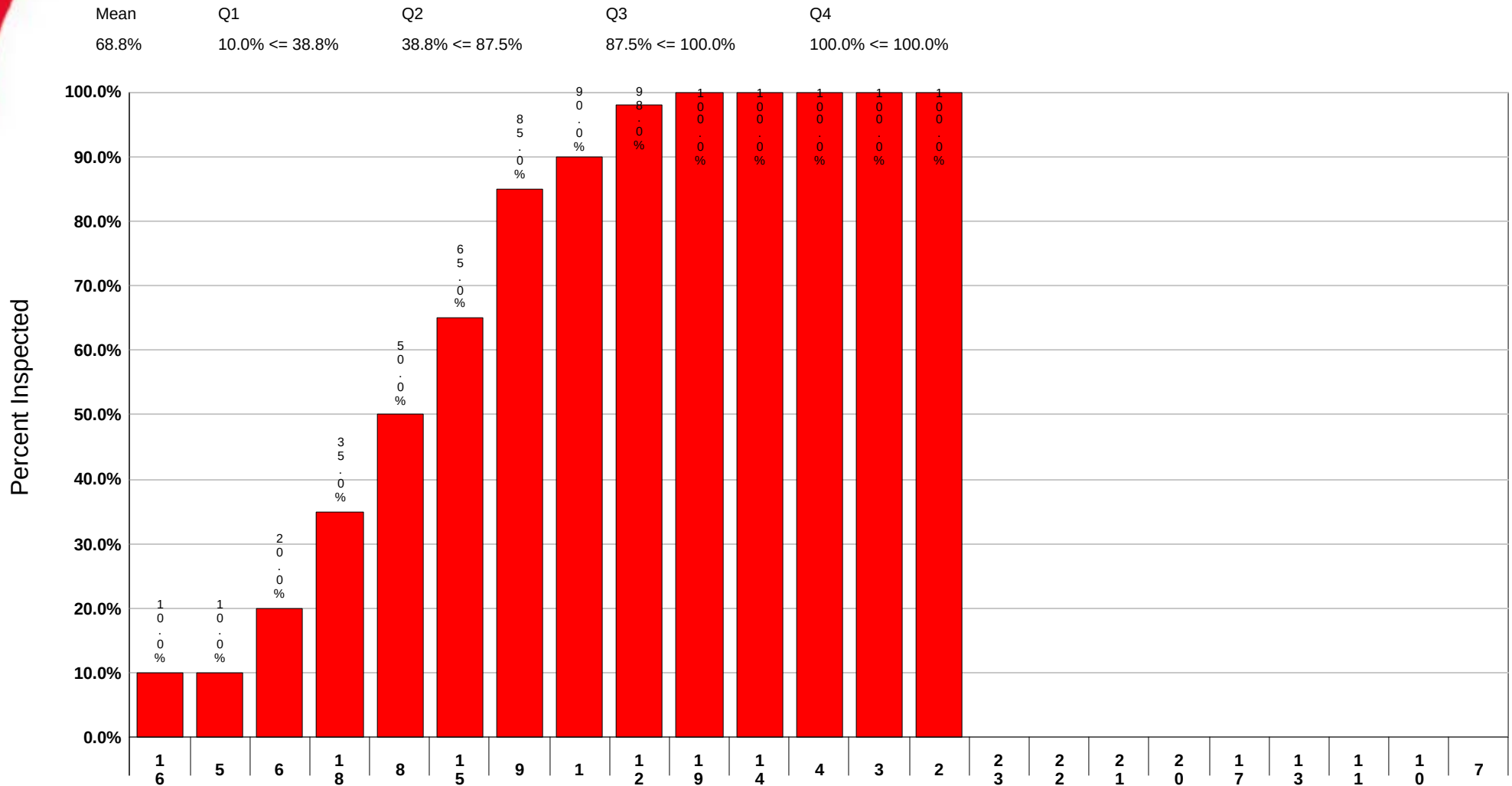
Volume: Transmission Vegetation Management, Final Report, 2006

ID Code: 40268

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Only companies with all the data are shown.

Percent of Vegetation Contractors Spot Inspected for Work Quality



Source/Calculation: BE.11.1

Volume: Transmission Vegetation Management, Final Report, 2006

ID Code: 40270

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Only companies with all the data are shown.

Frequency of Transmission Rights-Of-Way Management Activities

Number of Years

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:
1. Floor Management:	3	4	-	3	3	5	5	-	2	-	10	5	-	3	-	6	-	4	-	-	-	-	-	4.4
2. Side Management:	7	10	-	3	3	5	5	-	2	-	10	5	-	3	-	8	-	4	5	-	-	-	-	5.4
3. Easement, Access, Roads, Drainage:	-	-	-	3	5	5	-	2	-	2	5	-	1	-	-	-	5	-	-	-	-	-	-	3.1
4. Herbicide Application:	5	7	-	3	3	5	3	-	-	-	5	-	5	-	5	-	4	4	-	-	-	-	-	4.5
99. Other:	-	-	-	-	1	5	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1.8

Source/Calculation: BE.12.1

Volume: Transmission Vegetation Management, Final Report, 2006

ID Code: 3176

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Frequency of Transmission Rights-Of-Way Management Activities (cont.)

Number of Years

What is frequency of transmission rights-of-way management activities?

- Mowing
- Ordinance maintenance
- Patrols and Hot Spotting
- Some are restricted due to permitting.
- Urban trimming is on a 3 year cycle, rural side trimming is on a 7 year cycle.

Typical Unit Costs

For the Following Activities

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:
1. Mowing (per Acre):	\$120	-	-	\$88	\$0	-	-	\$237	\$400	-	\$700	\$200	-	\$500	-	\$47	-	-	\$65	-	-	-	-	\$173
2. Floor Management (per Acre):	-	-	-	\$186	-	-	-	-	\$400	-	-	-	-	-	-	\$78	-	-	-	-	-	-	-	\$221
3. Brush Removal (per Acre):	-	-	-	-	-	-	-	-	\$400	-	-	-	-	-	\$870	-	-	-	-	-	-	-	-	\$635
4. Line Clearance (Cost per Structure Mile):	\$2,900	-	-	\$7,710	\$8,300	\$1,800	-	\$1,000	\$3,500	-	\$2,500	\$3,800	-	-	-	\$1,800	-	-	-	-	-	-	-	\$2,783

Source/Calculation: BE.13.1

Volume: Transmission Vegetation Management, Final Report, 2006

ID Code: 10563

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-  ● Pg. 1781 Organization of Energy Operations and Transmission Operations Functions (cont.)
-  # Pg. 1782 Energy Controls Centers Currently in Service
-  ● Pg. 1783 Energy Controls Centers Currently in Service (cont.)
-  ● Pg. 1786 Functions Provided By the Energy Control Center for Transmission Operations
-  ● Pg. 1787 Functions Provided By the Energy Control Center for Transmission Operations (cont.)
-  ● Pg. 1807 Use of 24-Hour Shift Coverage in the Transmission (or Combined Transmission/Distribution) Operations Center
-  ● Pg. 1808 Use of 24-Hour Shift Coverage in the Transmission (or Combined Transmission/Distribution) Operations Center (cont.)

Organization of Energy Operations and Transmission Operations Functions

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Energy and Transmission Separate:																								0.0%
2. Energy and Transmission Together:						✓	✓							✓	✓									26.7%
3. Energy Separate and Transmission and Distribution Together:				✓					✓									✓	✓					26.7%
4. Separate Energy, Transmission, and Distribution.:	✓		✓					✓								✓								26.7%
99. Other:		✓									✓	✓												20.0%

Source/Calculation: BF.2.1

Volume: Transmission Operations: Control Center, Final Report, 2006

ID Code: 40235

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Organization of Energy Operations and Transmission Operations Functions (cont.)

How are the Energy Operations and Transmission Operations Center functions organized?

- Energie and Transmission are together Distribution is apart
- Energy, Transmission, Distribution
- No energy. Separate Transmission & Distribution.

Energy Controls Centers Currently in Service

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:
1. Energy Operations Centers:	1	-	1	-	-	-	-	1		-	-	-	-	-	-	1	-	-	-	-	-	-	-	0.80
2. Combined Energy & Transmission Operations Centers:		-		-	-	1	1			-	-	-	-	-	1		-	-	-	-	-	-	-	0.38
3. Combined T&D Operations Centers:		-		2	-	-	-		1	-	-	-	-	-	5		-	1	1	-	-	-	-	1.11
4. Transmission Operations Centers:	5	7	1	-	-	-	-	1		-	-	1	-	-	-	1	-	-	-	-	-	-	-	2.29
5. Distribution Operations Centers:	6	-	4	-	-	-	-	1		-	-	1	-	-	-	2	-	-	-	-	-	-	-	2.33
99. Other:	-	-	-	-	-	-	-	-		-	1	-	-	-	-	-	-	-	1	-	-	-	-	0.67

Source/Calculation:BF.3.1

Volume: Transmission Operations: Control Center, Final Report, 2006

ID Code:65428

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Energy Controls Centers Currently in Service (cont.)

Please indicate the number of Energy Controls Centers currently in service.

- Combined T&D Back-Up Center
- Energy + T&D

Functions Provided By the Energy Control Center for Transmission Operations

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Monitor Power Flows:	✓	✓		✓		✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓					100.0%
2. Monitor SCADA Systems:	✓	✓		✓		✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓					100.0%
3. Remotely Operate Transmission System:		✓		✓		✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓					92.9%
4. Dispatch Field Switching:		✓				✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓					85.7%
5. Emergency Response:	✓	✓		✓		✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓					100.0%
99. Other:	✓							✓						✓										21.4%

Source/Calculation:BF.4.1

Volume: Transmission Operations: Control Center, Final Report, 2006

ID Code:40237

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Functions Provided By the Energy Control Center for Transmission Operations (cont.)

Please list the functions that your Energy Control Center provides for Transmission Operations.

- Distribution functions
- Scheduling, bulk power reliability look-aheads, unit commitment, coordinating with neighboring companies.
- Transmission tagging/scheduling/OASIS Functions

Use of 24-Hour Shift Coverage in the Transmission (or Combined Transmission/Distribution) Operations Center

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent	
1. Three 8 hour shifts :							✓								✓				✓						20.0%
2. Two 12 hour shifts:		✓	✓			✓			✓		✓	✓				✓		✓							53.3%
3. Combination of above (i.e.12 Hour Weekends):								✓						✓											13.3%
99. Other:	✓			✓																					13.3%

Source/Calculation:BF.5.1

Volume: Transmission Operations: Control Center, Final Report, 2006

ID Code:65309

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Use of 24-Hour Shift Coverage in the Transmission (or Combined Transmission/Distribution) Operations Center (cont.)

How is 24-hour shift coverage maintained in the Transmission (or combined Transmission/Distribution) Operations Center?

- Our five transmission switching centers use three 8 hour shifts while the System Operations Center (which handles the typical bulk power transmission issues) uses two 12 hour shifts.
- Varies by Position - All 24/7

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-   Pg. 1809.1 Providing Services to the Transmission Line Department - Mapping & Records
-   Pg. 1810 Providing Services to the Transmission Line Department - Shops (e.g. rubbers goods, tool repair, etc)
-   Pg. 1811 Providing Services to the Transmission Line Department - IT infrastructure
-   Pg. 1812 Providing Services to the Transmission Line Department - Communications

Providing Services to the Transmission Line Department Mapping & Records

Please describe how the following functions are provided to the transmission line department (we are mainly interested in the organizational locations).

- Both Centralized and De-centralized
- Central Engineering Group provides support
- Centralized in 4 locations
- Centralizes Engineering group provides support
- Facilities records is the owner department of the records. Records are updated and monitored by: design staff, field staff, operating staff
- Function is done internally in the transmission engineering group. Once the job is completed, the layouts are forwarded to the department for mapping and record keeping.
- Mapping and records for the transmission line department are handled by Transmission personnel in the T&D Organization.
- N/A
- Provided as a support function by the Surveying & ROW Division which is part of the Customer Service & Support Operations Business Unit. Some records are kept by the Transmission Operations Dept., and some are corporate records in the SAP system.
- Transmission Department Centralized Mapping & Records is centralized with one are called the Engineering Support Section. The existing transmission lines are being converted using an ABB GIS process improvement.
- Transmission Engineering
- within transmission department
- Within Transmission Department

Source/Calculation:BG.2.1

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Providing Services to the Transmission Line Department

Shops (e.g. rubbers goods, tool repair, etc)

Please describe how the following functions are provided to the transmission line department (we are mainly interested in the organizational locations).

- All Rubber good are coordinated through the Meter shop for testing and routine maintenance on a regular basis. Company has tool repair facility located at the a construction center where tools are repaired and maintained.
- Both Centralized and De-centralized
- Central group
- Centralized group
- Centralized system shops provides service to entire company.
- corporate - inventory services
- In General Services
- N/A
- Operational support group
- Provided as a support function by Fleet & Shop Services Dept. which is part of the Customer Service & Support Operations Business Unit.
- Shops report to the Distribution function, and support areas requiring testing.
- The function is done internally by the tool room.

Source/Calculation:BG.2.2

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Providing Services to the Transmission Line Department

IT infrastructure

Please describe how the following functions are provided to the transmission line department (we are mainly interested in the organizational locations).

- Central Group
- Centralized
- Centralized group
- Centralized IT department provides service to entire company.
- corporate - information management
- In General Services
- IT infrastructure reports to the VP-SERVO. General support services are provided by this organization. Includes data center and support staff. Support provided via remote control tools and personnel dispatching.
- N/A
- Outsourced to CAPEGEMINI Energy
- Provided as a support function by the corporate IT Business Unit
- The IT infrastructure is coordinated through our ICS Business unit which is responsible for all communication and computer infrastructure in the Energy Delivery business unit.
- The support is provided by the Share Services group that is affiliated to the parent company

Providing Services to the Transmission Line Department Communications

Please describe how the following functions are provided to the transmission line department (we are mainly interested in the organizational locations).

- Central group
- Centralized
- Centralized group
- corporate - radio telecom
- In BGE Coporate
- Infrastructure for the communication paths consists of radio, Microwave, Fiber optics, and land line facilities mostly owned and operated by the company.
- Microwave, radio, and fiber optics communications are provided as a support function by Telecommunications Services which is part of the regulated Operations Technology Business Unit. PBX telephone is a corporate function of the IT Business Unit.
- N/A
- Outsourced to CAPEGEMINI Energy
- The communications department is an integral department within the Transmission, Substation and Project Management Group. Providing primary support to T&D, they also provide communications to the Company in general. ,
- The support is provided by the Share Services group that is affiliated to the parent company

Source/Calculation:BG.2.4

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-  ● Pg. 1817 EMS Software Vendor
-   Pg. 1817.1 EMS Software Vendor (cont.)
-  ● Pg. 1818 State Estimator Integrated into EMS
-  ● Pg. 1820 Tracking the State Estimator
-  # Pg. 1821 Average Statistics for State Estimator Last Year
-  ● Pg. 1822 Availability Calculation Counting Non-Convergent Solutions as Unavailable
-   Pg. 1823 Calculations Used for Accuracy and Availability - Availability
-   Pg. 1824 Calculations Used for Accuracy and Availability - Accuracy

EMS Software Vendor

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent:
1. AREVA:	✓													✓	✓									20.0%
2. ABB:						✓	✓				✓													20.0%
3. GE:				✓																				6.7%
4. Siemens:		✓						✓				✓				✓		✓	✓					40.0%
5. Telegyr:																								0.0%
99. Other:			✓						✓															13.3%

Source/Calculation:BF.6.1

Volume: Focus Area: Energy Management System, Final Report, 2006

ID Code:1600130

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EMS Software Vendor (cont.)

Who is the software vendor for your EMS?

- Open Systems International
- SNC Lavilin

Source/Calculation: BF.6.99

Volume: Focus Area: Energy Management System, Final Report, 2006

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State Estimator Integrated into EMS

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent:
1. Yes:	✓		✓	✓		✓	✓					✓		✓	✓	✓		✓	✓					73.3%
2. No:		✓						✓	✓		✓													26.7%

Source/Calculation:BF.7.1

Volume: Focus Area: Energy Management System, Final Report, 2006

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Tracking the State Estimator

Question:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent:
1. Availability:	✓		✓			✓	✓					✓			✓	✓		✓	✓					100.0%
2. Accuracy:	✓											✓				✓		✓						44.4%

Source/Calculation:BF.8.1

Volume: Focus Area: Energy Management System, Final Report, 2006

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Average Statistics for State Estimator Last Year

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:
1. Percent Available:	79%	-	99%	-	-	100%	100%	-	-	-	-	92%	-	-	99%	90%	-	95%	86%	-	-	-	-	93.3%
2. Percent Accurate:	-	-	-	-	-	-	-	-	-	-	-	95%	-	-	-	85%	-	85%	-	-	-	-	-	88.3%

Source/Calculation:BF.9.1

Volume: Focus Area: Energy Management System, Final Report, 2006

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Availability Calculation Counting Non-Convergent Solutions as Unavailable

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Yes:	✓		✓				✓					✓			✓				✓					66.7%
2. No:						✓							✓					✓						33.3%

Source/Calculation:BF.10.1

Volume: Focus Area: Energy Management System, Final Report, 2006

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Calculations Used for Accuracy and Availability

Availability

Please describe the calculations used for accuracy and availability.

- # of convergent solutions / # of state estimation executions
- $\{(\text{Number of SE solutions}) - (\text{Number of Non-Convergent solutions})\} / (\text{Number of SE solutions})$
- $100\% (\text{minus}) \text{ Abortion \% (equals) Availability \%} : \text{Abortion \% (equals) \# of Abortions per Month (divided) by \# of calculated 5 minutes intervals per month (times) 100}$
- based on the amount of non-convergent solutions.
- Number solved solutions/number unsolved (abort)
- One valid solution every 5 minutes
- see note
- The number of minutes per year minus the sum of forced outage duration minues plus the minutes of non-convergent solutions
- The number of SE solutions divided by the number of SE executions
- Total number of actual CA runs / total number of expected CA runs

Calculations Used for Accuracy and Availability

Accuracy

Please describe the calculations used for accuracy and availability.

- (Number of SE solutions that provide a useful power flow solution) / (Number of SE solutions)
- 5 MW or 5% of the bigger conductor ratings
- Maximum error rate is set to be 15%
- measures megawatt mismatches
- N/A
- see note

Source/Calculation:BF.11.2

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		Pg. 1825	Crew Performance Measures
		Pg. 1826	Crew Performance Measures (cont.)
		Pg. 1827	Benefits Seen From Having a Fully-Implemented Work Management System
		Pg. 1828	Benefits Seen From Having a Fully-Implemented Work Management System (cont.)
		Pg. 1829	Management Processes Supported by a Work Management System
		Pg. 1830	Management Processes Supported by a Work Management System (cont.)
		Pg. 1831	Work Management System Activities
		Pg. 1832	Work Management System Activities (cont.)
		Pg. 1833	Transmission Work Management System Vendor
		Pg. 1834	Transmission Work Management System Vendor (cont.)
		Pg. 1835	Years Since Transmission Work Management System Was Installed

Crew Performance Measures

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. Not Measured:																✓								6.7%
2. Actual Vs. Estimated Hours:	✓	✓	✓	✓		✓	✓	✓	✓			✓			✓			✓	✓					80.0%
3. Utilization By Activity:		✓					✓				✓													20.0%
4. Actual Vs. Estimated Dollars:			✓	✓		✓	✓		✓			✓		✓					✓					53.3%
5. Required Vs. Actual Crew Size:		✓							✓									✓						20.0%
6. Actual Vs. Standard Hours:		✓		✓								✓			✓									26.7%
99. Other:							✓	✓	✓			✓		✓										33.3%

Source/Calculation:BH.2.1

Volume: Focus Area: Transmission Line Work Management Process, Final Report, 2006

ID Code:7035

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Crew Performance Measures (cont.)

How is each crew's performance measured (e.g. what criteria are used)?

- Adherence to schedule
- Bid Comparison (Bid versus Actual, Bid vs. Bid)
- Closing review meetings on major projects
- Schedule Compliance
- We use estimates based on past history.

Benefits Seen From Having a Fully-Implemented Work Management System

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent	
1. No WMS:									✓		✓														13.3%
2. Reduced Maintenance Costs:		✓				✓	✓	✓								✓									33.3%
3. Reduced Construction Costs:						✓	✓	✓																	20.0%
4. Better On-Time Performance Meeting Customer Requests:						✓	✓	✓				✓			✓										33.3%
5. Improved Equipment Utilization:		✓				✓	✓	✓				✓			✓	✓									46.7%
6. Better Crew Utilization:		✓	✓	✓		✓	✓	✓				✓			✓	✓	✓								66.7%
7. Percent of Planned Tasks Completed:		✓	✓			✓	✓	✓							✓	✓			✓						53.3%
8. No Benefits:																									0.0%
99. Other:	✓								✓			✓		✓				✓							33.3%

Source/Calculation: BH.3.1

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Benefits Seen From Having a Fully-Implemented Work Management System (cont.)

If you have fully-implemented a work management system, what benefits have you seen?

- Better records of problems/maintenance
- Better Tracking and Reporting
- Improved System Reliability
- Project Tracking
- TnMP does not have a WMS but does operate under the guidelines of ERCOT (Electric Reliability Council of Texas) that manages the transmission grid for the state of Texas.

Management Processes Supported by a Work Management System

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent	
1. No Work Management System:									✓																6.7%
2. Priority Setting:	✓	✓	✓	✓		✓		✓	✓		✓	✓		✓	✓	✓			✓						86.7%
3. Resource Leveling:	✓					✓	✓	✓				✓		✓	✓	✓									53.3%
4. Work Order Generation:	✓	✓	✓			✓	✓		✓			✓		✓	✓	✓		✓	✓						80.0%
5. Productivity Tracking:	✓	✓	✓	✓		✓	✓	✓	✓			✓			✓	✓									73.3%
6. Cost Tracking (Unit Cost):		✓	✓	✓					✓							✓									33.3%
7. Cost Tracking (Work Order):	✓	✓	✓									✓		✓	✓	✓			✓						53.3%
8. Scheduling Field Personnel:	✓	✓	✓			✓	✓	✓	✓		✓	✓		✓	✓	✓									80.0%
9. Scheduling Design Personnel:			✓			✓	✓		✓			✓		✓	✓										46.7%
10. Long-Term Staff Scheduling:						✓			✓			✓			✓	✓									33.3%
11. Time Tracking for Payroll:			✓	✓					✓			✓		✓		✓									40.0%
12. Inventory management:		✓	✓				✓		✓			✓													33.3%
99. Other:									✓			✓						✓							20.0%

Source/Calculation: BH.4.1

Volume: Focus Area: Transmission Line Work Management Process, Final Report, 2006

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Management Processes Supported by a Work Management System (cont.)

Which of the following management processes are supported by a work management system?

- Need missing clerk to use other functions
- Outage coordination
- We follow TNMP Policy & Procedure Manual.

Work Management System Activities

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent	
1. No WMS:									✓		✓														13.3%
2. Field Inspections:	✓	✓	✓	✓		✓	✓	✓	✓			✓		✓	✓	✓		✓	✓						93.3%
3. Preventive Maintenance:	✓	✓	✓			✓	✓	✓	✓			✓		✓	✓	✓		✓	✓						86.7%
4. New Construction:	✓		✓			✓	✓	✓	✓			✓		✓	✓	✓		✓							73.3%
5. RCM:		✓				✓	✓																		20.0%
6. Corrective Maintenance:	✓	✓	✓	✓			✓	✓	✓			✓		✓	✓	✓			✓						80.0%
7. Vegetation Management:	✓	✓	✓	✓		✓		✓	✓			✓				✓		✓							66.7%
8. Rehabilitations:	✓	✓	✓				✓	✓				✓		✓	✓										53.3%
9. Rebuilds:	✓	✓				✓	✓	✓				✓		✓	✓	✓		✓							66.7%
99. Other:									✓			✓													13.3%

Source/Calculation: BH.5.1

Volume: Focus Area: Transmission Line Work Management Process, Final Report, 2006

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Work Management System Activities (cont.)

What type of activities are covered by your work management system?

- Indirect time, unavailable time, outages
- TNMP has a Policy & Procedure Manual that insures proper management of TNMP transmission system.

Transmission Work Management System Vendor

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Percent
1. No WMS:											✓													6.7%
2. Designed In-House:	✓			✓				✓	✓		✓		✓					✓						46.7%
3. Indus - Pass Port:						✓	✓																	13.3%
4. Maximo:		✓														✓			✓					20.0%
5. J.D. Edwards:																								0.0%
6. Synercom:																								0.0%
7. SAP:			✓								✓							✓						20.0%
8. Logica:														✓										6.7%
99. Other:									✓		✓													13.3%

Source/Calculation: BH.6.1

Volume: Focus Area: Transmission Line Work Management Process, Final Report, 2006

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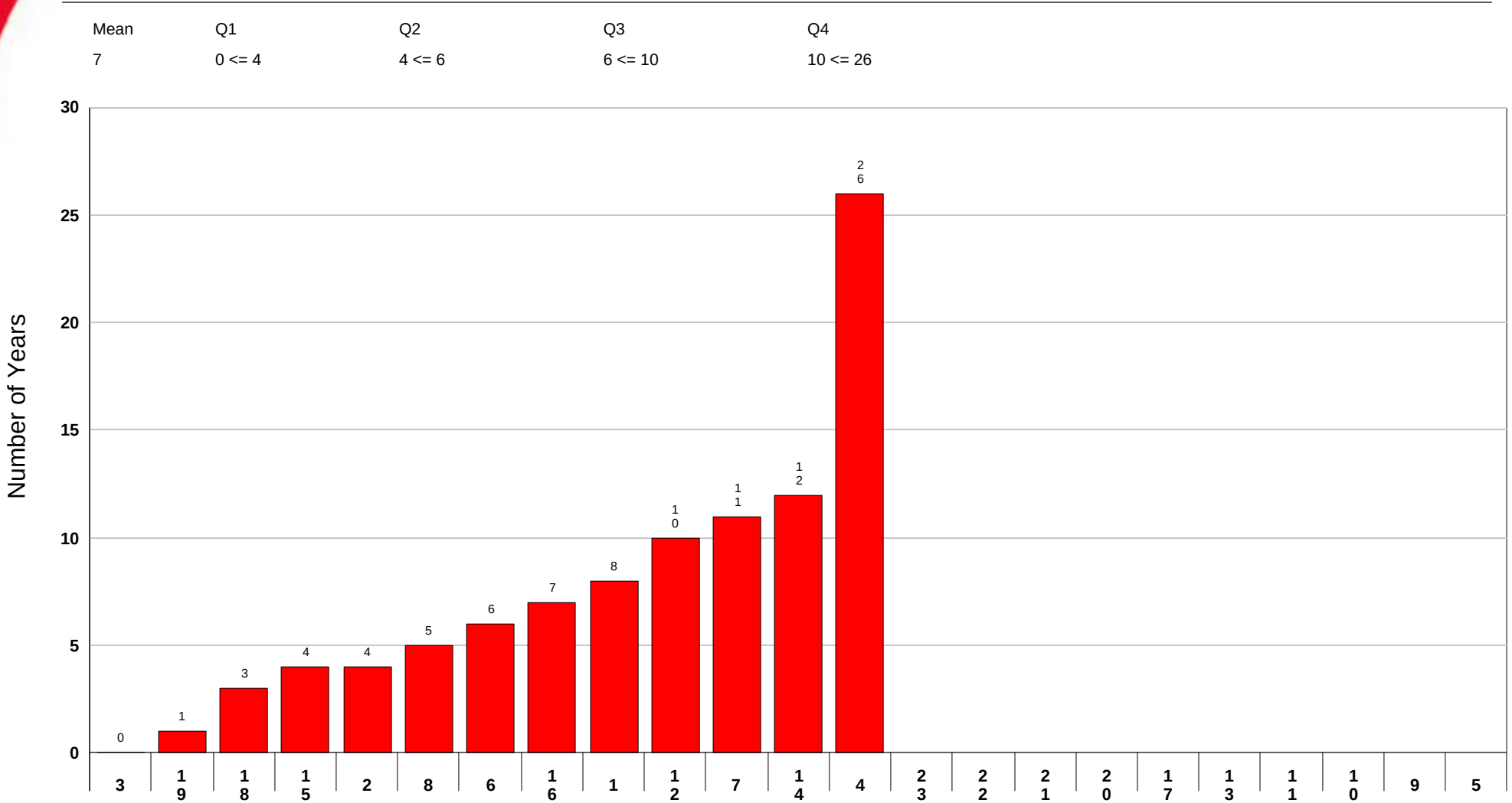
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Transmission Work Management System Vendor (cont.)

Who is the vendor for your transmission work management system?

- ERCOT (Electric Reliability Council of Texas)
- Microsoft Project

Years Since Transmission Work Management System Was Installed



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	#	Pg. 1844	Transmission Engineering Contracting - Percent of Activities Contracted
	#	Pg. 1845	Transmission Construction Contracting - Percent of Activities Contracted
	#	Pg. 1846	Transmission O&M Contracting - Percent of Activities Contracted
	#	Pg. 1847	Transmission O&M Contracting (cont.) - Percent of Activities Contracted
		Pg. 1848	Precent of Overall Transmission Work Contracted
	#	Pg. 1849	Most Successful Initiatives Undertaken to Improve Contracting Effectiveness - 1 = Lowest, 5 = Highest
		Pg. 1850	Most Successfull Initiatives Undertaken to Improve Contracting Effectiveness (cont.)

Transmission Engineering Contracting

Percent of Activities Contracted

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average	
1. Line Routing/Environmental Impact:	-	100%	-	50%	0%	95%	100%	0%	0%	-	-	100%	-	5%	70%	100%	-	70%	100%	-	-	-	-	-	60.8%
2. Line Design (Conductor, Structure, Shield Wire, Spotting):	-	100%	-	50%	0%	80%	80%	20%	18%	-	-	5%	-	10%	30%	75%	-	30%	50%	-	-	-	-	-	42.2%
3. Foundation Design:	-	100%	-	50%	20%	80%	80%	0%	13%	-	-	0%	-	0%	5%	75%	-	0%	25%	-	-	-	-	-	34.5%
4. Surveying:	-	100%	-	25%	20%	100%	100%	0%	13%	-	-	28%	-	10%	0%	100%	-	80%	100%	-	-	-	-	-	58.9%
99. Other:	-	-	-	-	-	-	80%	-	0%	-	-	100%	-	-	-	-	-	90%	-	-	-	-	-	-	67.5%
100. Total Engineering Activities Contracted:	-	100%	-	50%	5%	85%	90%	100%	11%	-	0%	20%	-	10%	30%	80%	-	35%	50%	-	-	-	-	-	41.1%

Source/Calculation:BI.2.1

Volume: Focus Area: Transmission Line Contracting, Final Report, 2006

ID Code:549

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Transmission Construction Contracting

Percent of Activities Contracted

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:
1. Capital Upgrade/New Lines/Added Capacity:	-	-	-	100%	950%	100%	900%	-	22%	-	-	80%	-	800%	900%	95%	-	950%	50%	-	-	-	-	81.5%
2. Replace In Kind/Rehabilitation/Capital Maintenance:	-	-	-	-	150%	500%	900%	-	30%	-	-	40%	-	200%	600%	800%	-	100%	500%	-	-	-	-	44.5%
3. Mandatory Relocation:	-	-	-	-	000%	100%	100%	-	6%	-	-	80%	-	600%	900%	100%	-	100%	500%	-	-	-	-	59.6%
4. Storm Restoration:	-	-	-	-	00%	80%	0%	-	13%	-	-	40%	-	50%	0%	90%	-	5%	50%	-	-	-	-	32.8%
5. Interconnects:	-	-	-	-	000%	100%	100%	-	34%	-	-	100%	-	50%	-	100%	-	90%	500%	-	-	-	-	69.3%
99. Other:	-	-	-	-	-	-	0%	-	0%	-	-	30%	-	-	-	-	-	-	-	-	-	-	-	10.0%
100. Total Construction Activities Contracted:	-	-	-	100%	900%	900%	95%	-	21%	-	0%	80%	-	600%	700%	95%	-	900%	500%	-	-	-	-	70.1%

Source/Calculation:BI.3.1

Volume: Focus Area: Transmission Line Contracting, Final Report, 2006

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Transmission O&M Contracting

Percent of Activities Contracted

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:	
1. Major Storm Response:	-	50%	-	-	0%	80%	0%	0%	9%	-	-	20%	-	0%	10%	95%	-	0%	50%	-	-	-	-	-	26.2%
2. Outage Response:	-	-	-	-	0%	50%	0%	0%	0%	-	-	0%	-	0%	0%	10%	-	0%	50%	-	-	-	-	-	10.0%
3. OH Preventive Maintenance:	-	-	-	-	90%	25%	0%	5%	24%	-	-	40%	-	0%	70%	10%	-	0%	50%	-	-	-	-	-	28.5%
4. UG Preventive Maintenance:	-	-	-	-	0%	50%	0%	-	0%	-	-	0%	-	100%	0%	100%	-	0%	25%	-	-	-	-	-	27.5%
5. OH Corrective Maintenance:	-	-	-	-	10%	30%	5%	5%	6%	-	-	5%	-	10%	70%	10%	-	0%	50%	-	-	-	-	-	18.3%
6. UG Corrective Maintenance:	-	-	-	-	0%	50%	5%	-	0%	-	-	35%	-	3908	0%	100%	-	0%	60%	-	-	-	-	-	390855.0%
7. Routine Patrols & Inspections:	-	-	-	-	0%	75%	70%	0%	0%	-	-	0%	-	95%	0%	5%	-	0%	50%	-	-	-	-	-	26.8%

Source/Calculation:BI.4.1

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Transmission O&M Contracting (cont.)

Percent of Activities Contracted

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:
8. ROW Vegetation & Trees:	-	90%	-	100%	100%	100%	100%	100%	61%	-	-	100%	-	900%	1000%	1000%	-	1000%	930%	-	-	-	-	94.9%
9. ROW Maintenance and Joint-use (access, mapping, grants to others):	-	-	-	50%	00%	100%	900%	500%	0%	-	-	12%	-	950%	80%	5%	-	105%	65%	-	-	-	-	46.4%
10. ROW Lease Payments (RR Licenses, permits, etc.):	-	-	-	-	0%	-	0%	0%	0%	-	-	10%	-	50%	0%	5%	-	10%	0%	-	-	-	-	3.0%
11. Safety & Training:	-	-	-	50%	200%	50%	0%	10%	0%	-	-	0%	-	0%	10%	0%	-	20%	0%	-	-	-	-	12.6%
12. Management & Supervision:	-	-	-	-	0%	10%	0%	0%	0%	-	-	0%	-	10%	0%	0%	-	0%	0%	-	-	-	-	1.8%
99. Other:	-	-	-	-	-	-	0%	-	0%	-	-	100%	-	-	100%	-	-	-	-	-	-	-	-	50.0%
100. Total Transmission O&M Activities Contracted:	-	10%	-	50%	70%	40%	50%	0%	8%	-	0%	50%	-	30%	60%	20%	-	10%	30%	-	-	-	-	30.6%

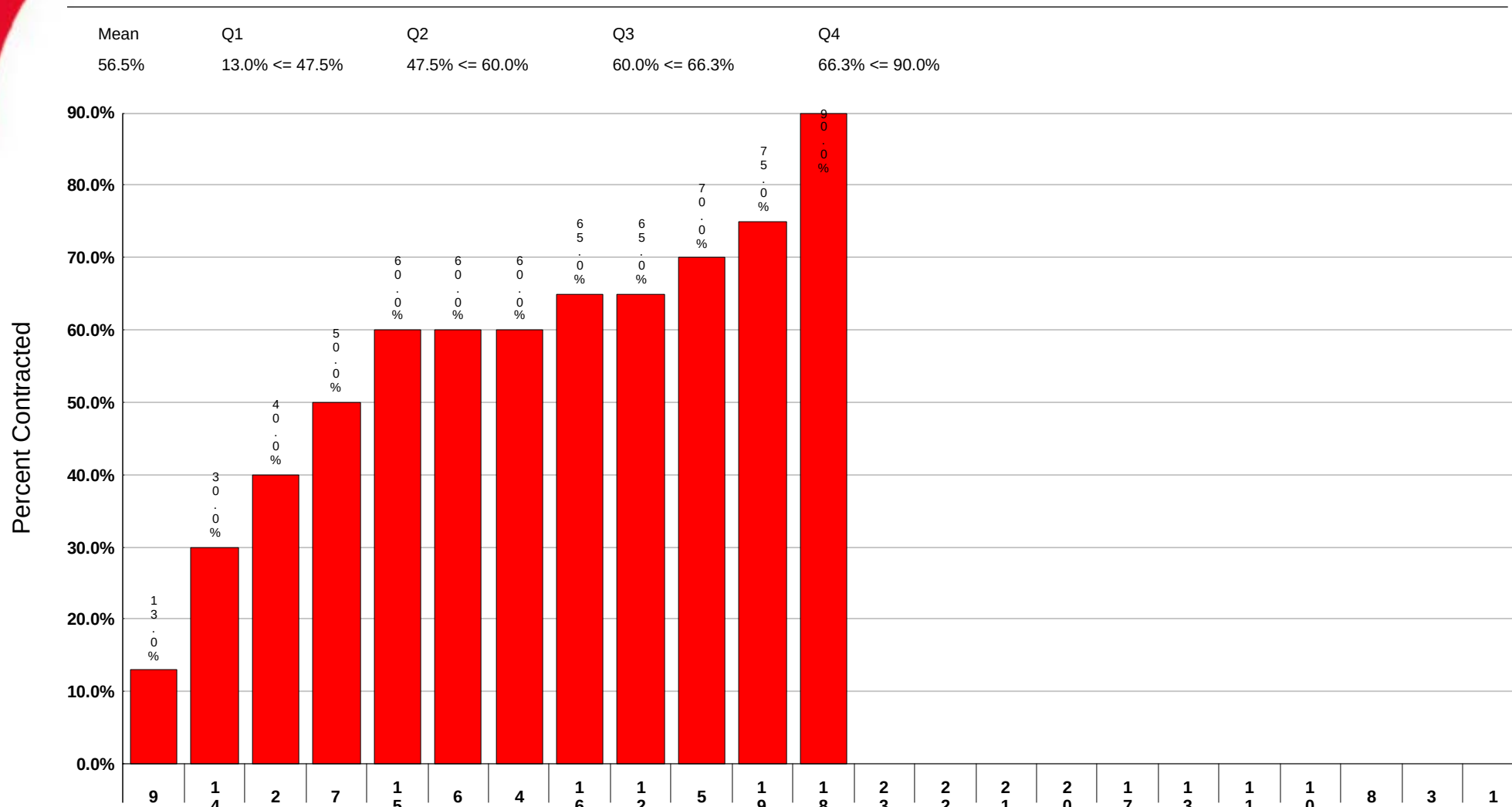
Source/Calculation: BI.4.8

Volume: Focus Area: Transmission Line Contracting, Final Report, 2006

ID Code: 27062

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Percent of Overall Transmission Work Contracted



Source/Calculation:BI.5.1

Volume: Focus Area: Transmission Line Contracting, Final Report, 2006

ID Code:2300093

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Only companies with all the data are shown.

Most Successful Initiatives Undertaken to Improve Contracting Effectiveness

1 = Lowest, 5 = Highest

Questions:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average:
1. Contractor Administration:	-	-	-	2	-	5	5	3	5	-	-	1	-	3	-	1	-	4	1	-	-	-	-	3.0
2. Contractor Safety Program:	-	-	-	3	2	1	2	-	3	-	-	2	-	2	3	4	-	4	4	-	-	-	-	2.7
3. Fewer Contractors:	-	-	-	-	-	2	-	2	2	-	-	3	-	-	-	-	-	1	3	-	-	-	-	2.2
4. Clear/Specific Contracts:	-	-	-	4	3	-	3	5	1	-	-	4	-	-	4	5	-	4	4	-	-	-	-	3.7
5. Alliance Agreements:	-	-	-	-	-	4	4	1	2	-	-	-	-	-	5	-	-	1	2	-	-	-	-	2.7
6. Routine Oversight:	-	-	-	-	1	-	1	-	1	-	-	-	-	1	-	3	-	3	4	-	-	-	-	2.0
7. Inspections/Field Audits:	-	-	-	1	5	3	-	-	2	-	-	5	-	5	2	2	-	5	5	-	-	-	-	3.5
8. Bid Fixed Price Contracts:	-	-	-	5	4	-	-	4	4	-	-	-	-	4	1	-	-	4	5	-	-	-	-	3.9
9. Performance Level Targets:	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	5	-	-	-	-	3.0
99. Other:	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Source/Calculation:BI.6.1

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Most Successful Initiatives Undertaken to Improve Contracting Effectiveness (cont.)

Source/Calculation:BI.6.99

Volume: Focus Area: Transmission Line Contracting, Final Report, 2006

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