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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Energy management system application program interface (EMS-API) – Part 301: Common information model (CIM) base

Interface de programmation d'application pour système de gestion d'énergie (EMS-API) – Partie 301: Base de modèle d'information commun (CIM)

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CONTENTS

FOREWORD 12
INTRODUCTION 14
1 Scope 16
2 Normative references 16
3 Terms and definitions 17
4 CIM specification 17
4.1 CIM modeling notation 17
4.2 CIM packages 17
4.2.1 CIM packages overview 17
4.2.2 Domain 19
4.2.3 Core 20
4.2.4 OperationalLimits 20
4.2.5 Topology 20
4.2.6 Wires 20
4.2.7 Generation 20
4.2.8 LoadModel 20
4.2.9 Outage 20
4.2.10 Protection 21
4.2.11 Equivalents 21
4.2.12 Meas 21
4.2.13 SCADA 21
4.2.14 ControlArea 21
4.2.15 Contingency 21
4.3 CIM classes and relationships 21
4.3.1 Classes 21
4.3.2 Generalization 22
4.3.3 Simple association 23
4.3.4 Aggregation 24
4.4 CIM model concepts and examples 24
4.4.1 Concepts 24
4.4.2 Containment, equipment hierarchies and naming 24
4.4.3 Connectivity model 26
4.4.4 Inheritance hierarchy 29
4.4.5 Transformer model 30
4.4.6 Measurements and controls 32
4.4.7 Regulating control models 36
4.5 Modeling guidelines 36
4.5.1 Modeling for change 36
4.5.2 Process for amendments to the CIM 37
4.5.3 Changes to the CIM UML model 37
4.5.4 Changes to the CIM standards documents 37
4.5.5 CIM profiles 37
4.6 Modeling tools 38
4.7 User implementation conventions 38
4.7.1 Conventions beyond UML 38
4.7.2 Number of Terminals for ConductingEquipment objects 38
4.8 CIM modeling examples 38

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Withdrawn

5 Detailed model 39
5.1 Overview 39
5.2 Context 39
6 Package architecture (normative) 41
6.1 IEC 61970 41
6.1.1 IEC 61970 package summary 41
6.1.2 IEC 61970CIMVersion 41
6.2 Domain 42
6.2.1 Domain package summary 42
6.2.2 AbsoluteDate Datatype 46
6.2.3 AbsoluteDateTime Datatype 46
6.2.4 ActivePower Datatype 46
6.2.5 ActivePowerChangeRate Datatype 47
6.2.6 Admittance Datatype 47
6.2.7 AngleDegrees Datatype 47
6.2.8 AngleRadians Datatype 47
6.2.9 ApparentPower Datatype 47
6.2.10 Boolean Primitive 47
6.2.11 Capacitance Datatype 48
6.2.12 Conductance Datatype 48
6.2.13 CostPerEnergyUnit Datatype 48
6.2.14 CostRate Datatype 48
6.2.15 Currency enumeration 48
6.2.16 CurrentFlow Datatype 49
6.2.17 Damping Datatype 49
6.2.18 Float Primitive 49
6.2.19 FloatQuantity Datatype 49
6.2.20 Frequency Datatype 50
6.2.21 Hours Datatype 50
6.2.22 Impedance Datatype 50
6.2.23 Inductance Datatype 50
6.2.24 Integer Primitive 50
6.2.25 IntegerQuantity Datatype 51
6.2.26 KWActivePower Datatype 51
6.2.27 LongLength Datatype 51
6.2.28 Minutes Datatype 51
6.2.29 MonetaryAmountPerEnergyUnit enumeration 51
6.2.30 MonetaryAmountPerHeatUnit enumeration 51
6.2.31 MonetaryAmountRate enumeration 52
6.2.32 Money Datatype 52
6.2.33 PerCent Datatype 52
6.2.34 Pressure Datatype 52
6.2.35 PU Datatype 52
6.2.36 Reactance Datatype 53
6.2.37 ReactivePower Datatype 53
6.2.38 RealEnergy Datatype 53
6.2.39 Resistance Datatype 53
6.2.40 RotationSpeed Datatype 53
6.2.41 Seconds Datatype 54

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Withdrawn

6.2.42 ShortLength Datatype 54
6.2.43 String Primitive 54
6.2.44 StringQuantity Datatype 54
6.2.45 Susceptance Datatype 54
6.2.46 Temperature Datatype 55
6.2.47 UnitMultiplier enumeration 55
6.2.48 UnitSymbol enumeration 55
6.2.49 Voltage Datatype 56
6.2.50 VoltagePerReactivePower Datatype 56
6.2.51 Volume Datatype 56
6.2.52 WaterLevel Datatype 57
6.2.53 Weight Datatype 57
6.3 Core 57
6.3.1 Core package summary 57
6.3.2 BasePower 62
6.3.3 BaseVoltage 62
6.3.4 BasicIntervalSchedule 62
6.3.5 Bay 63
6.3.6 BreakerConfiguration Enumeration 64
6.3.7 BusbarConfiguration Enumeration 64
6.3.8 Company 64
6.3.9 CompanyType enumeration 65
6.3.10 ConductingEquipment 65
6.3.11 ConnectivityNodeContainer 66
6.3.12 Curve 66
6.3.13 CurveData 67
6.3.14 CurveStyle enumeration 67
6.3.15 Equipment 68
6.3.16 EquipmentContainer 68
6.3.17 GeographicalRegion 69
6.3.18 IdentifiedObject 70
6.3.19 IrregularIntervalSchedule 70
6.3.20 IrregularTimePoint 71
6.3.21 ModelingAuthority 71
6.3.22 ModelingAuthoritySet 72
6.3.23 OperatingParticipant 72
6.3.24 OperatingShare 73
6.3.25 PhaseCode enumeration 73
6.3.26 PowerSystemResource 74
6.3.27 PsrList 75
6.3.28 PSRType 75
6.3.29 RegularIntervalSchedule 76
6.3.30 RegularTimePoint 76
6.3.31 ReportingGroup 77
6.3.32 ReportingSuperGroup 77
6.3.33 SubGeographicalRegion 78
6.3.34 Substation 78
6.3.35 Terminal 79
6.3.36 Unit 80

IECNORM.COM : Click to view the full PDF of IEC 61970-301:2011
Withdrawn

6.3.37 VoltageLevel 81
6.4 OperationalLimits 82
6.4.1 OperationalLimits package summary 82
6.4.2 ActivePowerLimit 83
6.4.3 ApparentPowerLimit 84
6.4.4 BranchGroup 84
6.4.5 BranchGroupTerminal 85
6.4.6 CurrentLimit 85
6.4.7 OperationalLimit 85
6.4.8 OperationalLimitDirectionKind enumeration 86
6.4.9 OperationalLimitSet 86
6.4.10 OperationalLimitType 87
6.4.11 VoltageLimit 87
6.5 Topology 88
6.5.1 Topology package summary 88
6.5.2 BusNameMarker 91
6.5.3 ConnectivityNode 92
6.5.4 TopologicalIsland 93
6.5.5 TopologicalNode 93
6.6 Wires 94
6.6.1 Wires package summary 94
6.6.2 ACLineSegment 104
6.6.3 Breaker 105
6.6.4 BusbarSection 106
6.6.5 CompositeSwitch 107
6.6.6 CompositeSwitchType Datatype 108
6.6.7 Conductor 108
6.6.8 ConductorType 109
6.6.9 Connector 110
6.6.10 CoolantType enumeration 111
6.6.11 DCLineSegment 111
6.6.12 Disconnector 112
6.6.13 EnergyConsumer 113
6.6.14 EnergySource 114
6.6.15 FrequencyConverter 115
6.6.16 Fuse 116
6.6.17 Ground 117
6.6.18 GroundDisconnector 118
6.6.19 HeatExchanger 118
6.6.20 Jumper 119
6.6.21 Junction 120
6.6.22 Line 121
6.6.23 LoadBreakSwitch 122
6.6.24 MutualCoupling 123
6.6.25 OperatingMode Datatype 123
6.6.26 Plant 124
6.6.27 PowerTransformer 124
6.6.28 ProtectedSwitch 125
6.6.29 ReactiveCapabilityCurve 126

Withdrawn
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6.6.30 RectifierInverter 127
6.6.31 RegulatingCondEq 128
6.6.32 RegulatingControl 129
6.6.33 RegulatingControlModeKind enumeration 130
6.6.34 RegulationSchedule 130
6.6.35 SeriesCompensator 131
6.6.36 ShuntCompensator 132
6.6.37 StaticVarCompensator 133
6.6.38 SVCControlMode enumeration 134
6.6.39 Switch 134
6.6.40 SynchronousMachine 135
6.6.41 SynchronousMachineOperatingMode enumeration 138
6.6.42 SynchronousMachineType enumeration 138
6.6.43 TapChanger 138
6.6.44 TapChangerKind enumeration 139
6.6.45 TransformerControlMode enumeration 139
6.6.46 TransformerCoolingType enumeration 140
6.6.47 TransformerWinding 140
6.6.48 VoltageControlZone 141
6.6.49 WindingConnection enumeration 142
6.6.50 WindingTest 142
6.6.51 WindingType enumeration 143
6.6.52 WireArrangement 143
6.6.53 WireType 144
6.7 Generation- Generation package summary 145
6.8 Production 145
6.8.1 Production package summary 145
6.8.2 AirCompressor 150
6.8.3 CAESPlant 151
6.8.4 Classification Datatype 152
6.8.5 CogenerationPlant 152
6.8.6 CombinedCyclePlant 153
6.8.7 CostPerHeatUnit Datatype 153
6.8.8 Emission Datatype 153
6.8.9 EmissionAccount 154
6.8.10 EmissionCurve 154
6.8.11 EmissionType enumeration 155
6.8.12 EmissionValueSource enumeration 155
6.8.13 FossilFuel 156
6.8.14 FuelAllocationSchedule 157
6.8.15 FuelType enumeration 157
6.8.16 GeneratingUnit 158
6.8.17 GeneratorControlMode enumeration 160
6.8.18 GeneratorControlSource enumeration 160
6.8.19 GeneratorOperatingMode enumeration 161
6.8.20 GenUnitOpCostCurve 161
6.8.21 GenUnitOpSchedule 162
6.8.22 GrossToNetActivePowerCurve 162
6.8.23 HeatInputCurve 163

IECNORM.COM : Click to view the full PDF of IEC 61970-301:2011
Withdrawn

6.8.24 HeatRate Datatype 164
6.8.25 HeatRateCurve 164
6.8.26 HydroEnergyConversionKind enumeration 165
6.8.27 HydroGeneratingEfficiencyCurve 165
6.8.28 HydroGeneratingUnit 166
6.8.29 HydroPlantType enumeration 168
6.8.30 HydroPowerPlant 168
6.8.31 HydroPump 169
6.8.32 HydroPumpOpSchedule 170
6.8.33 IncrementalHeatRateCurve 171
6.8.34 InflowForecast 171
6.8.35 LevelVsVolumeCurve 172
6.8.36 NuclearGeneratingUnit 173
6.8.37 PenstockLossCurve 174
6.8.38 PenstockType enumeration 175
6.8.39 Reservoir 175
6.8.40 ShutdownCurve 176
6.8.41 SpillwayGateType Enumeration 177
6.8.42 StartIgnFuelCurve 177
6.8.43 StartMainFuelCurve 178
6.8.44 StartRampCurve 178
6.8.45 StartupModel 179
6.8.46 SteamSendoutSchedule 180
6.8.47 SurgeTankCode enumeration 181
6.8.48 TailbayLossCurve 181
6.8.49 TargetLevelSchedule 181
6.8.50 ThermalGeneratingUnit 182
6.9 GenerationDynamics 185
6.9.1 GenerationDynamics package summary 185
6.9.2 BoilerControlMode enumeration 186
6.9.3 BWRSteamSupply 186
6.9.4 CombustionTurbine 187
6.9.5 CTTempActivePowerCurve 188
6.9.6 DrumBoiler 189
6.9.7 FossilSteamSupply 190
6.9.8 HeatRecoveryBoiler 191
6.9.9 HydroTurbine 192
6.9.10 PrimeMover 193
6.9.11 PWRSteamSupply 194
6.9.12 SteamSupply 195
6.9.13 SteamTurbine 196
6.9.14 Subcritical 197
6.9.15 Supercritical 198
6.9.16 TurbineType enumeration 199
6.10 LoadModel 199
6.10.1 LoadModel package summary 199
6.10.2 ConformLoad 201
6.10.3 ConformLoadGroup 201
6.10.4 ConformLoadSchedule 202

IECNORM.COM : Click to view the full PDF of IEC 61970-301:2011
Withdrawn

6.10.5 CustomerLoad 203
6.10.6 DayType 204
6.10.7 EnergyArea 204
6.10.8 InductionMotorLoad 204
6.10.9 Load 205
6.10.10 LoadArea 207
6.10.11 LoadGroup 207
6.10.12 LoadResponseCharacteristic 208
6.10.13 NonConformLoad 209
6.10.14 NonConformLoadGroup 210
6.10.15 NonConformLoadSchedule 210
6.10.16 PowerCutZone 211
6.10.17 Season 212
6.10.18 SeasonDayTypeSchedule 212
6.10.19 SeasonName enumeration 212
6.10.20 StationSupply 213
6.10.21 SubLoadArea 214
6.11 Outage 214
6.11.1 Outage package summary 214
6.11.2 ClearanceTag 215
6.11.3 ClearanceTagType 216
6.11.4 OutageSchedule 216
6.11.5 SwitchingOperation 217
6.11.6 SwitchState enumeration 218
6.12 Protection 218
6.12.1 Protection package summary 218
6.12.2 CurrentRelay 218
6.12.3 ProtectionEquipment 219
6.12.4 RecloseSequence 220
6.12.5 SynchrocheckRelay 221
6.13 Equivalents 222
6.13.1 Equivalents package summary 222
6.13.2 EquivalentBranch 223
6.13.3 EquivalentEquipment 224
6.13.4 EquivalentNetwork 225
6.13.5 EquivalentShunt 226
6.14 Meas 227
6.14.1 Meas package summary 227
6.14.2 Accumulator 231
6.14.3 AccumulatorLimit 232
6.14.4 AccumulatorLimitSet 232
6.14.5 AccumulatorValue 232
6.14.6 Analog 233
6.14.7 AnalogLimit 234
6.14.8 AnalogLimitSet 234
6.14.9 AnalogValue 235
6.14.10 Command 235
6.14.11 Control 236
6.14.12 ControlType 237

Withdrawn
IECNORM.COM : Click to view the full PDF of IEC 61970-301:2011

6.14.13 Discrete 237
6.14.14 DiscreteValue 238
6.14.15 Limit 238
6.14.16 LimitSet 239
6.14.17 Measurement 239
6.14.18 MeasurementType 240
6.14.19 MeasurementValue 241
6.14.20 MeasurementValueQuality 241
6.14.21 MeasurementValueSource 242
6.14.22 Quality61850 242
6.14.23 SetPoint 243
6.14.24 StringMeasurement 244
6.14.25 StringMeasurementValue 245
6.14.26 Validity enumeration 245
6.14.27 ValueAliasSet 246
6.14.28 ValueToAlias 246
6.15 SCADA 247
6.15.1 SCADA package summary 247
6.15.2 CommunicationLink 248
6.15.3 RemoteControl 249
6.15.4 RemotePoint 250
6.15.5 RemoteSource 250
6.15.6 RemoteUnit 251
6.15.7 RemoteUnitType enumeration 251
6.15.8 Source enumeration 251
6.16 ControlArea 252
6.16.1 ControlArea package summary 252
6.16.2 AltGeneratingUnitMeas 254
6.16.3 AltTieMeas 254
6.16.4 ControlArea 254
6.16.5 ControlAreaGeneratingUnit 255
6.16.6 ControlAreaTypeKind enumeration 255
6.16.7 TieFlow 256
6.17 Contingency 256
6.17.1 Contingency package summary 256
6.17.2 Contingency 257
6.17.3 ContingencyElement 258
6.17.4 ContingencyEquipment 258
6.17.5 ContingencyEquipmentStatusKind enumeration 259
Bibliography 260

Figure 1 – CIM IEC 61970-301 package diagram 19
Figure 2 – Example of generalization 23
Figure 3 – Example of simple association 23
Figure 4 – Example of aggregation 24
Figure 5 – Equipment containers 26
Figure 6 – Connectivity model 27
Figure 7 – Simple network example 28

IECNORM.COM : Click to view the full PDF of IEC 61970-301:2011
Withdrawn

Figure 8 – Simple network connectivity modeled with CIM topology 29
Figure 9 – Equipment inheritance hierarchy 30
Figure 10 – Transformer model 31
Figure 11 – Navigating from PSR to MeasurementValue 33
Figure 12 – Measurement placement 35
Figure 13 – Regulating control models 36
Figure 14 – CIM top level packages 39
Figure 15 – Main 41
Figure 16 – CombinedDatatypes 42
Figure 17 – BasicDatatypes 42
Figure 18 – ElectricityDatatypes 43
Figure 19 – EnumeratedUnitDatatypes 44
Figure 20 – GeneralDatatypes 45
Figure 21 – MonetaryDatatypes 45
Figure 22 – TimeDatatypes 46
Figure 23 – Reporting 58
Figure 24 – Main 59
Figure 25 – CurveSchedule 60
Figure 26 – Datatypes 60
Figure 27 – DocumentationExampleAggregation 61
Figure 28 – DocumentationExampleAssociation 61
Figure 29 – Ownership 61
Figure 30 – OperationalLimits 82
Figure 31 – BranchGroup 83
Figure 32 – TopologicalNodeTerminal 88
Figure 33 – TopologyMeasRelations 89
Figure 34 – TopologyReporting 90
Figure 35 – Main 91
Figure 36 – DocumentationExampleInheritance 95
Figure 37 – MutualCoupling 96
Figure 38 – Datatypes 97
Figure 39 – InheritanceHierarchy 98
Figure 40 – LineModel 99
Figure 41 – NamingHierarchyPart1 100
Figure 42 – NamingHierarchyPart2 101
Figure 43 – RegulatingEquipment 102
Figure 44 – TransformerModel 103
Figure 45 – VoltageControl 104
Figure 46 – Main 145
Figure 47 – Nuclear 146
Figure 48 – Main 147
Figure 49 – Datatypes 148
Figure 50 – Hydro 149

Withdrawn
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Figure 51 – Thermal 150
Figure 52 – Main 185
Figure 53 – Datatypes 185
Figure 54 – Main 200
Figure 55 – Datatypes 200
Figure 56 – Datatypes 214
Figure 57 – Main 215
Figure 58 – Main 218
Figure 59 – Main 223
Figure 60 – Datatypes 227
Figure 61 – Control 228
Figure 62 – InheritanceStructure 229
Figure 63 – Measurement 230
Figure 64 – Quality 231
Figure 65 – Datatypes 247
Figure 66 – Main 248
Figure 67 – ControlArea 252
Figure 68 – ControlAreaInheritance 253
Figure 69 – Datatypes 253
Figure 70 – Contingency 257

Table 1 – MeasurementType naming conventions 34
Table 2 – MeasurementValueSource naming conventions 35

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ENERGY MANAGEMENT SYSTEM APPLICATION PROGRAM INTERFACE (EMS-API) –

Part 301: Common information model (CIM) base

FOREWORD

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International Standard IEC 61970-301 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

This third edition cancels and replaces the second edition, published in 2009. This third edition constitutes a technical revision.

Major changes from the second edition include the following:

- regulation control models were added with a new RegulatingControl class which provides the capability to model multiple equipments participating in a regulation scheme;
- new "OperationalLimits" package for equipment ratings;
- partial ownership specification added;
- LoadResponseCharacteristic class was enhanced to better model the characteristic response of the load demand due to changes in system conditions such as voltage and frequency;

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- new ControlArea package added with load forecast and area interchange specifications;
- EPRI CIM for Planning project proposals to support the exchange of planning models were incorporated;
- branch group “interface” monitoring specification was added;
- composite switch model was changed to better model distribution use cases;
- extensions were added to support powerflow “case input” so that profiles are not required to use time based schedules and detailed connectivity (via new bus-branch model);
- new Equivalents package added to model equivalent networks;
- new Contingency package added to handle contingencies;
- various editorial changes to cleanup UML model;
- non-SI units have been changed to SI units.

The text of this standard is based on the following documents:

FDIS	Report on voting
57/1136/FDIS	57/1167/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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INTRODUCTION

This standard is one of several parts of the IEC 61970 series which define an application program interface (API) for an energy management system (EMS). This standard was originally based upon the work of the EPRI control center API (CCAPI) research project (RP-3654-1). The principle objectives of the EPRI CCAPI project were to

- reduce the cost and time needed to add new applications to an EMS;
- protect the investment of existing applications or systems that are working effectively with an EMS.

The principal objective of the IEC 61970 series of standards is to produce standards which facilitate the integration of EMS applications developed independently by different vendors, between entire EMS systems developed independently, or between an EMS system and other systems concerned with different aspects of power system operations, such as generation or distribution management systems (DMS). This is accomplished by defining application program interfaces to enable these applications or systems access to public data and exchange information independent of how such information is represented internally.

The common information model (CIM) specifies the semantics for this API. The component interface specifications (CIS), which are contained in other parts of the IEC 61970 standards, specify the content of the messages exchanged.

The CIM is an abstract model that represents all the major objects in an electric utility enterprise typically needed to model the operational aspects of a utility. This model includes public classes and attributes for these objects, as well as the relationships between them.

The objects represented in the CIM are abstract in nature and may be used in a wide variety of applications. The use of the CIM goes far beyond its application in an EMS. This standard should be understood as a tool to enable integration in any domain where a common power system model is needed to facilitate interoperability and plug compatibility between applications and systems independent of any particular implementation.

This standard defines the CIM base set of packages which provide a logical view of the functional aspects of an energy management system including SCADA. Other functional areas are standardized in separate IEC documents that augment and reference this base CIM standard. For example, IEC 61968-11 addresses distribution models and references this base CIM standard. While there are multiple IEC standards dealing with different parts of the CIM, there is a single, unified normalized information model comprising the CIM behind all these individual standard documents.

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning a computer-based implementation of an object-oriented power system model in a relational database. As such, it does not conflict with the development of any logical power system model including the common information model (CIM), where implementation of the model is not defined.

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ENERGY MANAGEMENT SYSTEM APPLICATION PROGRAM INTERFACE (EMS-API) –

Part 301: Common information model (CIM) base

1 Scope

This part of IEC 61970 deals with the common information model (CIM), an abstract model that represents all the major objects in an electric utility enterprise typically involved in utility operations.

The object classes represented in the CIM are abstract in nature and may be used in a wide variety of applications. The use of the CIM goes far beyond its application in an EMS. This standard should be understood as a tool to enable integration in any domain where a common power system model is needed to facilitate interoperability and plug compatibility between applications and systems independent of any particular implementation.

By providing a standard way of representing power system resources as object classes and attributes, along with their relationships, the CIM facilitates the integration of energy management system (EMS) applications developed independently by different vendors, between entire EMS systems developed independently, or between an EMS system and other systems concerned with different aspects of power system operations, such as generation or distribution management. SCADA (supervisory control and data acquisition) is modeled to the extent necessary to support power system simulation and inter-control center communication. The CIM facilitates integration by defining a common language (i.e., semantics and syntax) based on the CIM to enable these applications or systems to access public data and exchange information independent of how such information is represented internally.

Due to the size of the complete CIM, the object classes contained in the CIM are grouped into a number of logical packages, each of which represents a certain part of the overall power system being modeled. Collections of these packages are progressed as separate International Standards. This particular International Standard specifies a base set of packages which provide a logical view of the functional aspects of energy management system (EMS) information within the electric utility enterprise that is shared between all applications. Other standards specify more specific parts of the model that are needed by only certain applications. Subclause 4.2 provides the current grouping of packages into standard documents.

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2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61850 (all parts), *Communication networks and systems in substations*

IEC 61850-7-4:2010, *Communication networks and systems for power utility automation – Part 7-4: Basic communication structure – Compatible logical node classes and data object classes*

IEC 61968 (all parts), *Application integration at electric utilities – System interfaces for distribution management*

IEC 61970-2, *Energy management system application program interface (EMS-API) – Glossary*

ISO 8601:2004, *Data elements and interchange formats – Information interchange – Representation of dates and times*

3 Terms and definitions

For the purposes of this document, the terms and definitions of IEC 61970-2 apply, as well as the following.

NOTE Refer to International Electrotechnical Vocabulary, IEC 60050, for general glossary definitions.

3.1
energy management system
EMS
computer system comprising a software platform providing basic support services and a set of applications providing the functionality needed for the effective operation of electrical generation and transmission facilities so as to assure adequate security of energy supply at minimum cost

3.2
application program interface
API
the set of public functions provided by an executable application component for use by other executable application components

4 CIM specification

4.1 CIM modeling notation

The CIM is defined using object-oriented modeling techniques. Specifically, the CIM specification uses the unified modeling language (UML) notation, which defines the CIM as a group of packages.

Each package in the CIM contains one or more class diagrams showing graphically all the classes in that package and their relationships. Each class is then defined in text in terms of its attributes and relationships to other classes.

The UML notation is described in object management group (OMG) documents and several published textbooks.

4.2 CIM packages

4.2.1 CIM packages overview

The CIM is partitioned into a set of packages. A package is a general purpose means of grouping related model elements. There is no specific semantic meaning. The packages have been chosen to make the model easier to design, understand and review. The common information model consists of the complete set of packages. Entities may have associations that cross many package boundaries. Each application will use information represented in several packages.

The comprehensive CIM is partitioned into groups of packages for convenience in managing and maintaining them. These groups are assigned to different working groups within technical committee 57.

WG13 packages include:

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a) IEC 61970-301 (this document) with the following packages:
   - Domain
   - Core
   - OperationalLimits
   - Topology
   - Wires
   - Generation
   - Generation.GenerationDynamics
   - Generation.Production
   - LoadModel
   - Outage
   - Protection
   - Equivalents
   - Meas
   - SCADA
   - ControlArea
   - Contingency

b) Packages dealing with market operations, such as energy scheduling, financial, and reservations.

WG14 packages in the IEC 61968 series of standards describe additional parts of the CIM that deal with other logical views of utility operations including include assets, location, activities, consumers, documentation, work management, and distribution-specific network models.

Note that the package boundaries do not imply application boundaries. An application may use CIM entities from several packages. It is also anticipated CIM packages outside of this document will have dependencies upon some of the packages described in this document, and particularly the Domain and Core packages, though other dependencies will also exist.

Figure 1 shows the packages defined for IEC 61970-301 CIM base and their dependency relationships. The dashed line indicates a dependency relationship, with the arrowhead pointing from the dependent package to the package on which it has a dependency.

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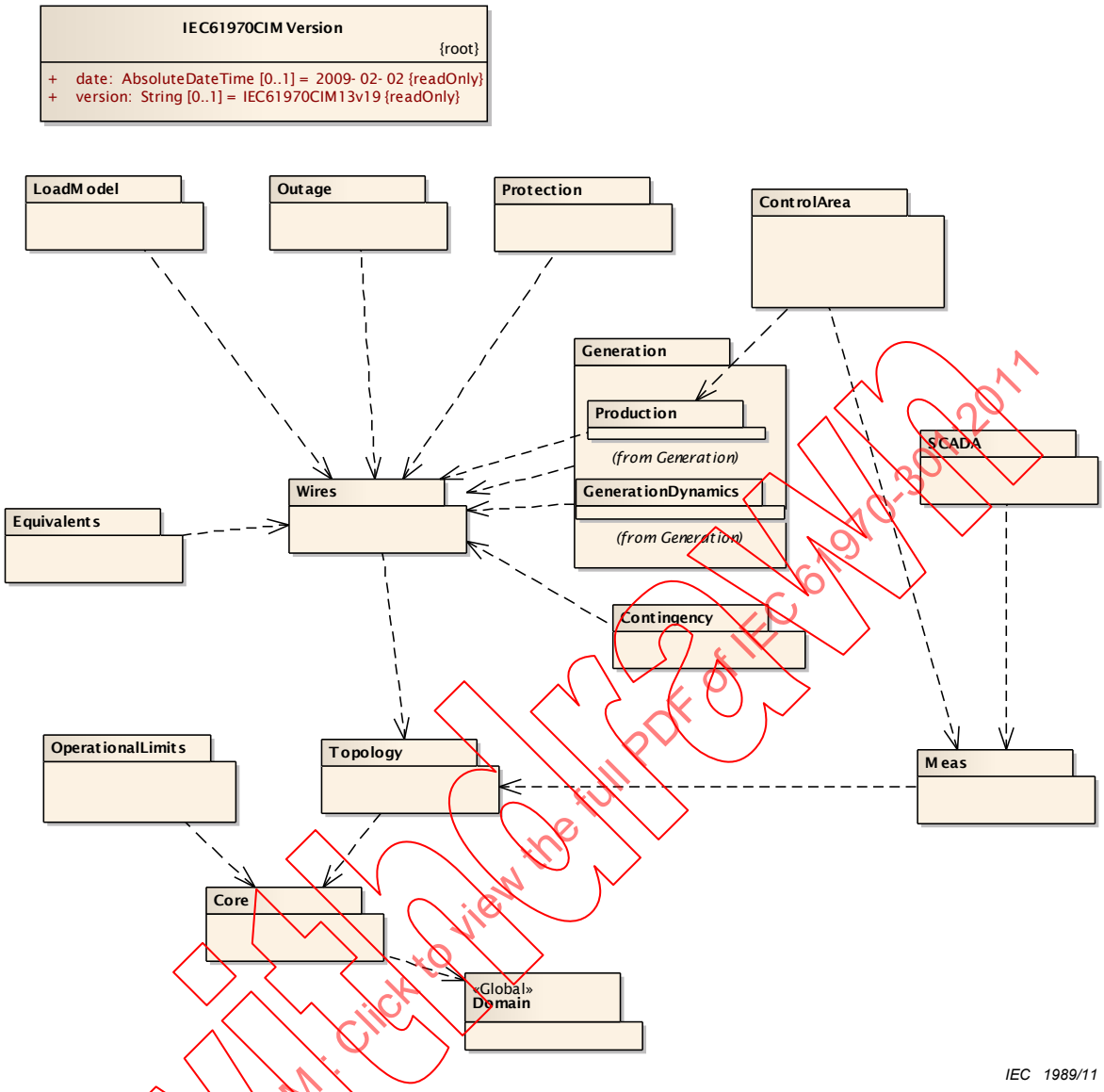

Figure 1 – CIM IEC 61970-301 package diagram

The subclauses below summarize the contents of each CIM package. Clause 6 contains the specification for each of the CIM packages.

NOTE The contents of the CIM defined in this specification were auto-generated from the CIM UML electronic model release IEC 61970CIM13v19, which is available at through the CIM users group.

4.2.2 Domain

The Domain package is a data dictionary of quantities and units that define datatypes for attributes (properties) that may be used by any class in any other package.

This package contains the definition of primitive datatypes, including units of measure and permissible values. Each datatype contains a value attribute and an optional unit of measure, which is specified as a static variable initialized to the textual description of the unit of measure. The value of the "units" string may be country or customer specific. Typical values are given. Permissible values for enumerations are listed in the documentation for the attribute using UML constraint syntax inside curly braces. Lengths of variable strings are listed in the descriptive text where required.

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4.2.3 Core

Contains the core PowerSystemResource and ConductingEquipment entities shared by all applications plus common collections of those entities. Not all applications require all the Core entities. This package does not depend on any other package except the Domain package, but most of the other packages have associations and generalizations that depend on it.

4.2.4 OperationalLimits

The OperationalLimits package models a specification of limits associated with equipment and other operational entities.

4.2.5 Topology

An extension to the Core package that in association with the Terminal class, models Connectivity, that is the physical definition of how equipment is connected together. In addition it models Topology, that is the logical definition of how equipment is connected via closed switches. The Topology definition is independent of the other electrical characteristics.

4.2.6 Wires

An extension to the Core and Topology package that models information on the electrical characteristics of Transmission and Distribution networks. This package is used by network applications such as State Estimation, Load Flow and Optimal Power Flow.

4.2.7 Generation

Generation is divided into two separate packages, Production and Generation, which are described below.

4.2.7.1 Generation.Production

The Production package is responsible for classes which describe various kinds of generators. These classes also provide production costing information which is used to economically allocate demand among committed units and calculate reserve quantities.

4.2.7.2 Generation.GenerationDynamics

The GenerationDynamics package contains prime movers, such as turbines and boilers, which are needed for simulation and educational purposes.

4.2.8 LoadModel

This package is responsible for modeling the energy consumers and the system load as curves and associated curve data. Special circumstances that may affect the load, such as seasons and daytypes, are also included here.

This information is used by Load Forecasting and Load Management.

4.2.9 Outage

An extension to the Core and Wires packages that models information on the current and planned network configuration. These entities are optional within typical network applications.

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4.2.10 Protection

An extension to the Core and Wires packages that models information for protection equipment such as relays. These entities are used within training simulators and distribution network fault location applications.

4.2.11 Equivalents

The equivalents package models equivalent networks.

4.2.12 Meas

Contains entities that describe dynamic measurement data exchanged between applications.

4.2.13 SCADA

Contains entities to model information used by supervisory control and data acquisition (SCADA) applications. Supervisory control supports operator control of equipment, such as opening or closing a breaker. Data acquisition gathers telemetered data from various sources. The subtypes of the Telemetry entity deliberately match the IEC 61850 definitions.

This package also supports alarm presentation but it is not expected to be used by other applications.

4.2.14 ControlArea

The ControlArea package models area specifications which can be used for a variety of purposes. The package as a whole models potentially overlapping control area specifications for the purpose of actual generation control, load forecast area load capture, or powerflow based analysis.

4.2.15 Contingency

Contingencies to be studied.

4.3 CIM classes and relationships

4.3.1 Classes

The class diagram(s) for each CIM package shows all the classes in the package and their relationships. Where relationships exist with classes in other packages, those classes are also shown with a note identifying the package which owns the class.

Classes and objects model what is in a power system that needs to be represented in a common way to EMS applications. A class is a description of an object found in the real world, such as a power transformer, generator, or load that needs to be represented as part of the overall power system model in an EMS. Other types of objects include things such as schedules and measurements that EMS applications also need to process, analyze, and store. Such objects need a common representation to achieve the purposes of the EMS-API standard for plug-compatibility and interoperability. A particular object in a power system with a unique identity is modeled as an instance of the class to which it belongs.

It should also be noted that the CIM is defined to facilitate data exchange. As defined in this document, CIM entities have no behavior. In order to make the CIM as generic as possible, it is highly desirable to make it easy to configure for specific implementations. In general, it is easier to change the value or domain of an attribute than to change a class definition. These principles imply that the CIM should avoid defining too many specific sub-types of classes. Instead, the CIM defines generic classes with attributes giving the type name. Applications

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may then use this information to instantiate specific object types as required. Applications may need additional information to define the set of valid types and relationships.

Classes have attributes that describe the characteristics of the objects. Each class in the CIM contains the attributes that describe and identify a specific instance of the class. Only the attributes that are of public interest to EMS applications are included in the class descriptions.

Each attribute has a type, which identifies what kind of attribute it is. Typical attributes are of type integer, float, boolean, string, and enumeration, which are called primitive types. However, many additional types are defined as part of the CIM specification. For example, ShuntCompensator has a "maxU" attribute of type Voltage. The definition of data types is contained in the Domain package described in Subclause 4.2.2. The UML stereotypes of Primitive, enumeration, and Datatype are added to classes used as types. The Datatype stereotype is used with a specific CIM semantics for a triple of attributes {value, unit, multiplier}, which implies custom mapping to serialization artifacts such as RDFS, OWL, and XSD. Classes with these stereotypes do not participate in generalization or association relationships and are simply used as types for attributes.

All CIM attributes are implicitly optional in the sense that profiles using the CIM may eliminate any attributes.

Relationships between classes reveal how they are structured in terms of each other. CIM classes are related in a variety of ways, as described in the subclauses below.

4.3.2 Generalization

A generalization is a relationship between a more general and a more specific class. The more specific class can contain only additional information. For example, a PowerTransformer is a specific type of Equipment. Generalization provides for the specific class to inherit attributes and relationships from all the more general classes above it.

Figure 2 is an example of generalization. In this example taken from the Wires package, a Breaker is a more specific type of ProtectedSwitch, which in turn is a more specific type of Switch, which is a more specific type of ConductingEquipment, etc. A PowerTransformer is another more specific type of Equipment. Note that PowerSystemResource inherits from class IdentifiedObject which is not on the diagram.

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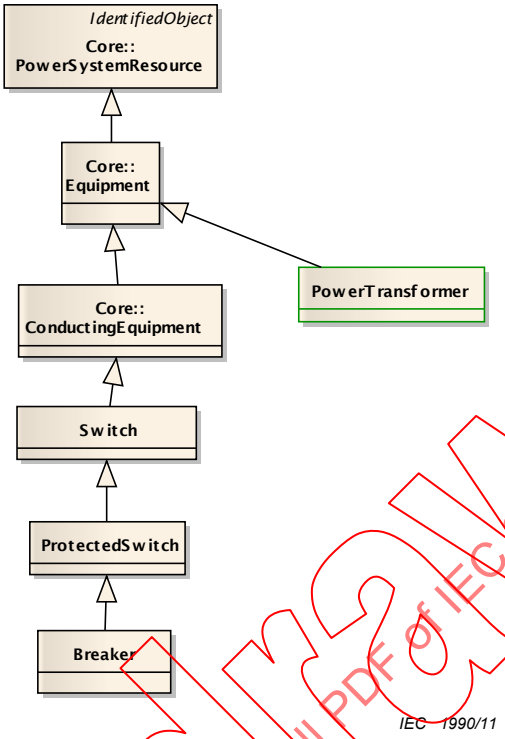

Figure 2 – Example of generalization

4.3.3 Simple association

An association is a conceptual connection between classes. Each association has two "association ends". The "association ends" were called "roles" prior to the UML 2.0 specification. Each association end describes the role the target class (i.e., the class the association end goes *to*) has in relation to the source class (i.e., the class the association end goes *from*). Association ends are usually given the name of the target class with or without a verb phrase. Each association end also has multiplicity/cardinality, which is an indication of how many objects may participate in the given relationship. In the CIM, associations are not named, only association ends are named. For example, in the CIM there is an association between a BaseVoltage and a VoltageLevel (See Figure 3 which is taken from the Wires package). Multiplicity is shown at both ends of the association. In this example, a VoltageLevel object may reference 1 BaseVoltage, and a BaseVoltage may be referenced by 0 or more VoltageLevel objects.

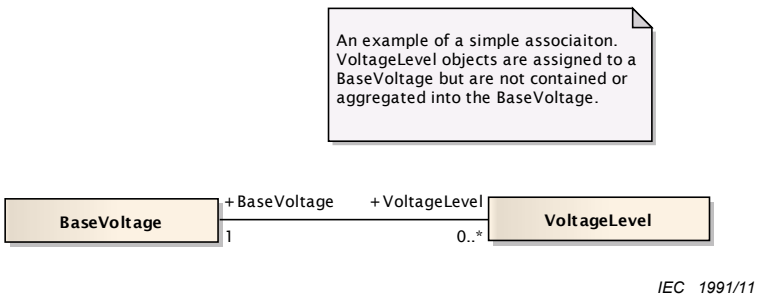

Figure 3 – Example of simple association

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4.3.4 Aggregation

Aggregation is a special case of association. Aggregation indicates that the relationship between the classes is some sort of whole-part relationship, where the whole class “consists of” or “contains” the part class, and the part class is “part of” the whole class. The part class does not inherit from the whole class as in generalization. Figure 4 illustrates an aggregation between the EquipmentContainer class and the Equipment class, which is taken from the Core package. As shown, an Equipment can be a member of zero or one EquipmentContainer objects, but an EquipmentContainer object can contain any number of Equipment objects.

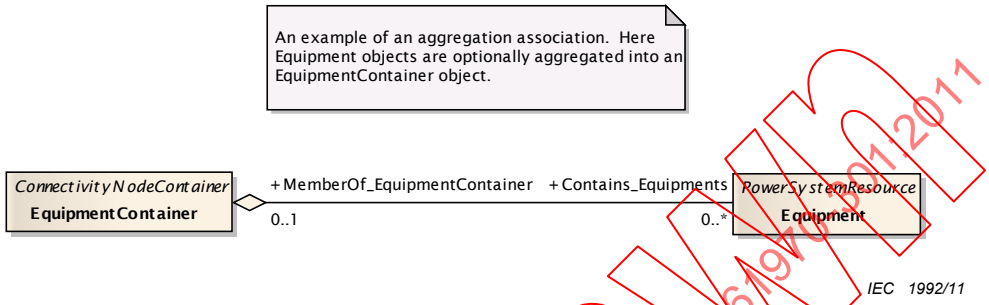

Figure 4 – Example of aggregation

4.4 CIM model concepts and examples

4.4.1 Concepts

The CIM classes, attributes, types, and relationships are specified in Clauses 5 and 6. Clause 6 comprises a complete description of the IEC 61970-301 CIM Base model. To help understand how to interpret the CIM, some key model concepts used in the CIM are introduced and described in the following subclauses.

4.4.2 Containment, equipment hierarchies and naming

4.4.2.1 Containment structure

Figure 5 shows the concept of equipment containers to form hierarchies in the CIM. Equipment containers represent ways of organizing and naming equipment typically found within a substation. As may be seen, there is some flexibility provided in which containers are used in a specific application of the CIM in order to accommodate different international practices as well as differences typically found between transmission and distribution substations. Bay, VoltageLevel, Substation, Line, and Plant are all types of EquipmentContainers. In general, a Bay is contained within a specific VoltageLevel, which in turn is contained within a Substation. Substations and Lines may be contained within SubGeographicRegions and GeographicRegions.

One containment hierarchy is used with the IdentifiedObject class to create hierarchical naming intended for human consumption. One hierarchy is specifically used to name equipment according to its function in the power system. This is the functional naming hierarchy. Other common identifications beside functional names are asset serial numbers. The functional name is different from a serial number in that it relates to the function of a particular equipment position or location in the power system. Regardless of what specific piece of physical equipment is placed at a location, the functional name is the same but the serial number varies depending on the physical equipment currently used.

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4.4.2.2 IdentifiedObject class

The IdentifiedObject class contained in the Core package is inherited by all PowerSystemResource and many other classes. This class contains six attributes to be used for naming all PowerSystemResource objects. It is intended that values should be assigned to each attribute in a manner consistent with the attribute definitions.

The following are definitions and conventions for how to use the IdentifiedObject attributes when naming PowerSystemResource objects (for more details, refer to documentation for IdentifiedObject and its attributes in Clause 6):

- name: A free text name.
- localName: A local short name of the instance. Objects that are structured in a functional naming hierarchy have this name local to each particular level in the hierarchy. The name shall be unique among objects contained by the same parent.
- pathName: Objects that are structured in a functional naming hierarchy have a pathName which contains all the IdentifiedObject.localNames from the object to the root. The pathName, then, is a concatenation of all these names from the leaf object up to the root of the containment hierarchy, similar to a file path name. For example, if node "A" contains node "B" that contains node "C", then the pathName for node "C" may look like "A.B.C". The type of delimiters used between localNames is not specified but is a local implementation issue.
- aliasName: A free text name of the instance. This attribute can also be used for localization.
- description: A free format description of the instance.
- mRID (Master Resource ID): A globally unique machine-readable identifier for an object instance.

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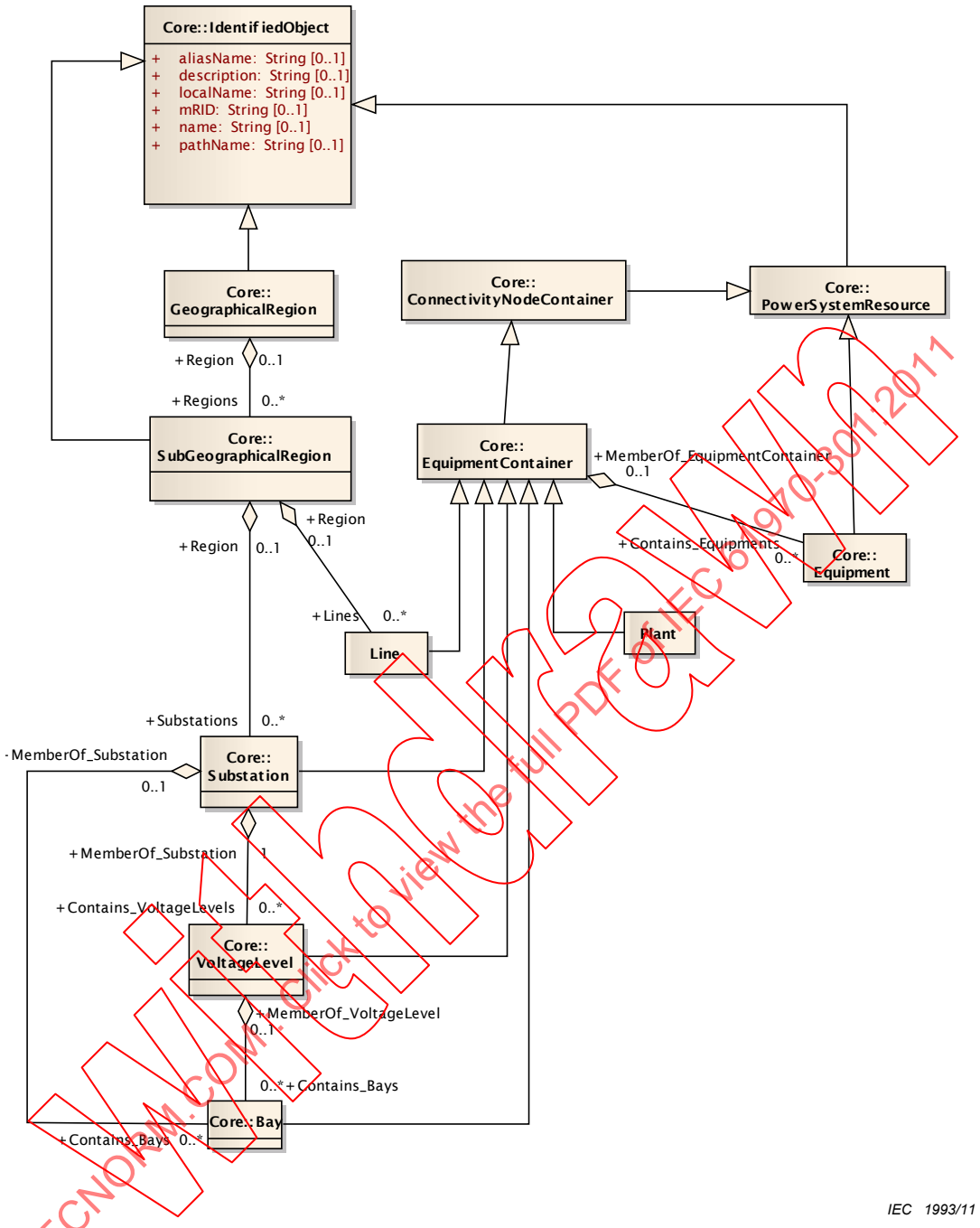

Figure 5 – Equipment containers

The diagrams NamingHierarchyPart1 and NamingHierarchyPart2 in the Wires package show the functional naming hierarchy (refer to the Wires package documentation in Clause 6 for the details).

4.4.3 Connectivity model

4.4.3.1 Connectivity description

Figure 6 shows the Topology class diagram which models connectivity between different types of ConductingEquipment. Also included is a portion of the Meas package class diagram dealing with measurements to illustrate how measurements are associated with conducting equipment.

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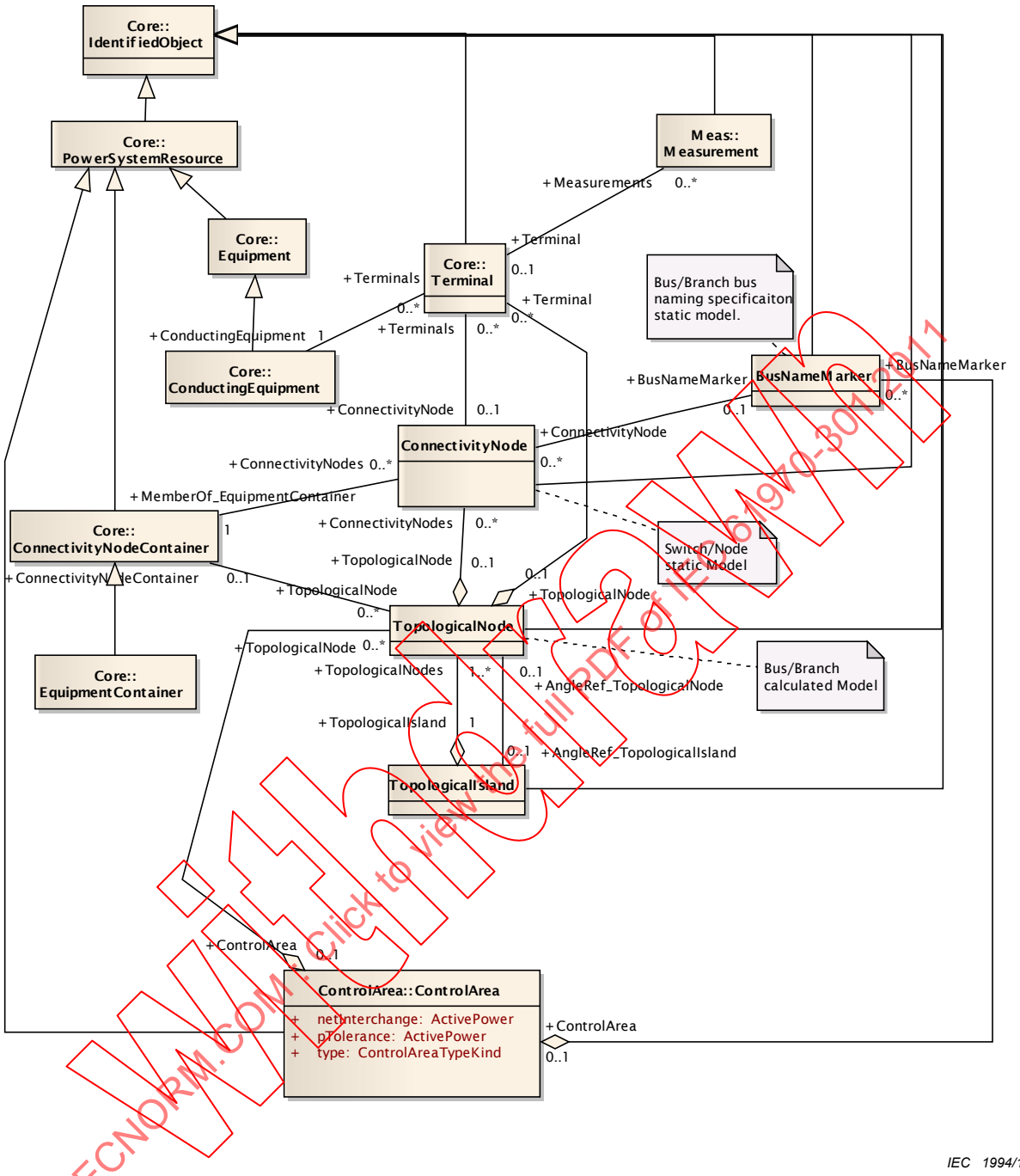

Figure 6 – Connectivity model

To model connectivity, Terminal and ConnectivityNode classes are defined. A Terminal belongs to one ConductingEquipment, although ConductingEquipment may have any number of Terminals. Each Terminal may be connected to a ConnectivityNode, which is a point where terminals of conducting equipment are connected together with zero impedance. A ConnectivityNode may have any number of terminals connected, and may be a member of a TopologicalNode (i.e., a bus), which is in turn a member of a TopologicalIsland. TopologicalNodes and TopologicalIslands are created as a result of a topology processor evaluating the “as built” topology and the actual switch positions.

It is possible to exchange messages directly involving TopologicalNode and bypassing the ConnectivityNode details by using the TopologicalNode to Terminal association. This is often useful for exchanges involving bus/branch models which do not typically contain switch detail.

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EquipmentContainers, which are a specialization of a ConnectivityNodeContainer, may contain zero or more ConnectivityNodes. The associations, ConductingEquipment – Terminal and Terminal – ConnectivityNode, capture the as built topology of an actual power system network. For each Terminal connected to a ConnectivityNode, the associations of the other Terminal(s) connected to the same ConectivityNode identify the ConductingEquipment object(s) that are electrically connected. Similar connectivity at the “bus/branch” level of detail can be expressed using the TopologicalNode instead of the ConnectivityNode.

To model the analog values such as voltage and power, each Terminal has an association with a Measurement class from the Meas package. Although not shown in Figure 6, a Measurement object is associated with at least one MeasurementValue object. Each MeasurementValue object is an instance of a measurement from a specific source, for example, a telemetered measurement. In a study context, the measurement values would have a calculation source instead.

Clause 6 contains a complete description of each class in Figure 6 along with the definition of all the attributes and relationships supported in each class.

4.4.3.2 Connectivity and containment example

To illustrate how the connectivity model and containment model would appear as objects, a small example is presented in Figure 7. The example shows a transmission line with a T-junction spanning two substations and a substation having two voltage levels with a transformer between them. The transmission line consists of two different cables. One of the voltage levels is shown with a busbar section having a single busbar and two very simple switchgear bays connecting to the busbar.

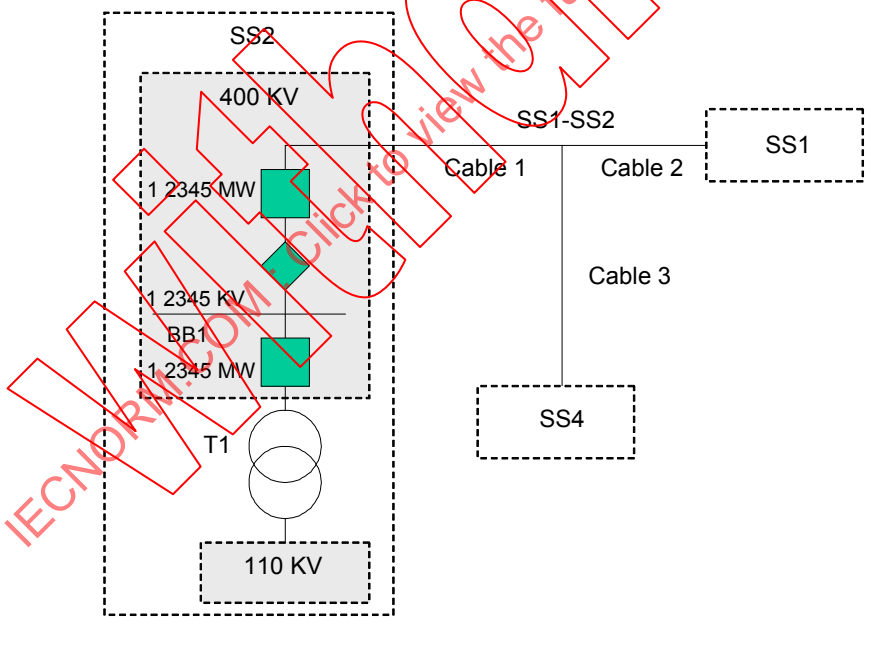

Figure 7 – Simple network example

Figure 8 shows how connectivity is modeled in the CIM as well as one way (but not necessarily the only way) containment is modeled for the diagram in Figure 8. The shaded square boxes represent EquipmentContainers, and the white square boxes represent ConductingEquipment. Darker shading indicates the EquipmentContainer is higher up in the containment hierarchy (i.e., Substation is highest, VoltageLevel next, etc.). White circles represent ConnectivityNodes, and black small circles represent Terminals. A Terminal belongs to a ConductingEquipment, and a ConnectivityNode belongs to an

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EquipmentContainer. This means that the borders (or contact points) between ConductingEquipment are their Terminals interconnected via ConnectivityNodes.

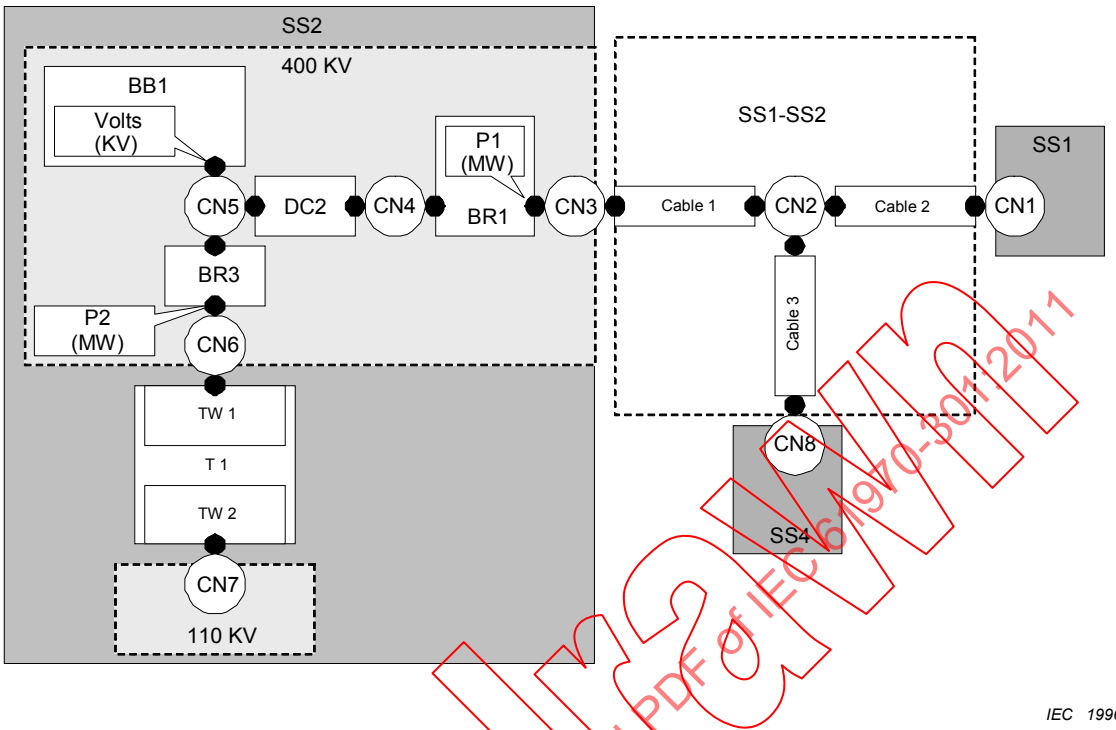

Figure 8 – Simple network connectivity modeled with CIM topology

The Line SS1-SS2 contains three ACLineSegments (Cable1, Cable2, and Cable3) and associated ConnectivityNode (CN2) to model a T junction, which provides a connection to SS4. This represents just one way that this configuration could be modeled. Each ACLineSegment has two Terminals. Cable1 is connected to CN3 and CN2 via these Terminals. CN3 is contained by the VoltageLevel 400KV. The breaker BR1 has two terminals of which one is connected to CN3.

Measurements are represented by square callouts where the arrow points to a Terminal. P1 is connected to the right Terminal belonging to Breaker BR1. Note that P1 is drawn inside the box representing BR1. This is because a Measurement may belong to a PowerSystemResource (PSR), as is the case with BR1. P2 is drawn inside the VoltageLevel 400KV, which means it belongs to the 400KV VoltageLevel instead of BR3.

4.4.4 Inheritance hierarchy

Figure 9 shows an overview of the inheritance hierarchy modeled in the CIM. This overview, which is included as one of the Wires package diagrams, actually spans most of the CIM packages.

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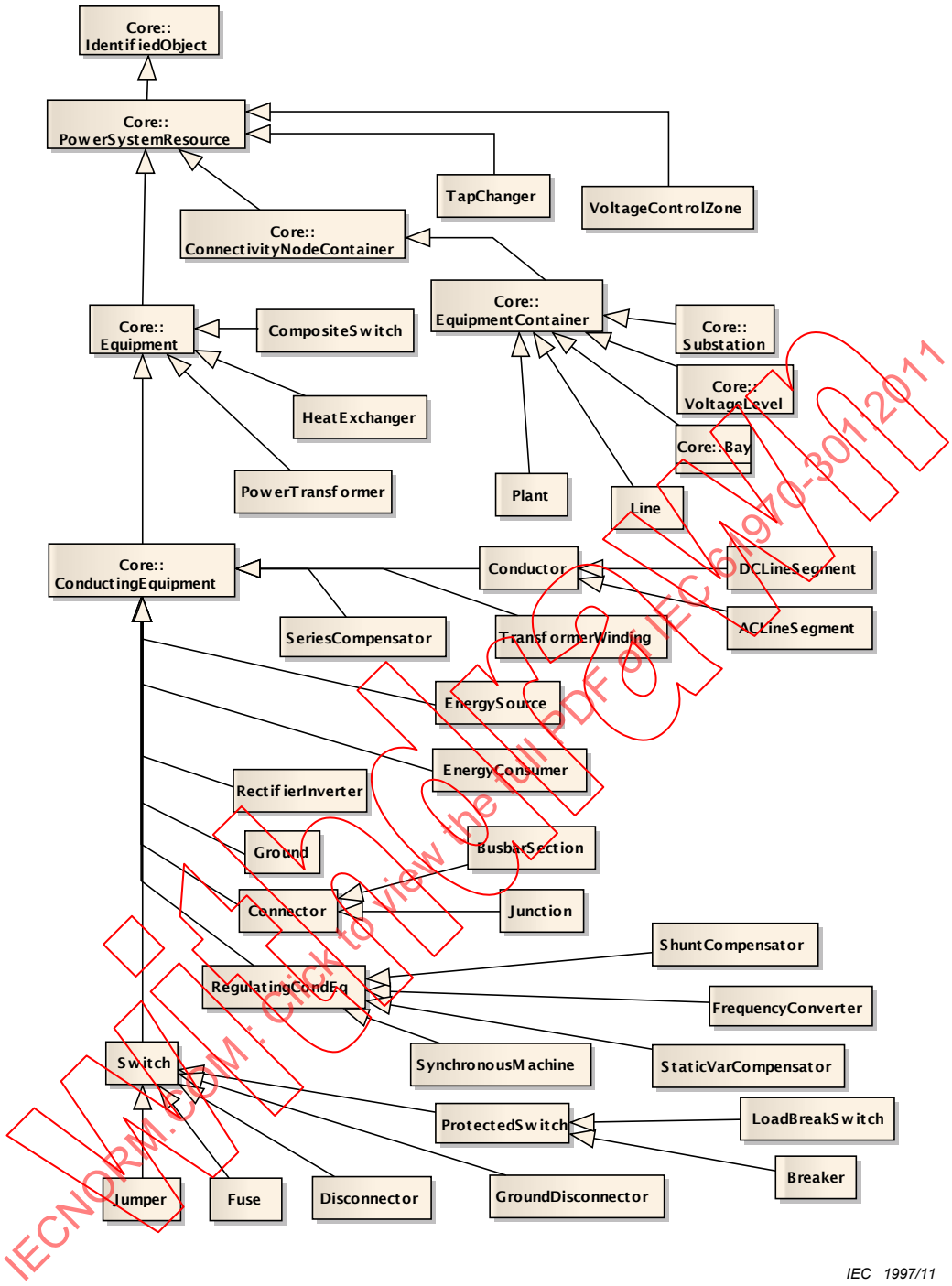

Figure 9 – Equipment inheritance hierarchy

4.4.5 Transformer model

Figure 10 shows a portion of the Wires class diagram which models a PowerTransformer device.

As shown, a PowerTransformer is a specialized class of Equipment, which is a specialized class of a PowerSystemResource, as is ConductingEquipment and TapChanger. This is shown by the use of the generalization-type of relationship, which uses an arrow to point to the general class, and permits the PowerTransformer to inherit attributes from both Equipment and PowerSystemResource.

A PowerTransformer also has a relationship to TransformerWinding, which is modeled with an aggregation-type of relationship using a diamond symbol to point from the part class to the whole class. As shown, a PowerTransformer may have (or contain) one or more TransformerWindings, but a TransformerWinding may belong to (or be a member of) only one PowerTransformer.

The TransformerWinding has other relationships as well:

a generalization relationship with ConductingEquipment;

an association relationship with the WindingTest class, such that a TransformerWinding object may be TestedFrom from 0, 1, or more WindingTest objects;

an aggregation relationship with the TapChanger class, such that a TransformerWinding object may have 0, 1, or more TapChanger objects associated with it.

Clause 6 contains a complete description of each class in Figure 10 along with the definition of all the attributes and relationships supported in each class.

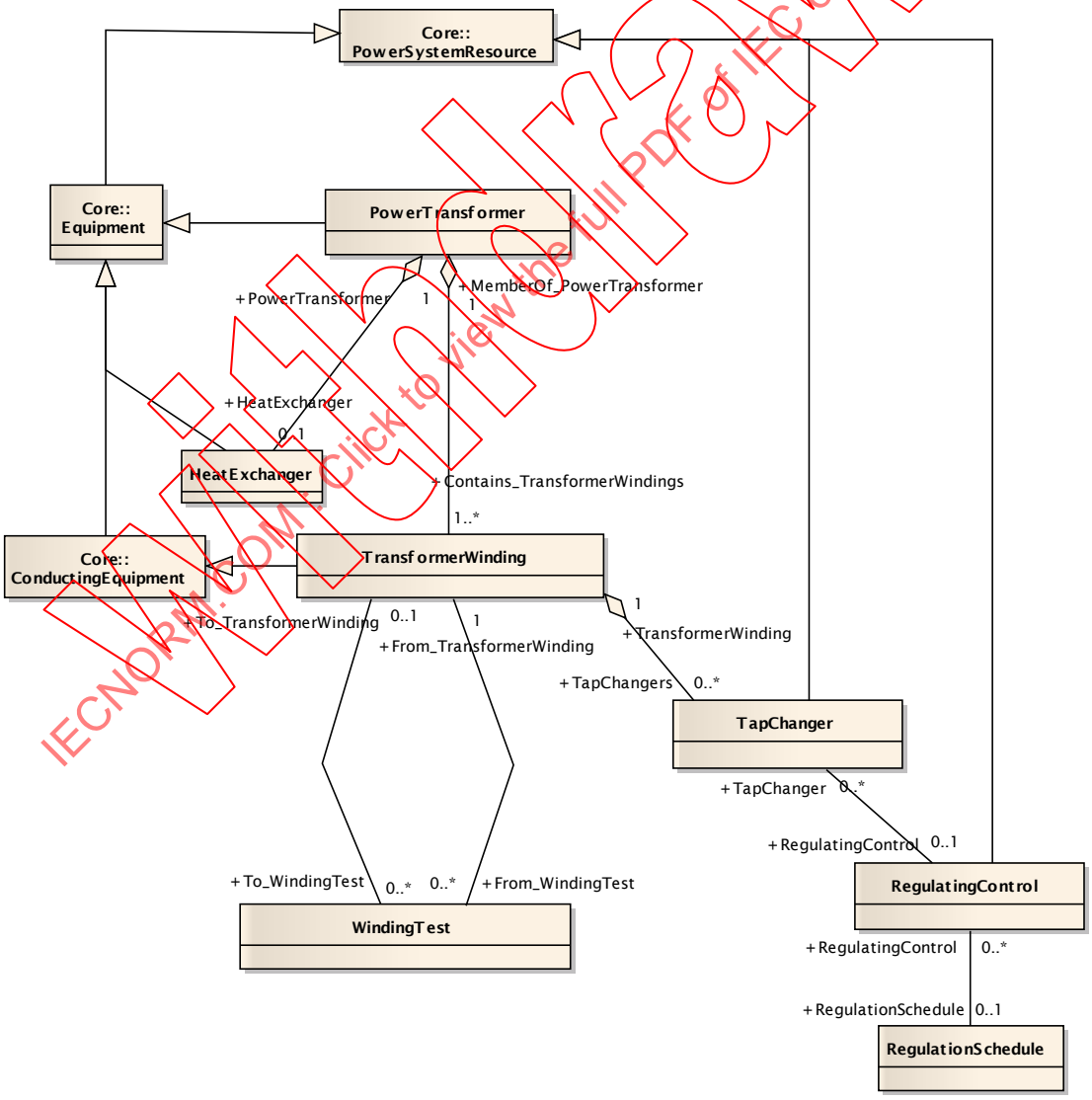

Figure 10 – Transformer model

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4.4.6 Measurements and controls

4.4.6.1 Measurement overview

Measurements are used to represent the state variables that can be found in industrial processes. Each industrial process has its specific types of measurements. A power system typically has power flows, voltages, positions (e.g., breakers, isolators), fault indications (air pressure, oil pressure over temperature, etc.), counters (e.g., energy), etc.

The name "Measurement" would seem to indicate that all the state variables are measured. This is not always strictly the case as many measurements are calculated by SCADA or EMS/DMS functions, such as State Estimator or Power Flow calculations. As a consequence, a measurement may have a number of alternate values (e.g., manually supplied, telemetered, state estimated, optimized etc.). This is supported by the Measurement and MeasurementValue models in the Meas package.

4.4.6.2 Control overview

Controls are used to represent control variables. Power system control variables typically are set points, raise lower commands, select before execute commands and on/off commands etc. The Meas package supports control variables with the Control model.

4.4.6.3 Use of measurement-related classes

A PowerSystemResource (PSR) may have zero to many measurements associated with it by containing one or more measurements. Each measurement may have one or more measurement values. Observing the following guidelines will enable applications to navigate and find the required measurement values in a consistent way (see Figure 11).

a) Measurements of a PowerSystemResource are classified by MeasurementType.

b) MeasurementValues of a Measurement are classified by MeasurementValueSource.

   MeasurementType[1] inherits from IdentifiedObject. The values to be used for MeasurementType.name, MeasurementType.aliasName, and MeasurementType.description are specified in Table 1.

c) MeasurementValueSource also inherits from IdentifiedObject. The values to be used for MeasurementValueSource.name and MeasurementValueSource.description are given in Table 2. This table provides a number of source names to be used where possible. However, the exact names to be used for specific applications are defined in related IEC 61970 component interface specifications (CIS).

d) The tables may be extended for proprietary needs. The names added must start with a unique name (e.g. the company name) and an underscore. Example: xyz_AverageTemperature.

e) The ValueAliasSet is used for discrete measurements and describes mappings from values to symbolic names. Different communication protocols (e.g. for RTUs and for control centers as ICCP or ELCOM) use different data encodings. A system may have a system wide mapping for all Discrete values or group the Discrete values and make a mapping per group. Creation of a single system wide mapping that covers existing communication protocols is outside the scope of this specification.

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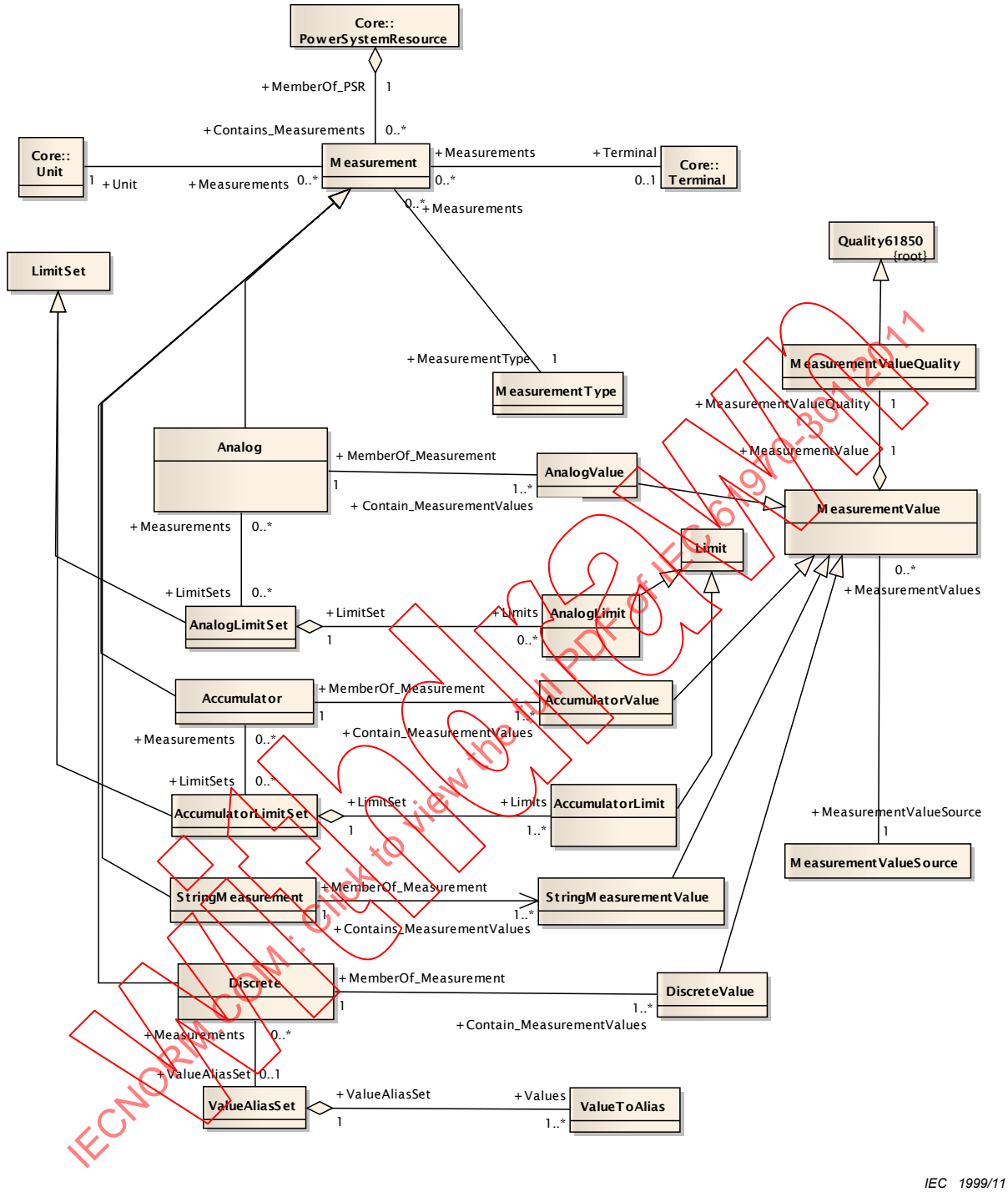
[1] MeasurementType is different from Unit, which is part of the Domain package described in 4.2.2. MeasurementType describes “what” is measured rather than the unit of measure including scaling, which is the purpose of Unit.



IEC 1999/11

Figure 11 – Navigating from PSR to MeasurementValue

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Table 1 – MeasurementType naming conventions

name	aliasName	description
Current	Amp	Current (rms) of a non-three phase circuit
ThreePhaseCurrent	AvAmps	Total current (rms) in a three phase circuit
PhaseCurrent	A	Measured phase current
Frequency	Hz	Frequency
PowerFactor	PwrFact	Power factor not allocated to a phase
ThreePhasePowerFactor	TotPF	Average power factor in a three phase circuit
ThreePhaseApparentPower	TotVA	Total apparent power in a three phase circuit
ThreePhaseReactivePower	TotVAr	Total reactive power in a three phase circuit
ThreePhaseActivePower	TotW	Total real power in a three phase circuit
ApparentPower	VoltAmp	Apparent power in a non-three phase circuit
ReactivePower	VoltAmpr	Reactive power in a non-three phase circuit
Voltage	Vol	Voltage (rms) not allocated to a phase
ActivePower	Watt	Real power in a non-three phase circuit
Pressure	Pres	Pressure
Temperature	Tmp	Temperature
Angle	Ang	Angle between voltage and current
ApparentEnergy	TotVAh	Apparent energy
ReactiveEnergy	TotVArh	Reactive energy
ActiveEnergy	TotWh	Real energy
Automatic	Auto	Automatic operation (not manual)
LocalOperation	Loc	Local operation (not remote)
SwitchPosition	Pos	Switch position [2bits= intermediate,open,closed,ignore]
TapPosition	TapPos	Tap position of power transformer or phaseshifter
Operation Count	OperCnt	Operation count - typically for switches

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Table 1 describes various types of measurements also defined in IEC 61850. The meaning of the columns in Table 1 are as follows:

- name (MeasurementType.name) is the IEC 61970 measurement type name.
- aliasName (MeasurementType.aliasName) is the name assigned to the data in IEC 61850. (Refer to Clause 6 of IEC 61850-7-4, data object name semantics).
- description (MeasurementType.description) of the data.

It shall be noted that Table 1 is a non exhaustive list and that the mapping between measurements as defined in a control center and a substation is non-trivial.

Table 2 – MeasurementValueSource naming conventions

name	description
SCADA	Telemetered values received from a local SCADA system
CCLink	Value received from a remote control center via TASE.2 or other control center protocol
Operator	Operator entered value (always manually maintained, PSR is not connected to an RTU)
Estimated	Value updated by a state estimator
PowerFlow	Value updated as result of a Powerflow
Forecasted	Value that is planned or forecasted
Calculated	Calculated from other measurement values (e.g., a sum)
Allocated	Calculated by a load allocator

Following these conventions:

- each Measurement instance represents a technological quantity of a PowerSystemResource;
- each MeasurementValue of a Measurement represents a value for the technological quantity, as supplied from a single source;
- the source attribute in MeasurementValueQuality then indicates whether the source actually provided the current value, or whether it had been substituted or defaulted.

4.4.6.4 Attachment of measurements

As mentioned in the previous subclause and as shown in Figure 11, Measurements are contained by a PowerSystemResource. This is sufficient for Measurements that are not related to connectivity, e.g. temperature, weight, size.

To specify the location of a Measurement in the network, an association to Terminal is used. Examples include power flows, voltages, and currents. Voltages have no direction and can be attached wherever appropriate in relation to the sensor placement. Flows have direction and must be attached such the flow direction is evident from the placement.

Figure 12 shows two examples of the placement of Measurements.

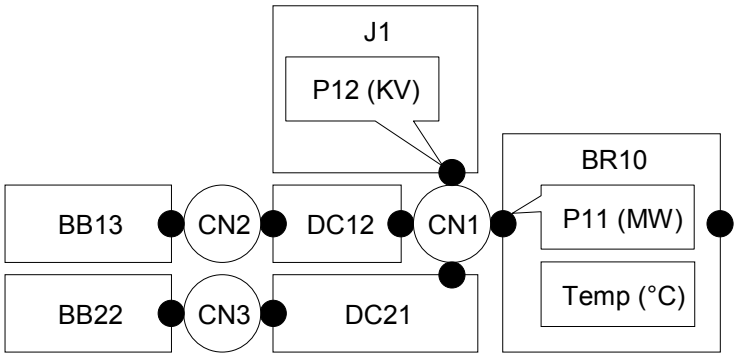

Figure 12 – Measurement placement

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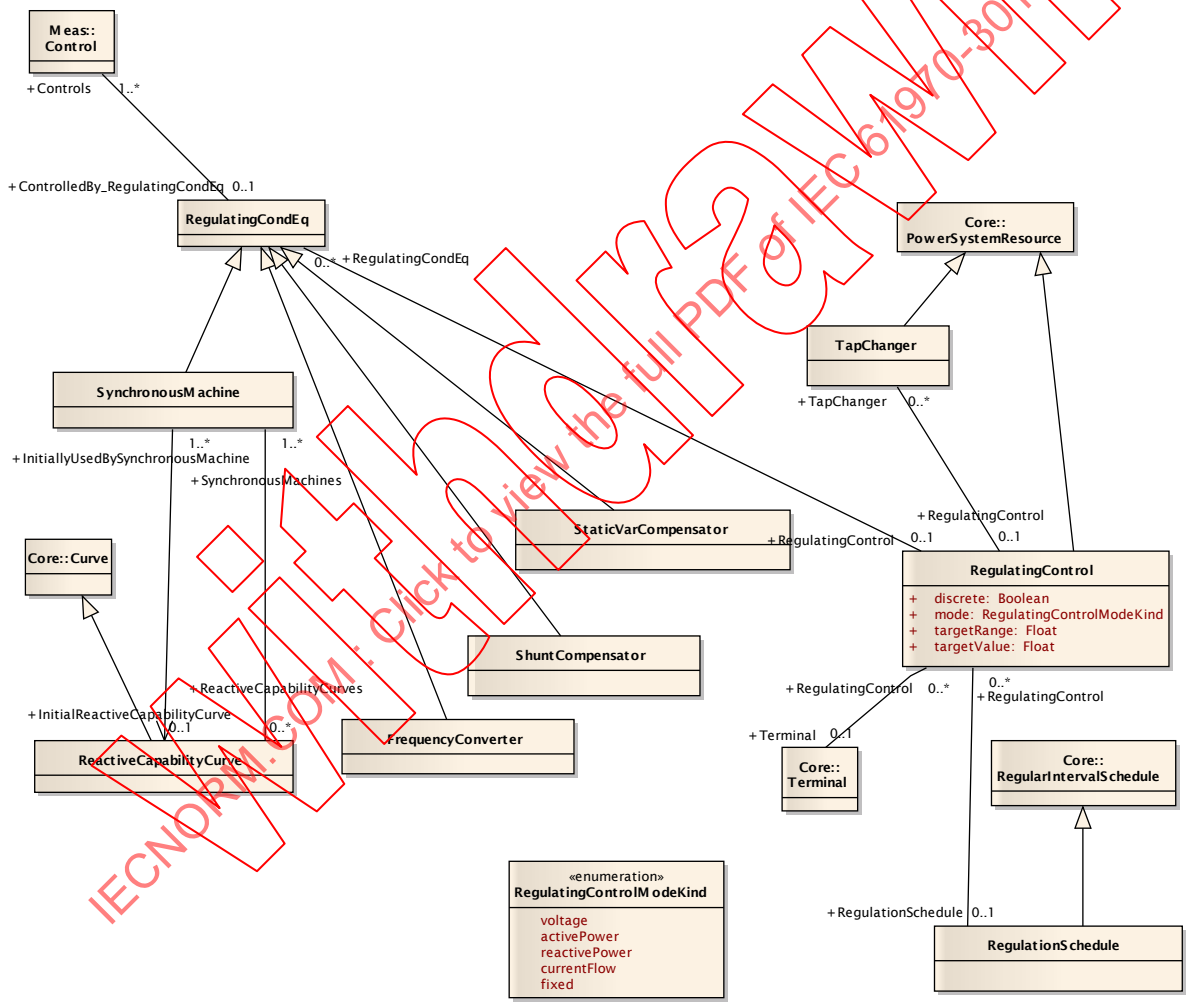
P12 is a voltage Measurement that measures the voltage at the Junction J1. P12 is topologically related to the ConnectivityNode CN1 via the Terminal in Junction J1. P11 is a Measurement that measures the flow through Breaker BR10 at the side connected to the ConnectivityNode CN1. P11 is topologically related to the ConnectivityNode CN1 via the left Terminal in Breaker BR10. Temp is a Measurement that measures the Breaker temperature. As a temperature is not related to connectivity, it has no relation to a Terminal - it just belongs to the Breaker BR10.

4.4.7 Regulating control models

Regulation control, such as automatic voltage control at generators or voltage tap control at transformers is modeled using a class named RegulationControl. The RegulatingControl class provides the capability to model multiple equipment participating in a regulation scheme. These regulation schemes may be physical or manually implemented in actual power system operation, but are reflected in the models used for power system analysis purposes. Figure 13 shows how RegulatingCondEq and TapChanger classes can participate in regulation.



IEC 2001/11

Figure 13 – Regulating control models

4.5 Modeling guidelines

4.5.1 Modeling for change

The following subclauses provide guidelines on how to maintain and extend the CIM.

The CIM is meant to contain classes and attributes that will be exchanged over public interfaces between major applications. The goal is to keep, as much as possible, only the generic features from which a detailed implementation may be derived. In general, it is easier

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to change the value or domain of an attribute than to change a class definition. This makes the model more robust because it is able to support a broader class of requirements, and more stable because new requirements may be able to be handled without requiring changes to the model.

4.5.2 Process for amendments to the CIM

It may be desirable to amend the CIM to either revise the existing model or to extend the CIM to model additional elements of an electric utility power system. The recommended process for such amendments is as follows.

a) Prepare a Use Case(s) to describe the desired changes. This should include proposed changes to the appropriate class diagrams showing new/revised classes, attributes, and associations.

b) The Use Case(s) is then reviewed by the appropriate IEC working group to decide if the requested changes should be treated as revisions to the current CIM standard, or if they should be treated as private amendments, not requiring a change to the standard itself.

c) Proposed amendments accepted by the working group will be added to a list of outstanding issues, and at the appropriate time, a new version of the CIM model will be prepared and an update made to the appropriate IEC CIM specification.

4.5.3 Changes to the CIM UML model

From a modeling perspective, when the CIM is extended, the approach is to start with the existing CIM UML model. The extensions may be added in any of several ways that are available in UML, but in all cases the approach is to inspect the current model and determine the best way to build off of the existing class diagrams. The extensions may take the form of any of the following, starting from the simplest to the most complex:

- adding additional attributes or associations to existing classes;
- adding new classes that are specializations of existing classes;
- adding new classes via associations with existing classes.

The main objective is to reuse the existing CIM to the maximum extent possible. From a packaging point of view, extensions should be made to existing packages where possible. If the extensions comprise a new domain of application, then consideration should be given to creating a new package for the additions, but still creating the necessary associations to the existing package, keeping in mind that even though a new package is being created, the CIM is still a single model.

4.5.4 Changes to the CIM standards documents

From a documentation perspective, when the CIM is extended, a decision shall be made whether the changes constitute updates to existing CIM standards documents, or whether a new Part 3xx specification is required. In either case, the extensions will then become part of the IEC standard CIM.

4.5.5 CIM profiles

An implementation of the CIM need not include all classes, attributes, or associations in the standard CIM specification to be compliant with the CIM standard. Profiles may be defined to specify which elements shall be included (i.e., mandatory elements) in a particular use of the CIM, as well as which are optional. These profiles are defined in the Part 4xx series of standards.

An example is the profile for exchanging power system models. This profile specifies how the CIM is to be used for exchanging power system models in XML, and also specifies the mandatory and optional classes, attributes, and associations to be supported for this use of

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the CIM. Profiles can be maintained using tools such as the open source CIMTool, available at http://www.CIMTool.org.

4.6 Modeling tools

Previous editions of CIM were created and maintained using Rational ROSE[2], but this release was constructed using Enterprise Architect product. The entire CIM UML model exists as an Enterprise Architect[3] project file and is viewable with that tool, including the class diagrams and descriptions of classes, attributes, types, and relationships. Viewing the CIM in this fashion provides a graphical navigation interface that permits all CIM specification data to be viewed via point-and-click from the class diagram in each package. A free viewer is available through Sparx Systems.

Ideally, the CIM information model is independent of any specific UML tool, though experience has shown that exchanges between different tools are often less than perfect. Until tool interoperability is proven effective, future changes to the CIM specification, resulting in new versions of this standard, will be incorporated first into the Enterprise Architect project description to ensure a single source for the CIM model data.

Clause 6 of this document was auto-generated using a publicly available tool called CIMinEA which uses the automation interfaces of Microsoft Word and Enterprise Architect and the standard IEC format and styles.

4.7 User implementation conventions

4.7.1 Conventions beyond UML

This following subclauses provide recommended user conventions when using the CIM in actual system implementations.

4.7.2 Number of Terminals for ConductingEquipment objects

The following ConductingEquipment classes have two terminals: ACLineSegment, DCLineSegment, Jumper, Fuse, Breaker, Disconnector, LoadBreakSwitch, SeriesCompensator. All other ConductingEquipment leaf classes have a single terminal.

4.8 CIM modeling examples

Power system models have been created from the CIM UML model in various ways. The first example is an RDF (Resource Description Framework) Schema version of the CIM, which uses XML (extensible markup language) to describe a power system network model. IEC 61970-501 and other profile standards in development are used to specify the model exchange format. RDF schema versions of the CIM have been used to create XML model files of actual networks for purposes of interoperability testing. An RDF schema version of the CIM is generated from the CIM UML model file using software tools based on the RDF schema specification of the CIM.

It should be noted that an RDF schema version of the CIM is still metadata rather than an instantiation of an actual network. However, complete network model files with descriptions of all network elements and their electrical connectivity can be generated by system suppliers using proprietary export tools, and then imported by other systems via a similar import tool, which is used to populate a local network engineering tool database. Examples of such CIM

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2 Rational ROSE is the trade name of a product previously supplied by IBM. This information is given for the convenience of users of this document and does not constitute an endorsement by the IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

3 Enterprise Architect is the trade name of a product supplied by Sparx Systems. This information is given for the convenience of users of this document and does not constitute an endorsement by the IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

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XML models include the Siemens 100 bus model, the Areva 60 bus model, and the ABB 40 bus model files[4] used for CIM XML interoperability testing.

5 Detailed model

5.1 Overview

The common information model (CIM) represents a comprehensive logical view of energy management system information. This definition includes the public classes and attributes, as well as the relationships between them. The following subclauses describe how Clause 6 is structured. Clause 6 is automatically generated from the CIM model maintained with the tools described in 4.6.

5.2 Context

The CIM is partioned into subpackages. The Domain package defines datatypes used by the other packages. The Generation package is subdivided into Production and GenerationDynamics packages. Classes within the packages are listed alphabetically. Native class attributes are listed first, followed by inherited attributes in order of depth of inheritance, then by attribute name. Native associations are listed first for each class, followed by inherited associations in order of depth of inheritance, then alphabetically by class name, then alphabetically by association end name. The associations are described according to the role of each class participating in the association. The association ends are listed under the class at each end of an association.

Figure 14 shows the top level packages included in this document.

Figure 14 – CIM top level packages

For each package, the model information for each class is fully described. Attribute and association end information for native and inherited attributes is listed as below. For any inherited attributes or association ends the “note” column will contain text indicating the attributes is inherited from a specific class. The note column for native attributes and association ends contains the actual description.

Attributes

name	type	note
native1	Float	A floating point native attribute of the class is described here
native2	ActivePower	Documenation for another native attribute of type ActivePower
Name	Float	Inherited from class IdentifiedObject

In the Attributes table, in some cases, an attribute is a constant, in which case the phrase “(const)” is added in the name column of the attributes table. In such cases, the attribute normally has an initial value also which is preceded by an equal sign and appended to the attribute name.

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4 Siemens100 bus model, Areva 60 bus model, and ABB 40 model are the trade names of products supplied by Siemens, Areva, and ABB. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

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Association ends

Mult from	[Mult] name (type)	note
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inhertted from class IdentifiedObject
0..*	[0..*] OperatedBy_Companies (Company)	inherited from class PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from class PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inhertted from class PowerSystemResource

In the Association Ends table, the first column describes the multiplicity at the other end of the association (i.e., the multiplicity of the class for which association ends are being described). The multiplicity of the association end itself is included in brackets. The association end name is listed in plain text. The class at the other end of the association is within the parentheses. A multiplicity of zero indicates an optional association. A multiplicity of "*" indicates any number is allowed. For example, a multiplicity of [1..*] indicates a range from 1 to any larger number is allowed.

In the case that a class is an enumeration, the Attributes table is replaced by the Enums table as shown below, since enumeration literals have no type. There are no inherited enumeration literals for an enumeration class.

Enums

name	note
native1	This is the first native enumeration value.
native2	This is the second native enumeration value.
native3	There are typically no inherited attributes for enumerations.

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6 Package architecture (normative)

6.1 IEC 61970

6.1.1 IEC 61970 package summary

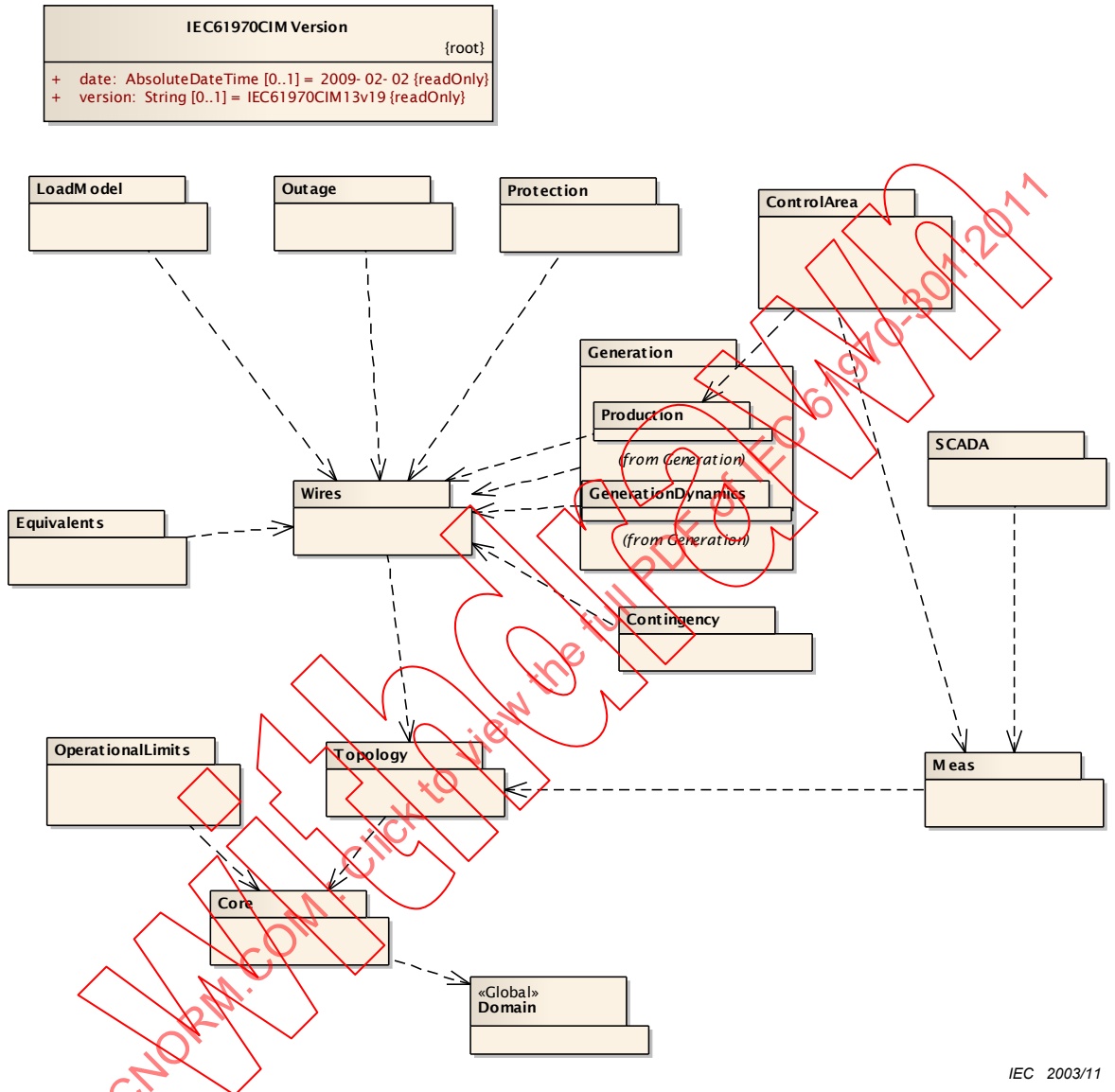

Figure 15 – Main

Figure 15 is documented as follows. This diagram shows all 61970 packages and their logical dependencies.

6.1.2 IEC 61970CIMVersion

This is the IEC 61970 CIM version number assigned to this UML model file.

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Attributes

name	type	note
date=2009-02-02 (const)	AbsoluteDateTime	Form is YYYY-MM-DD for example for January 5, 2009 it is 2009-01-05.
version=IEC 61970CIM13v19 (const)	String	Form is IEC 61970CIMXXvYY where XX is the major CIM package version and the YY is the minor version. For example IEC 61970CIM13v18.

6.2 Domain

6.2.1 Domain package summary

The Domain package is a data dictionary of quantities and units that define datatypes for attributes (properties) that may be used by any class in any other package.

This package contains the definition of primitive datatypes, including units of measure and permissible values. Each datatype contains a value attribute and an optional unit of measure, which is specified as a static variable initialized to the textual description of the unit of measure. The value of the "units" string may be country or customer specific. Typical values are given. Permissible values for enumerations are listed in the documentation for the attribute using UML constraint syntax inside curly braces. Lengths of variable strings are listed in the descriptive text where required.

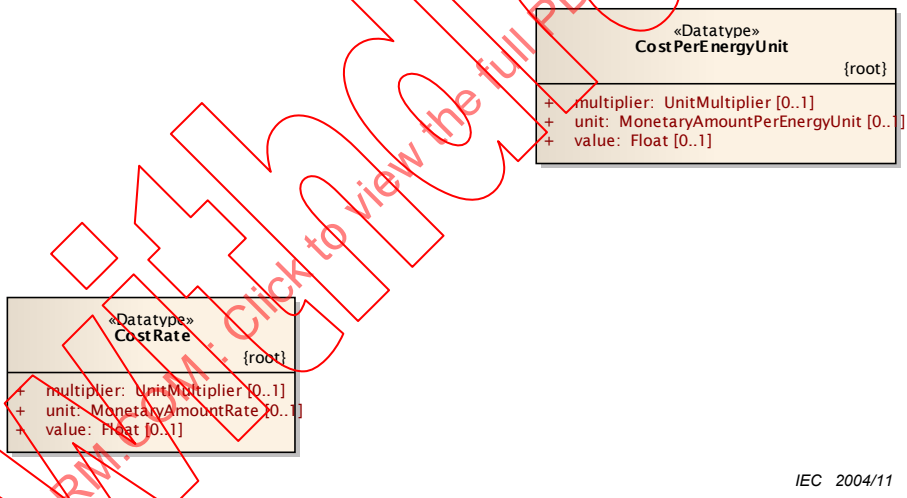

Figure 16 – CombinedDatatypes

Figure 16 is documented as follows. This diagram includes the datatypes that are combined from datatypes in the other diagrams.

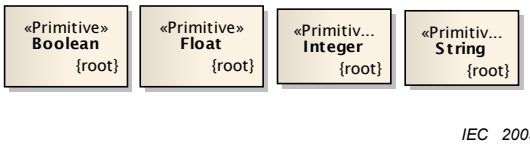

Figure 17 – BasicDatatypes

Figure 17 is documented as follows. This diagram shows basic datatypes that are the basis for all other datatypes.

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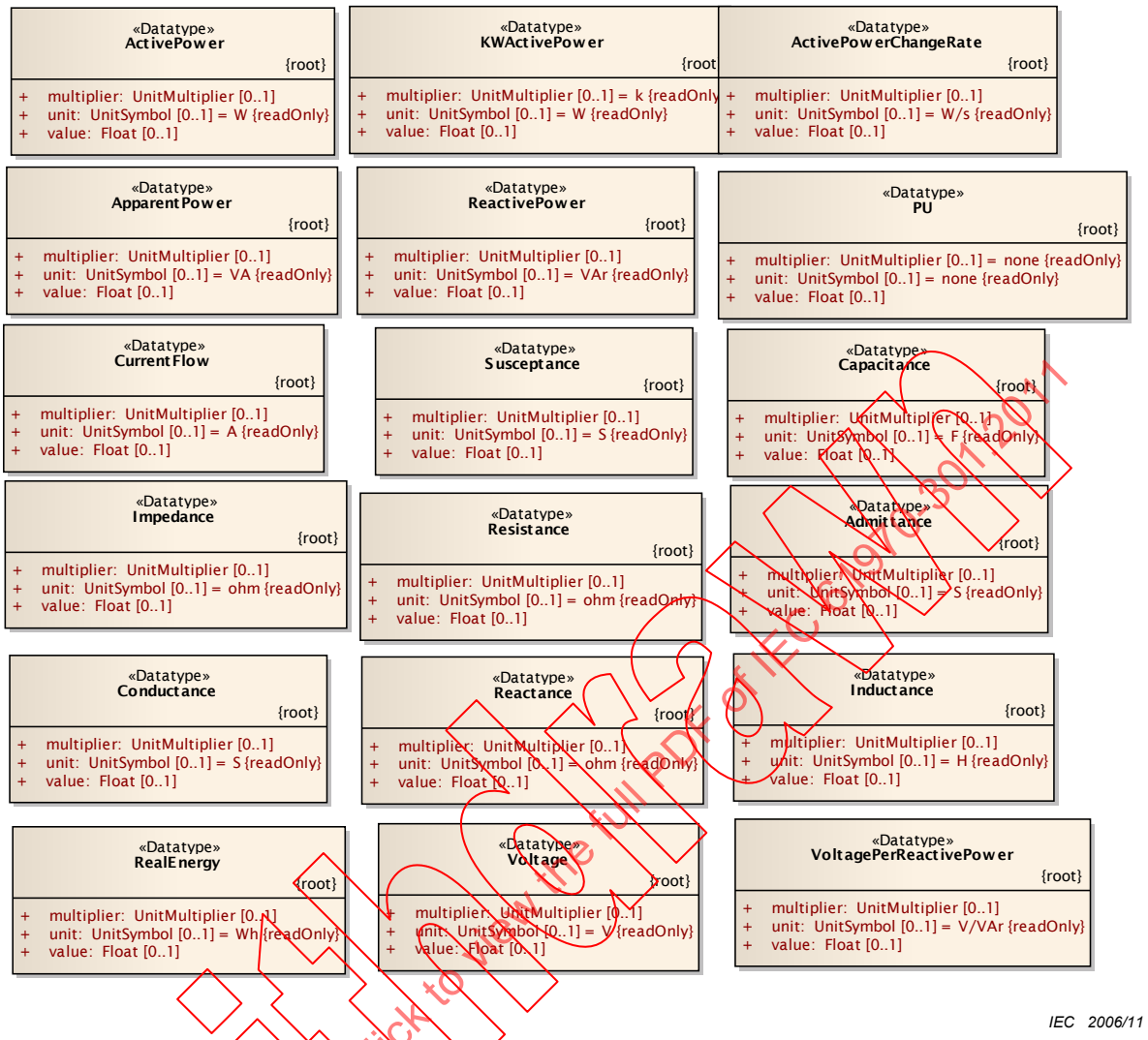

Figure 18 – ElectricityDatatypes

Figure 18 is documented as follows. This diagram shows electricity-related data types.

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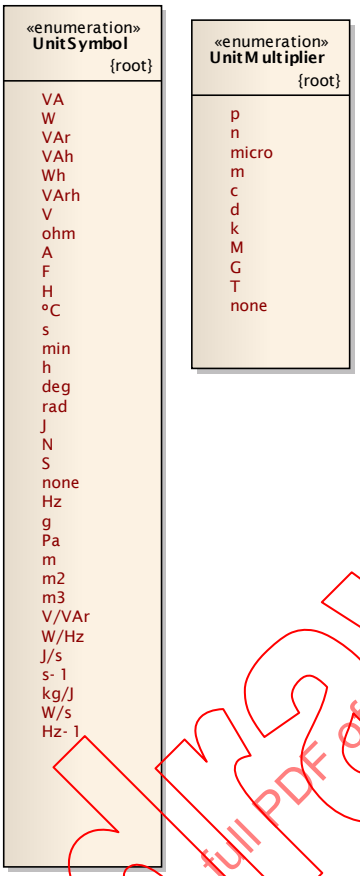

Figure 19 – EnumeratedUnitDatatypes

Figure 19 is documented as follows. This diagram shows enumerated data types related to the SI unit system.

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Figure 20 – GeneralDatatypes

Figure 20 is documented as follows. This diagram shows general related data types.

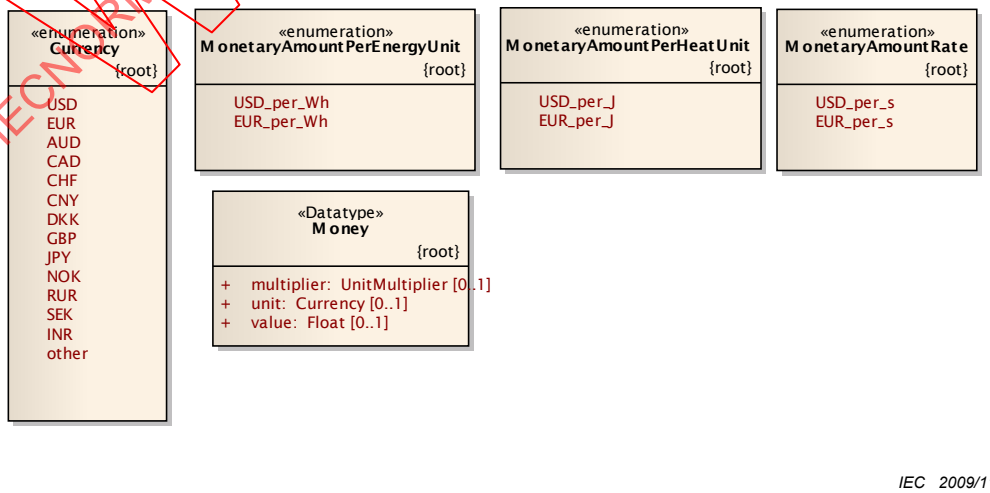

Figure 21 – MonetaryDatatypes

Figure 21 is documented as follows. This diagram shows monetary related data types.

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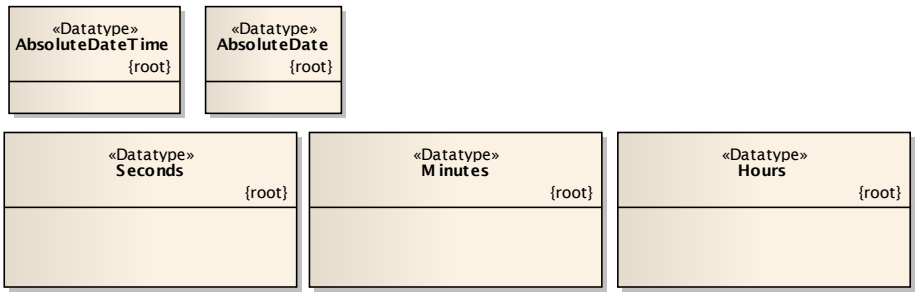

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Figure 22 – TimeDatatypes

Figure 22 is documented as follows. This diagram shows time-related data types.

6.2.2 AbsoluteDate Datatype

Date and time as "yyyy-mm-dd", which conforms with ISO 8601. UTC time zone is specified as "yyyy-mm-dd".

Attributes

name	type	note
value	String	String representation of date, refer to description of the class.

6.2.3 AbsoluteDateTime Datatype

Date and time as "yyyy-mm-ddThh:mm:ss.sss", which conforms with ISO 8601. UTC time zone is specified as "yyyy-mm-ddThh:mm:ss.sssZ". A local timezone relative UTC is specified as "yyyy-mm-ddThh:mm:ss.sss-hh:mm".

AbsoluteDateTime can be used both for calender time, e.g. 2007-02-07T10:30, and for relative time, e.g. 10:30.

Attributes

name	type	note
value	String	String representation of date and time, refer to description of the class.

6.2.4 ActivePower Datatype

Product of RMS value of the voltage and the RMS value of the in-phase component of the current

Attributes

name	type	note
value	Float	
unit=W (const)	UnitSymbol	
multiplier	UnitMultiplier	

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6.2.5 ActivePowerChangeRate Datatype

Attributes

name	type	note
value	Float	
unit=W/s (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.6 Admittance Datatype

Ratio of current to voltage.

Attributes

name	type	note
value	Float	
unit=S (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.7 AngleDegrees Datatype

Measurement of angle in degrees.

Attributes

name	type	note
value	Float	
unit=deg (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.8 AngleRadians Datatype

Phase angle in radians.

Attributes

name	type	note
value	Float	
unit=rad (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.9 ApparentPower Datatype

Product of the RMS value of the voltage and the RMS value of the current.

Attributes

name	type	note
value	Float	
unit=VA (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.10 Boolean Primitive

A type with the value space "true" and "false".

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6.2.11 Capacitance Datatype

A farad, the typical unit, is the capacitance in which a charge of 1 coulomb produces 1 V potential difference between its terminals.

Attributes

name	type	note
value	Float	
unit=F (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.12 Conductance Datatype

Factor by which voltage must be multiplied to give corresponding power lost from a circuit. Real part of admittance.

Attributes

name	type	note
value	Float	
unit=S (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.13 CostPerEnergyUnit Datatype

Cost, in units of currency, per quantity of electrical energy generated.

Attributes

name	type	note
value	Float	
unit	MonetaryAmountPerEnergyUnit	
multiplier	UnitMultiplier	

6.2.14 CostRate Datatype

Cost, in units of currency, per hour of elapsed time.

Attributes

name	type	note
value	Float	
unit	MonetaryAmountRate	
multiplier	UnitMultiplier	

6.2.15 Currency enumeration

Monetary currencies. Apologies for this list not being exhaustive.

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Enums

name	note
USD	US dollar
EUR	European euro
AUD	Australian dollar
CAD	Canadian dollar
CHF	Swiss francs
CNY	Chinese yuan renminbi
DKK	Danish crown
GBP	British pound
JPY	Japanese yen
NOK	Norwegian crown
RUR	Russian ruble
SEK	Swedish crown
INR	India rupees
other	Another type of currency.

6.2.16 CurrentFlow Datatype

Electrical current (positive flow is out of the ConductingEquipment into the ConnectivityNode).

Attributes

name	type	note
value	Float	
unit=A (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.17 Damping Datatype

Per-unit active power variation with per-unit frequency referenced on the system apparent power base. Typical values in range 1,0 to 2,0.

Attributes

name	type	note
value	Float	
unit=Hz-1 (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.18 Float Primitive

A floating point number. The range is unspecified and not limited.

6.2.19 FloatQuantity Datatype

Quantity with Float value and associated unit information.

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Attributes

name	type	note
value	Float	
unit	UnitSymbol	
multiplier	UnitMultiplier	

6.2.20 Frequency Datatype

Cycles per second.

Attributes

name	type	note
value	Float	
unit=Hz (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.21 Hours Datatype

Time, in hours.

Attributes

name	type	note
value	Float	
unit=h (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.22 Impedance Datatype

Ratio of voltage to current.

Attributes

name	type	note
value	Float	
unit=ohm (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.23 Inductance Datatype

Inductance.

Attributes

name	type	note
value	Float	
unit=H (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.24 Integer Primitive

An integer number. The range is unspecified and not limited.

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6.2.25 IntegerQuantity Datatype

Quantity with integer value and associated unit information.

Attributes

name	type	note
value	Integer	
unit	UnitSymbol	
multiplier	UnitMultiplier	

6.2.26 KWActivePower Datatype

Active power in kilowatts.

Attributes

name	type	note
value	Float	
unit=W (const)	UnitSymbol	
multiplier=k (const)	UnitMultiplier	

6.2.27 LongLength Datatype

Long unit of length.

Attributes

name	type	note
value	Float	
unit=m (const)	UnitSymbol	
multiplier=k (const)	UnitMultiplier	

6.2.28 Minutes Datatype

Time in minutes.

Attributes

name	type	note
value	Float	
unit=min (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.29 MonetaryAmountPerEnergyUnit enumeration

Monetary amount per energy unit.

Enums

name	note
USD_per_Wh	
EUR_per_Wh	

6.2.30 MonetaryAmountPerHeatUnit enumeration

Monetary amount per joule.

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Enums

name	note
USD_per_J	
EUR_per_J	

6.2.31 MonetaryAmountRate enumeration

Monetary amount per second.

Enums

name	note
USD_per_s	
EUR_per_s	

6.2.32 Money Datatype

Amount of money.

Attributes

name	type	note
value	Float	
unit	Currency	
multiplier	UnitMultiplier	

6.2.33 PerCent Datatype

Normally 0 to 100 on a defined base.

Attributes

name	type	note
value	Float	Normally 0 to 100 on a defined base
unit=none (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.34 Pressure Datatype

Pressure in Pascal.

Attributes

name	type	note
value	Float	
unit=Pa (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.35 PU Datatype

Per Unit - a positive or negative value referred to a defined base. Values typically range from −10 to +10.

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Attributes

name	type	note
value	Float	
unit=none (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.36 Reactance Datatype

Reactance (imaginary part of impedance), at rated frequency.

Attributes

name	type	note
value	Float	
unit=ohm (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.37 ReactivePower Datatype

Product of RMS value of the voltage and the RMS value of the quadrature component of the current.

Attributes

name	type	note
value	Float	
unit=VAr (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.38 RealEnergy Datatype

Real electrical energy.

Attributes

name	type	note
value	Float	
unit=Wh (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.39 Resistance Datatype

Resistance (real part of impedance).

Attributes

name	type	note
value	Float	
unit=ohm (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.40 RotationSpeed Datatype

Number of revolutions per second.

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Attributes

name	type	note
value	Float	
unit=s-1 (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.41 Seconds Datatype

Time, in seconds.

Attributes

name	type	note
value	Float	Time, in seconds
unit=s (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.42 ShortLength Datatype

Short unit of length.

Attributes

name	type	note
value	Float	
unit=m (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.43 String Primitive

A string consisting of a sequence of 8 bit characters. The character encoding is UTF-8. The string length is unspecified and unlimited.

6.2.44 StringQuantity Datatype

Quantity with string value (when it is not important whether it is an integral or a floating point number) and associated unit information.

Attributes

name	type	note
value	String	
unit	UnitSymbol	
multiplier	UnitMultiplier	

6.2.45 Susceptance Datatype

Imaginary part of admittance.

Attributes

name	type	note
value	Float	
unit=S (const)	UnitSymbol	
multiplier	UnitMultiplier	

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6.2.46 Temperature Datatype

Value of temperature in degrees Celsius.

Attributes

name	type	note
value	Float	
unit=°C (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.47 UnitMultiplier enumeration

The unit multipliers defined for the CIM.

Enums

name	note
p	Pico 10**–12
n	Nano 10**–9
micro	Micro 10**–6
m	Milli 10**–3
c	Centi 10**–2
d	Deci 10**–1
k	Kilo 10**3
M	Mega 10**6
G	Giga 10**9
T	Tera 10**12
None	

6.2.48 UnitSymbol enumeration

The units defined for usage in the CIM.

Enums

name	note
VA	Apparent power in volt ampere
W	Active power in watt
VAr	Reactive power in volt ampere reactive
VAh	Apparent energy in volt ampere hours
Wh	Real energy in what hours
VArh	Reactive energy in volt ampere reactive hours
V	Voltage in volt
ohm	Resistance in ohm
A	Current in ampere
F	Capacitance in farad
H	Inductance in henry
°C	Relative temperature in degrees Celsius
s	Time in seconds
min	Time in minutes

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name	note
h	Time in hours
deg	Plane angle in degrees
rad	Plane angle in radians
J	Energy in joule
N	Force in newton
S	Conductance in siemens
none	Dimension less quantity, e.g. count, per unit, etc.
Hz	Frequency in hertz
g	Mass in gram
Pa	Pressure in pascal (n/m2)
m	Length in meter
m2	Area in square meters
m3	Volume in cubic meters
V/VAr	Volt per volt ampere reactive
W/Hz	Watt per hertz
J/s	Joule per second
s–1	per second
kg/J	Mass per energy
W/s	Watt per second
Hz–1	per Hertz

6.2.49 Voltage Datatype

Electrical voltage.

Attributes

name	type	note
value	Float	
unit=V (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.50 VoltagePerReactivePower Datatype

Voltage variation with reactive power.

Attributes

name	type	note
value	Float	
unit=V/VAr (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.51 Volume Datatype

Volume.

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Attributes

name	type	note
value	Float	
unit=m3 (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.52 WaterLevel Datatype

Reservoir water level referred to a given datum such as mean sea level.

Attributes

name	type	note
value	Float	
unit=m (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.53 Weight Datatype

The weight of an object.

Attributes

name	type	note
value	Float	
unit=g (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.3 Core

6.3.1 Core package summary

Contains the core PowerSystemResource and ConductingEquipment entities shared by all applications plus common collections of those entities. Not all applications require all the Core entities. This package does not depend on any other package except the Domain package, but most of the other packages have associations and generalizations that depend on it.

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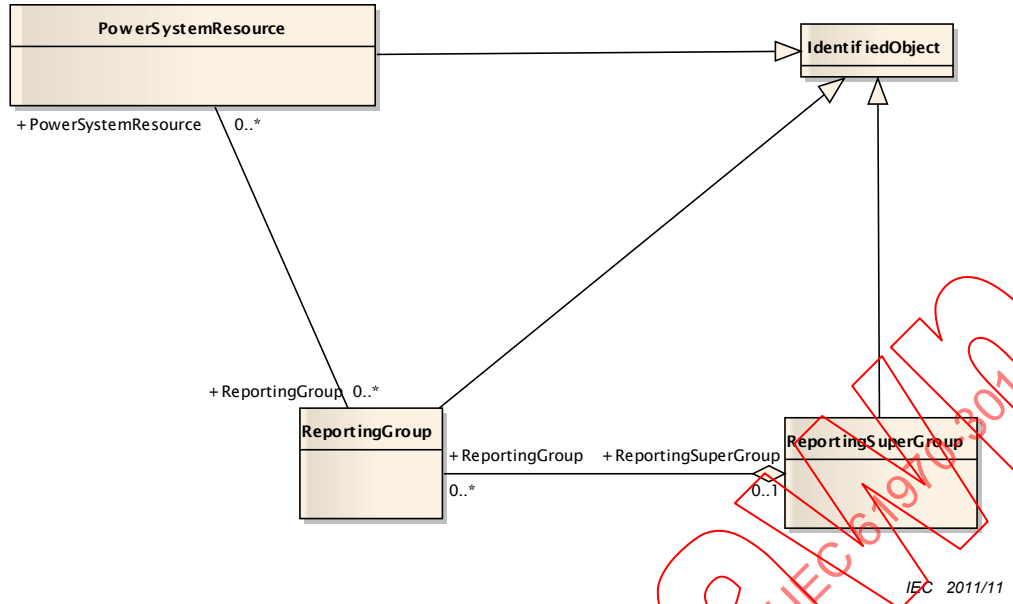

Figure 23 – Reporting

Figure 23 is not documented.

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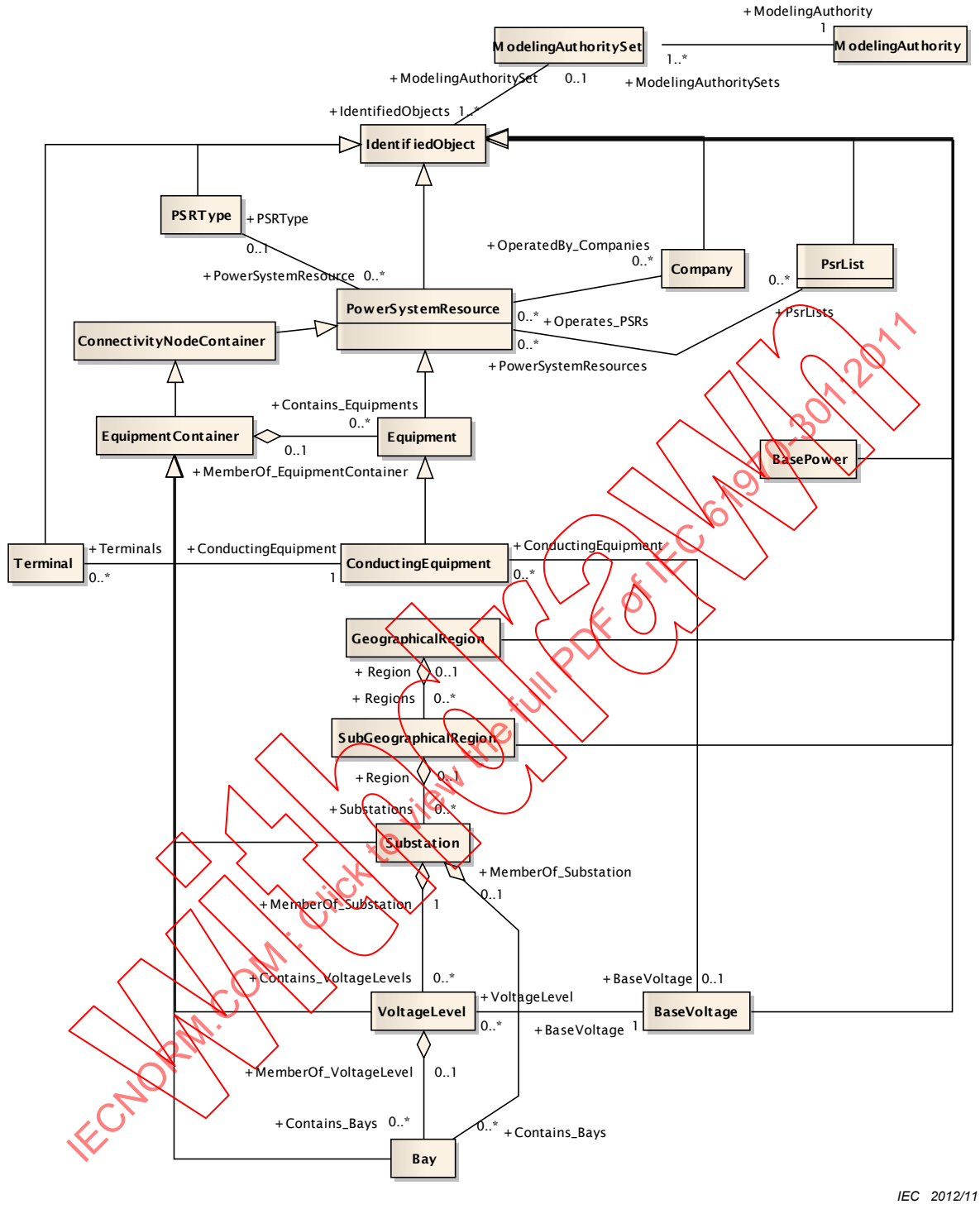

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Figure 24 – Main

Figure 24 is documented as follows. This diagram is intended to show all classes needed for any application of the CIM for modeling transmission and generation systems.

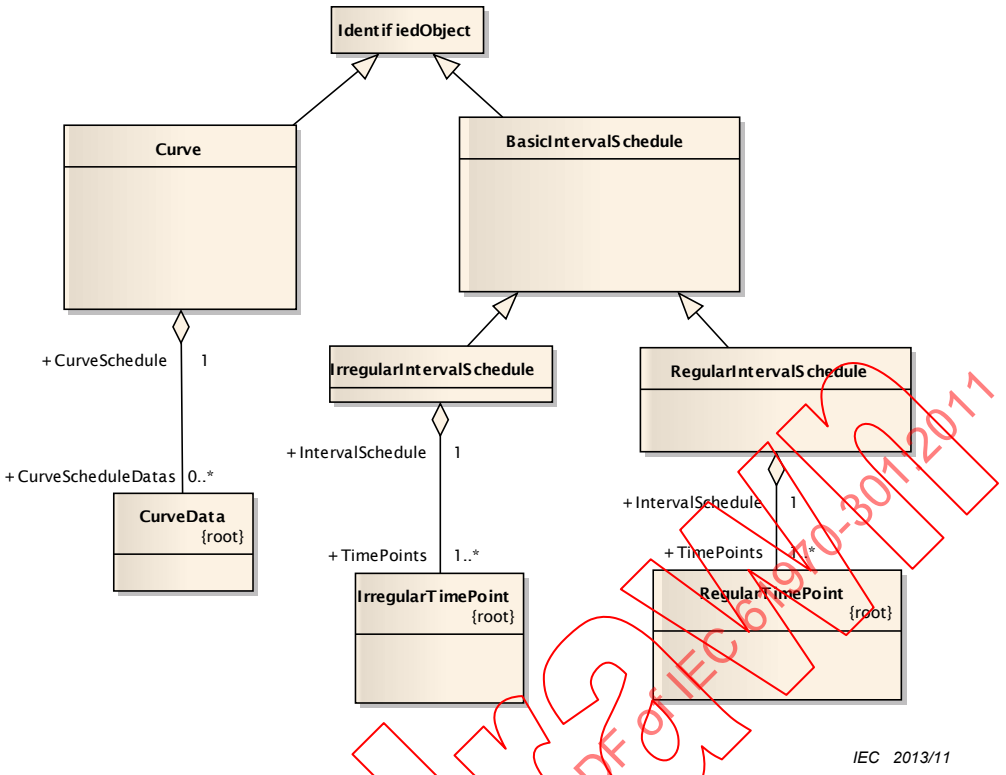

Figure 25 – CurveSchedule

Figure 25 is not documented.

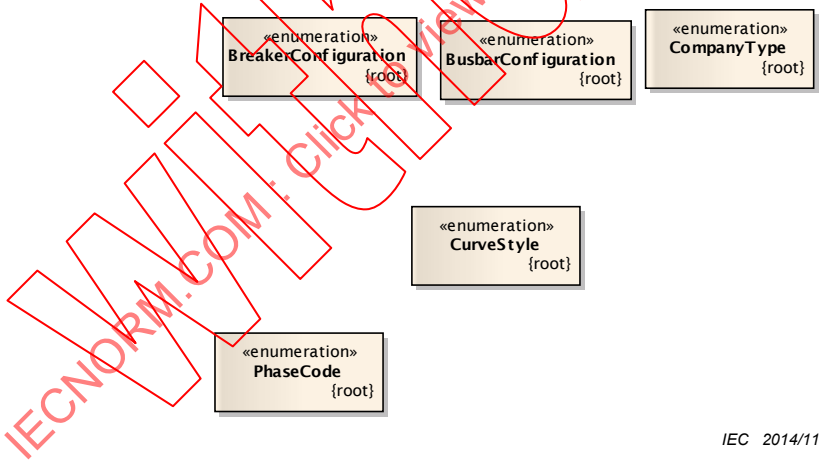

Figure 26 – Datatypes

Figure 26 is documented as follows. This diagram shows the data types specific to the Core package.

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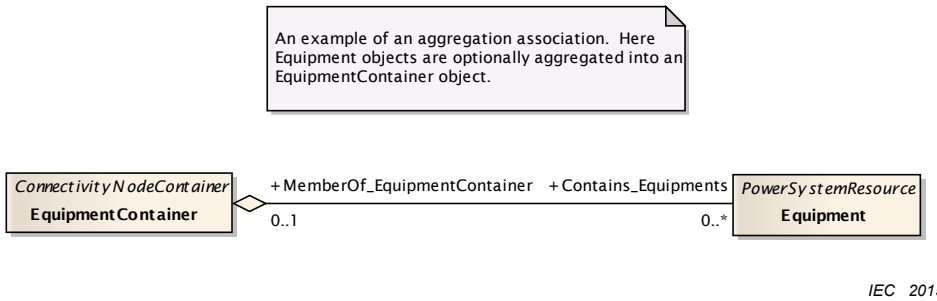

Figure 27 – DocumentationExampleAggregation

Figure 27 is not documented.

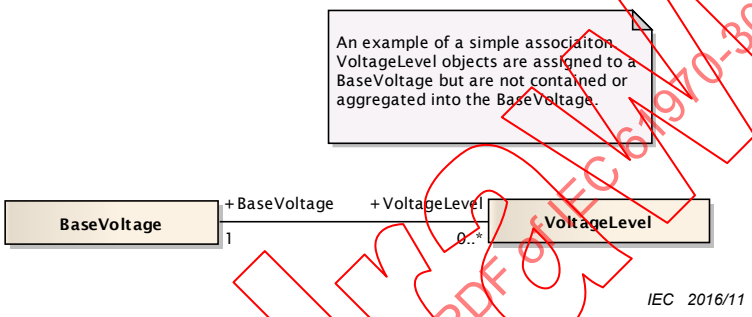

Figure 28 – DocumentationExampleAssociation

Figure 28 is documented as follows. This diagram is an example used for documentation purposes. It shows how a simple association and an aggregation association are expressed in UML diagrams.

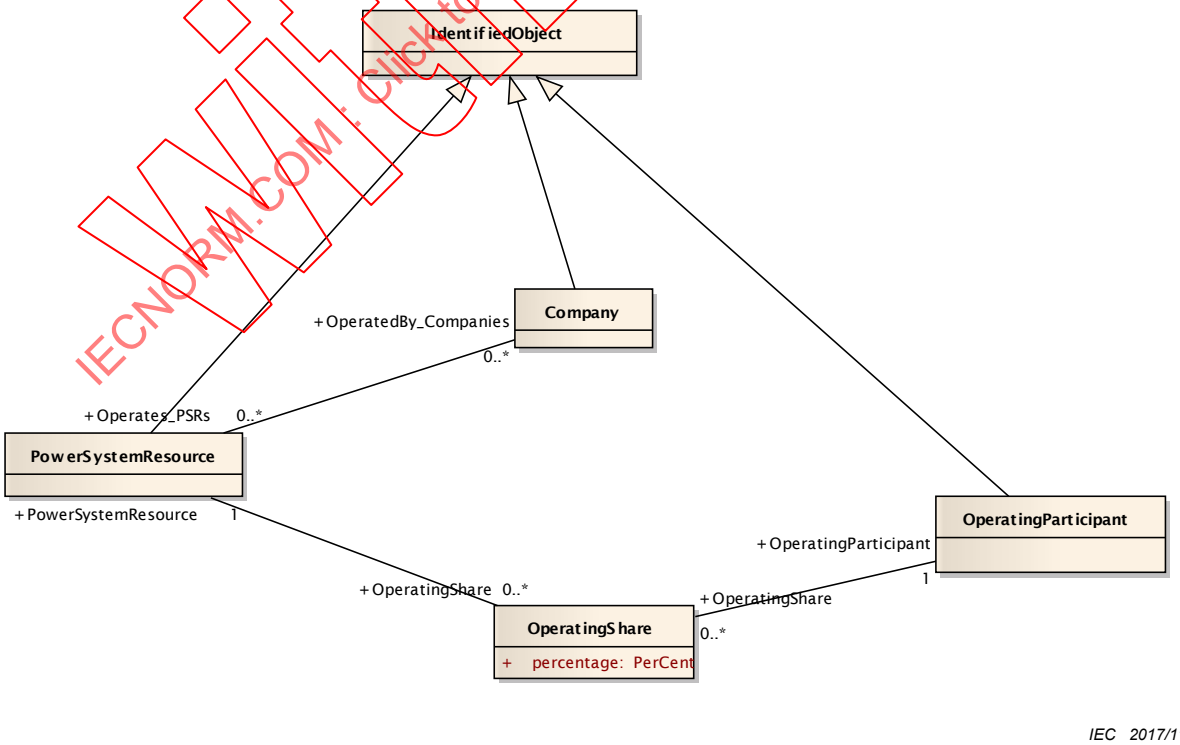

Figure 29 – Ownership

Figure 29 is not documented.

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6.3.2 BasePower

The BasePower class defines the base power used in the per unit calculations.

Attributes

name	type	note
basePower	ApparentPower	Definition of base power
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.3 BaseVoltage

Collection of BaseVoltages which is used to verify that the BusbarSection.BaseVoltage and other voltage attributes in the CIM are given a value existing in the collection.

Attributes

name	type	note
isDC	Boolean	If true, this is a direct current base voltage and items assigned to this base voltage are also associated with a direct current capabilities. False indicates alternating current.
nominalVoltage	Voltage	The PowerSystemResource's base voltage
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] ConductingEquipment (ConductingEquipment)	Use association to ConductingEquipment only when there is no VoltageLevel container used.
1	[0..*] VoltageLevel (VoltageLevel)	The VoltageLevels having this BaseVoltage.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.4 BasicIntervalSchedule

Schedule of values at points in time.

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Attributes

name	type	note
startTime	AbsoluteDateTime	The time for the first time point
value1Unit	UnitSymbol	Value1 units of measure
value1Multiplier	UnitMultiplier	Multiplier for value1
value2Unit	UnitSymbol	Value2 units of measure
value2Multiplier	UnitMultiplier	Multiplier for value2
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.5 Bay

A collection of power system resources (within a given substation) including conducting equipment, protection relays, measurements, and telemetry.

Attributes

name	type	note
bayEnergyMeasFlag	Boolean	Indicates the presence/absence of energy measurements.
bayPowerMeasFlag	Boolean	Indicates the presence/absence of active/reactive power measurements.
breakerConfiguration	BreakerConfiguration	Breaker configuration
busBarConfiguration	BusbarConfiguration	Bus bar configuration
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] MemberOf_Substation (Substation)	The association is used in the naming hierarchy.
0..*	[0..1] MemberOf_VoltageLevel (VoltageLevel)	The association is used in the naming hierarchy.
0..1	[0..*] Contains_Equipments (Equipment)	inherited from: EquipmentContainer
1	[0..*] ConnectivityNodes (ConnectivityNode)	inherited from:

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Mult from	[Mult] name (type)	note
		ConnectivityNodeContainer
0..1	[0..*] TopologicalNode (TopologicalNode)	inherited from: ConnectivityNodeContainer
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.6 BreakerConfiguration Enumeration

Switching arrangement for Bay.

Enums

name	note
singleBreaker	
breakerAndAHalf	
doubleBreaker	
noBreaker	

6.3.7 BusbarConfiguration Enumeration

Busbar layout for Bay.

Enums

name	note
singleBus	
doubleBus	
mainWithTransfer	
ringBus	

6.3.8 Company

A company is a legal entity that owns and operates power system resources and is a party to interchange and transmission contracts.

Attributes

name	type	note
companyType	CompanyType	The type of company
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] Operates_PSRs (PowerSystemResource)	PowerSystemResources the company operates
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.9 CompanyType enumeration

Type of company.

Enums

name	note
pool	
municipal	
isPrivate	

6.3.10 ConductingEquipment

The parts of the power system that are designed to carry current or that are conductively connected therewith. ConductingEquipment is contained within an EquipmentContainer that may be a Substation, or a VoltageLevel or a Bay within a Substation.

Attributes

name	type	note
phases	PhaseCode	Describes the phases carried by a conducting equipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] BaseVoltage (BaseVoltage)	Use association to ConductingEquipment only when there is no VoltageLevel container used.
1	[0..*] ClearanceTags (ClearanceTag)	Conducting equipment may have multiple clearance tags for authorized field work.
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	Protection equipment may be used to protect specific Conducting Equipment. Multiple equipment may be protected or monitored by multiple protection equipment.
1	[0..*] Terminals (Terminal)	ConductingEquipment has 1 or 2 terminals that may be connected to other ConductingEquipment terminals via ConnectivityNodes.
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment

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Mult from	[Mult] name (type)	note
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.11 ConnectivityNodeContainer

A base class for all objects that may contain ConnectivityNodes or TopologicalNodes.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[0..*] ConnectivityNodes (ConnectivityNode)	Connectivity nodes contained by this container
0..1	[0..*] TopologicalNode (TopologicalNode)	The topological nodes which belong to this connectivity node container
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.12 Curve

Relationship between an independent variable (X-axis) and one or two dependent variables (Y1-axis and Y2-axis). Curves can also serve as schedules.

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Attributes

name	type	note
curveStyle	CurveStyle	The style or shape of the curve
xUnit	UnitSymbol	The X-axis units of measure
xMultiplier	UnitMultiplier	Multiplier for X-axis
y1Unit	UnitSymbol	The Y1-axis units of measure
y1Multiplier	UnitMultiplier	Multiplier for Y1-axis
y2Unit	UnitSymbol	The Y2-axis units of measure
y2Multiplier	UnitMultiplier	Multiplier for Y2-axis
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[0..*] CurveScheduleDatas (CurveData)	The point data values that define a curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.13 CurveData

Data point values for defining a curve or schedule.

Attributes

name	type	note
xvalue	Float	The data value of the X-axis variable, depending on the X-axis units
y1value	Float	The data value of the first Y-axis variable, depending on the Y-axis units
y2value	Float	The data value of the second Y-axis variable (if present), depending on the Y-axis units

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] CurveSchedule (Curve)	The Curve defined by this CurveData

6.3.14 CurveStyle enumeration

Style or shape of curve.

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Enums

name	note
constantYValue	
straightLineYValues	
rampYValue	
formula	

6.3.15 Equipment

The parts of a power system that are physical devices, electronic or mechanical

Attributes

name	type	note
normallyInService	Boolean	The equipment is normally in service
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[0..*] ContingencyEquipment (ContingencyEquipment)	The contingency element associated with the equipment.
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	The association is used in the naming hierarchy.
1	[0..*] OperationalLimitSet (OperationalLimitSet)	The equipment limit sets associated with the equipment.
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.16 EquipmentContainer

A modeling construct to provide a root class for all Equipment classes.

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Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] Contains_Equipments (Equipment)	The association is used in the naming hierarchy.
1	[0..*] ConnectivityNodes (ConnectivityNode)	inherited from: ConnectivityNodeContainer
0..1	[0..*] TopologicalNode (TopologicalNode)	inherited from: ConnectivityNodeContainer
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.17 GeographicalRegion

A geographical region of a power system network model.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] Regions (SubGeographicalRegion)	The association is used in the naming hierarchy.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.3.18 IdentifiedObject

This is a root class to provide common naming attributes for all classes needing naming attributes.

Attributes

name	type	note
mRID	String	A Model Authority issues mRIDs. Given that each Model Authority has a unique id and this id is part of the mRID, then the mRID is globally unique.
name	String	The name is a free text human readable name of the object. It may be non unique and may not correlate to a naming hierarchy.
localName	String	The localName is a human readable name of the object. It is only used with objects organized in a naming hierarchy. The simplest naming hierarchy has just one parent (the root) giving a flat naming hierarchy. However, the naming hierarchy usually has several levels, e.g. Substation, VoltageLevel, Equipment etc. Children of the same parent have names that are unique among them. If the uniqueness requirement cannot be met IdentifiedObject.localName shall not be used, use IdentifiedObject.name instead.
pathName	String	The pathname is a system unique name composed from all IdentifiedObject.localNames in a naming hierarchy path from the object to the root.
aliasName	String	The aliasName is free text human readable name of the object alternative to IdentifiedObject.name. It may be non unique and may not correlate to a naming hierarchy.
description	String	The description is a free human readable text describing or naming the object. It may be non unique and may not correlate to a naming hierarchy.

Association ends

Mult from	[Mult] name (type)	note
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	An IdentifiedObject belongs to a Modeling Authority Set for purposes of defining a group of data maintained by the same Modeling Authority.

6.3.19 IrregularIntervalSchedule

The schedule has TimePoints where the time between them varies.

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Attributes

name	type	note
startTime	AbsoluteDateTime	inherited from: BasicIntervalSchedule
value1Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value1Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
value2Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value2Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[1..*] TimePoints (IrregularTimePoint)	The point data values that define a curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.20 IrregularTimePoint

TimePoints for a schedule where the time between the points varies.

Attributes

name	type	note
time	Seconds	The time is relative the BasicTimeSchedule.startTime.
value1	Float	The first value at the time. The meaning of the value is defined by the class inhering the IrregularIntervalSchedule.
value2	Float	The second value at the time. The meaning of the value is defined by the class inhering the IrregularIntervalSchedule.

Association ends

Mult from	[Mult] name (type)	note
1..*	[1] IntervalSchedule (IrregularIntervalSchedule)	An IrregularTimePoint belongs to an IrregularIntervalSchedule.

6.3.21 ModelingAuthority

A modeling authority is an entity responsible for supplying and maintaining the data defining a specific set of objects in a network model.

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Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[1..*] ModelingAuthoritySets (ModelingAuthoritySet)	A modeling authority supplies and maintains the data for the objects in a Modeling Authority Set.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.22 ModelingAuthoritySet

A modeling authority set is a group of objects in a network model where the data is supplied and maintained by the same modeling authority.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1..*] IdentifiedObjects (IdentifiedObject)	An IdentifiedObject belongs to a modeling authority set for purposes of defining a group of data maintained by the same modeling authority.
1..*	[1] ModelingAuthority (ModelingAuthority)	A modeling authority supplies and maintains the data for the objects in a Modeling Authority Set.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.23 OperatingParticipant

An operator of multiple PowerSystemResource objects. Note multiple OperatingParticipants may operate the same PowerSystemResource object. This can be used for modeling jointly owned units where each owner operates as a contractual share.

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Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[0..*] OperatingShare (OperatingShare)	The operating shares of an operating participant. An operating participant can be reused for any number of PSR's.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.24 OperatingShare

Specifies the contract relationship between a PowerSystemResource and a contract participant.

Attributes

name	type	note
percentage	PerCent	Percentage ownership for this device. The percentage indicates the percentage ownership of the PSROwner for the PowerSystemResource. The total percentage ownership for a PowerSystemResource should add to 100 %.

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] OperatingParticipant (OperatingParticipant)	The linkage to an owner and its linkage attributes like percentage ownership. The ownership percentage should add to 100 % for all owners of a PowerSystemResource, but a PSROwner may own any percentage of any number of PowerSystemResource objects.
0..*	[1] PowerSystemResource (PowerSystemResource)	The PowerSystemResource to which the attributes apply. The percentage ownership of all owners of a PowerSystemResource should add to 100 %.

6.3.25 PhaseCode enumeration

Enumeration of phase identifiers.

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Enums

name	note
ABCN	
ABC	
ABN	
ACN	
BCN	
AB	
AC	
BC	
AN	
BN	
CN	
A	
B	
C	
N	

6.3.26 PowerSystemResource

A power system resource can be an item of equipment such as a Switch, an EquipmentContainer containing many individual items of equipment such as a Substation, or an organizational entity such as Company or SubControlArea. This provides for the nesting of collections of PowerSystemResources within other PowerSystemResources. For example, a Switch could be a member of a Substation and a Substation could be a member of a division of a Company.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] OperatedBy_Companies (Company)	A power system resource may be part of one or more companies.
1	[0..*] Contains_Measurements (Measurement)	The Measurements that are included in the naming hierarchy where the PSR is the containing object.
1	[0..*] OperatingShare (OperatingShare)	The linkage to any number of operating share objects.
1	[0..1] OutageSchedule (OutageSchedule)	A power system resource may have an outage schedule.
0..*	[0..*] PsrLists (PsrList)	
0..*	[0..1] PSRType (PSRType)	PSRType (custom classification) for this PowerSystemResource.
0..*	[0..*] ReportingGroup (ReportingGroup)	Reporting groups to which this PSR belongs.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.27 PsrList

Arbitrary list of PowerSystemResources. Can be used for various purposes, including grouping for report generation.

Attributes

name	type	note
typePSRList	String	Type of power system resources in this list
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] PowerSystemResources (PowerSystemResource)	
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.28 PSRType

Classifying instances of the same class, e.g. overhead and underground ACLineSegments. This classification mechanism is intended to provide flexibility outside the scope of this standard, i.e. provide customization that is non standard.

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Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] PowerSystemResource (PowerSystemResource)	Power system resources classified with this PSRType
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.29 RegularIntervalSchedule

The schedule has TimePoints where the time between them is constant.

Attributes

name	type	note
timeStep	Seconds	The time between each pair of subsequent RegularTimePoints
endTime	AbsoluteDateTime	The time for the last time point
startTime	AbsoluteDateTime	inherited from: BasicIntervalSchedule
value1Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value1Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
value2Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value2Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[1..*] TimePoints (RegularTimePoint)	The point data values that define a curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.30 RegularTimePoint

TimePoints for a schedule where the time between the points is constant.

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Attributes

name	type	note
sequenceNumber	Integer	The position of the RegularTimePoint in the sequence. Note that time points don't have to be sequential, i.e. time points may be omitted. The actual time for a RegularTimePoint is computed by multiplying the RegularIntervalSchedule.timeStep with the RegularTimePoint.sequenceNumber and add the BasicIntervalSchedule.startTime.
value1	Float	The first value at the time. The meaning of the value is defined by the class inhering the RegularIntervalSchedule.
value2	Float	The second value at the time. The meaning of the value is defined by the class inhering the RegularIntervalSchedule.

Association ends

Mult from	[Mult] name (type)	note
1..*	[1] IntervalSchedule (RegularIntervalSchedule)	A RegularTimePoint belongs to a RegularIntervalSchedule.

6.3.31 ReportingGroup

A reporting group is used for various ad-hoc groupings used for reporting.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] BusNameMarker (BusNameMarker)	The BusNameMarkers that belong to this reporting group
0..*	[0..*] PowerSystemResource (PowerSystemResource)	PSR's which belong to this reporting group
0..*	[0..1] ReportingSuperGroup (ReportingSuperGroup)	Reporting super group to which this reporting group belongs
0..1	[0..*] TopologicalNode (TopologicalNode)	The topological nodes that belong to the reporting group
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.32 ReportingSuperGroup

A reporting super group groups reporting groups for a higher level report.

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Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] ReportingGroup (ReportingGroup)	Reporting groups that are grouped under this group group.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.33 SubGeographicalRegion

A subset of a geographical region of a power system network model.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] Region (GeographicalRegion)	The association is used in the naming hierarchy.
0..1	[0..*] Lines (Line)	A Line can be contained by a SubGeographical Region.
0..1	[0..*] Substations (Substation)	The association is used in the naming hierarchy.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.34 Substation

A collection of equipment for purposes other than generation or utilization, through which electric energy in bulk is passed for the purposes of switching or modifying its characteristics.

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Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] Contains_Bays (Bay)	The association is used in the naming hierarchy.
0..*	[0..1] Region (SubGeographicalRegion)	The association is used in the naming hierarchy.
1	[0..*] Contains_VoltageLevels (VoltageLevel)	The association is used in the naming hierarchy.
0..1	[0..*] Contains_Equipments (Equipment)	inherited from: EquipmentContainer
1	[0..*] ConnectivityNodes (ConnectivityNode)	inherited from: ConnectivityNodeContainer
0..1	[0..*] TopologicalNode (TopologicalNode)	inherited from: ConnectivityNodeContainer
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.35 Terminal

An electrical connection point to a piece of conducting equipment. Terminals are connected at physical connection points called "connectivity nodes".

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
1	[0..*] BranchGroupTerminal (BranchGroupTerminal)	The directed branch group terminals for which the terminal is monitored.
0..*	[1] ConductingEquipment (ConductingEquipment)	ConductingEquipment has 1 or 2 terminals that may be connected to other ConductingEquipment terminals via ConnectivityNodes.
0..*	[0..1] ConnectivityNode (ConnectivityNode)	Terminals interconnect with zero impedance at a node. Measurements on a node apply to all of its terminals.
0..1	[0..*] Measurements (Measurement)	
1	[0..*] HasFirst_MutualCoupling (MutualCoupling)	Mutual couplings associated with the branch as the first branch.
1	[0..*] HasSecond_MutualCoupling (MutualCoupling)	Mutual couplings with the branch associated as the first branch.
0..1	[0..*] OperationalLimitSet (OperationalLimitSet)	The operational limits sets that apply specifically to this terminal. Other operational limits sets may apply to this terminal through the association to Equipment.
0..1	[0..*] RegulatingControl (RegulatingControl)	The terminal is regulated by a control.
1	[0..2] TieFlow (TieFlow)	The control area tie flows to which this terminal associates.
0..*	[0..1] TopologicalNode (TopologicalNode)	The topological node associated with the terminal. This can be used as an alternative to the connectivity node path to topological node, thus making it unnecessary to model connectivity nodes in some cases. Note that the if connectivity nodes are in the model, this association would probably not be used.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.36 Unit

Quantity being measured. The Unit.name shall be unique among all specified quantities and describe the quantity. The Unit.aliasName is meant to be used for localization.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
1	[0..*] Controls (Control)	The Controls having the Unit.
1	[0..*] Measurements (Measurement)	The Measurements having the Unit
1	[0..*] ProtectionEquipments (ProtectionEquipment)	
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.3.37 VoltageLevel

A collection of equipment at one common system voltage forming a switchgear. The equipment typically consist of breakers, busbars, instrumentation, control, regulation and protection devices as well as assemblies of all these.

Attributes

name	type	note
highVoltageLimit	Voltage	The bus bar's high voltage limit
lowVoltageLimit	Voltage	The bus bar's low voltage limit
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] BaseVoltage (BaseVoltage)	The base voltage used for all equipment within the VoltageLevel.
0..1	[0..*] Contains_Bays (Bay)	The association is used in the naming hierarchy.
0..*	[1] MemberOf_Substation (Substation)	The association is used in the naming hierarchy.
0..1	[0..*] Contains_Equipments (Equipment)	inherited from: EquipmentContainer
1	[0..*] ConnectivityNodes (ConnectivityNode)	inherited from: ConnectivityNodeContainer
0..1	[0..*] TopologicalNode (TopologicalNode)	inherited from: ConnectivityNodeContainer
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.4 OperationalLimits

6.4.1 OperationalLimits package summary

The OperationalLimits package models a specification of limits associated with equipment and other operational entities.

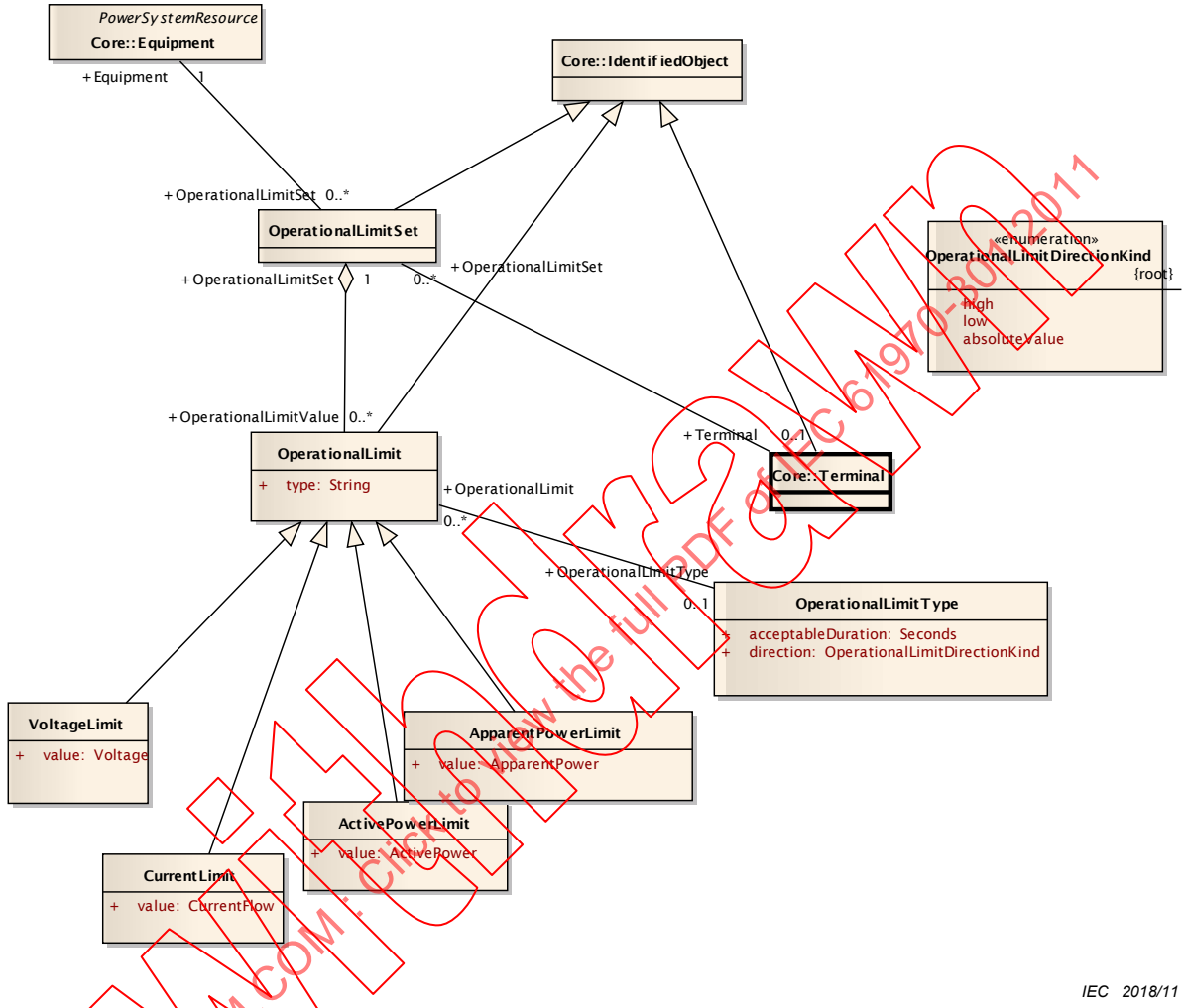

Figure 30 – OperationalLimits

Figure 30 is documented as follows. Operational limits as they tie back into the core model.

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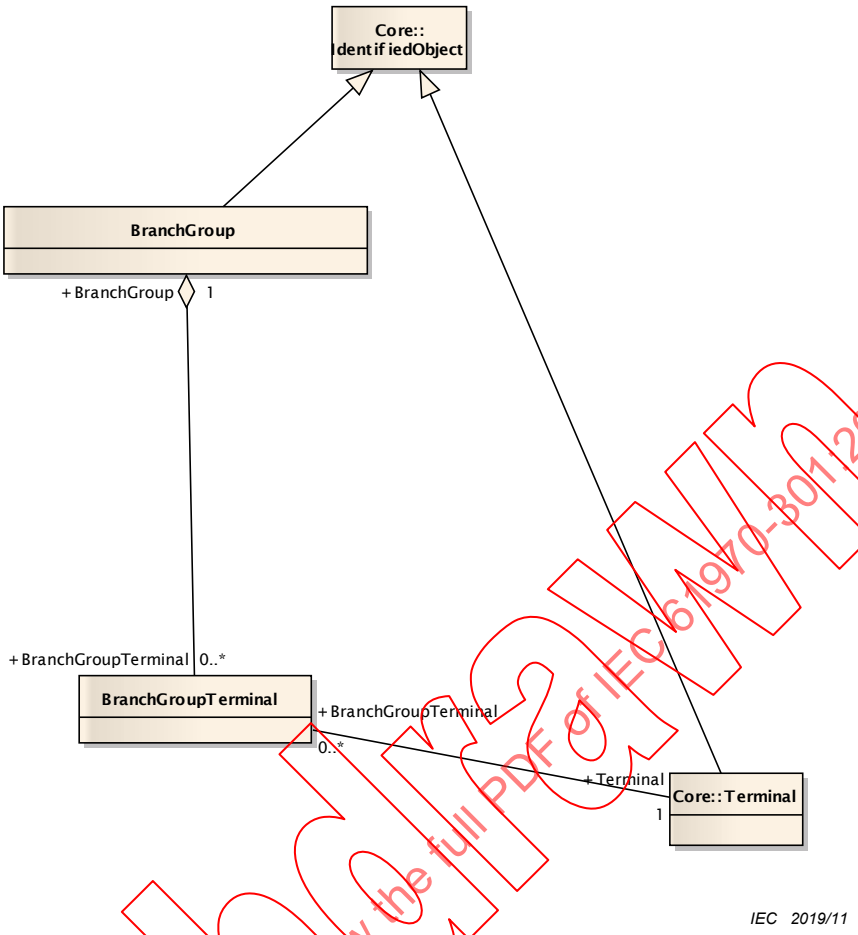

Figure 31 – BranchGroup

Figure 31 is not documented.

6.4.2 ActivePowerLimit

Limit on active power flow.

Attributes

name	type	note
value	ActivePower	Value of active power limit
type	String	inherited from: OperationalLimit
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] OperationalLimitSet (OperationalLimitSet)	inherited from: OperationalLimit

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Mult from	[Mult] name (type)	note
0..*	[0..1] OperationalLimitType (OperationalLimitType)	inherited from: OperationalLimit
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.4.3 ApparentPowerLimit

Apparent power limit.

Attributes

name	type	note
value	ApparentPower	The apparent power limit
type	String	inherited from: OperationalLimit
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] OperationalLimitSet (OperationalLimitSet)	inherited from: OperationalLimit
0..*	[0..1] OperationalLimitType (OperationalLimitType)	inherited from: OperationalLimit
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.4.4 BranchGroup

A group of branch terminals whose directed flow summation is to be monitored. A branch group need not form a cutset of the network.

Attributes

name	type	note
maximumActivePower	ActivePower	The maximum active power flow
maximumReactivePower	ReactivePower	The maximum reactive power flow
minimumActivePower	ActivePower	The minimum active power flow
minimumReactivePower	ReactivePower	The minimum reactive power flow
monitorActivePower	Boolean	Monitor the active power flow.
monitorReactivePower	Boolean	Monitor the reactive power flow
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
1	[0..*] BranchGroupTerminal (BranchGroupTerminal)	The directed branch group terminals to be summed
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.4.5 BranchGroupTerminal

A specific directed terminal flow for a branch group.

Attributes

name	type	note
positiveFlowIn	Boolean	The flow into the terminal is summed if set true. The flow out of the terminal is summed if set false.

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] BranchGroup (BranchGroup)	The branch group to which the directed branch group terminals belong
0..*	[1] Terminal (Terminal)	The terminal to be summed

6.4.6 CurrentLimit

Operational limit on current.

Attributes

name	type	note
value	CurrentFlow	Limit on current flow
type	String	inherited from: OperationalLimit
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] OperationalLimitSet (OperationalLimitSet)	inherited from: OperationalLimit
0..*	[0..1] OperationalLimitType (OperationalLimitType)	inherited from: OperationalLimit
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.4.7 OperationalLimit

A value associated with a specific kind of limit.

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Attributes

name	type	note
type	String	Used to specify high/low and limit levels
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] OperationalLimitSet (OperationalLimitSet)	The limit set to which the limit values belong
0..*	[0..1] OperationalLimitType (OperationalLimitType)	The limit type associated with this limit
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.4.8 OperationalLimitDirectionKind enumeration

The direction of an operational limit.

Enums

name	note
high	The limit is a high limit. If applied to a terminal flow, the positive direction is into the terminal.
low	The limit is a low limit. If applied to a terminal flow, the positive direction is into the terminal.
absoluteValue	If the absolute value of the monitored value is above the limit value, the limit is violated. In effect, the limit is both a high limit and its negative a low limit.

6.4.9 OperationalLimitSet

A set of limits associated with equipment. Sets of limits might apply to a specific temperature, or season for example. A set of limits may contain may different severiteis of limit levels that would apply to the same equipment. The set may contain limits of different types such as apparent power and current limits or high and low voltage limits that are logically applied together as a set.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..*	[1] Equipment (Equipment)	The equipment to which the limit set applies.
1	[0..*] OperationalLimitValue (OperationalLimit)	Values of equipment limits.
0..*	[0..1] Terminal (Terminal)	The terminal specifically associated to this operational limit set. If no terminal is associated, all terminals of the equipment are implied.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.4.10 OperationalLimitType

A type of limit. The meaning of a specific limit is described in this class.

Attributes

name	type	note
acceptableDuration	Seconds	The nominal acceptable duration of the limit. Limits are commonly expressed in terms of the a time limit for which the limit is normally acceptable. The actual acceptable duration of a specific limit may depend on other local factors such as temperature or wind speed.
direction	OperationalLimitDirectionKind	The direction of the limit.

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] OperationalLimit (OperationalLimit)	The operational limits associated with this type of limit

6.4.11 VoltageLimit

Operational limit applied to voltage.

Attributes

name	type	note
value	Voltage	Limit on voltage. High or low limit depends on the OperatoinalLimit.limitKind
type	String	inherited from: OperationalLimit
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..*	[1] OperationalLimitSet (OperationalLimitSet)	inherited from: OperationalLimit
0..*	[0..1] OperationalLimitType (OperationalLimitType)	inherited from: OperationalLimit
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.5 Topology

6.5.1 Topology package summary

An extension to the Core package that in association with the Terminal class models Connectivity, that is the physical definition of how equipment is connected together. In addition it models Topology, that is the logical definition of how equipment is connected via closed switches. The Topology definition is independent of the other electrical characteristics.

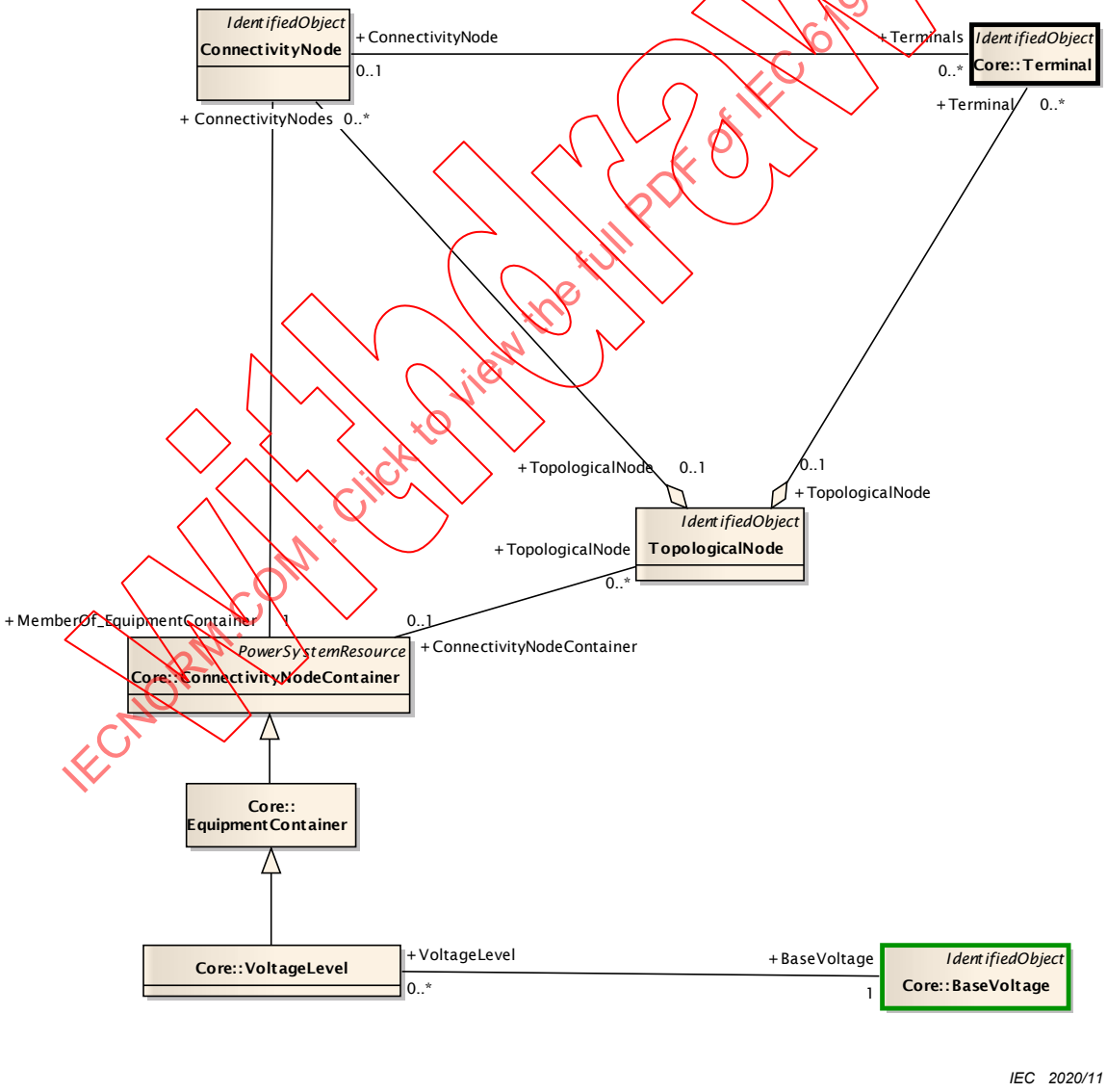

Figure 32 – TopologicalNodeTerminal

Figure 32 is not documented.

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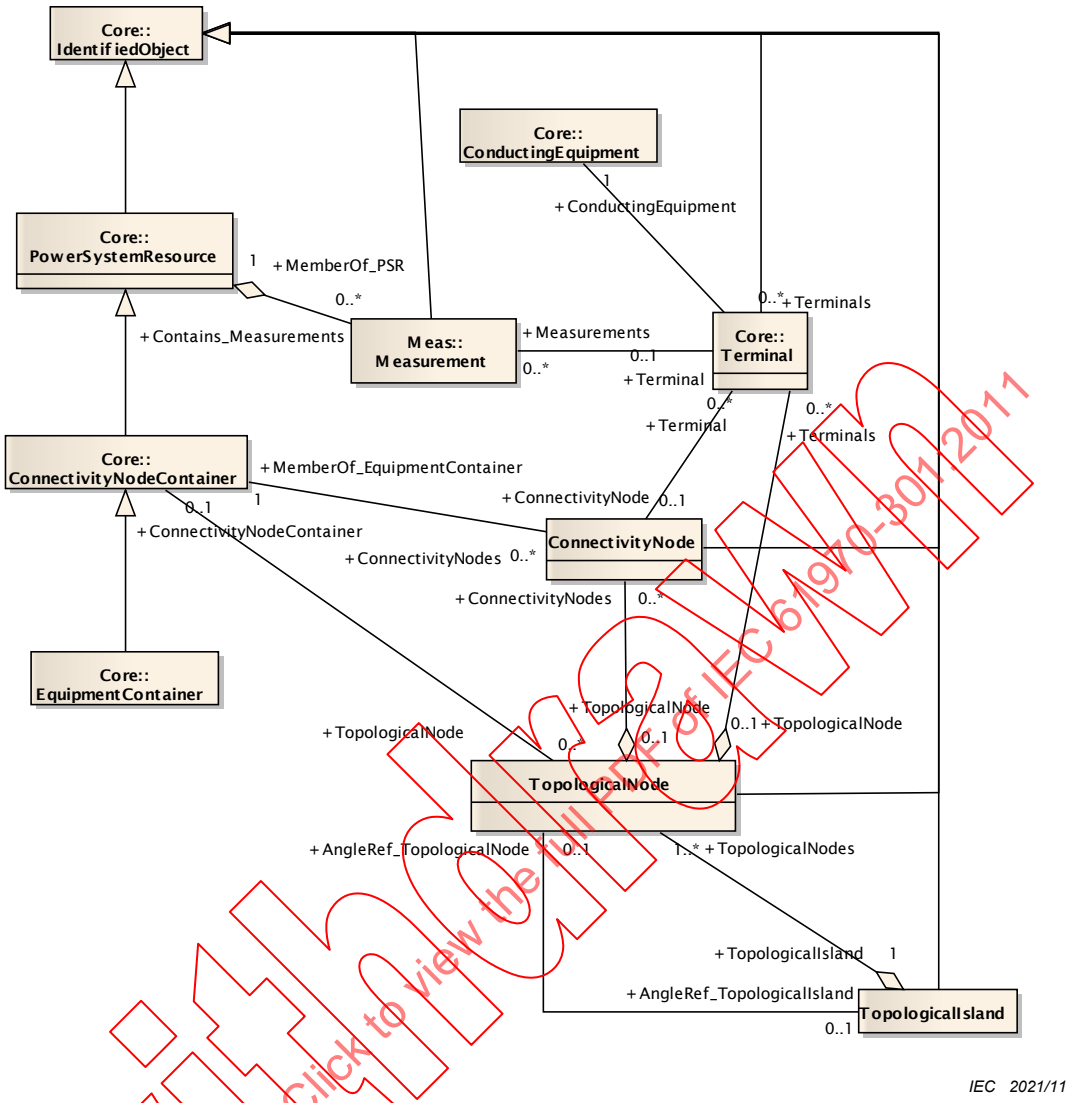

Figure 33 – TopologyMeasRelations

Figure 33 is not documented.

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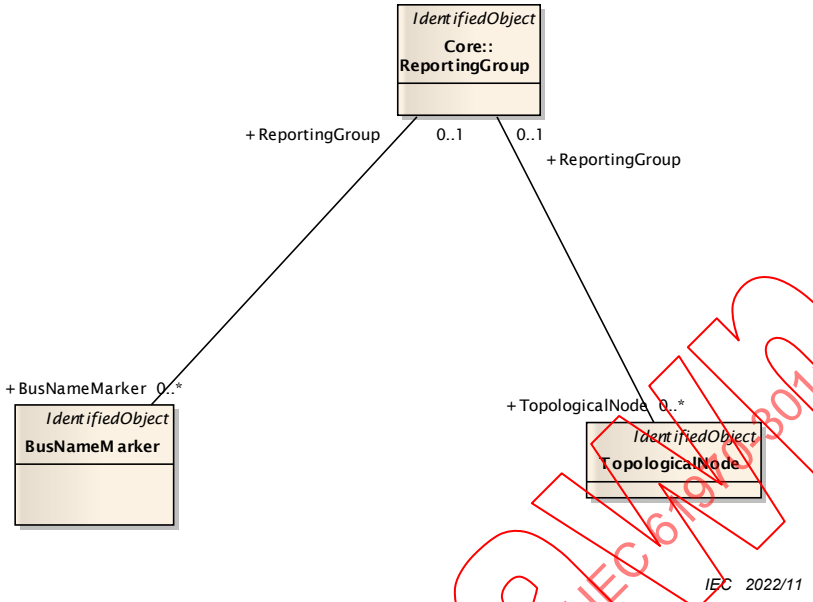

Figure 34 – TopologyReporting

Figure 34 is not documented.

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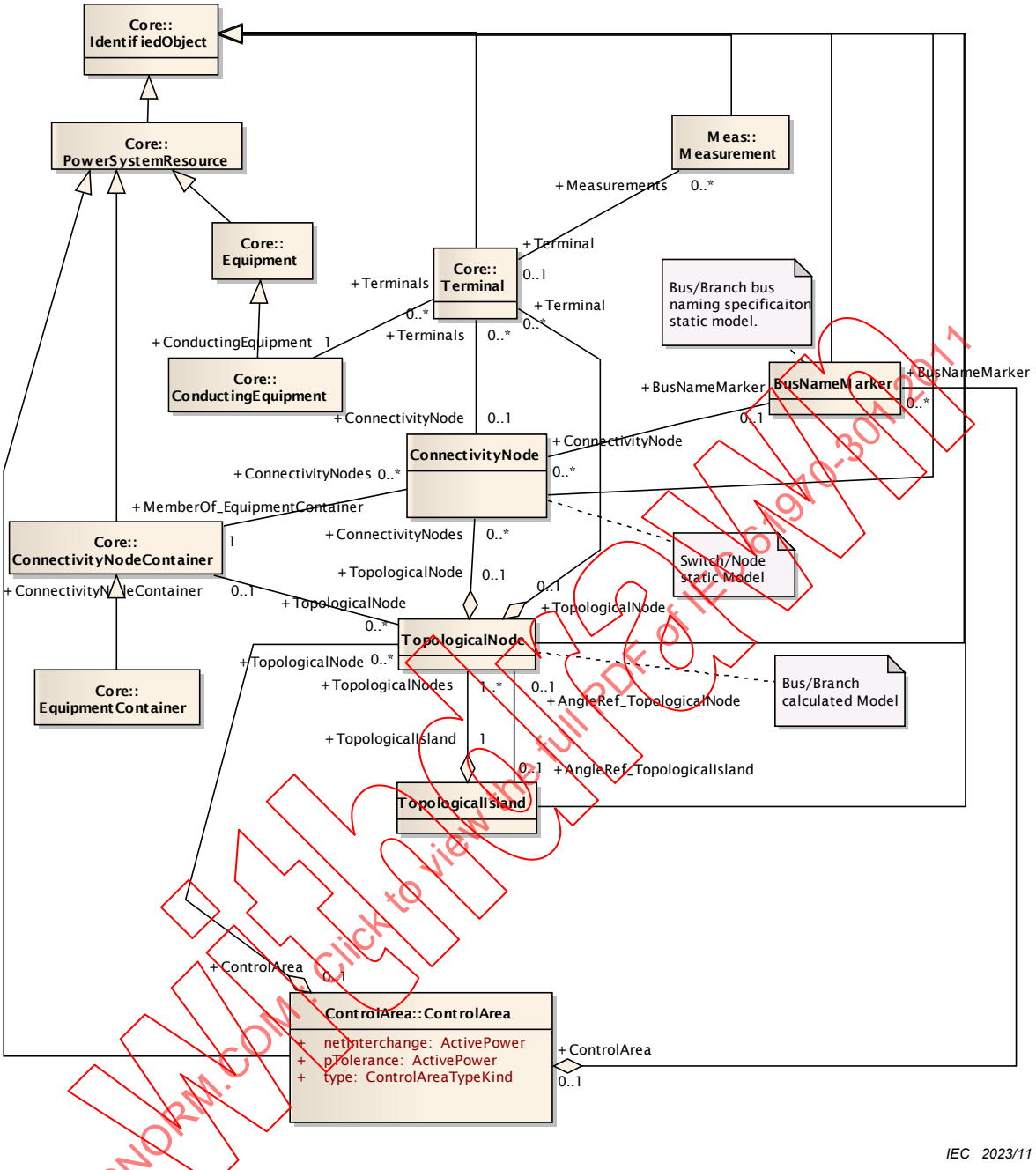

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Figure 35 – Main

Figure 35 is documented as follows. This diagram shows all classes included in the Topology package as well as the key external classes that have associations with Topology classes.

6.5.2 BusNameMarker

Used to apply user standard names to topology buses. Typically used for "bus/branch" case generation. Associated with one or more ConnectivityNodes that are normally a part of the bus name. The associated ConnectivityNodes are to be connected by non-retained switches. For a ring bus station configuration, all busbar connectivity nodes in the ring are typically associated. For a breaker and a half scheme, both busbars would be associated. For a ring bus, all busbars would be associated. For a "straight" busbar configuration, only the main connectivity node at the busbar would be associated.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] ConnectivityNode (ConnectivityNode)	The list of nodes which have the same bus name in the normal topology. Note that this list of ConnectivityNodes should be connected by objects derived from Switch that are normally closed.
0..*	[0..1] ControlArea (ControlArea)	The control area into which the BusNameMarker is included.
0..*	[0..1] ReportingGroup (ReportingGroup)	The reporting group to which this BusNameMarker belongs.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.5.3 ConnectivityNode

Connectivity nodes are points where terminals of conducting equipment are connected together with zero impedance.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] BusNameMarker (BusNameMarker)	The associated name of the bus (TopologicalNode) containing the ConnectivityNode is derived by an algorithm that uses the bus name marker.
0..*	[1] MemberOf_EquipmentContainer (ConnectivityNodeContainer)	Container of this connectivity node.
0..1	[0..*] Terminals (Terminal)	Terminals interconnect with zero impedance at a node. Measurements on a node apply to all of its terminals.
0..*	[0..1] TopologicalNode (TopologicalNode)	Several ConnectivityNode(s) may combine together to form a single TopologicalNode, depending on the current state of the network.

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Mult from	[Mult] name (type)	note
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.5.4 TopologicalIsland

An electrically connected subset of the network. Topological islands can change as the current network state changes (i.e., disconnect switches, breakers, etc. change state).

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..1] AngleRef_TopologicalNode (TopologicalNode)	The angle reference for the island. Normally there is one TopologicalNode that is selected as the angle reference for each island. Other reference schemes exist, so the association is optional.
1	[1..*] TopologicalNodes (TopologicalNode)	A topological node belongs to a topological island
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.5.5 TopologicalNode

A set of connectivity nodes that, in the current network state, are connected together through any type of closed switches, including jumpers. Topological nodes can change as the current network state changes (i.e., switches, breakers, etc. change state).

Attributes

name	type	note
energized	Boolean	True if node energized
loadCarrying	Boolean	True if node is load carrying
netInjectionP	ActivePower	Net injection active power
netInjectionQ	ReactivePower	Net injection reactive power
observabilityFlag	Boolean	The observability status of the node
phaseAngle	AngleRadians	Phase angle of node
voltage	Voltage	Voltage of node
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject

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name	type	note
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] ConnectivityNodes (ConnectivityNode)	Several ConnectivityNode(s) may combine together to form a single TopologicalNode, depending on the current state of the network.
0..*	[0..1] ConnectivityNodeContainer (ConnectivityNodeContainer)	The connectivity node container to which the topological node belongs.
0..*	[0..1] ControlArea (ControlArea)	The control area into which the node is included.
0..*	[0..1] ReportingGroup (ReportingGroup)	The reporting group to which the topological node belongs.
0..1	[0..*] Terminal (Terminal)	The terminals associated with the topological node. This can be used as an alternative to the connectivity node path to terminal, thus making it unnecessary to model connectivity nodes in some cases. Note that the if connectivity nodes are in the model, this association would probably not be used.
0..1	[0..1] AngleRef_TopologicalIsland (TopologicalIsland)	The island for which the node is an angle reference. Normally there is one angle reference node for each island.
1..*	[1] TopologicalIsland (TopologicalIsland)	A topological node belongs to a topological island.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6 Wires

6.6.1 Wires package summary

An extension to the Core and Topology package that models information on the electrical characteristics of transmission and distribution networks. This package is used by network applications such as State Estimation, Load Flow and Optimal Power Flow.

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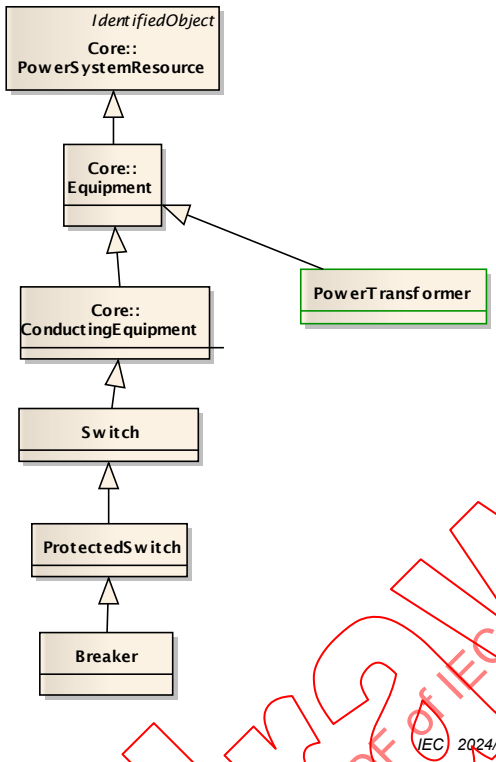

Figure 36 – DocumentationExampleInheritance

Figure 36 is documented as follows. This shows an example of inheritance in UML. This diagram is only to support figures in the documentation.

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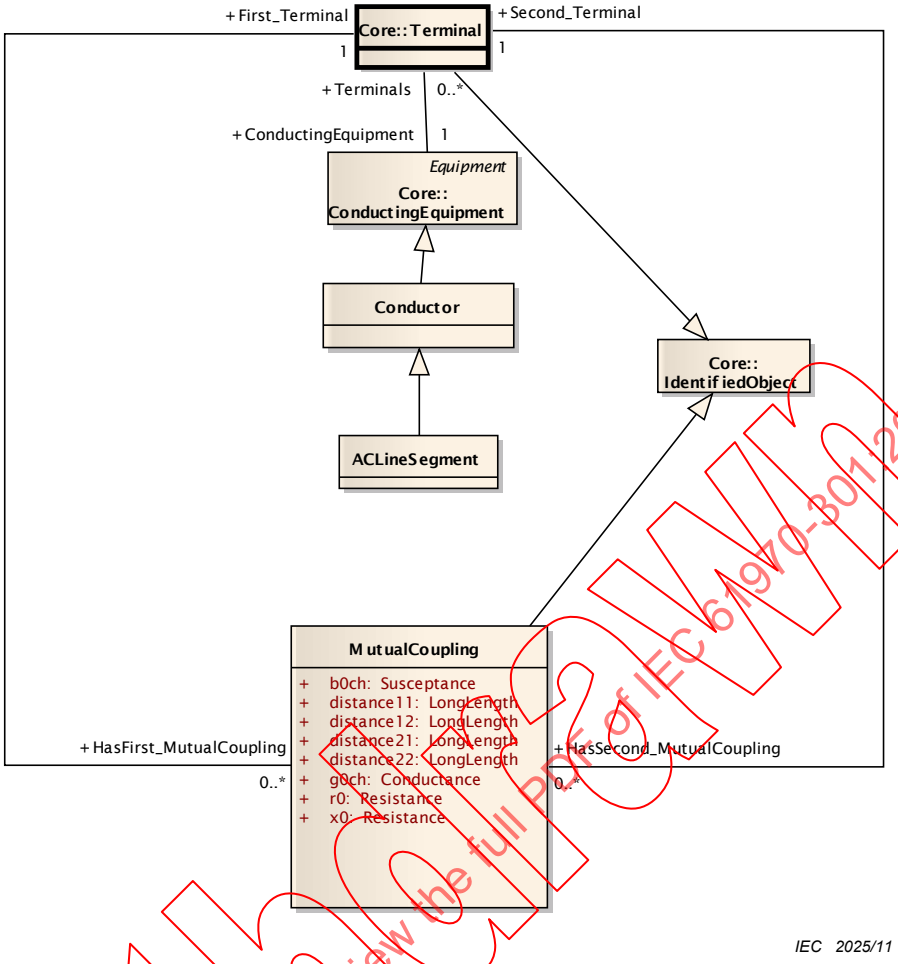

Figure 37 – MutualCoupling

Figure 37 is not documented.

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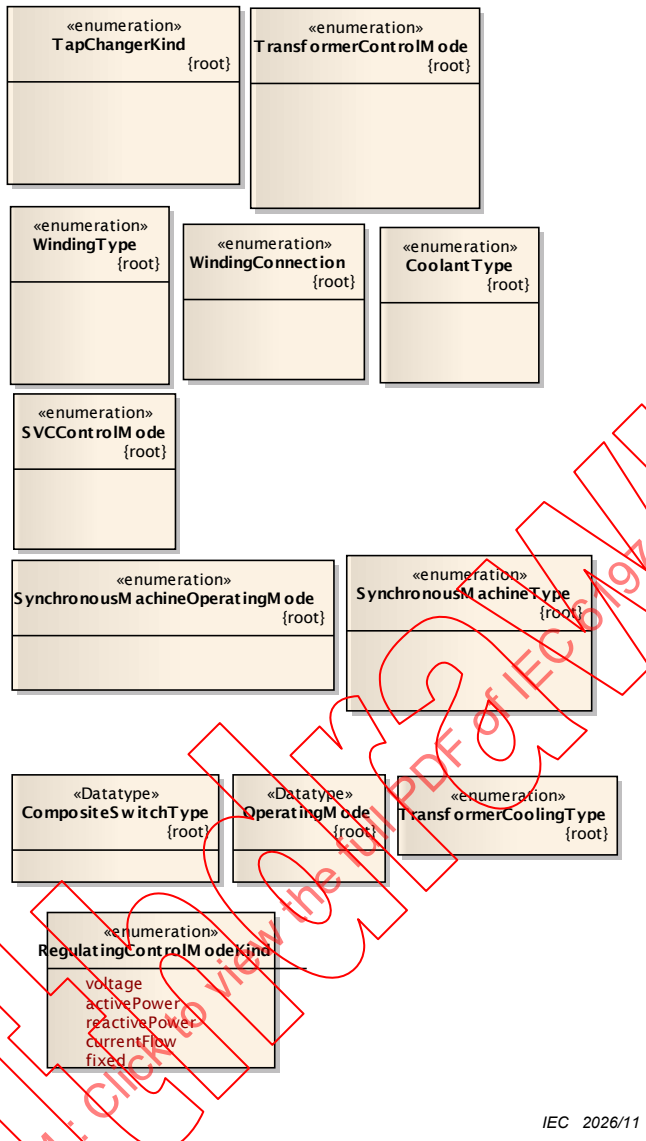

Figure 38 – Datatypes

Figure 38 is documented as follows. This diagram shows the data types specific to the Wires package.

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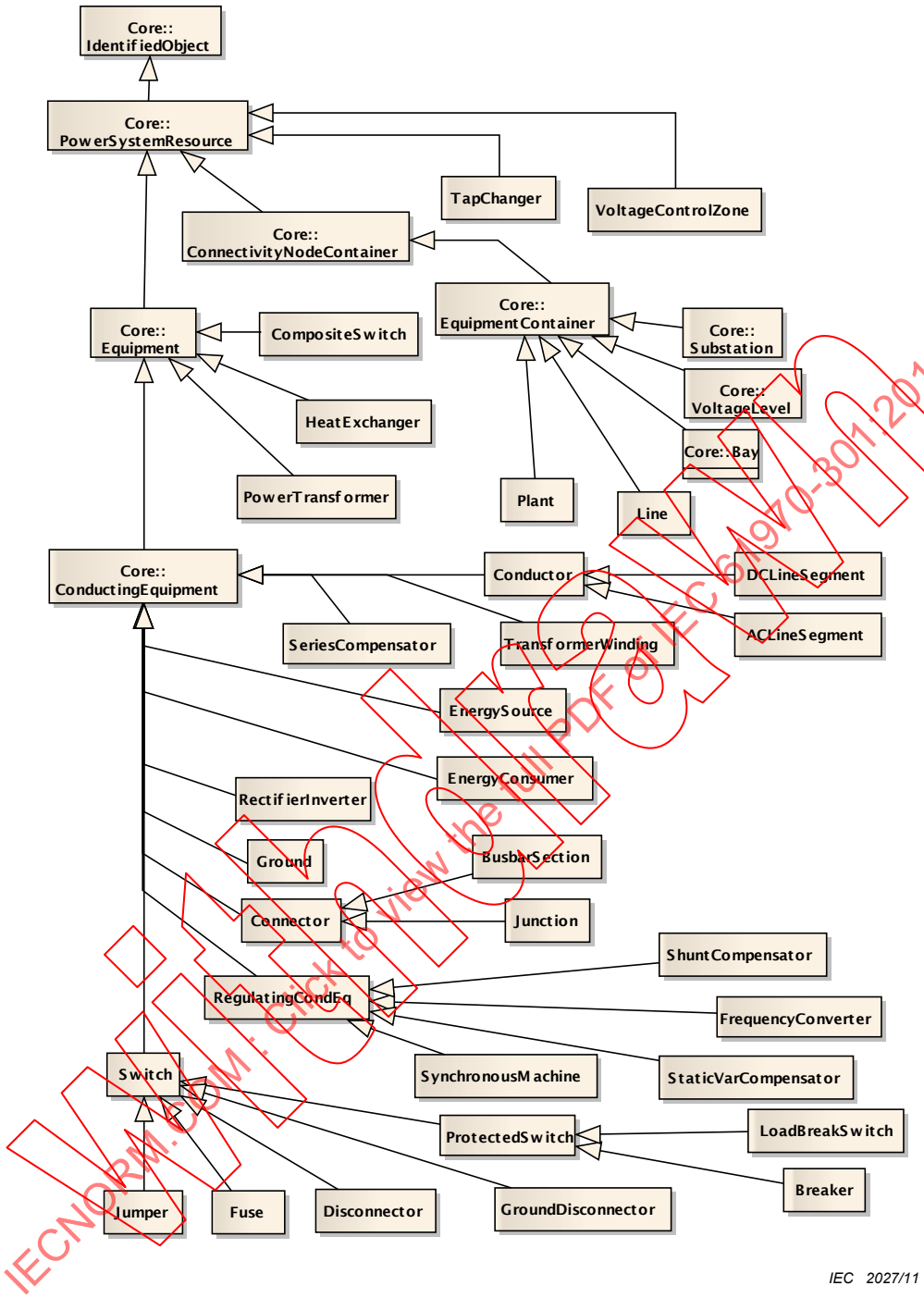

Figure 39 – InheritanceHierarchy

Figure 39 is documented as follows. This diagram describes inheritance between classes in and related to the Wires package.

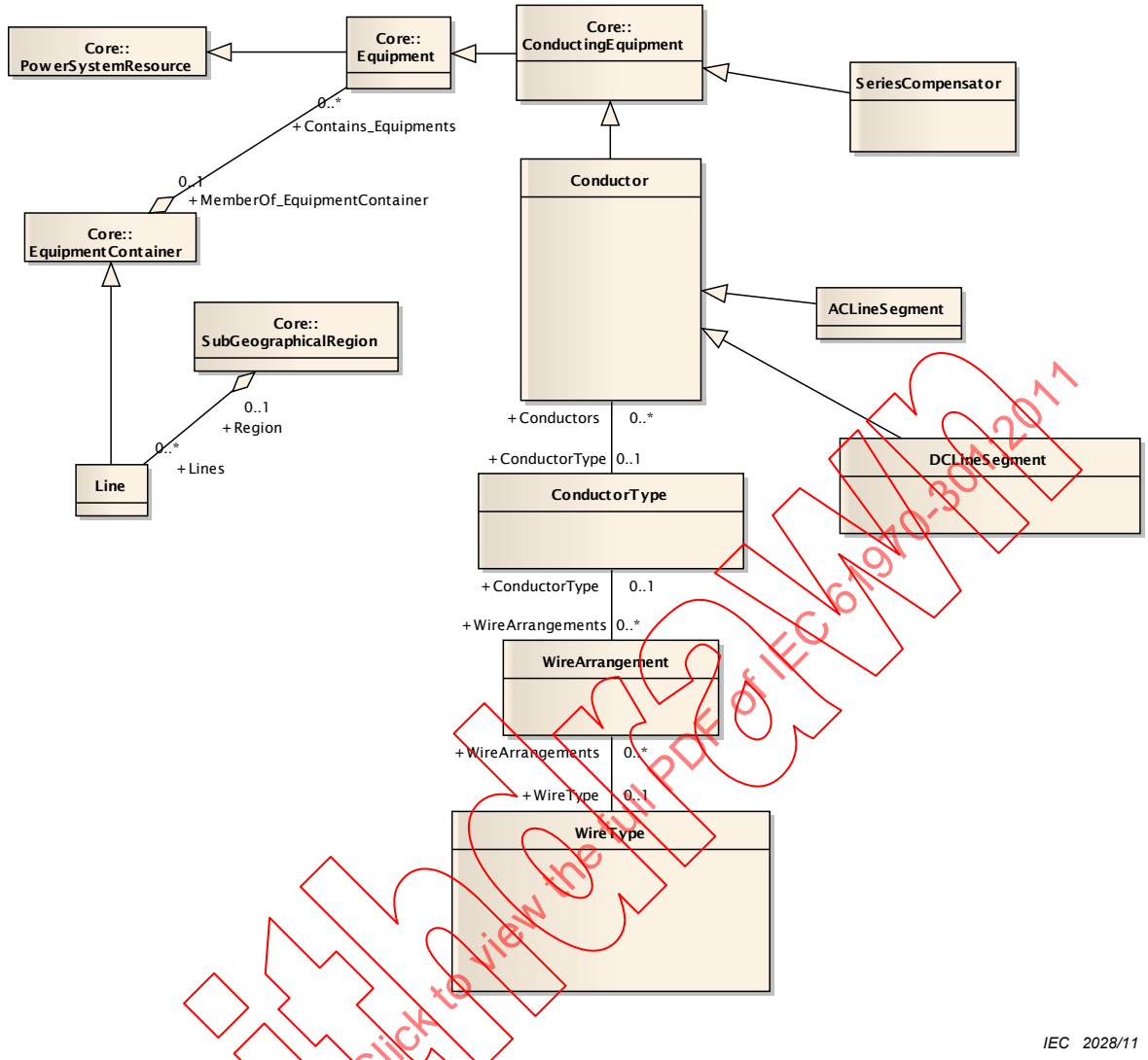

Figure 40 – LineModel

Figure 40 is documented as follows. This diagram shows all classes related to the transmission line model.

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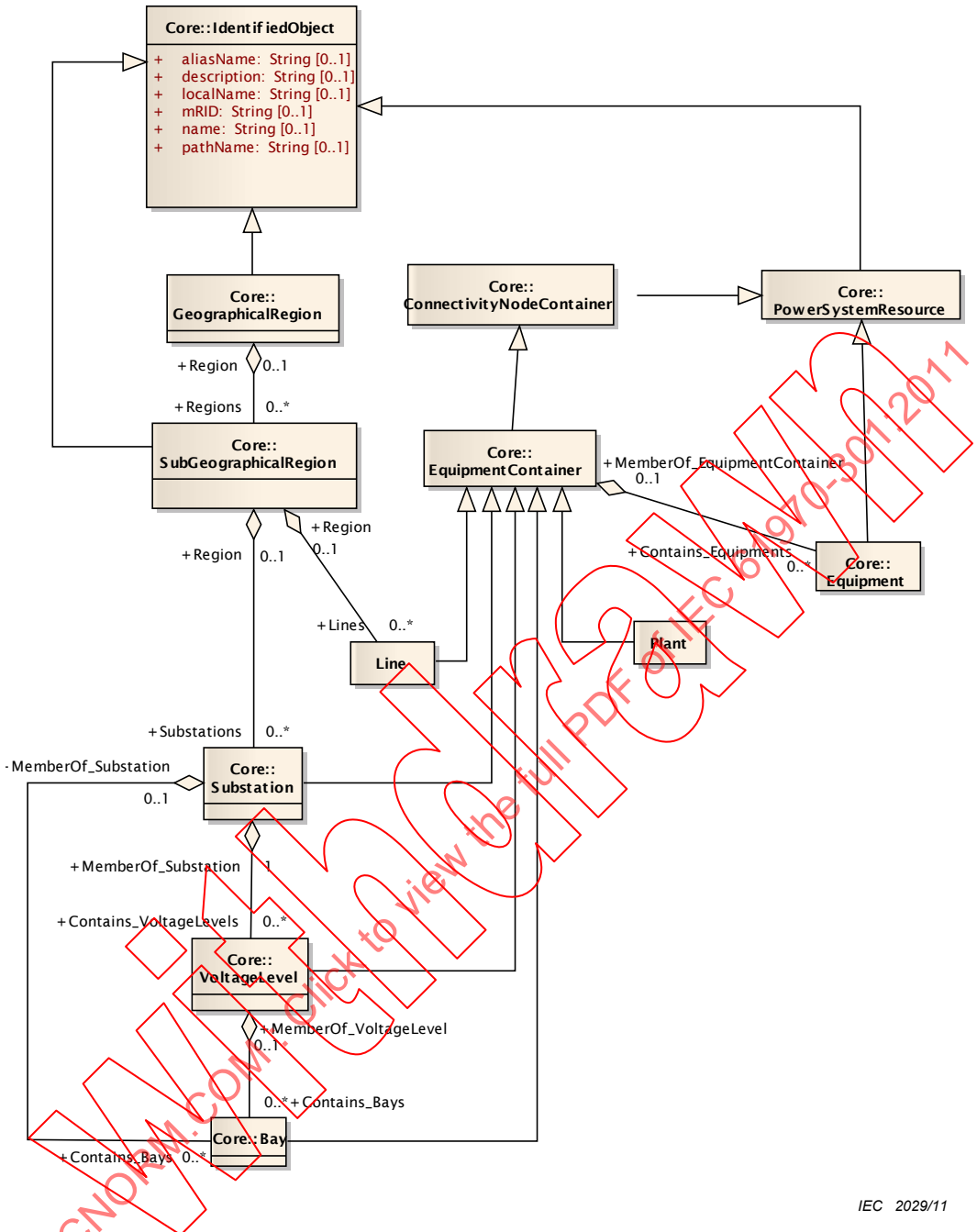

Figure 41 – NamingHierarchyPart1

Figure 41 is documented as follows. The diagram shows the upper part of the naming hierarchy. The hierarchy is a way to organize and name equipment. Hence it is tightly related to the IdentifiedObject and it's attributes. The Equipment class is further specialized into many subtypes that are all contained by subclasses of the EquipmentContainer.

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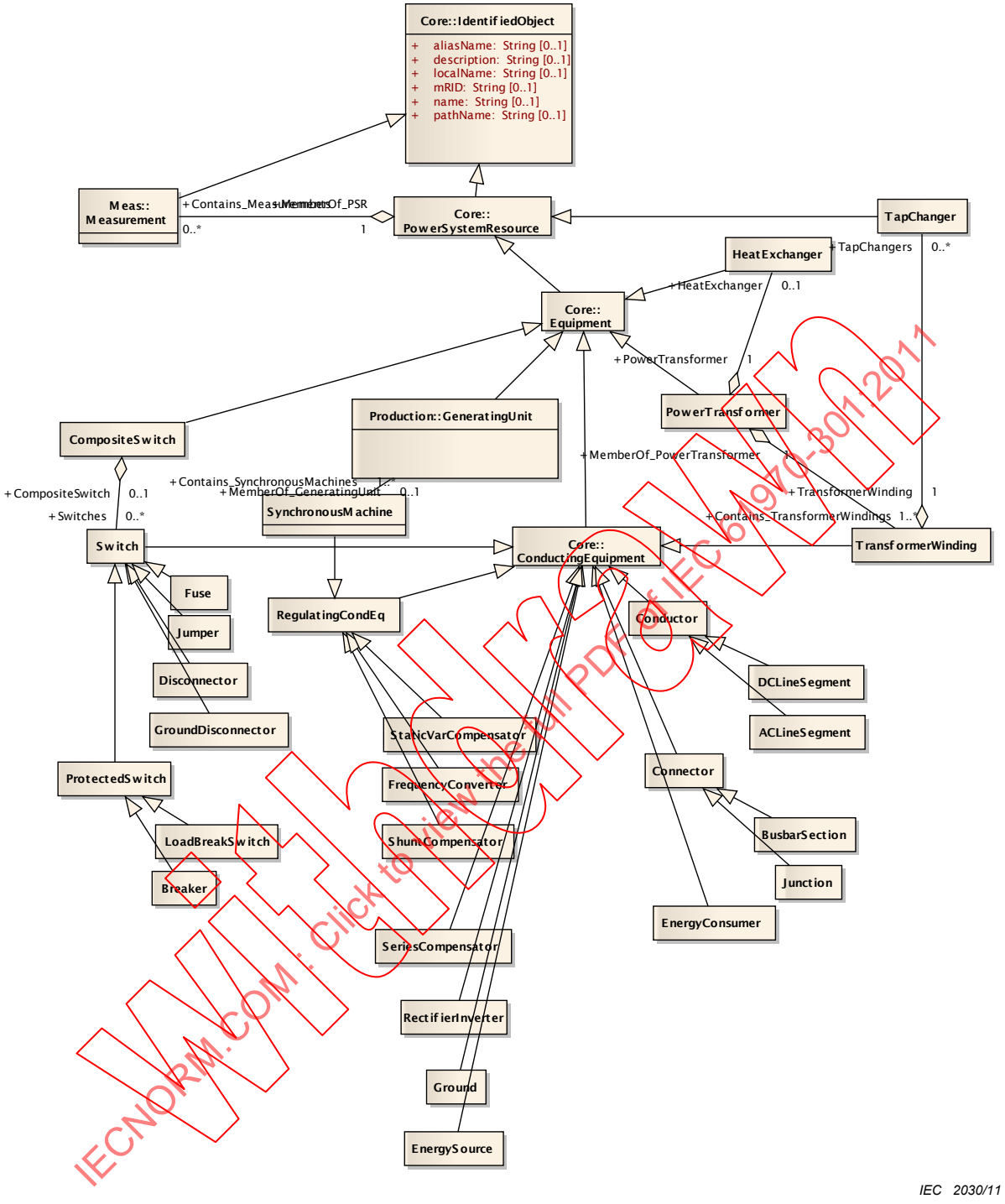

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Figure 42 – NamingHierarchyPart2

Figure 42 is documented as follows. The diagram shows the lower part of the naming hierarchy. It shows how the Equipment class is further specialized into many subtypes that are all contained by subclasses of the EquipmentContainer. For the subclasses of equipment container refer to part 1 of the diagram.

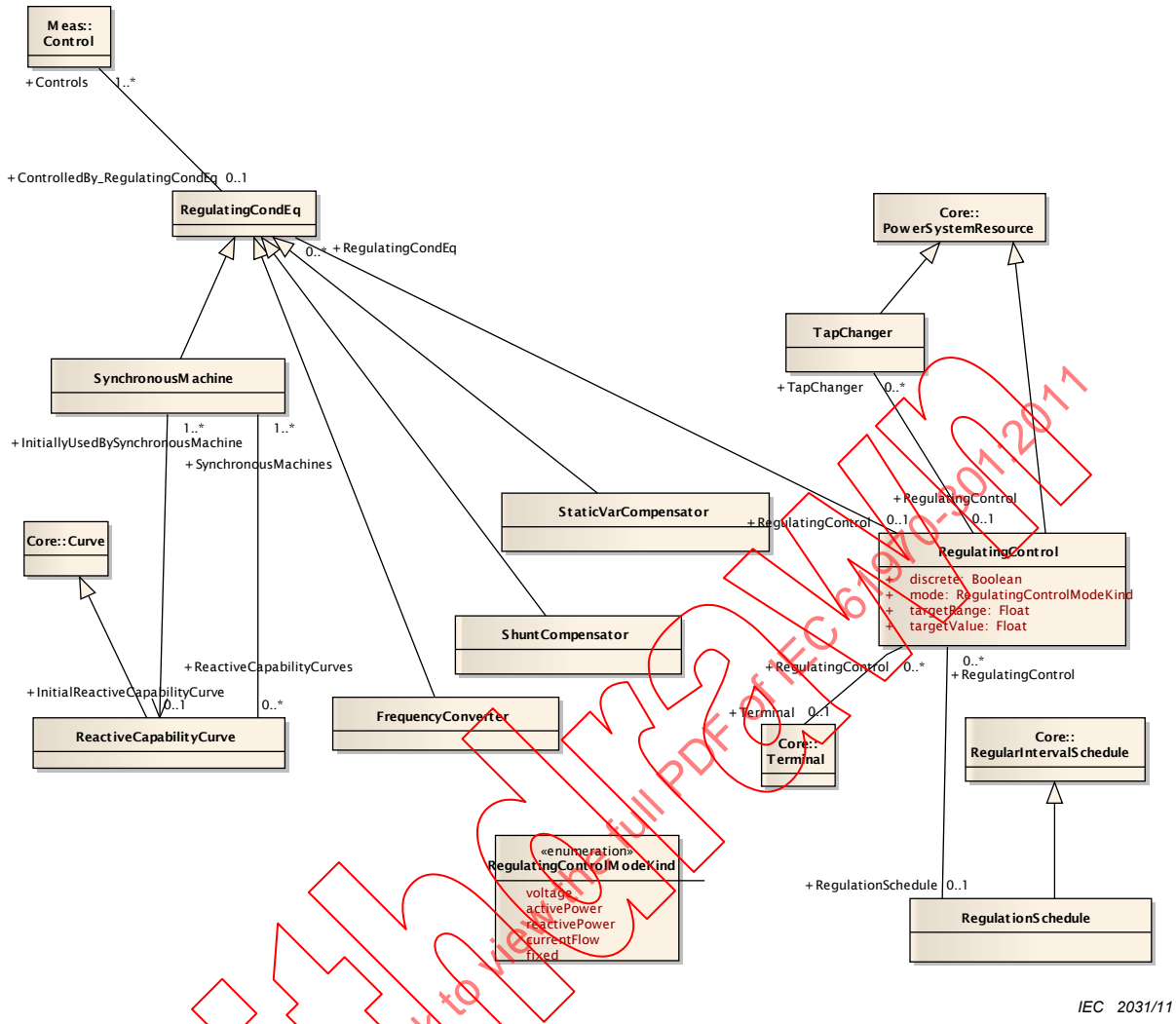

Figure 43 – RegulatingEquipment

Figure 43 is documented as follows. The diagram shows all classes related to equipment regulation and reactive power compensation.

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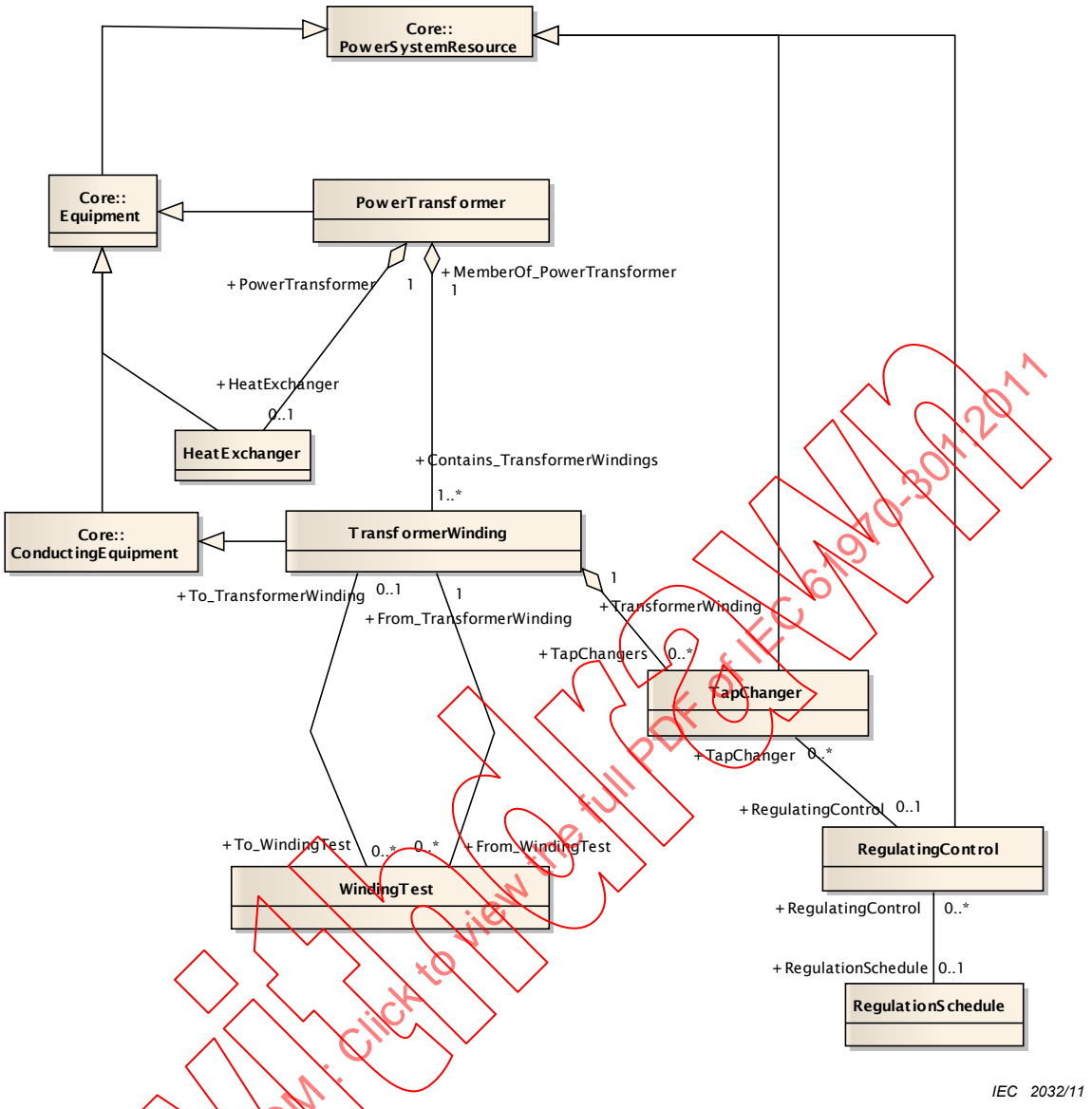

Figure 44 – TransformerModel

Figure 44 is documented as follows. This diagram shows all classes related to the transformer model.

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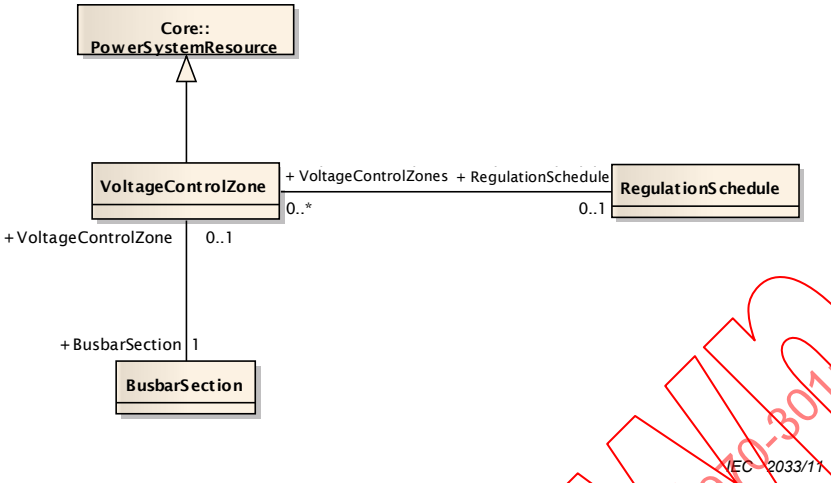

Figure 45 – VoltageControl

Figure 45 is documented as follows. This diagram shows all classes related to area voltage control.

6.6.2 ACLineSegment

A wire or combination of wires, with consistent electrical characteristics, building a single electrical system, used to carry alternating current between points in the power system.

Attributes

name	type	note
b0ch	Susceptance	inherited from: Conductor
bch	Susceptance	inherited from: Conductor
g0ch	Conductance	inherited from: Conductor
gch	Conductance	inherited from: Conductor
length	LongLength	inherited from: Conductor
r	Resistance	inherited from: Conductor
r0	Resistance	inherited from: Conductor
x	Reactance	inherited from: Conductor
x0	Reactance	inherited from: Conductor
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] ConductorType (ConductorType)	inherited from: Conductor
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.3 Breaker

A mechanical switching device capable of making, carrying, and breaking currents under normal circuit conditions and also making, carrying for a specified time, and breaking currents under specified abnormal circuit conditions e.g. those of short circuit.

Attributes

name	type	note
ratedCurrent	CurrentFlow	Fault interrupting current rating.
inTransitTime	Seconds	The transition time from open to close.
normalOpen	Boolean	inherited from: Switch
switchOnCount	Integer	inherited from: Switch
switchOnDate	AbsoluteDateTime	inherited from: Switch
retained	Boolean	inherited from: Switch
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] OperatedBy_ProtectionEquipments (ProtectionEquipment)	inherited from: ProtectedSwitch
1	[0..*] RecloseSequences (RecloseSequence)	inherited from: ProtectedSwitch
0..*	[0..1] CompositeSwitch (CompositeSwitch)	inherited from: Switch
0..*	[0..*] SwitchingOperations (SwitchingOperation)	inherited from: Switch
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.4 BusbarSection

A conductor, or group of conductors, with negligible impedance, that serve to connect other conducting equipment within a single substation.

Voltage measurements are typically obtained from VoltageTransformers that are connected to busbar sections. A bus bar section may have many physical terminals but for analysis is modeled with exactly one logical terminal.

Attributes

name	type	note
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
1	[0..1] VoltageControlZone (VoltageControlZone)	A VoltageControlZone is controlled by a designated BusbarSection.
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.5 CompositeSwitch

A model of a set of individual Switches normally enclosed within the same cabinet and possibly with interlocks that restrict the combination of switch positions. These are typically found in medium voltage distribution networks.

A CompositeSwitch could represent a Ring-Main-Unit (RMU), or pad-mounted switchgear, with primitive internal devices such as an internal bus-bar plus 3 or 4 internal switches each of which may individually be open or closed. A CompositeSwitch and a set of contained Switches can also be used to represent a multi-position switch e.g. a switch that can connect a circuit to Ground, Open or Busbar.

Attributes

name	type	note
compositeSwitchType	CompositeSwitchType	An alphanumeric code that can be used as a reference to extra information such as the description of the interlocking scheme if any.
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] Switches (Switch)	Switches contained in this Composite switch
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.6 CompositeSwitchType Datatype

An alphanumeric code that can be used as a reference to extra information such as the description of the interlocking scheme if any.

Attributes

name	type	note
value	String	

6.6.7 Conductor

Combination of conducting material with consistent electrical characteristics, building a single electrical system, used to carry current between points in the power system.

Attributes

name	type	note
b0ch	Susceptance	Zero sequence shunt (charging) susceptance, uniformly distributed, of the entire line section.
bch	Susceptance	Positive sequence shunt (charging) susceptance, uniformly distributed, of the entire line section.
g0ch	Conductance	Zero sequence shunt (charging) conductance, uniformly distributed, of the entire line section.
gch	Conductance	Positive sequence shunt (charging) conductance, uniformly distributed, of the entire line section.
length	LongLength	Segment length for calculating line section capabilities
r	Resistance	Positive sequence series resistance of the entire line section.
r0	Resistance	Zero sequence series resistance of the entire line section.
x	Reactance	Positive sequence series reactance of the entire line section.

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name	type	note
x0	Reactance	Zero sequence series reactance of the entire line section
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] ConductorType (ConductorType)	Sections of conductor are physically described by a conductor type
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.8 ConductorType

Wire or cable conductor (per IEEE specs). A specific type of wire or combination of wires not insulated from one another, suitable for carrying electric current. It may be bare or insulated.

Attributes

name	type	note
sheathResistance	Resistance	Resistance of the sheath for cable conductors
sheathReactance	Reactance	Reactance of the sheath for cable conductors
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject

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name	type	note
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] Conductors (Conductor)	Sections of conductor are physically described by a conductor type.
0..1	[0..*] WireArrangements (WireArrangement)	A ConductorType is made up of wires that can be configured in several ways.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.9 Connector

A conductor, or group of conductors, with negligible impedance, that serve to connect other conducting equipment within a single substation and are modeled with a single logical terminal.

Attributes

name	type	note
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.6.10 CoolantType enumeration

Method of cooling a machine.

Enums

name	note
air	
hydrogenGas	
water	

6.6.11 DCLineSegment

A wire or combination of wires not insulated from one another, with consistent electrical characteristics, used to carry direct current between points in the DC region of the power system.

Attributes

name	type	note
dcSegmentInductance	Inductance	Inductance of the DC line segment
dcSegmentResistance	Resistance	Resistance of the DC line segment
b0ch	Susceptance	inherited from: Conductor
bch	Susceptance	inherited from: Conductor
g0ch	Conductance	inherited from: Conductor
gch	Conductance	inherited from: Conductor
length	LongLength	inherited from: Conductor
r	Resistance	inherited from: Conductor
r0	Resistance	inherited from: Conductor
x	Reactance	inherited from: Conductor
x0	Reactance	inherited from: Conductor
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] ConductorType (ConductorType)	inherited from: Conductor
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment

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Mult from	[Mult] name (type)	note
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.12 Disconnector

A manually operated or motor operated mechanical switching device used for changing the connections in a circuit, or for isolating a circuit or equipment from a source of power. It is required to open or close circuits when negligible current is broken or made.

Attributes

name	type	note
normalOpen	Boolean	inherited from: Switch
switchOnCount	Integer	inherited from: Switch
switchOnDate	AbsoluteDateTime	inherited from: Switch
retained	Boolean	inherited from: Switch
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] CompositeSwitch (CompositeSwitch)	inherited from: Switch
0..*	[0..*] SwitchingOperations (SwitchingOperation)	inherited from: Switch
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment

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Mult from	[Mult] name (type)	note
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.13 EnergyConsumer

Generic user of energy: a point of consumption on the power system model.

Attributes

name	type	note
customerCount	Integer	Number of individual customers represented by this Demand.
pfixed	ActivePower	Active power of the load that is a fixed quantity.
pfixedPct	PerCent	Fixed active power as per cent of load group fixed active power.
qfixed	ReactivePower	Reactive power of the load that is a fixed quantity.
qfixedPct	PerCent	Fixed reactive power as per cent of load group fixed reactive power.
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] LoadResponse (LoadResponseCharacteristic)	The load response characteristic of this load.
1..*	[0..1] PowerCutZone (PowerCutZone)	An energy consumer is assigned to a power cut zone.
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment

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Mult from	[Mult] name (type)	note
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.14 EnergySource

A generic equivalent for an energy supplier on a transmission or distribution voltage level.

Attributes

name	type	note
xn	Reactance	Negative sequence Thevenin reactance
rn	Resistance	Negative sequence Thevenin resistance
nominalVoltage	Voltage	Phase-to-phase nominal voltage
x	Reactance	Positive sequence Thevenin reactance
r	Resistance	Positive sequence Thevenin resistance
voltageAngle	AngleRadians	Phase angle of a-phase open circuit
voltageMagnitude	Voltage	Phase-to-phase open circuit voltage magnitude
x0	Reactance	Zero sequence Thevenin reactance
r0	Resistance	Zero sequence Thevenin resistance
activePower	ActivePower	High voltage source load
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment

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Mult from	[Mult] name (type)	note
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.15 FrequencyConverter

A device to convert from one frequency to another (e.g., frequency F1 to F2) comprises a pair of FrequencyConverter instances. One converts from F1 to DC, the other converts the DC to F2.

Attributes

name	type	note
frequency	Frequency	Frequency on the AC side.
maxP	ActivePower	The maximum active power on the DC side at which the frequency converter should operate.
maxU	Voltage	The maximum voltage on the DC side at which the frequency converter should operate.
minP	ActivePower	The minimum active power on the DC side at which the frequency converter should operate.
minU	Voltage	The minimum voltage on the DC side at which the frequency converter should operate.
operatingMode	OperatingMode	Operating mode for the frequency converter
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1..*] Controls (Control)	inherited from: RegulatingCondEq
0..*	[0..1] RegulatingControl (RegulatingControl)	inherited from: RegulatingCondEq
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment

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Mult from	[Mult] name (type)	note
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.16 Fuse

An overcurrent protective device with a circuit opening fusible part that is heated and severed by the passage of overcurrent through it. A fuse is considered a switching device because it breaks current.

Attributes

name	type	note
ampRating	CurrentFlow	Fault interrupting current rating
normalOpen	Boolean	inherited from: Switch
switchOnCount	Integer	inherited from: Switch
switchOnDate	AbsoluteDateTime	inherited from: Switch
retained	Boolean	inherited from: Switch
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] CompositeSwitch (CompositeSwitch)	inherited from: Switch
0..*	[0..*] SwitchingOperations (SwitchingOperation)	inherited from: Switch
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment

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Mult from	[Mult] name (type)	note
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.17 Ground

A common point for connecting grounded conducting equipment such as shunt capacitors. The power system model can have more than one ground.

Attributes

name	type	note
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.6.18 GroundDisconnector

A manually operated or motor operated mechanical switching device used for isolating a circuit or equipment from Ground.

Attributes

name	type	note
normalOpen	Boolean	inherited from: Switch
switchOnCount	Integer	inherited from: Switch
switchOnDate	AbsoluteDateTime	inherited from: Switch
retained	Boolean	inherited from: Switch
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] CompositeSwitch (CompositeSwitch)	inherited from: Switch
0..*	[0..*] SwitchingOperations (SwitchingOperation)	inherited from: Switch
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.19 HeatExchanger

Equipment for the cooling of electrical equipment and the extraction of heat.

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Attributes

name	type	note
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1] PowerTransformer (PowerTransformer)	A transformer may have a heat exchanger.
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.20 Jumper

A short section of conductor with negligible impedance which can be manually removed and replaced if the circuit is de-energized. Note that zero-impedance branches can be modeled by an ACLineSegment with a zero impedance ConductorType.

Attributes

name	type	note
normalOpen	Boolean	inherited from: Switch
switchOnCount	Integer	inherited from: Switch
switchOnDate	AbsoluteDateTime	inherited from: Switch
retained	Boolean	inherited from: Switch
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject

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name	type	note
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] CompositeSwitch (CompositeSwitch)	inherited from: Switch
0..*	[0..*] SwitchingOperations (SwitchingOperation)	inherited from: Switch
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.21 Junction

A point where one or more conducting equipments are connected with zero resistance.

Attributes

name	type	note
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment

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Mult from	[Mult] name (type)	note
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.22 Line

A component part of a system extending between adjacent substations or from a substation to an adjacent interconnection point.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] Region (SubGeographicalRegion)	A Line can be contained by a SubGeographical Region.
0..1	[0..*] Contains_Equipments (Equipment)	inherited from: EquipmentContainer
1	[0..*] ConnectivityNodes (ConnectivityNode)	inherited from: ConnectivityNodeContainer
0..1	[0..*] TopologicalNode (TopologicalNode)	inherited from: ConnectivityNodeContainer
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.6.23 LoadBreakSwitch

A mechanical switching device capable of making, carrying, and breaking currents under normal operating conditions.

Attributes

name	type	note
ratedCurrent	CurrentFlow	Current carrying capacity of a wire or cable under stated thermal conditions
normalOpen	Boolean	inherited from: Switch
switchOnCount	Integer	inherited from: Switch
switchOnDate	AbsoluteDateTime	inherited from: Switch
retained	Boolean	inherited from: Switch
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] OperatedBy_ProtectionEquipments (ProtectionEquipment)	inherited from: ProtectedSwitch
1	[0..*] RecloseSequences (RecloseSequence)	inherited from: ProtectedSwitch
0..*	[0..1] CompositeSwitch (CompositeSwitch)	inherited from: Switch
0..*	[0..*] SwitchingOperations (SwitchingOperation)	inherited from: Switch
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.6.24 MutualCoupling

This class represents the zero sequence line mutual coupling.

Attributes

name	type	note
b0ch	Susceptance	Zero sequence mutual coupling shunt (charging) susceptance, uniformly distributed, of the entire line section
distance11	LongLength	Distance from the first line's specified terminal to start of coupled region
distance12	LongLength	Distance from the first line's from specified terminal to end of coupled region
distance21	LongLength	Distance from the second line's specified terminal to start of coupled region
distance22	LongLength	Distance from the second line's specified terminal to end of coupled region
g0ch	Conductance	Zero sequence mutual coupling shunt (charging) conductance, uniformly distributed, of the entire line section
r0	Resistance	Zero sequence branch-to-branch mutual impedance coupling, resistance
x0	Resistance	Zero sequence branch-to-branch mutual impedance coupling, reactance
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] First_Terminal (Terminal)	The starting terminal for the calculation of distances along the first branch of the mutual coupling. Normally MutualCoupling would only be used for terminals of AC line segments. The first and second terminals of a mutual coupling should point to different AC line segments.
0..*	[1] Second_Terminal (Terminal)	The starting terminal for the calculation of distances along the second branch of the mutual coupling.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.25 OperatingMode Datatype

Textual name for an operating mode.

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Attributes

name	type	note
value	String	

6.6.26 Plant

A Plant is a collection of equipment for purposes of generation.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] Contains_Equipments (Equipment)	inherited from: EquipmentContainer
1	[0..*] ConnectivityNodes (ConnectivityNode)	inherited from: ConnectivityNodeContainer
0..1	[0..*] TopologicalNode (TopologicalNode)	inherited from: ConnectivityNodeContainer
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.27 PowerTransformer

An electrical device consisting of two or more coupled windings, with or without a magnetic core, for introducing mutual coupling between electric circuits. Transformers can be used to control voltage and phase shift (active power flow).

Attributes

name	type	note
bmagSat	PerCent	Core shunt magnetizing susceptance in the saturation region
magBaseU	Voltage	The reference voltage at which the magnetizing saturation measurements were made
magSatFlux	PerCent	Core magnetizing saturation curve knee flux level
phases	PhaseCode	Describes the phases carried by a power transformer

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name	type	note
transfCoolingType	TransformerCoolingType	Type of transformer cooling
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[0..1] HeatExchanger (HeatExchanger)	A transformer may have a heat exchanger.
1	[1..*] Contains_TransformerWindings (TransformerWinding)	A transformer has windings.
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.28 ProtectedSwitch

A ProtectedSwitch is a switching device that can be operated by ProtectionEquipment.

Attributes

name	type	note
normalOpen	Boolean	inherited from: Switch
switchOnCount	Integer	inherited from: Switch
switchOnDate	AbsoluteDateTime	inherited from: Switch
retained	Boolean	inherited from: Switch
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] OperatedBy_ProtectionEquipments (ProtectionEquipment)	Protection equipments that operate this ProtectedSwitch.
1	[0..*] RecloseSequences (RecloseSequence)	A breaker may have zero or more automatic reclosures after a trip occurs.
0..*	[0..1] CompositeSwitch (CompositeSwitch)	inherited from: Switch
0..*	[0..*] SwitchingOperations (SwitchingOperation)	inherited from: Switch
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.29 ReactiveCapabilityCurve

Reactive power rating envelope versus the synchronous machine's active power, in both the generating and motoring modes. For each active power value there is a corresponding high and low reactive power limit value. Typically there will be a separate curve for each coolant condition, such as hydrogen pressure. The Y1 axis values represent reactive minimum and the Y2 axis values represent reactive maximum.

Attributes

name	type	note
coolantTemperature	Temperature	The machine's coolant temperature (e.g., ambient air or stator circulating water)
hydrogenPressure	Pressure	The hydrogen coolant pressure
curveStyle	CurveStyle	inherited from: Curve
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject

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Withdrawn

name	type	note
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1..*] InitiallyUsedBySynchronousMachine (SynchronousMachine)	Synchronous machines using this curve as default.
0..*	[1..*] SynchronousMachines (SynchronousMachine)	Synchronous machines using this curve.
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.30 RectifierInverter

Bi-directional AC-DC conversion equipment that can be used to control DC current, DC voltage, DC power flow, or firing angle.

Attributes

name	type	note
ratedU	Voltage	Rectifier/inverter primary base voltage.
bridges	Integer	Number of bridges.
commutatingReactance	Reactance	Commutating reactance at AC bus frequency.
commutatingResistance	Resistance	Commutating resistance.
compoundResistance	Resistance	Compounding resistance.
minCompoundVoltage	Voltage	Minimum compounded DC voltage.
frequency	Frequency	Frequency on the AC side.
maxP	ActivePower	The maximum active power on the DC side at which the converter should operate.
minP	ActivePower	The minimum active power on the DC side at which the converter should operate.
maxU	Voltage	The maximum voltage on the DC side at which the converter should operate.
minU	Voltage	The minimum voltage on the DC side at which the converter should operate.
operatingMode	OperatingMode	Operating mode for the converter.
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.31 RegulatingCondEq

RegulatingCondEq is a type of ConductingEquipment that can regulate Measurements and have a RegulationSchedule.

Attributes

name	type	note
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1..*] Controls (Control)	The controller outputs used to actually govern a regulating device, e.g. the magnetization of a synchronous machine or capacitor bank breaker actuator.
0..*	[0..1] RegulatingControl (RegulatingControl)	copy from ...
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment

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Mult from	[Mult] name (type)	note
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.32 RegulatingControl

Specifies a set of equipment that works together to control a power system quantity such as voltage or flow.

Attributes

name	type	note
mode	RegulatingControlModeKind	The regulating control mode presently available. This specification allows for determining the kind of regulation without need for obtaining the units from a schedule.
targetRange	Float	This is the case input target range. This performs the same function as the value2 attribute on the regulation schedule in the case that schedules are not used. The value has the units appropriate to the mode attribute.
targetValue	Float	The target value specified for case input. This value can be used for the target value without the use of schedules. The value has the units appropriate to the mode attribute.
discrete	Boolean	The regulation is performed in a discrete mode.
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] RegulatingCondEq (RegulatingCondEq)	The equipment participating in regulating control.
0..*	[0..1] RegulationSchedule (RegulationSchedule)	Schedule for this regulating regulating control.
0..1	[0..*] TapChanger (TapChanger)	The tap changers participating in

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Mult from	[Mult] name (type)	note
		regulation.
0..*	[0..1] Terminal (Terminal)	The terminal associated with this regulating control.
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.33 RegulatingControlModeKind enumeration

The kind of regulation model. For example: regulating voltage, reactive power, active power, etc.

Enums

name	note
voltage	Voltage is specified.
activePower	Active power is specified.
reactivePower	Reactive power is specified.
currentFlow	Current flow is specified.
fixed	The regulation mode is fixed, and thus not regulating.

6.6.34 RegulationSchedule

A pre-established pattern over time for a controlled variable, e.g., busbar voltage.

Attributes

name	type	note
lineDropCompensation	Boolean	Flag to indicate that line drop compensation is to be applied
lineDropR	Resistance	Line drop resistance
lineDropX	Reactance	Line drop reactance
timeStep	Seconds	inherited from: RegularIntervalSchedule
endTime	AbsoluteDateTime	inherited from: RegularIntervalSchedule
startTime	AbsoluteDateTime	inherited from: BasicIntervalSchedule
value1Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value1Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
value2Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value2Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject

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name	type	note
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] RegulatingControl (RegulatingControl)	Regulating controls that have this Schedule.
0..1	[0..*] VoltageControlZones (VoltageControlZone)	A VoltageControlZone may have a voltage regulation schedule.
1	[1..*] TimePoints (RegularTimePoint)	inherited from: RegularIntervalSchedule
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.35 SeriesCompensator

A series compensator is a series capacitor or reactor or an AC transmission line without charging susceptance.

Attributes

name	type	note
r	Resistance	Positive sequence resistance
x	Reactance	Positive sequence reactance
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource

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Mult from	[Mult] name (type)	note
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.36 ShuntCompensator

A shunt capacitor or reactor or switchable bank of shunt capacitors or reactors. A section of a shunt compensator is an individual capacitor or reactor. Negative values for mVArPerSection and nominalMVAr indicate that the compensator is a reactor.

Attributes

name	type	note
aVRDelay	Seconds	Time delay required for the device to be connected or disconnected by automatic voltage regulation (AVR).
b0PerSection	Susceptance	Zero sequence shunt (charging) susceptance per section.
g0PerSection	Conductance	Zero sequence shunt (charging) conductance per section.
maximumSections	Integer	For a capacitor bank, the maximum number of sections that may be switched in.
maxU	Voltage	The maximum voltage at which the capacitor bank should operate.
minU	Voltage	The minimum voltage at which the capacitor bank should operate.
nomQ	ReactivePower	Nominal reactive power output of the capacitor bank at the nominal voltage. This number should be positive.
nomU	Voltage	The nominal voltage at which the nominal reactive power was measured. This should normally be within 10 % of the voltage at which the capacitor is connected to the network.
normalSections	Integer	For a capacitor bank, the normal number of sections switched in. This number should correspond to the nominal reactive power (nomQ).
reactivePerSection	ReactivePower	For a capacitor bank, the size in reactive power of each switchable section at the nominal voltage.
switchOnCount	Integer	The switch on count since the capacitor count was last reset or initialized.
switchOnDate	AbsoluteDateTime	The date and time when the capacitor bank was last switched on.
voltageSensitivity	VoltagePerReactivePower	Voltage sensitivity required for the device to regulate the bus voltage, in voltage/reactive power.
yPerSection	Admittance	For a capacitor bank, the admittance of each switchable section. Calculated using the reactive power per section and corrected for network voltage.
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject

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name	type	note
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1..*] Controls (Control)	inherited from: RegulatingCondEq
0..*	[0..1] RegulatingControl (RegulatingControl)	inherited from: RegulatingCondEq
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.37 StaticVarCompensator

A facility for providing variable and controllable shunt reactive power. The SVC typically consists of a stepdown transformer, filter, thyristor-controlled reactor, and thyristor-switched capacitor arms.

The SVC may operate in fixed MVar output mode or in voltage control mode. When in voltage control mode, the output of the SVC will be proportional to the deviation of voltage at the controlled bus from the voltage setpoint. The SVC characteristic slope defines the proportion. If the voltage at the controlled bus is equal to the voltage setpoint, the SVC MVar output is zero.

Attributes

name	type	note
capacitiveRating	Reactance	Maximum available capacitive reactive power.
inductiveRating	Reactance	Maximum available inductive reactive power.
sVCControlMode	SVCControlMode	SVC control mode.
slope	VoltagePerReactivePower	The characteristics slope of an SVC defines how the reactive power output changes in proportion to the difference between the regulated bus voltage and the voltage setpoint.
voltageSetPoint	Voltage	The reactive power output of the SVC is proportional to the difference between the voltage at the regulated bus and the voltage setpoint. When the regulated bus voltage is equal to the voltage setpoint, the reactive power

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name	type	note
		output is zero.
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1..*] Controls (Control)	inherited from: RegulatingCondEq
0..*	[0..1] RegulatingControl (RegulatingControl)	inherited from: RegulatingCondEq
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.38 SVCControlMode enumeration

Static VAr compensator control mode.

Enums

name	note
reactivePower	
voltage	
off	

6.6.39 Switch

A generic device designed to close, or open, or both, one or more electric circuits.

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Attributes

name	type	note
normalOpen	Boolean	The attribute is used in cases when no Measurement for the status value is present. If the switch has a status measurement, the Discrete.normalValue is expected to match with the Switch.normalOpen.
switchOnCount	Integer	The switch on count since the switch was last reset or initialized.
switchOnDate	AbsoluteDateTime	The date and time when the switch was last switched on.
retained	Boolean	Branch is retained in a bus branch model.
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] CompositeSwitch (CompositeSwitch)	Composite switch this switch belongs to.
0..*	[0..*] SwitchingOperations (SwitchingOperation)	A switch may be operated by many schedules.
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.40 SynchronousMachine

An electromechanical device that operates synchronously with the network. It is a single machine operating either as a generator or synchronous condenser or pump.

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Attributes

name	type	note
aVRToManualLag	Seconds	Time delay required when switching from automatic voltage regulation (AVR) to Manual for a lagging MVAr violation.
aVRToManualLead	Seconds	Time delay required when switching from automatic voltage regulation (AVR) to Manual for a leading MVAr violation.
baseQ	ReactivePower	Default base reactive power value. This value represents the initial reactive power that can be used by any application function.
condenserP	ActivePower	Active power consumed when in condenser mode operation.
coolantCondition	Float	Temperature or pressure of coolant medium.
coolantType	CoolantType	Method of cooling the machine.
damping	Damping	Damping torque coefficient, a proportionality constant that, when multiplied by the angular velocity of the rotor poles with respect to the magnetic field (frequency), results in the damping torque.
inertia	PU	The energy stored in the rotor when operating at rated speed. This value is used in the accelerating power reference frame for operator training simulator solutions.
manualToAVR	Seconds	Time delay required when switching from Manual to automatic voltage regulation (AVR). This value is used in the accelerating power reference frame for powerflow solutions.
maxQ	ReactivePower	Maximum reactive power limit. This is the maximum (nameplate) limit for the unit.
maxU	Voltage	Maximum voltage limit for the unit.
minQ	ReactivePower	Minimum reactive power limit for the unit.
minU	Voltage	Minimum voltage limit for the unit.
operatingMode	SynchronousMachineOperatingMode	Current mode of operation.
qPercent	PerCent	Percent of the coordinated reactive control that comes from this machine.
r	Resistance	Positive sequence resistance of the synchronous machine.
r0	Resistance	Zero sequence resistance of the synchronous machine.
r2	Resistance	Negative sequence resistance.
ratedS	ApparentPower	Nameplate apparent power rating for the unit.
referencePriority	Integer	Priority of unit for reference bus selection. 0 = don t care (default) 1 = highest priority. 2 is less than 1 and so on.
type	SynchronousMachineType	Modes that this synchronous machine can operate in.
x	Reactance	Positive sequence reactance of the synchronous machine.
x0	Reactance	Zero sequence reactance of the synchronous machine.
x2	Reactance	Negative sequence reactance.
xDirectSubtrans	Reactance	Direct-axis subtransient reactance, also known as X"d.
xDirectSync	Reactance	Direct-axis synchronous reactance: the quotient of a sustained value of that AC component of

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name	type	note
		armature voltage that is produced by the total direct-axis flux due to direct-axis armature current and the value of the AC component of this current, the machine running at rated speed. (Xd)
xDirectTrans	Reactance	Direct-axis transient reactance, also known as X'd.
xQuadSubtrans	Reactance	Quadrature-axis subtransient reactance, also known as X"q.
xQuadSync	Reactance	Quadrature-axis synchronous reactance (Xq): the ratio of the component of reactive armature voltage, due to the quadrature-axis component of armature current, to this component of current, under steady state conditions and at rated frequency.
xQuadTrans	Reactance	Quadrature-axis transient reactance, also known as X'q.
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1..*	[0..1] MemberOf_GeneratingUnit (GeneratingUnit)	A synchronous machine may operate as a generator and as such becomes a member of a generating unit.
1	[0..1] Drives_HydroPump (HydroPump)	The synchronous machine drives the turbine which moves the water from a low elevation to a higher elevation. The direction of machine rotation for pumping may or may not be the same as for generating.
0..*	[0..*] DrivenBy_PrimeMover (PrimeMover)	Prime movers that drive this SynchronousMachine.
1..*	[0..1] InitialReactiveCapabilityCurve (ReactiveCapabilityCurve)	The default ReactiveCapabilityCurve for use by a SynchronousMachine.
1..*	[0..*] ReactiveCapabilityCurves (ReactiveCapabilityCurve)	All available reactive capability curves for this SynchronousMachine.
0..1	[1..*] Controls (Control)	inherited from: RegulatingCondEq
0..*	[0..1] RegulatingControl (RegulatingControl)	inherited from: RegulatingCondEq
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment

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Mult from	[Mult] name (type)	note
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.41 SynchronousMachineOperatingMode enumeration

Synchronous machine operating mode.

Enums

name	note
generator	
condenser	

6.6.42 SynchronousMachineType enumeration

Synchronous machine type.

Enums

name	note
generator	
condenser	
generator_or_condenser	

6.6.43 TapChanger

Mechanism for changing transformer winding tap positions.

Attributes

name	type	note
highStep	Integer	Highest possible tap step position, advance from neutral.
initialDelay	Seconds	For an LTC, the delay for initial tap changer operation (first step change).
lowStep	Integer	Lowest possible tap step position, retard from neutral.
neutralStep	Integer	The neutral tap step position for this winding.
neutralU	Voltage	Voltage at which the winding operates at the neutral tap setting.
normalStep	Integer	The tap step position used in "normal" network operation for this winding. For a "Fixed" tap changer indicates the current physical tap setting.
stepPhaseShiftIncrement	AngleDegrees	Phase shift per step position. A positive value indicates a positive phase shift from the winding where the tap is located to the other winding (for a two-winding transformer).

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name	type	note
stepVoltageIncrement	PerCent	Tap step increment, in per cent of nominal voltage, per step position.
subsequentDelay	Seconds	For an LTC, the delay for subsequent tap changer operation (second and later step changes).
tculControlMode	TransformerControlMode	For an LTC, the tap changer control mode.
type	TapChangerKind	The type of tap changer. Indicates the ability of the transformer to perform various regulation tasks. The tap changer must be also be associated with a RegulationControl object before any regulation is possible.
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] RegulatingControl (RegulatingControl)	
0..*	[1] TransformerWinding (TransformerWinding)	A transformer winding may have tap changers, separately for voltage and phase angle.
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.44 TapChangerKind enumeration

Transformer tap changer type. Indicates the capabilities of the tap changer independent of the operating mode.

Enums

name	note
fixed	Not capable of control. This is also indicated by no association of TapChanger to a RegulatingControl.
voltageControl	Capable of voltage control.
phaseControl	Capable of phase control.
voltageAndPhaseControl	Capable of voltage and phase control.

6.6.45 TransformerControlMode enumeration

Control modes for a transformer.

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Enums

name	note
off	Off control
local	Local control
volt	Voltage control
active	Active power flow control
reactive	Reactive power flow control

6.6.46 TransformerCoolingType enumeration

Type of transformer cooling.

6.6.47 TransformerWinding

A winding is associated with each defined terminal of a transformer (or phase shifter).

Attributes

name	type	note
b	Susceptance	Magnetizing branch susceptance (B mag).
b0	Susceptance	Zero sequence magnetizing branch susceptance.
connectionType	WindingConnection	The type of connection of the winding.
emergencyS	ApparentPower	The apparent power that the winding can carry under emergency conditions.
g	Conductance	Magnetizing branch conductance (G mag).
g0	Conductance	Zero sequence magnetizing branch conductance.
grounded	Boolean	Set if the winding is grounded.
insulationU	Voltage	Basic insulation level voltage rating.
r	Resistance	Positive sequence series resistance of the winding.
r0	Resistance	Zero sequence series resistance of the winding.
ratedS	ApparentPower	The normal apparent power rating for the winding.
ratedU	Voltage	The rated voltage (phase-to-phase) of the winding, usually the same as the neutral voltage.
rground	Resistance	Ground resistance path through connected grounding transformer.
shortTermS	ApparentPower	Apparent power that the winding can carry for a short period of time.
windingType	WindingType	The type of winding.
x	Reactance	Positive sequence series reactance of the winding.
x0	Reactance	Zero sequence series reactance of the winding.
xground	Reactance	Ground reactance path through connected grounding transformer.
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject

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name	type	note
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1..*	[1] MemberOf_PowerTransformer (PowerTransformer)	A transformer has windings.
1	[0..*] TapChangers (TapChanger)	A transformer winding may have tap changers, separately for voltage and phase angle. If a TransformerWinding does not have an associated TapChanger, the winding is assumed to be fixed tap.
1	[0..*] From_WindingTest (WindingTest)	The transformer winding tests for which the transformer winding (terminal) participates as the "from" part of the test.
0..1	[0..*] To_WindingTest (WindingTest)	The winding tests for which the transformer winding (terminal) participates as the "to" end of the test.
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.6.48 VoltageControlZone

An area of the power system network which is defined for secondary voltage control purposes. A voltage control zone consists of a collection of substations with a designated bus bar section whose voltage will be controlled.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1] BusbarSection (BusbarSection)	A VoltageControlZone is controlled by a designated BusbarSection.
0..*	[0..1] RegulationSchedule (RegulationSchedule)	A VoltageControlZone may have a voltage regulation schedule.
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.49 WindingConnection enumeration

Winding connection type.

Enums

name	note
D	Delta
Y	Wye
Z	ZigZag

6.6.50 WindingTest

Physical winding test data for the winding/tap pairs of a transformer (or phase shifter). This test data can be used to derive other attributes of specific transformer or phase shifter models.

Attributes

name	type	note
excitingCurrent	PerCent	The exciting current on open-circuit test, expressed as a percentage of rated current, at nominal voltage.
fromTapStep	Integer	The tap step number for the "from" winding of the test pair.
leakageImpedance	Impedance	The leakage impedance measured at the "from" winding with the "to" winding short-circuited

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name	type	note
		and all other windings open-circuited. Leakage impedance is expressed in units based on the apparent power and voltage ratings of the "from" winding.
loadLoss	KWActivePower	The load loss kW ("to" winding short-circuited) from the test report.
noLoadLoss	KWActivePower	The no load loss kW "to" winding open-circuited) from the test report.
phaseShift	AngleDegrees	The phase shift measured at the open-circuited "to" winding, with the "from" winding set to the "from" winding's rated voltage and all other windings open-circuited.
toTapStep	Integer	The tap step number for the "to" winding of the test pair.
voltage	Voltage	The voltage measured at the open-circuited "to" winding, with the "from" winding set to the "from" winding's rated voltage and all other windings open-circuited.
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] From_TransformerWinding (TransformerWinding)	The winding from which the test was conducted.
0..*	[0..1] To_TransformerWinding (TransformerWinding)	The winding to which the test was conducted. Note that although the "from" side of the test is required, the "to" side of a test is not always required.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.51 WindingType enumeration

Winding type.

Enums

name	note
primary	
secondary	
tertiary	
quaternary	

6.6.52 WireArrangement

Identification, spacing and configuration of the wires of a ConductorType, with reference to their type.

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Attributes

name	type	note
mountingPointX	Integer	Mounting point where wire One is mounted
mountingPointY	Integer	Mounting point where wire One is mounted
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] ConductorType (ConductorType)	A ConductorType is made up of wires that can be configured in several ways.
0..*	[0..1] WireType (WireType)	A WireType is mounted at a specified place in a WireArrangement.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.6.53 WireType

Wire conductor (per IEEE specs). A specific type of wire or combination of wires, not insulated from each other, suitable for carrying electrical current.

Attributes

name	type	note
phaseConductorCount	Integer	Number of conductor strands in the (symmetrical) bundle (1 to 12).
phaseConductorSpacing	ShortLength	Distance between conductor strands in a (symmetrical) bundle.
ratedCurrent	CurrentFlow	Current carrying capacity of a wire or cable under stated thermal conditions.
gMR	ShortLength	Geometric mean radius. If we replace the conductor by a thin walled tube of radius GMR, then its reactance is identical to the reactance of the actual conductor.
radius	ShortLength	The radius of the conductor.
resistance	Resistance	The resistance per unit length of the conductor.
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] WireArrangements (WireArrangement)	A WireType is mounted at a specified place in a WireArrangement.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.7 Generation – Generation package summary

This package contains packages that have information for Unit Commitment and Economic Dispatch of Hydro and Thermal Generating Units, Load Forecasting, Automatic Generation Control, and Unit Modeling for Dynamic Training Simulator.

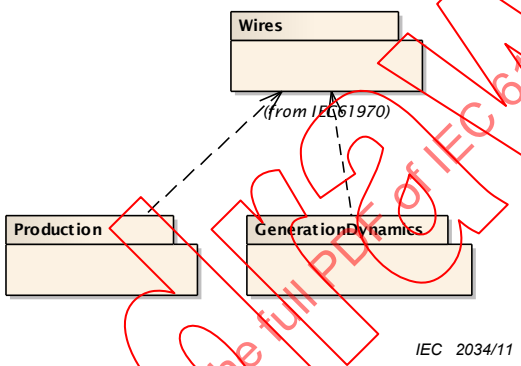

Figure 46 – Main

Figure 46 is documented as follows. This diagram shows the two main packages comprising Gereration and their dependency relationship with the Wires package.

6.8 Production

6.8.1 Production package summary

The production package is responsible for classes which describe various kinds of generators. These classes also provide production costing information which is used to economically allocate demand among committed units and calculate reserve quantities.

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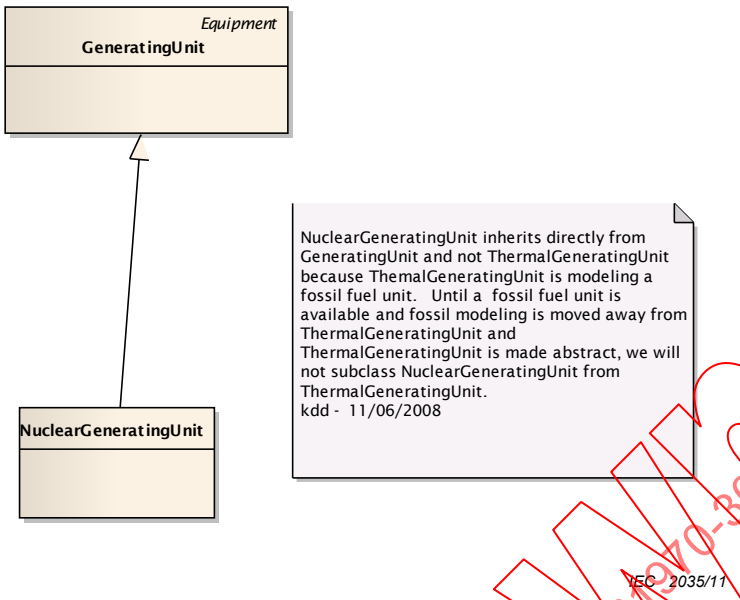

Figure 47 – Nuclear

Figure 47 is not documented.

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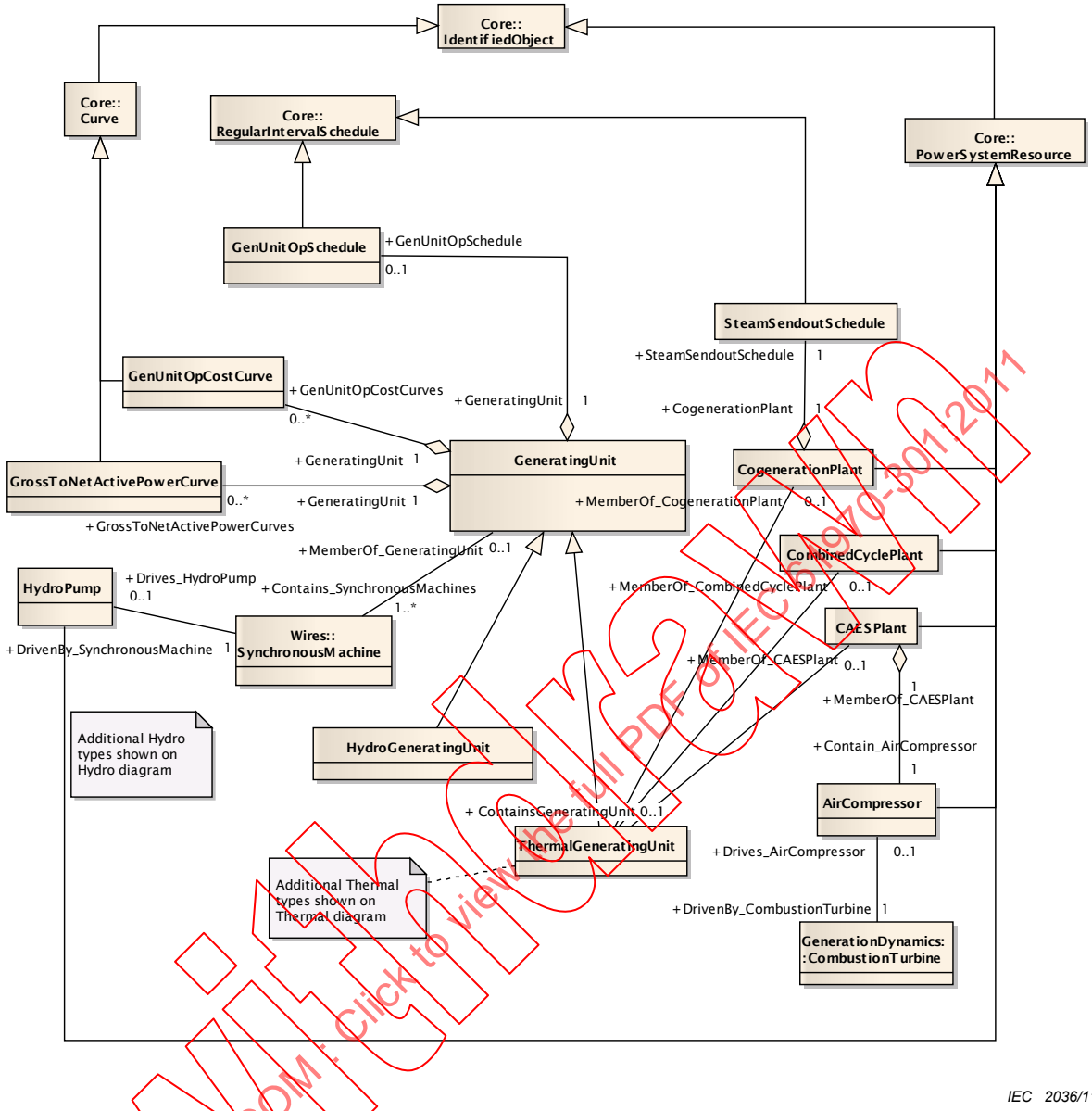

Figure 48 – Main

Figure 48 is documented as follows. This diagram shows all classes included in the Production package that are needed by both Hydro and Thermal generation. It also shows key external classes that have associations with Production classes.

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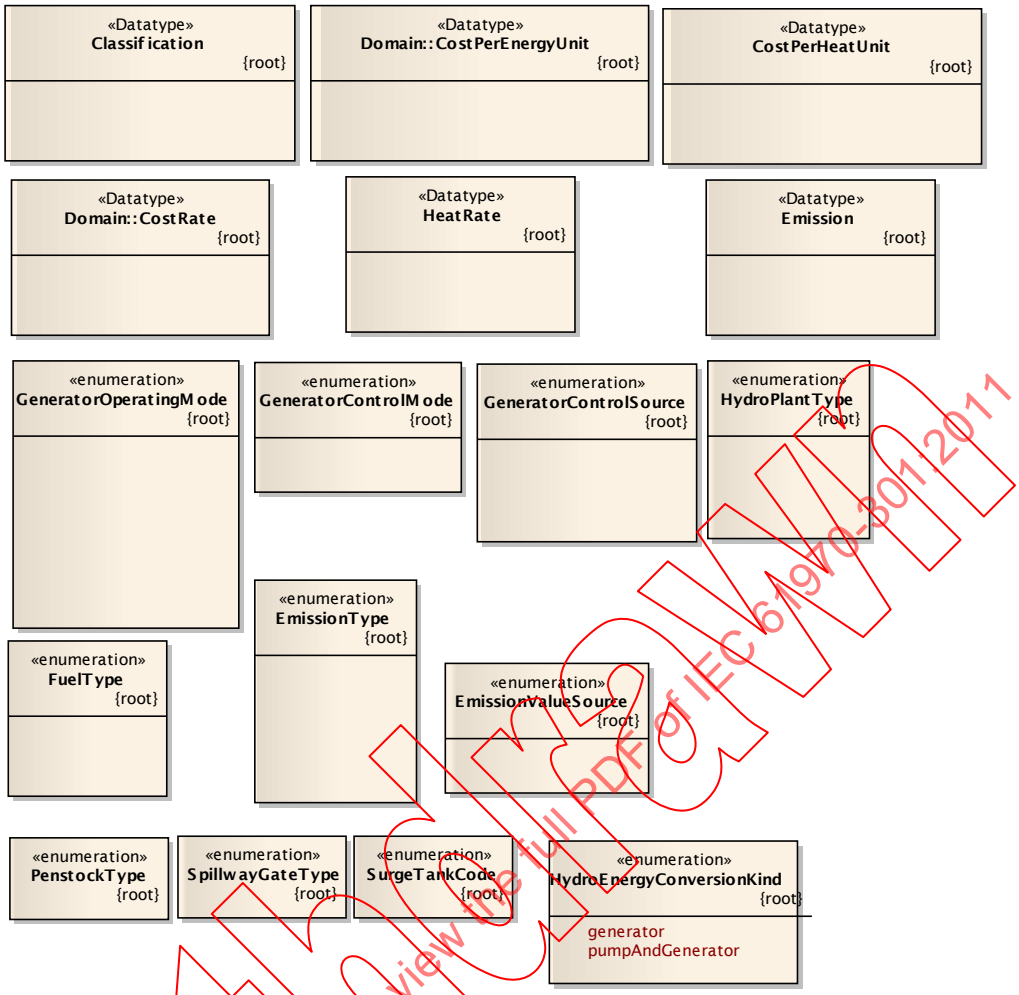

Figure 49 – Datatypes

Figure 49 is documented as follows. This diagram shows the data types specific to the Production package.

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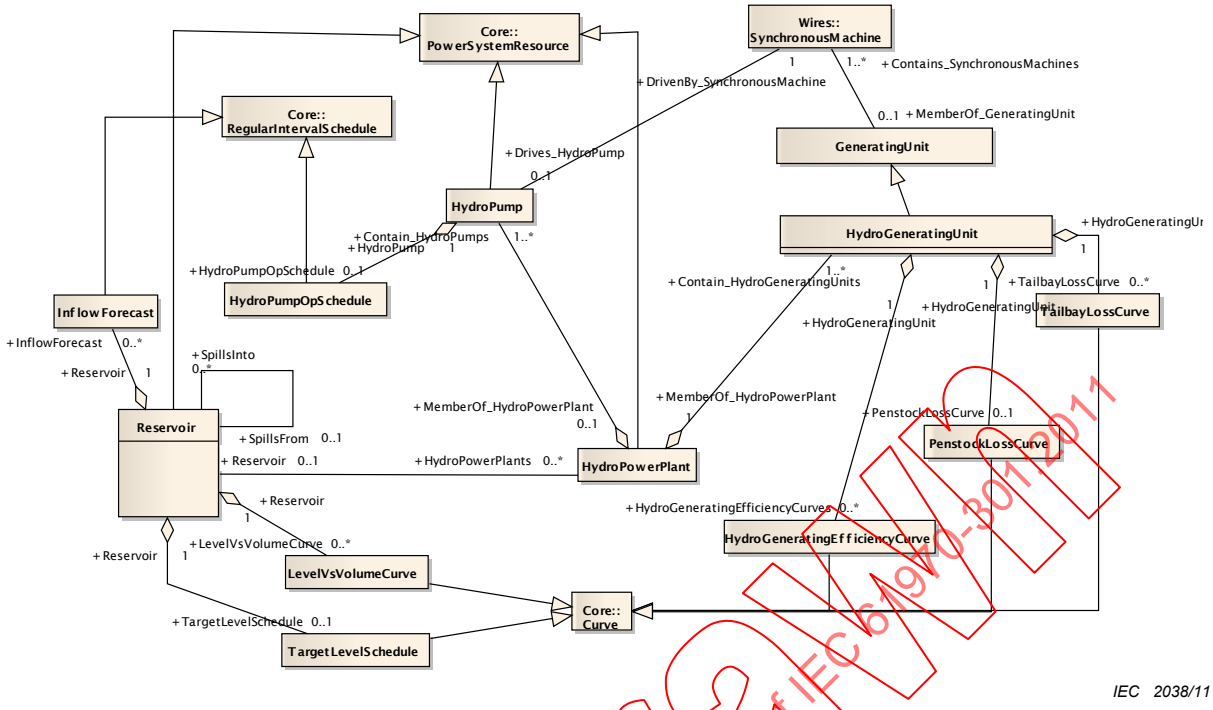

Figure 50 – Hydro

Figure 50 is documented as follows. This diagram shows all classes included in the Hydro package as well as the key external classes that have associations with Hydro classes.

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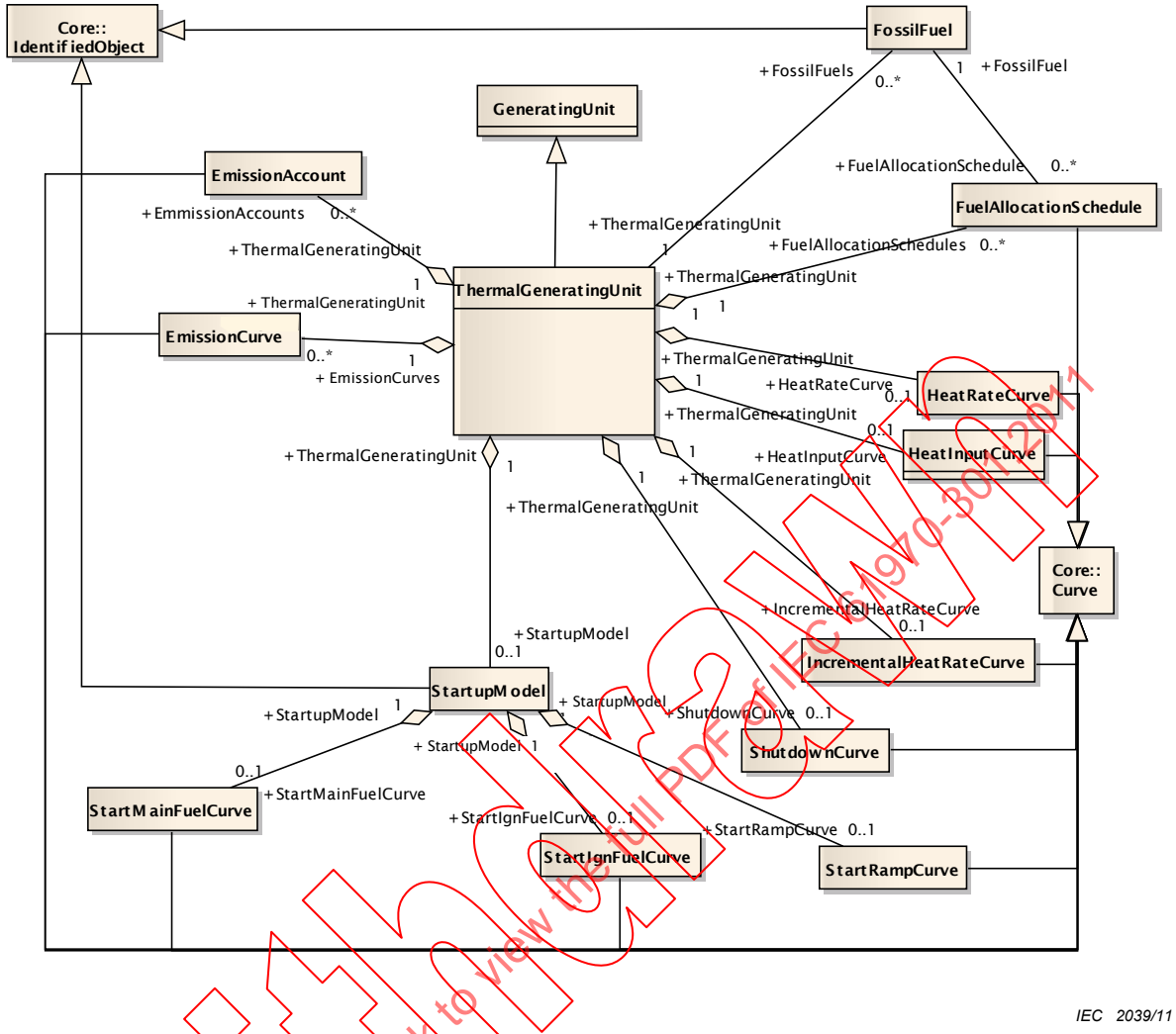

Figure 51 – Thermal

Figure 51 is documented as follows. This diagram shows all classes included in the Thermal package as well as the key external classes that have associations with Thermal classes.

6.8.2 AirCompressor

Combustion turbine air compressor which is an integral part of a compressed air energy storage (CAES) plant.

Attributes

name	type	note
airCompressorRating	Float	Rating of the CAES air compressor
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
1	[1] MemberOf_CAESPlant (CAESPlant)	An air compressor may be a member of a compressed air energy storage plant.
0..1	[1] DrivenBy_CombustionTurbine (CombustionTurbine)	A CAES air compressor is driven by combustion turbine.
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.3 CAESPlant

Compressed air energy storage plant.

Attributes

name	type	note
energyStorageCapacity	RealEnergy	The rated energy storage capacity
ratedCapacityP	ActivePower	The CAES plant's gross rated generating capacity
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[1] Contain_AirCompressor (AirCompressor)	An air compressor may be a member of a compressed air energy storage plant.
0..1	[0..1] Contain_ThermalGeneratingUnit (ThermalGeneratingUnit)	A thermal generating unit may be a member of a compressed air energy storage plant.
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.8.4 Classification Datatype

1..n, with 1 the most detailed, highest priority, etc.

Attributes

name	type	note
value	Integer	
unit=none (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.8.5 CogenerationPlant

A set of thermal generating units for the production of electrical energy and process steam (usually from the output of the steam turbines). The steam sendout is typically used for industrial purposes or for municipal heating and cooling.

Attributes

name	type	note
cogenHPSendoutRating	Float	The high pressure steam sendout
cogenHPSteamRating	Float	The high pressure steam rating
cogenLPSendoutRating	Float	The low pressure steam sendout
cogenLPSteamRating	Float	The low pressure steam rating
ratedP	ActivePower	The rated output active power of the cogeneration plant
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[1] SteamSendoutSchedule (SteamSendoutSchedule)	A cogeneration plant has a steam sendout schedule.
0..1	[0..*] Contain_ThermalGeneratingUnits (ThermalGeneratingUnit)	A thermal generating unit may be a member of a cogeneration plant.
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.8.6 CombinedCyclePlant

A set of combustion turbines and steam turbines where the exhaust heat from the combustion turbines is recovered to make steam for the steam turbines, resulting in greater overall plant efficiency.

Attributes

name	type	note
combCyclePlantRating	ActivePower	The combined cycle plant's active power output rating
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] Contain_ThermalGeneratingUnits (ThermalGeneratingUnit)	A thermal generating unit may be a member of a combined cycle plant.
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.7 CostPerHeatUnit Datatype

Cost, in units of currency, per quantity of heat generated.

Attributes

name	type	note
value	Float	
unit	MonetaryAmountPerHeatUnit	
multiplier	UnitMultiplier	

6.8.8 Emission Datatype

Quantity of emission per fuel heat content.

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Attributes

name	type	note
value	Float	
unit=kg/J (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.8.9 EmissionAccount

Accounts for tracking emissions usage and credits for thermal generating units. A unit may have zero or more emission accounts, and will typically have one for tracking usage and one for tracking credits.

Attributes

name	type	note
emissionType	EmissionType	The type of emission, for example sulfur dioxide (SO2). The y1AxisUnits of the curve contains the unit of measure (e.g. kg) and the emissionType is the type of emission (e.g. sulfer dioxide).
emissionValueSource	EmissionValueSource	The source of the emission value.
curveStyle	CurveStyle	inherited from: Curve
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] ThermalGeneratingUnit (ThermalGeneratingUnit)	A thermal generating unit may have one or more emission allowance accounts.
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.10 EmissionCurve

Relationship between the unit's emission rate in units of mass per hour (Y-axis) and output active power (X-axis) for a given type of emission. This curve applies when only one type of fuel is being burned.

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Attributes

name	type	note
emissionContent	Emission	The emission content per quantity of fuel burned.
emissionType	EmissionType	The type of emission, which also gives the production rate measurement unit. The y1AxisUnits of the curve contains the unit of measure (e.g. kg) and the emissionType is the type of emission (e.g. sulfer dioxide).
isNetGrossP	Boolean	Flag is set to true when output is expressed in net active power
curveStyle	CurveStyle	inherited from: Curve
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] ThermalGeneratingUnit (ThermalGeneratingUnit)	A thermal generating unit may have one or more emission curves.
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.11 EmissionType enumeration

The type of emission.

Enums

name	note
sulfurDioxide	
carbonDioxide	
nitrogenOxide	
hydrogenSulfide	
chlorine	
carbonDisulfide	

6.8.12 EmissionValueSource enumeration

The source of the emission value.

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Enums

name	note
measured	
calculated	

6.8.13 FossilFuel

The fossil fuel consumed by the non-nuclear thermal generating units, e.g., coal, oil, gas.

Attributes

name	type	note
fossilFuelType	FuelType	The type of fossil fuel, such as coal, oil, or gas.
fuelCost	CostPerHeatUnit	The cost in terms of heat value for the given type of fuel.
fuelDispatchCost	CostPerHeatUnit	The cost of fuel used for economic dispatching which includes: fuel cost, transportation cost, and incremental maintenance cost.
fuelEffFactor	PU	The efficiency factor for the fuel (per unit) in terms of the effective energy absorbed.
fuelHandlingCost	CostPerHeatUnit	Handling and processing cost associated with this fuel.
fuelHeatContent	Float	The amount of heat per weight (or volume) of the given type of fuel.
fuelMixture	PerCent	Relative amount of the given type of fuel, when multiple fuels are being consumed.
fuelSulfur	PU	The fuel's fraction of pollution credit per unit of heat content.
highBreakpointP	ActivePower	The active power output level of the unit at which the given type of fuel is switched on. This fuel (e.g., oil) is sometimes used to supplement the base fuel (e.g., coal) at high active power output levels.
lowBreakpointP	ActivePower	The active power output level of the unit at which the given type of fuel is switched off. This fuel (e.g., oil) is sometimes used to stabilize the base fuel (e.g., coal) at low active power output levels.
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[0..*] FuelAllocationSchedule (FuelAllocationSchedule)	A fuel allocation schedule must have a fossil fuel.
0..*	[1] ThermalGeneratingUnit (ThermalGeneratingUnit)	A thermal generating unit may have one or more fossil fuels.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.8.14 FuelAllocationSchedule

The amount of fuel of a given type which is allocated for consumption over a specified period of time.

Attributes

name	type	note
fuelAllocationEndDate	AbsoluteDateTime	The end time and date of the fuel allocation schedule.
fuelAllocationStartDate	AbsoluteDateTime	The start time and date of the fuel allocation schedule.
fuelType	FuelType	The type of fuel, which also indicates the corresponding measurement unit.
maxFuelAllocation	Float	The maximum amount fuel that is allocated for consumption for the scheduled time period.
minFuelAllocation	Float	The minimum amount fuel that is allocated for consumption for the scheduled time period, e.g., based on a "take-or-pay" contract.
curveStyle	CurveStyle	inherited from: Curve
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] FossilFuel (FossilFuel)	A fuel allocation schedule must have a fossil fuel.
0..*	[1] ThermalGeneratingUnit (ThermalGeneratingUnit)	A thermal generating unit may have one or more fuel allocation schedules.
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.15 FuelType enumeration

Type of fuel.

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Enums

name	note
coal	
oil	
gas	

6.8.16 GeneratingUnit

A single or set of synchronous machines for converting mechanical power into alternating-current power. For example, individual machines within a set may be defined for scheduling purposes while a single control signal is derived for the set. In this case, there would be a GeneratingUnit for each member of the set and an additional GeneratingUnit corresponding to the set.

Attributes

name	type	note
allocSpinResP	ActivePower	The planned unused capacity (spinning reserve) which can be used to support emergency load.
autoCntrlMarginP	ActivePower	The planned unused capacity which can be used to support automatic control overruns.
baseP	ActivePower	For dispatchable units, this value represents the economic active power basepoint. For units that are not dispatchable, this value represents the fixed generation value. The value must be between the operating low and high limits.
controlDeadband	ActivePower	Unit control error deadband. When a unit's desired active power change is less than this deadband, then no control pulses will be sent to the unit.
controlPulseHigh	Seconds	Pulse high limit which is the largest control pulse that the unit can respond to.
controlPulseLow	Seconds	Pulse low limit which is the smallest control pulse that the unit can respond to.
controlResponseRate	ActivePowerChangeRate	Unit response rate which specifies the active power change for a control pulse of one second in the most responsive loading level of the unit.
dispReserveFlag	Boolean	
efficiency	PU	The efficiency of the unit in converting mechanical energy, from the prime mover, into electrical energy.
energyMinP	HeatRate	
fastStartFlag	Boolean	
fuelPriority	Integer	
genControlMode	GeneratorControlMode	The unit control mode.
genControlSource	GeneratorControlSource	The source of controls for a generating unit.
genOperatingMode	GeneratorOperatingMode	Operating mode for secondary control.
governorMPL	PU	Governor motor position limit.
governorSCD	PerCent	Governor speed changer droop.
highControlLimit	ActivePower	High limit for secondary (AGC) control.
initialP	ActivePower	Default initial active power which is used to store a powerflow result for the initial active power for this unit in this network configuration.
longPF	Float	Generating unit economic participation factor.
lowControlLimit	ActivePower	Low limit for secondary (AGC) control.

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name	type	note
lowerRampRate	ActivePowerChangeRate	
maxEconomicP	ActivePower	Maximum high economic active power limit, that should not exceed the maximum operating active power limit.
maximumAllowableSpinningReserve	ActivePower	Maximum allowable spinning reserve. Spinning reserve will never be considered greater than this value regardless of the current operating point.
maxOperatingP	ActivePower	This is the maximum operating active power limit the dispatcher can enter for this unit.
minEconomicP	ActivePower	Low economic active power limit that must be greater than or equal to the minimum operating active power limit.
minimumOffTime	Seconds	Minimum time interval between unit shutdown and startup.
minOperatingP	ActivePower	This is the minimum operating active power limit the dispatcher can enter for this unit.
modelDetail	Classification	Detail level of the generator model data.
normalPF	Float	Generating unit economic participation factor.
penaltyFactor	Float	Defined as: 1 / (1 - Incremental transmission loss); with the incremental transmission loss expressed as a plus or minus value. The typical range of penalty factors is (0,9 to 1,1).
raiseRampRate	ActivePowerChangeRate	
ratedGrossMaxP	ActivePower	The unit's gross rated maximum capacity (Book Value).
ratedGrossMinP	ActivePower	The gross rated minimum generation level which the unit can safely operate at while delivering power to the transmission grid.
ratedNetMaxP	ActivePower	The net rated maximum capacity determined by subtracting the auxiliary power used to operate the internal plant machinery from the rated gross maximum capacity.
shortPF	Float	Generating unit economic participation factor.
spinReserveRamp	ActivePowerChangeRate	
startupCost	Money	The initial startup cost incurred for each start of the GeneratingUnit.
startupTime	Seconds	Time it takes to get the unit on-line, from the time that the prime mover mechanical power is applied.
stepChange	ActivePower	
tieLinePF	Float	Generating unit economic participation factor.
variableCost	Money	The variable cost component of production per unit of ActivePower.
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
1	[0..*] ControlAreaGeneratingUnit (ControlAreaGeneratingUnit)	ControlArea specifications for this generating unit.
1	[0..*] GenUnitOpCostCurves (GenUnitOpCostCurve)	A generating unit may have one or more cost curves, depending upon fuel mixture and fuel cost.
1	[0..1] GenUnitOpSchedule (GenUnitOpSchedule)	A generating unit may have an operating schedule, indicating the planned operation of the unit.
1	[0..*] GrossToNetActivePowerCurves (GrossToNetActivePowerCurve)	A generating unit may have a gross active power to net active power curve, describing the losses and auxiliary power requirements of the unit.
0..1	[1..*] Contains_SynchronousMachines (SynchronousMachine)	A synchronous machine may operate as a generator and as such becomes a member of a generating unit.
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.17 GeneratorControlMode enumeration

Unit control modes.

Enums

name	note
setpoint	
pulse	

6.8.18 GeneratorControlSource enumeration

The source of controls for a generating unit.

Enums

name	note
Unavailable	
offAGC	
onAGC	
PlantControl	

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6.8.19 GeneratorOperatingMode enumeration

Operating mode for secondary generator control.

Enums

name	note
Off	
Manual	
Fixed	
LFC	
AGC	
EDC	
MRN	
REG	

6.8.20 GenUnitOpCostCurve

Relationship between unit operating cost (Y-axis) and unit output active power (X-axis). The operating cost curve for thermal units is derived from heat input and fuel costs. The operating cost curve for hydro units is derived from water flow rates and equivalent water costs.

Attributes

name	type	note
isNetGrossP	Boolean	Flag is set to true when output is expressed in net active power
curveStyle	CurveStyle	inherited from: Curve
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] GeneratingUnit (GeneratingUnit)	A generating unit may have one or more cost curves, depending upon fuel mixture and fuel cost.
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.8.21 GenUnitOpSchedule

The generating unit's Operator-approved current operating schedule (or plan), typically produced with the aid of unit commitment type analyses. The X-axis represents absolute time. The Y1-axis represents the status (0=off-line and unavailable: 1=available: 2=must run: 3=must run at fixed power value: etc.). The Y2-axis represents the must run fixed power value where required.

Attributes

name	type	note
timeStep	Seconds	inherited from: RegularIntervalSchedule
endTime	AbsoluteDateTime	inherited from: RegularIntervalSchedule
startTime	AbsoluteDateTime	inherited from: BasicIntervalSchedule
value1Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value1Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
value2Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value2Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1] GeneratingUnit (GeneratingUnit)	A generating unit may have an operating schedule, indicating the planned operation of the unit.
1	[1..*] TimePoints (RegularTimePoint)	inherited from: RegularIntervalSchedule
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.22 GrossToNetActivePowerCurve

Relationship between the generating unit's gross active power output on the X-axis (measured at the terminals of the machine(s)) and the generating unit's net active power output on the Y-axis (based on utility-defined measurements at the power station). Station service loads, when modeled, should be treated as non-conforming bus loads. There may be more than one curve, depending on the auxiliary equipment that is in service.

Attributes

name	type	note
curveStyle	CurveStyle	inherited from: Curve
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve

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mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] GeneratingUnit (GeneratingUnit)	A generating unit may have a gross active power to net active power curve, describing the losses and auxiliary power requirements of the unit.
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.23 HeatInputCurve

Relationship between unit heat input in energy per time for main fuel (Y1-axis) and supplemental fuel (Y2-axis) versus unit output in active power (X-axis). The quantity of main fuel used to sustain generation at this output level is prorated for throttling between definition points. The quantity of supplemental fuel used at this output level is fixed and not prorated.

Attributes

name	type	note
auxPowerOffset	ActivePower	Power output - auxiliary power offset adjustment factor.
auxPowerMult	PU	Power output - auxiliary power multiplier adjustment factor.
heatInputEff	PU	Heat input - efficiency multiplier adjustment factor.
heatInputOffset	HeatRate	Heat input - offset adjustment factor.
isNetGrossP	Boolean	Flag is set to true when output is expressed in net active power.
curveStyle	CurveStyle	inherited from: Curve
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..1	[1] ThermalGeneratingUnit (ThermalGeneratingUnit)	A thermal generating unit may have a heat input curve.
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.24 HeatRate Datatype

Heat generated, in energy per time unit of elapsed time.

Attributes

name	type	note
value	Float	
unit=J/s (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.8.25 HeatRateCurve

Relationship between unit heat rate per active power (Y-axis) and unit output (X-axis). The heat input is from all fuels.

Attributes

name	type	note
isNetGrossP	Boolean	Flag is set to true when output is expressed in net active power.
curveStyle	CurveStyle	inherited from: Curve
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1] ThermalGeneratingUnit (ThermalGeneratingUnit)	A thermal generating unit may have a heat rate curve.
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.8.26 HydroEnergyConversionKind enumeration

Specifies the capability of the hydro generating unit to convert energy as a generator or pump.

Enums

name	note
generator	Able to generate power, but not able to pump water for energy storage.
pumpAndGenerator	Able to both generate power and pump water for energy storage.

6.8.27 HydroGeneratingEfficiencyCurve

Relationship between unit efficiency in percent and unit output active power for a given net head in meters. The relationship between efficiency, discharge, head, and power output is expressed as follows: $E = KP / HQ$.

where

E is the percentage;

P is the active power;

H is the height;

Q is the volume/time unit;

K is the constant.

For example, a curve instance for a given net head could relate efficiency (Y-axis) versus active power output (X-axis) or versus discharge on the X-axis.

Attributes

name	type	note
curveStyle	CurveStyle	inherited from: Curve
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..*	[1] HydroGeneratingUnit (HydroGeneratingUnit)	A hydro generating unit has an efficiency curve.
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.28 HydroGeneratingUnit

A generating unit whose prime mover is a hydraulic turbine (e.g., Francis, Pelton, Kaplan).

Attributes

name	type	note
energyConversionCapability	HydroEnergyConversionKind	Energy conversion capability for generating
hydroUnitWaterCost	Float	The equivalent cost of water that drives the hydro turbine, expressed as cost per volume
allocSpinResP	ActivePower	inherited from: GeneratingUnit
autoCntrlMarginP	ActivePower	inherited from: GeneratingUnit
baseP	ActivePower	inherited from: GeneratingUnit
controlDeadband	ActivePower	inherited from: GeneratingUnit
controlPulseHigh	Seconds	inherited from: GeneratingUnit
controlPulseLow	Seconds	inherited from: GeneratingUnit
controlResponseRate	ActivePowerChangeRate	inherited from: GeneratingUnit
dispReserveFlag	Boolean	inherited from: GeneratingUnit
efficiency	PU	inherited from: GeneratingUnit
energyMinP	HeatRate	inherited from: GeneratingUnit
fastStartFlag	Boolean	inherited from: GeneratingUnit
fuelPriority	Integer	inherited from: GeneratingUnit
genControlMode	GeneratorControlMode	inherited from: GeneratingUnit
genControlSource	GeneratorControlSource	inherited from: GeneratingUnit
genOperatingMode	GeneratorOperatingMode	inherited from: GeneratingUnit
governorMPL	PU	inherited from: GeneratingUnit
governorSCD	PerCent	inherited from: GeneratingUnit
highControlLimit	ActivePower	inherited from: GeneratingUnit
initialP	ActivePower	inherited from: GeneratingUnit
longPF	Float	inherited from: GeneratingUnit
lowControlLimit	ActivePower	inherited from: GeneratingUnit
lowerRampRate	ActivePowerChangeRate	inherited from: GeneratingUnit
maxEconomicP	ActivePower	inherited from: GeneratingUnit
maximumAllowableSpinningReserve	ActivePower	inherited from: GeneratingUnit
maxOperatingP	ActivePower	inherited from: GeneratingUnit
minEconomicP	ActivePower	inherited from: GeneratingUnit
minimumOffTime	Seconds	inherited from: GeneratingUnit
minOperatingP	ActivePower	inherited from: GeneratingUnit
modelDetail	Classification	inherited from: GeneratingUnit

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name	type	note
normalPF	Float	inherited from: GeneratingUnit
penaltyFactor	Float	inherited from: GeneratingUnit
raiseRampRate	ActivePowerChangeRate	inherited from: GeneratingUnit
ratedGrossMaxP	ActivePower	inherited from: GeneratingUnit
ratedGrossMinP	ActivePower	inherited from: GeneratingUnit
ratedNetMaxP	ActivePower	inherited from: GeneratingUnit
shortPF	Float	inherited from: GeneratingUnit
spinReserveRamp	ActivePowerChangeRate	inherited from: GeneratingUnit
startupCost	Money	inherited from: GeneratingUnit
startupTime	Seconds	inherited from: GeneratingUnit
stepChange	ActivePower	inherited from: GeneratingUnit
tieLinePF	Float	inherited from: GeneratingUnit
variableCost	Money	inherited from: GeneratingUnit
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[0..*] HydroGeneratingEfficiencyCurves (HydroGeneratingEfficiencyCurve)	A hydro generating unit has an efficiency curve.
1..*	[1] MemberOf_HydroPowerPlant (HydroPowerPlant)	The hydro generating unit belongs to a hydro power plant.
1	[0..1] PenstockLossCurve (PenstockLossCurve)	A hydro generating unit has a penstock loss curve.
1	[0..*] TailbayLossCurve (TailbayLossCurve)	A hydro generating unit has a tailbay loss curve.
1	[0..*] ControlAreaGeneratingUnit (ControlAreaGeneratingUnit)	inherited from: GeneratingUnit
1	[0..*] GenUnitOpCostCurves (GenUnitOpCostCurve)	inherited from: GeneratingUnit
1	[0..1] GenUnitOpSchedule (GenUnitOpSchedule)	inherited from: GeneratingUnit
1	[0..*] GrossToNetActivePowerCurves (GrossToNetActivePowerCurve)	inherited from: GeneratingUnit
0..1	[1..*] Contains_SynchronousMachines (SynchronousMachine)	inherited from: GeneratingUnit
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource

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Mult from	[Mult] name (type)	note
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.29 HydroPlantType enumeration

The type of hydro power plant.

Enums

name	note
runOfRiver	
pumpedStorage	
majorStorage	
minorStorage	

6.8.30 HydroPowerPlant

A hydro power station which can generate or pump. When generating, the generator turbines receive their water from an upper reservoir. When pumping, the pumps receive their water from a lower reservoir.

Attributes

name	type	note
dischargeTravelDelay	Seconds	Water travel delay from tailbay to next downstream hydro power station
hydroPlantType	HydroPlantType	The type of hydro power plant
penstockType	PenstockType	Type and configuration of hydro plant penstock(s)
plantDischargeCapacity	Float	Total plant discharge capacity in cubic meters per second
genRatedP	ActivePower	The hydro plant's generating rating active power for rated head conditions
pumpRatedP	ActivePower	The hydro plant's pumping rating active power for rated head conditions
plantRatedHead	Float	The plant's rated gross head in meters
surgeTankCode	SurgeTankCode	A code describing the type (or absence) of surge tank that is associated with the hydro power plant
surgeTankCrestLevel	WaterLevel	The level at which the surge tank spills
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
1	[1..*] Contain_HydroGeneratingUnits (HydroGeneratingUnit)	The hydro generating unit belongs to a hydro power plant.
0..1	[1..*] Contain_HydroPumps (HydroPump)	The hydro pump may be a member of a pumped storage plant or a pump for distributing water.
0..*	[1] GenSourcePumpDischarge (Reservoir)	Generators are supplied water from or pumps discharge water to an upstream reservoir.
0..*	[0..1] Reservoir (Reservoir)	Generators discharge water to or pumps are supplied water from a downstream reservoir.
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.31 HydroPump

A synchronous motor-driven pump, typically associated with a pumped storage plant.

Attributes

name	type	note
pumpDischAtMaxHead	Float	The pumping discharge (m^3/s) under maximum head conditions, usually at full gate
pumpDischAtMinHead	Float	The pumping discharge (m^3/s) under minimum head conditions, usually at full gate
pumpPowerAtMaxHead	ActivePower	The pumping power under maximum head conditions, usually at full gate
pumpPowerAtMinHead	ActivePower	The pumping power under minimum head conditions, usually at full gate.
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1..*	[0..1] MemberOf_HydroPowerPlant (HydroPowerPlant)	The hydro pump may be a member of a pumped storage plant or a pump for distributing water.
1	[0..1] HydroPumpOpSchedule (HydroPumpOpSchedule)	The hydro pump has a pumping schedule over time, indicating when pumping is to

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Mult from	[Mult] name (type)	note
		occur.
0..1	[1] DrivenBy_SynchronousMachine (SynchronousMachine)	The synchronous machine drives the turbine which moves the water from a low elevation to a higher elevation. The direction of machine rotation for pumping may or may not be the same as for generating.
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.32 HydroPumpOpSchedule

The hydro pump's operator-approved current operating schedule (or plan), typically produced with the aid of unit commitment type analyses.The unit's operating schedule status is typically given as: (0=unavailable) (1=avilable to startup or shutdown) (2=must pump).

Attributes

name	type	note
timeStep	Seconds	inherited from: RegularIntervalSchedule
endTime	AbsoluteDateTime	inherited from: RegularIntervalSchedule
startTime	AbsoluteDateTime	inherited from: BasicIntervalSchedule
value1Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value1Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
value2Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value2Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1] HydroPump (HydroPump)	The hydro pump has a pumping schedule over time, indicating when pumping is to occur.
1	[1..*] TimePoints (RegularTimePoint)	inherited from: RegularIntervalSchedule
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.8.33 IncrementalHeatRateCurve

Relationship between unit incremental heat rate in (delta energy/time) per (delta active power) and unit output in active power. The IHR curve represents the slope of the HeatInputCurve. Note that the "incremental heat rate" and the "heat rate" have the same engineering units.

Attributes

name	type	note
isNetGrossP	Boolean	Flag is set to true when output is expressed in net active power.
curveStyle	CurveStyle	inherited from: Curve
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1] ThermalGeneratingUnit (ThermalGeneratingUnit)	A thermal generating unit may have an incremental heat rate curve.
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.34 InflowForecast

Natural water inflow to a reservoir, usually forecasted from predicted rain and snowmelt. Typically in one hour increments for up to 10 days. The forecast is given in average cubic meters per second over the time increment.

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Attributes

name	type	note
timeStep	Seconds	inherited from: RegularIntervalSchedule
endTime	AbsoluteDateTime	inherited from: RegularIntervalSchedule
startTime	AbsoluteDateTime	inherited from: BasicIntervalSchedule
value1Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value1Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
value2Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value2Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] Reservoir (Reservoir)	A reservoir may have a "natural" inflow forecast.
1	[1..*] TimePoints (RegularTimePoint)	inherited from: RegularIntervalSchedule
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.35 LevelVsVolumeCurve

Relationship between reservoir volume and reservoir level. The volume is at the y-axis and the reservoir level at the x-axis.

Attributes

name	type	note
curveStyle	CurveStyle	inherited from: Curve
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..*	[1] Reservoir (Reservoir)	A reservoir may have a level versus volume relationship.
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.36 NuclearGeneratingUnit

A nuclear generating unit.

Attributes

name	type	note
allocSpinResP	ActivePower	inherited from: GeneratingUnit
autoCntrlMarginP	ActivePower	inherited from: GeneratingUnit
baseP	ActivePower	inherited from: GeneratingUnit
controlDeadband	ActivePower	inherited from: GeneratingUnit
controlPulseHigh	Seconds	inherited from: GeneratingUnit
controlPulseLow	Seconds	inherited from: GeneratingUnit
controlResponseRate	ActivePowerChangeRate	inherited from: GeneratingUnit
dispReserveFlag	Boolean	inherited from: GeneratingUnit
efficiency	PU	inherited from: GeneratingUnit
energyMinP	HeatRate	inherited from: GeneratingUnit
fastStartFlag	Boolean	inherited from: GeneratingUnit
fuelPriority	Integer	inherited from: GeneratingUnit
genControlMode	GeneratorControlMode	inherited from: GeneratingUnit
genControlSource	GeneratorControlSource	inherited from: GeneratingUnit
genOperatingMode	GeneratorOperatingMode	inherited from: GeneratingUnit
governorMPL	PU	inherited from: GeneratingUnit
governorSCD	PerCent	inherited from: GeneratingUnit
highControlLimit	ActivePower	inherited from: GeneratingUnit
initialP	ActivePower	inherited from: GeneratingUnit
longPF	Float	inherited from: GeneratingUnit
lowControlLimit	ActivePower	inherited from: GeneratingUnit
lowerRampRate	ActivePowerChangeRate	inherited from: GeneratingUnit
maxEconomicP	ActivePower	inherited from: GeneratingUnit
maximumAllowableSpinningReserve	ActivePower	inherited from: GeneratingUnit
maxOperatingP	ActivePower	inherited from: GeneratingUnit
minEconomicP	ActivePower	inherited from: GeneratingUnit
minimumOffTime	Seconds	inherited from: GeneratingUnit
minOperatingP	ActivePower	inherited from: GeneratingUnit
modelDetail	Classification	inherited from: GeneratingUnit
normalPF	Float	inherited from: GeneratingUnit
penaltyFactor	Float	inherited from: GeneratingUnit
raiseRampRate	ActivePowerChangeRate	inherited from: GeneratingUnit
ratedGrossMaxP	ActivePower	inherited from: GeneratingUnit

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name	type	note
ratedGrossMinP	ActivePower	inherited from: GeneratingUnit
ratedNetMaxP	ActivePower	inherited from: GeneratingUnit
shortPF	Float	inherited from: GeneratingUnit
spinReserveRamp	ActivePowerChangeRate	inherited from: GeneratingUnit
startupCost	Money	inherited from: GeneratingUnit
startupTime	Seconds	inherited from: GeneratingUnit
stepChange	ActivePower	inherited from: GeneratingUnit
tieLinePF	Float	inherited from: GeneratingUnit
variableCost	Money	inherited from: GeneratingUnit
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[0..*] ControlAreaGeneratingUnit (ControlAreaGeneratingUnit)	inherited from: GeneratingUnit
1	[0..*] GenUnitOpCostCurves (GenUnitOpCostCurve)	inherited from: GeneratingUnit
1	[0..1] GenUnitOpSchedule (GenUnitOpSchedule)	inherited from: GeneratingUnit
1	[0..*] GrossToNetActivePowerCurves (GrossToNetActivePowerCurve)	inherited from: GeneratingUnit
0..1	[1..*] Contains_SynchronousMachines (SynchronousMachine)	inherited from: GeneratingUnit
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.37 PenstockLossCurve

Relationship between penstock head loss (in meters) and total discharge through the penstock (in cubic meters per second). One or more turbines may be connected to the same penstock.

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Attributes

name	type	note
curveStyle	CurveStyle	inherited from: Curve
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1] HydroGeneratingUnit (HydroGeneratingUnit)	A hydro generating unit has a penstock loss curve.
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.38 PenstockType enumeration

Type of hydro plant penstock.

6.8.39 Reservoir

A water storage facility within a hydro system, including: ponds, lakes, lagoons, and rivers. The storage is usually behind some type of dam.

Attributes

name	type	note
activeStorageCapacity	Volume	Storage volume between the full supply level and the normal minimum operating level.
energyStorageRating	Float	The reservoir's energy storage rating in energy for given head conditions.
fullSupplyLevel	WaterLevel	Full supply level, above which water will spill. This can be the spillway crest level or the top of closed gates.
grossCapacity	Volume	Total capacity of reservoir.
normalMinOperateLevel	WaterLevel	Normal minimum operating level below which the penstocks will draw air.
riverOutletWorks	String	River outlet works for riparian right releases or other purposes.
spillTravelDelay	Seconds	The spillway water travel delay to the next downstream reservoir.

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name	type	note
spillwayCapacity	Float	The flow capacity of the spillway in cubic meters per second.
spillwayCrestLength	Float	The length of the spillway crest in meters.
spillwayCrestLevel	WaterLevel	Spillway crest level above which water will spill.
spillWayGateType	SpillwayGateType	Type of spillway gate, including parameters.
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] HydroPowerPlants (HydroPowerPlant)	Generators discharge water to or pumps are supplied water from a downstream reservoir.
1	[0..*] UpstreamFrom (HydroPowerPlant)	Generators are supplied water from or pumps discharge water to an upstream reservoir.
1	[0..*] InflowForecast (InflowForecast)	A reservoir may have a "natural" inflow forecast.
1	[0..*] LevelVsVolumeCurve (LevelVsVolumeCurve)	A reservoir may have a level versus volume relationship.
0..1	[0..*] SpillsInto (Reservoir)	A reservoir may spill into a downstream reservoir
1	[0..1] TargetLevelSchedule (TargetLevelSchedule)	A reservoir may have a water level target schedule.
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.40 ShutdownCurve

Relationship between the rate in gross active power/minute (Y-axis) at which a unit should be shutdown and its present gross MW output (X-axis).

Attributes

name	type	note
shutdownCost	Money	Fixed shutdown cost
shutdownDate	AbsoluteDateTime	The date and time of the most recent generating unit shutdown
curveStyle	CurveStyle	inherited from: Curve

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name	type	note
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1] ThermalGeneratingUnit (ThermalGeneratingUnit)	A thermal generating unit may have a shutdown curve.
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.41 SpillwayGateType Enumeration

Type of spillway gate.

6.8.42 StartIgnFuelCurve

The quantity of ignition fuel (Y-axis) used to restart and repay the auxiliary power consumed versus the number of hours (X-axis) the unit was off line.

Attributes

name	type	note
ignitionFuelType	FuelType	Type of ignition fuel
curveStyle	CurveStyle	inherited from: Curve
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..1	[1] StartupModel (StartupModel)	The unit's startup model may have a startup ignition fuel curve.
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.43 StartMainFuelCurve

The quantity of main fuel (Y-axis) used to restart and repay the auxiliary power consumed versus the number of hours (X-axis) the unit was off line.

Attributes

name	type	note
mainFuelType	FuelType	Type of main fuel
curveStyle	CurveStyle	inherited from: Curve
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1] StartupModel (StartupModel)	The unit's startup model may have a startup main fuel curve.
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.44 StartRampCurve

Rate in gross active power/minute (Y-axis) at which a unit can be loaded versus the number of hours (X-axis) the unit was off line.

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Attributes

name	type	note
hotStandbyRamp	ActivePowerChangeRate	The startup ramp rate in gross for a unit that is on hot standby
curveStyle	CurveStyle	inherited from: Curve
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1] StartupModel (StartupModel)	The unit's startup model may have a startup ramp curve
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.45 StartupModel

Unit start up characteristics depending on how long the unit has been off line.

Attributes

name	type	note
fixedMaintCost	CostRate	Fixed maintenance cost
hotStandbyHeat	HeatRate	The amount of heat input per time unit required for hot standby operation.
incrementalMaintCost	CostPerEnergyUnit	Incremental maintenance cost.
minimumDownTime	Hours	The minimum number of hours the unit must be down before restart.
minimumRunTime	Hours	The minimum number of hours the unit must be operating before being allowed to shut down.
riskFactorCost	Money	The opportunity cost associated with the return in monetary unit. This represents the restart's "share" of the unit depreciation and risk of an event which would damage the unit.
startupCost	Money	Total miscellaneous start up costs.
startupDate	AbsoluteDateTime	The date and time of the most recent generating unit startup.

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name	type	note
startupPriority	Integer	Startup priority within control area where lower numbers indicate higher priorities. More than one unit in an area may be assigned the same priority.
stbyAuxP	ActivePower	The unit's auxiliary active power consumption to maintain standby mode.
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[0..1] StartIgnFuelCurve (StartIgnFuelCurve)	The unit's startup model may have a startup ignition fuel curve.
1	[0..1] StartMainFuelCurve (StartMainFuelCurve)	The unit's startup model may have a startup main fuel curve.
1	[0..1] StartRampCurve (StartRampCurve)	The unit's startup model may have a startup ramp curve.
0..1	[1] ThermalGeneratingUnit (ThermalGeneratingUnit)	A thermal generating unit may have a startup model.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.46 SteamSendoutSchedule

The cogeneration plant's steam sendout schedule in volume per time unit.

Attributes

name	type	note
timeStep	Seconds	inherited from: RegularIntervalSchedule
endTime	AbsoluteDateTime	inherited from: RegularIntervalSchedule
startTime	AbsoluteDateTime	inherited from: BasicIntervalSchedule
value1Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value1Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
value2Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value2Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
1	[1] CogenerationPlant (CogenerationPlant)	A cogeneration plant has a steam sendout schedule
1	[1..*] TimePoints (RegularTimePoint)	inherited from: RegularIntervalSchedule
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.47 SurgeTankCode enumeration

Type (or absence) of surge tank that is associated with the hydro power plant.

6.8.48 TailbayLossCurve

Relationship between tailbay head loss height (y-axis) and the total discharge into the power station's tailbay volume per time unit (x-axis) . There could be more than one curve depending on the level of the tailbay reservoir or river level.

Attributes

name	type	note
curveStyle	CurveStyle	inherited from: Curve
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] HydroGeneratingUnit (HydroGeneratingUnit)	A hydro generating unit has a tailbay loss curve.
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.49 TargetLevelSchedule

Reservoir water level targets from advanced studies or "rule curves". Typically in 1 h increments for up to 10 days.

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Attributes

name	type	note
highLevelLimit	WaterLevel	High target level limit, above which the reservoir operation will be penalized
lowLevelLimit	WaterLevel	Low target level limit, below which the reservoir operation will be penalized
curveStyle	CurveStyle	inherited from: Curve
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1] Reservoir (Reservoir)	A reservoir may have a water level target schedule.
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.8.50 ThermalGeneratingUnit

A generating unit whose prime mover could be a steam turbine, combustion turbine, or diesel engine.

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Attributes

name	type	note
oMCost	CostPerHeatUnit	Operating and maintenance cost for the thermal unit
allocSpinResP	ActivePower	inherited from: GeneratingUnit
autoCntrlMarginP	ActivePower	inherited from: GeneratingUnit
baseP	ActivePower	inherited from: GeneratingUnit
controlDeadband	ActivePower	inherited from: GeneratingUnit
controlPulseHigh	Seconds	inherited from: GeneratingUnit
controlPulseLow	Seconds	inherited from: GeneratingUnit
controlResponseRate	ActivePowerChangeRate	inherited from: GeneratingUnit
dispReserveFlag	Boolean	inherited from: GeneratingUnit
efficiency	PU	inherited from: GeneratingUnit
energyMinP	HeatRate	inherited from: GeneratingUnit
fastStartFlag	Boolean	inherited from: GeneratingUnit
fuelPriority	Integer	inherited from: GeneratingUnit
genControlMode	GeneratorControlMode	inherited from: GeneratingUnit
genControlSource	GeneratorControlSource	inherited from: GeneratingUnit
genOperatingMode	GeneratorOperatingMode	inherited from: GeneratingUnit
governorMPL	PU	inherited from: GeneratingUnit
governorSCD	PerCent	inherited from: GeneratingUnit
highControlLimit	ActivePower	inherited from: GeneratingUnit
initialP	ActivePower	inherited from: GeneratingUnit
longPF	Float	inherited from: GeneratingUnit
lowControlLimit	ActivePower	inherited from: GeneratingUnit
lowerRampRate	ActivePowerChangeRate	inherited from: GeneratingUnit
maxEconomicP	ActivePower	inherited from: GeneratingUnit
maximumAllowableSpinningReserve	ActivePower	inherited from: GeneratingUnit
maxOperatingP	ActivePower	inherited from: GeneratingUnit
minEconomicP	ActivePower	inherited from: GeneratingUnit
minimumOffTime	Seconds	inherited from: GeneratingUnit
minOperatingP	ActivePower	inherited from: GeneratingUnit
modelDetail	Classification	inherited from: GeneratingUnit
normalPF	Float	inherited from: GeneratingUnit
penaltyFactor	Float	inherited from: GeneratingUnit
raiseRampRate	ActivePowerChangeRate	inherited from: GeneratingUnit
ratedGrossMaxP	ActivePower	inherited from: GeneratingUnit
ratedGrossMinP	ActivePower	inherited from: GeneratingUnit
ratedNetMaxP	ActivePower	inherited from: GeneratingUnit
shortPF	Float	inherited from: GeneratingUnit
spinReserveRamp	ActivePowerChangeRate	inherited from: GeneratingUnit
startupCost	Money	inherited from: GeneratingUnit
startupTime	Seconds	inherited from: GeneratingUnit
stepChange	ActivePower	inherited from: GeneratingUnit
tieLinePF	Float	inherited from: GeneratingUnit

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name	type	note
variableCost	Money	inherited from: GeneratingUnit
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..1] MemberOf_CAESPlant (CAESPlant)	A thermal generating unit may be a member of a compressed air energy storage plant.
0..*	[0..1] MemberOf_CogenerationPlant (CogenerationPlant)	A thermal generating unit may be a member of a cogeneration plant.
0..*	[0..1] MemberOf_CombinedCyclePlant (CombinedCyclePlant)	A thermal generating unit may be a member of a combined cycle plant.
1	[0..*] EmmissionAccounts (EmissionAccount)	A thermal generating unit may have one or more emission allowance accounts.
1	[0..*] EmissionCurves (EmissionCurve)	A thermal generating unit may have one or more emission curves.
1	[0..*] FossilFuels (FossilFuel)	A thermal generating unit may have one or more fossil fuels.
1	[0..*] FuelAllocationSchedules (FuelAllocationSchedule)	A thermal generating unit may have one or more fuel allocation schedules.
1	[0..1] HeatInputCurve (HeatInputCurve)	A thermal generating unit may have a heat input curve.
1	[0..1] HeatRateCurve (HeatRateCurve)	A thermal generating unit may have a heat rate curve.
1	[0..1] IncrementalHeatRateCurve (IncrementalHeatRateCurve)	A thermal generating unit may have an incremental heat rate curve.
1	[0..1] ShutdownCurve (ShutdownCurve)	A thermal generating unit may have a shutdown curve.
1	[0..1] StartupModel (StartupModel)	A thermal generating unit may have a startup model.
1	[0..*] ControlAreaGeneratingUnit (ControlAreaGeneratingUnit)	inherited from: GeneratingUnit
1	[0..*] GenUnitOpCostCurves (GenUnitOpCostCurve)	inherited from: GeneratingUnit
1	[0..1] GenUnitOpSchedule (GenUnitOpSchedule)	inherited from: GeneratingUnit
1	[0..*] GrossToNetActivePowerCurves (GrossToNetActivePowerCurve)	inherited from: GeneratingUnit
0..1	[1..*] Contains_SynchronousMachines (SynchronousMachine)	inherited from: GeneratingUnit
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource

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Mult from	[Mult] name (type)	note
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.9 GenerationDynamics

6.9.1 GenerationDynamics package summary

The Generation Dynamics package contains prime movers, such as turbines and boilers, which are needed for simulation and educational purposes.

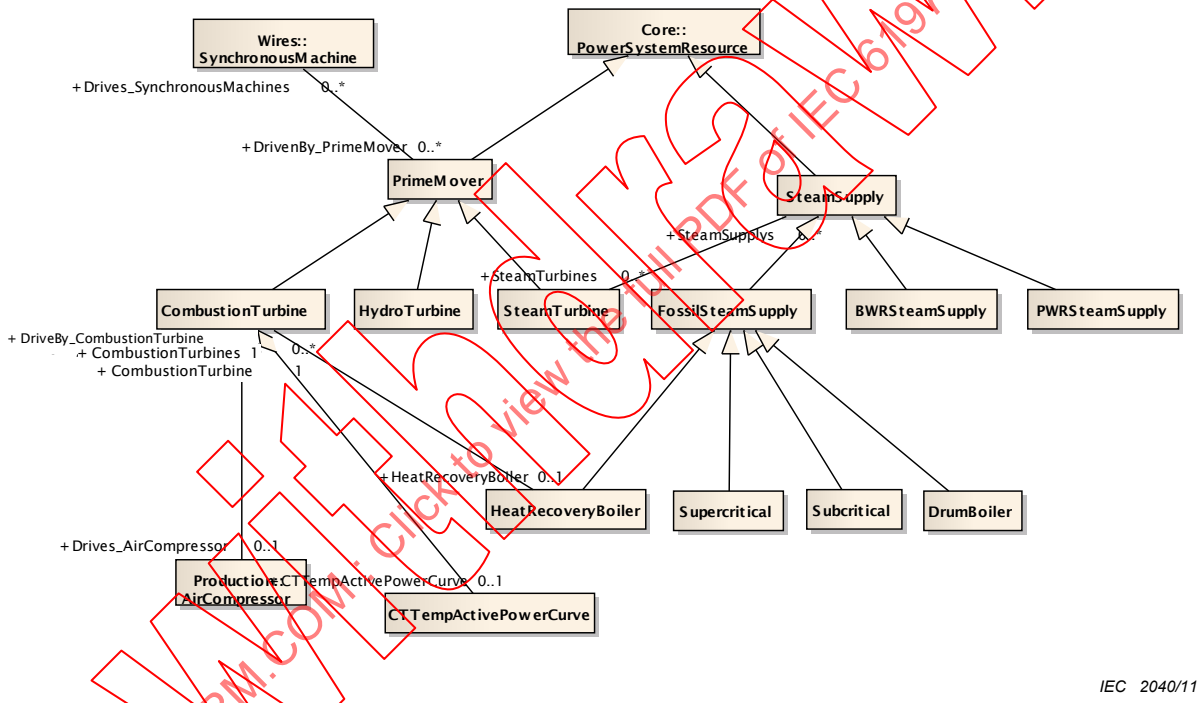

Figure 52 – Main

Figure 52 is documented as follows. This diagram shows all classes included in the GenerationDynamics package as well as the key external classes that have associations with GenerationDynamics classes.

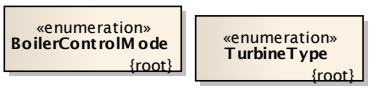

Figure 53 – Datatypes

Figure 53 is documented as follows. This diagram shows the data types specific to the GenerationDynamics package.

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6.9.2 BoilerControlMode enumeration

Boiler control mode.

Enums

name	note
following	
coordinated	

6.9.3 BWRSteamSupply

Boiling water reactor used as a steam supply to a steam turbine.

Attributes

name	type	note
highPowerLimit	PU	High power limit
inCoreThermalTC	Seconds	In-core thermal time constant
integralGain	Float	Integral gain
lowerLimit	PU	Initial lower limit
lowPowerLimit	PU	Low power limit
pressureLimit	PU	Pressure limit
pressureSetpointGA	Float	Pressure setpoint gain adjuster
pressureSetpointTC1	Seconds	Pressure setpoint time constant
pressureSetpointTC2	Seconds	Pressure setpoint time constant
proportionalGain	Float	Proportional gain
rfAux1	PU	Coefficient for modeling the effect of off-nominal frequency and voltage on recirculation and core flow, which affects the BWR power output
rfAux2	PU	Coefficient for modeling the effect of off-nominal frequency and voltage on recirculation and core flow, which affects the BWR power output
rfAux3	PU	Coefficient for modeling the effect of off-nominal frequency and voltage on recirculation and core flow, which affects the BWR power output
rfAux4	PU	Coefficient for modeling the effect of off-nominal frequency and voltage on recirculation and core flow, which affects the BWR power output
rfAux5	PU	Coefficient for modeling the effect of off-nominal frequency and voltage on recirculation and core flow, which affects the BWR power output
rfAux6	PU	Coefficient for modeling the effect of off-nominal frequency and voltage on recirculation and core flow, which affects the BWR power output
rfAux7	PU	Coefficient for modeling the effect of off-nominal frequency and voltage on recirculation and core flow, which affects the BWR power output
rfAux8	PU	Coefficient for modeling the effect of off-nominal frequency and voltage on recirculation and core flow, which affects the BWR power output
rodPattern	PU	Rod pattern
rodPatternConstant	Float	Constant associated with rod pattern
upperLimit	PU	Initial upper limit
steamSupplyRating	Float	inherited from: SteamSupply

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name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] SteamTurbines (SteamTurbine)	inherited from: SteamSupply
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.9.4 CombustionTurbine

A prime mover that is typically fueled by gas or light oil.

Attributes

name	type	note
ambientTemp	Temperature	Default ambient temperature to be used in modeling applications
auxPowerVersusFrequency	PU	Off-nominal frequency effect on turbine auxiliaries. Per unit reduction in auxiliary active power consumption versus per unit reduction in frequency (from rated frequency)
auxPowerVersusVoltage	PU	Off-nominal voltage effect on turbine auxiliaries. Per unit reduction in auxiliary active power consumption versus per unit reduction in auxiliary bus voltage (from a specified voltage level)
capabilityVersusFrequency	PU	Off-nominal frequency effect on turbine capability. Per unit reduction in unit active power capability versus per unit reduction in frequency (from rated frequency)
heatRecoveryFlag	Boolean	Flag that is set to true if the combustion turbine is associated with a heat recovery boiler
powerVariationByTemp	PU	Per unit change in power per (versus) unit change in ambient temperature
referenceTemp	Temperature	Reference temperature at which the output of the turbine was defined
timeConstant	Seconds	The time constant for the turbine
primeMoverRating	Float	inherited from: PrimeMover
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject

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name	type	note
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[0..1] Drives_AirCompressor (AirCompressor)	A CAES air compressor is driven by combustion turbine.
1	[0..1] CTTempActivePowerCurve (CTTempActivePowerCurve)	A combustion turbine may have an active power versus ambient temperature relationship.
0..*	[0..1] HeatRecoveryBoiler (HeatRecoveryBoiler)	A combustion turbine may have a heat recovery boiler for making steam.
0..*	[0..*] Drives_SynchronousMachines (SynchronousMachine)	inherited from: PrimeMover
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.9.5 CTTempActivePowerCurve

Relationship between the combustion turbine's power output rating in gross active power (X-axis) and the ambient air temperature (Y-axis).

Attributes

name	type	note
curveStyle	CurveStyle	inherited from: Curve
xUnit	UnitSymbol	inherited from: Curve
xMultiplier	UnitMultiplier	inherited from: Curve
y1Unit	UnitSymbol	inherited from: Curve
y1Multiplier	UnitMultiplier	inherited from: Curve
y2Unit	UnitSymbol	inherited from: Curve
y2Multiplier	UnitMultiplier	inherited from: Curve
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..1	[1] CombustionTurbine (CombustionTurbine)	A combustion turbine may have an active power versus ambient temperature relationship.
1	[0..*] CurveScheduleDatas (CurveData)	inherited from: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.9.6 DrumBoiler

Drum boiler.

Attributes

name	type	note
drumBoilerRating	Float	Rating of drum boiler in steam units
auxPowerVersusFrequency	PU	inherited from: FossilSteamSupply
auxPowerversusVoltage	PU	inherited from: FossilSteamSupply
controlIC	Float	inherited from: FossilSteamSupply
boilerControlMode	BoilerControlMode	inherited from: FossilSteamSupply
controlErrorBiasP	Float	inherited from: FossilSteamSupply
controlPC	Float	inherited from: FossilSteamSupply
controlPEB	Float	inherited from: FossilSteamSupply
controlPED	PU	inherited from: FossilSteamSupply
controlTC	Float	inherited from: FossilSteamSupply
feedWaterIG	Float	inherited from: FossilSteamSupply
feedWaterPG	Float	inherited from: FossilSteamSupply
feedWaterTC	Seconds	inherited from: FossilSteamSupply
fuelDemandLimit	PU	inherited from: FossilSteamSupply
fuelSupplyDelay	Seconds	inherited from: FossilSteamSupply
mechPowerSensorLag	Seconds	inherited from: FossilSteamSupply
fuelSupplyTC	Seconds	inherited from: FossilSteamSupply
maxErrorRateP	Float	inherited from: FossilSteamSupply
minErrorRateP	Float	inherited from: FossilSteamSupply
pressureCtrlDG	Float	inherited from: FossilSteamSupply
pressureCtrlIG	Float	inherited from: FossilSteamSupply
pressureCtrlPG	Float	inherited from: FossilSteamSupply
pressureFeedback	Integer	inherited from: FossilSteamSupply
superHeater1Capacity	Float	inherited from: FossilSteamSupply
superHeater2Capacity	Float	inherited from: FossilSteamSupply
superHeaterPipePD	Float	inherited from: FossilSteamSupply
throttlePressureSP	PU	inherited from: FossilSteamSupply
steamSupplyRating	Float	inherited from: SteamSupply
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject

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name	type	note
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] SteamTurbines (SteamTurbine)	inherited from: SteamSupply
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.9.7 FossilSteamSupply

Fossil fueled boiler (e.g., coal, oil, gas).

Attributes

name	type	note
auxPowerVersusFrequency	PU	Off-nominal frequency effect on auxiliary real power. Per unit active power variation versus per unit frequency variation.
auxPowerversusVoltage	PU	Off-nominal voltage effect on auxiliary real power. Per unit active power variation versus per unit voltage variation.
controlIC	Float	Integral constant
boilerControlMode	BoilerControlMode	The control mode of the boiler
controlErrorBiasP	Float	Active power error bias ratio
controlPC	Float	Proportional constant
controlPEB	Float	Pressure error bias ratio
controlPED	PU	Pressure error deadband
controlTC	Float	Time constant
feedWaterIG	Float	Feedwater integral gain ratio
feedWaterPG	Float	Feedwater proportional gain ratio
feedWaterTC	Seconds	Feedwater time constant ratio
fuelDemandLimit	PU	Fuel demand limit
fuelSupplyDelay	Seconds	Fuel delay
mechPowerSensorLag	Seconds	Mechanical power sensor lag
fuelSupplyTC	Seconds	Fuel supply time constant
maxErrorRateP	Float	Active power maximum error rate limit
minErrorRateP	Float	Active power minimum error rate limit
pressureCtrlDG	Float	Pressure control derivative gain ratio
pressureCtrlIG	Float	Pressure control integral gain ratio
pressureCtrlPG	Float	Pressure control proportional gain ratio

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name	type	note
pressureFeedback	Integer	Pressure feedback indicator
superHeater1Capacity	Float	Drum/primary superheater capacity
superHeater2Capacity	Float	Secondary superheater capacity
superHeaterPipePD	Float	Superheater pipe pressure drop constant
throttlePressureSP	PU	Throttle pressure setpoint
steamSupplyRating	Float	inherited from: SteamSupply
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] SteamTurbines (SteamTurbine)	inherited from: SteamSupply
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.9.8 HeatRecoveryBoiler

The heat recovery system associated with combustion turbines in order to produce steam for combined cycle plants.

Attributes

name	type	note
steamSupplyRating2	Float	The steam supply rating in kilopounds per hour, if dual pressure boiler
auxPowerVersusFrequency	PU	inherited from: FossilSteamSupply
auxPowerversusVoltage	PU	inherited from: FossilSteamSupply
controlIC	Float	inherited from: FossilSteamSupply
boilerControlMode	BoilerControlMode	inherited from: FossilSteamSupply
controlErrorBiasP	Float	inherited from: FossilSteamSupply
controlPC	Float	inherited from: FossilSteamSupply
controlPEB	Float	inherited from: FossilSteamSupply
controlPED	PU	inherited from: FossilSteamSupply
controlTC	Float	inherited from: FossilSteamSupply
feedWaterIG	Float	inherited from: FossilSteamSupply
feedWaterPG	Float	inherited from: FossilSteamSupply

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name	type	note
feedWaterTC	Seconds	inherited from: FossilSteamSupply
fuelDemandLimit	PU	inherited from: FossilSteamSupply
fuelSupplyDelay	Seconds	inherited from: FossilSteamSupply
mechPowerSensorLag	Seconds	inherited from: FossilSteamSupply
fuelSupplyTC	Seconds	inherited from: FossilSteamSupply
maxErrorRateP	Float	inherited from: FossilSteamSupply
minErrorRateP	Float	inherited from: FossilSteamSupply
pressureCtrlDG	Float	inherited from: FossilSteamSupply
pressureCtrlIG	Float	inherited from: FossilSteamSupply
pressureCtrlPG	Float	inherited from: FossilSteamSupply
pressureFeedback	Integer	inherited from: FossilSteamSupply
superHeater1Capacity	Float	inherited from: FossilSteamSupply
superHeater2Capacity	Float	inherited from: FossilSteamSupply
superHeaterPipePD	Float	inherited from: FossilSteamSupply
throttlePressureSP	PU	inherited from: FossilSteamSupply
steamSupplyRating	Float	inherited from: SteamSupply
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] CombustionTurbines (CombustionTurbine)	A combustion turbine may have a heat recovery boiler for making steam.
0..*	[0..*] SteamTurbines (SteamTurbine)	inherited from: SteamSupply
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.9.9 HydroTurbine

A water driven prime mover. Typical turbine types are: Francis, Kaplan, and Pelton.

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Attributes

name	type	note
gateRateLimit	Float	Gate rate limit
gateUpperLimit	PU	Gate upper limit
minHeadMaxP	ActivePower	Maximum efficiency active power at minimum head conditions
maxHeadMaxP	ActivePower	Maximum efficiency active power at maximum head conditions
speedRating	RotationSpeed	Rated speed in number of revolutions
speedRegulation	PU	Speed regulation
transientDroopTime	Seconds	Transient droop time constant
transientRegulation	PU	Transient regulation
turbineRating	ActivePower	Rated turbine active power
turbineType	TurbineType	Type of turbine
waterStartingTime	Seconds	Water starting time
primeMoverRating	Float	inherited from: PrimeMover
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] Drives_SynchronousMachines (SynchronousMachine)	inherited from: PrimeMover
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.9.10 PrimeMover

The machine used to develop mechanical energy used to drive a generator.

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Attributes

name	type	note
primeMoverRating	Float	Rating of prime mover
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] Drives_SynchronousMachines (SynchronousMachine)	Synchronous machines this prime mover drives
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.9.11 PWRSteamSupply

Pressurized water reactor used as a steam supply to a steam turbine.

Attributes

name	type	note
coldLegFBLagTC	PU	Cold leg feedback lag time constant
coldLegFBLeadTC1	PU	Cold leg feedback lead time constant
coldLegFBLeadTC2	PU	Cold leg feedback lead time constant
coldLegFG1	PU	Cold leg feedback Gain 1
coldLegFG2	PU	Cold leg feedback Gain 2
coldLegLagTC	PU	Cold leg lag time constant
coreHTLagTC1	PU	Core heat transfer lag time constant
coreHTLagTC2	PU	Core heat transfer lag time constant
coreNeutronicsEffTC	PU	Core neutronics effective time constant
coreNeutronicsHT	PU	Core neutronics and heat transfer
feedbackFactor	PU	Feedback factor
hotLegLagTC	PU	Hot leg lag time constant
hotLegSteamGain	PU	Hot leg steam gain
hotLegToColdLegGain	PU	Hot leg to cold leg gain
pressureCG	PU	Pressure control gain

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name	type	note
steamFlowFG	PU	Steam flow feedback gain
steamPressureDropLagTC	PU	Steam pressure drop lag time constant
steamPressureFG	PU	Steam pressure feedback gain
throttlePressureFactor	PU	Throttle pressure factor
throttlePressureSP	PU	Throttle pressure setpoint
steamSupplyRating	Float	inherited from: SteamSupply
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] SteamTurbines (SteamTurbine)	inherited from: SteamSupply
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.9.12 SteamSupply

Steam supply for steam turbine.

Attributes

name	type	note
steamSupplyRating	Float	Rating of steam supply
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] SteamTurbines (SteamTurbine)	Steam turbines may have steam supplied by a steam supply.
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.9.13 SteamTurbine

Steam turbine.

Attributes

name	type	note
crossoverTC	Seconds	Crossover time constant
reheater1TC	Seconds	First reheater time constant
reheater2TC	Seconds	Second reheater time constant
shaft1PowerHP	Float	Fraction of power from shaft 1 high pressure turbine output
shaft1PowerIP	Float	Fraction of power from shaft 1 intermediate pressure turbine output
shaft1PowerLP1	Float	Fraction of power from shaft 1 first low pressure turbine output
shaft1PowerLP2	Float	Fraction of power from shaft 1 second low pressure turbine output
shaft2PowerHP	Float	Fraction of power from shaft 2 high pressure turbine output
shaft2PowerIP	Float	Fraction of power from shaft 2 intermediate pressure turbine output
shaft2PowerLP1	Float	Fraction of power from shaft 2 first low pressure turbine output
shaft2PowerLP2	Float	Fraction of power from shaft 2 second low pressure turbine output
steamChestTC	Seconds	Steam chest time constant
primeMoverRating	Float	inherited from: PrimeMover
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] SteamSupplys (SteamSupply)	Steam turbines may have steam supplied by a steam supply.
0..*	[0..*] Drives_SynchronousMachines (SynchronousMachine)	inherited from: PrimeMover
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.9.14 Subcritical

Once-through subcritical boiler.

Attributes

name	type	note
auxPowerVersusFrequency	PU	inherited from: FossilSteamSupply
auxPowerversusVoltage	PU	inherited from: FossilSteamSupply
controlIC	Float	inherited from: FossilSteamSupply
boilerControlMode	BoilerControlMode	inherited from: FossilSteamSupply
controlErrorBiasP	Float	inherited from: FossilSteamSupply
controlPC	Float	inherited from: FossilSteamSupply
controlPEB	Float	inherited from: FossilSteamSupply
controlPED	PU	inherited from: FossilSteamSupply
controlTC	Float	inherited from: FossilSteamSupply
feedWaterIG	Float	inherited from: FossilSteamSupply
feedWaterPG	Float	inherited from: FossilSteamSupply
feedWaterTC	Seconds	inherited from: FossilSteamSupply
fuelDemandLimit	PU	inherited from: FossilSteamSupply
fuelSupplyDelay	Seconds	inherited from: FossilSteamSupply
mechPowerSensorLag	Seconds	inherited from: FossilSteamSupply
fuelSupplyTC	Seconds	inherited from: FossilSteamSupply
maxErrorRateP	Float	inherited from: FossilSteamSupply
minErrorRateP	Float	inherited from: FossilSteamSupply
pressureCtrlDG	Float	inherited from: FossilSteamSupply
pressureCtrlIG	Float	inherited from: FossilSteamSupply
pressureCtrlPG	Float	inherited from: FossilSteamSupply
pressureFeedback	Integer	inherited from: FossilSteamSupply
superHeater1Capacity	Float	inherited from: FossilSteamSupply
superHeater2Capacity	Float	inherited from: FossilSteamSupply
superHeaterPipePD	Float	inherited from: FossilSteamSupply

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name	type	note
throttlePressureSP	PU	inherited from: FossilSteamSupply
steamSupplyRating	Float	inherited from: SteamSupply
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] SteamTurbines (SteamTurbine)	inherited from: SteamSupply
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.9.15 Supercritical

Once-through supercritical boiler.

Attributes

name	type	note
auxPowerVersusFrequency	PU	inherited from: FossilSteamSupply
auxPowerversusVoltage	PU	inherited from: FossilSteamSupply
controlIC	Float	inherited from: FossilSteamSupply
boilerControlMode	BoilerControlMode	inherited from: FossilSteamSupply
controlErrorBiasP	Float	inherited from: FossilSteamSupply
controlPC	Float	inherited from: FossilSteamSupply
controlPEB	Float	inherited from: FossilSteamSupply
controlPED	PU	inherited from: FossilSteamSupply
controlTC	Float	inherited from: FossilSteamSupply
feedWaterIG	Float	inherited from: FossilSteamSupply
feedWaterPG	Float	inherited from: FossilSteamSupply
feedWaterTC	Seconds	inherited from: FossilSteamSupply
fuelDemandLimit	PU	inherited from: FossilSteamSupply
fuelSupplyDelay	Seconds	inherited from: FossilSteamSupply
mechPowerSensorLag	Seconds	inherited from: FossilSteamSupply
fuelSupplyTC	Seconds	inherited from: FossilSteamSupply

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name	type	note
maxErrorRateP	Float	inherited from: FossilSteamSupply
minErrorRateP	Float	inherited from: FossilSteamSupply
pressureCtrlDG	Float	inherited from: FossilSteamSupply
pressureCtrlIG	Float	inherited from: FossilSteamSupply
pressureCtrlPG	Float	inherited from: FossilSteamSupply
pressureFeedback	Integer	inherited from: FossilSteamSupply
superHeater1Capacity	Float	inherited from: FossilSteamSupply
superHeater2Capacity	Float	inherited from: FossilSteamSupply
superHeaterPipePD	Float	inherited from: FossilSteamSupply
throttlePressureSP	PU	inherited from: FossilSteamSupply
steamSupplyRating	Float	inherited from: SteamSupply
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] SteamTurbines (SteamTurbine)	inherited from: SteamSupply
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.9.16 TurbineType enumeration

Type of turbine.

Enums

name	note
francis	
pelton	
kaplan	

6.10 LoadModel

6.10.1 LoadModel package summary

This package is responsible for modeling the energy consumers and the system load as curves and associated curve data. Special circumstances that may affect the load, such as seasons and daytypes, are also included here.

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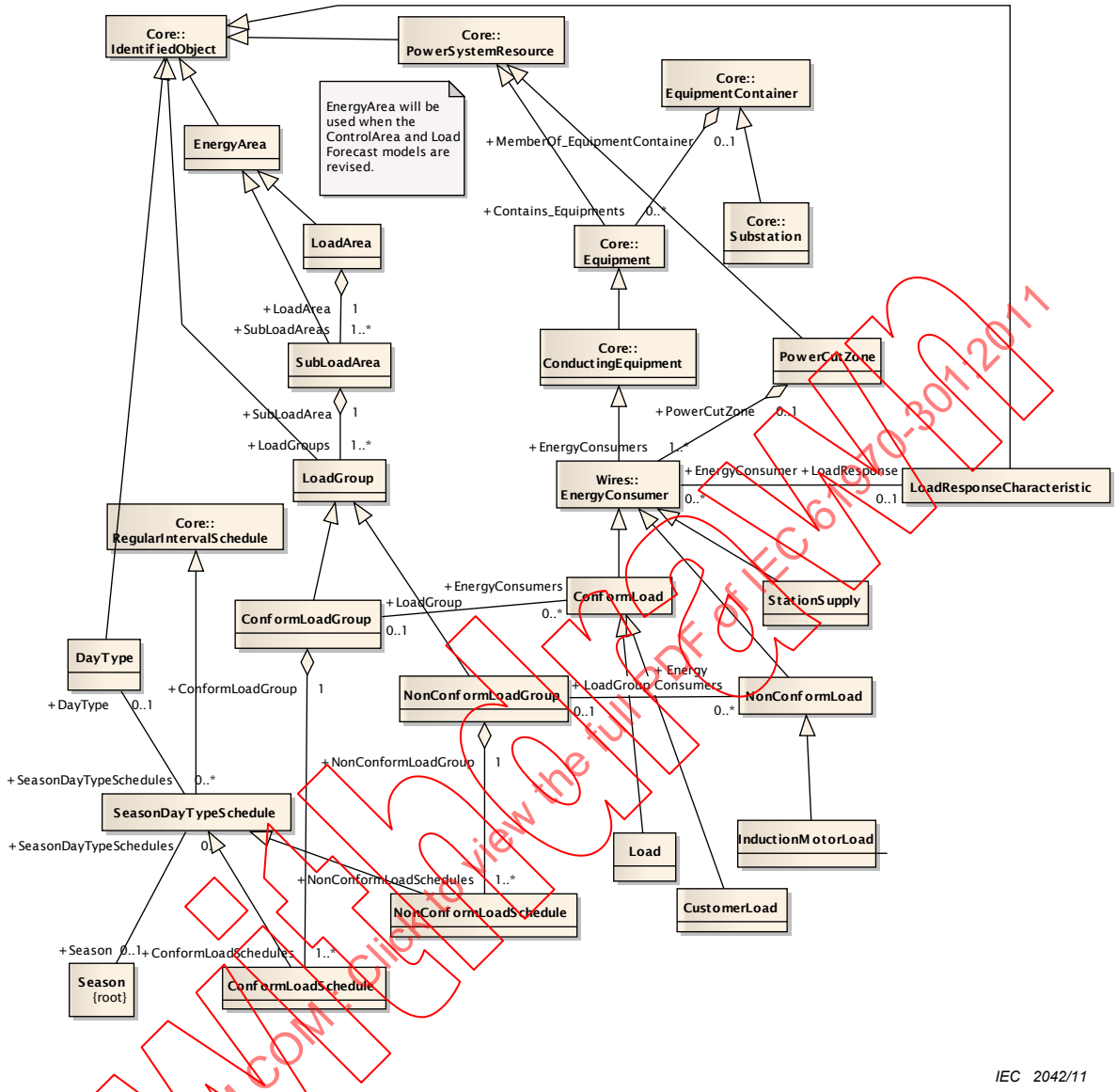
This information is used by Load Forecasting and Load Management.



IEC 2042/11

Figure 54 – Main

Figure 54 is documented as follows. This diagram shows all classes included in the LoadModel package as well as the key external classes that have associations with LoadModel classes.

IEC 2043/11

Figure 55 – Datatypes

Figure 55 is not documented.

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6.10.2 ConformLoad

ConformLoad represent loads that follow a daily load change pattern where the pattern can be used to scale the load with a system load.

Attributes

name	type	note
customerCount	Integer	inherited from: EnergyConsumer
pfixed	ActivePower	inherited from: EnergyConsumer
pfixedPct	PerCent	inherited from: EnergyConsumer
qfixed	ReactivePower	inherited from: EnergyConsumer
qfixedPct	PerCent	inherited from: EnergyConsumer
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] LoadGroup (ConformLoadGroup)	Group of this ConformLoad
0..*	[0..1] LoadResponse (LoadResponseCharacteristic)	inherited from: EnergyConsumer
1..*	[0..1] PowerCutZone (PowerCutZone)	inherited from: EnergyConsumer
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.10.3 ConformLoadGroup

Load that follows a daily and seasonal load variation pattern.

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Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] EnergyConsumers (ConformLoad)	Conform loads assigned to this ConformLoadGroup
1	[1..*] ConformLoadSchedules (ConformLoadSchedule)	The ConformLoadSchedules in the ConformLoadGroup
1..*	[1] SubLoadArea (SubLoadArea)	inherited from: LoadGroup
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.10.4 ConformLoadSchedule

A curve of load versus time (X-axis) showing the active power values (Y1-axis) and reactive power (Y2-axis) for each unit of the period covered. This curve represents a typical pattern of load over the time period for a given day type and season.

Attributes

name	type	note
timeStep	Seconds	inherited from: RegularIntervalSchedule
endTime	AbsoluteDateTime	inherited from: RegularIntervalSchedule
startTime	AbsoluteDateTime	inherited from: BasicIntervalSchedule
value1Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value1Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
value2Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value2Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1..*	[1] ConformLoadGroup (ConformLoadGroup)	The ConformLoadGroup where the ConformLoadSchedule belongs
0..*	[0..1] DayType (DayType)	inherited from: SeasonDayTypeSchedule
0..*	[0..1] Season (Season)	inherited from: SeasonDayTypeSchedule

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Mult from	[Mult] name (type)	note
1	[1..*] TimePoints (RegularTimePoint)	inherited from: RegularIntervalSchedule
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.10.5 CustomerLoad

A meter for measuring customer energy consumption.

Attributes

name	Type	Note
customerCount	Integer	inherited from: EnergyConsumer
pfixed	ActivePower	inherited from: EnergyConsumer
pfixedPct	PerCent	inherited from: EnergyConsumer
qfixed	ReactivePower	inherited from: EnergyConsumer
qfixedPct	PerCent	inherited from: EnergyConsumer
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] LoadGroup (ConformLoadGroup)	inherited from: ConformLoad
0..*	[0..1] LoadResponse (LoadResponseCharacteristic)	inherited from: EnergyConsumer
1..*	[0..1] PowerCutZone (PowerCutZone)	inherited from: EnergyConsumer
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.10.6 DayType

Group of similar days, e.g., Mon/Tue/Wed, Thu/Fri, Sat/Sun, Holiday1, Holiday2.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] SeasonDayTypeSchedules (SeasonDayTypeSchedule)	Schedules that use this DayType
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.10.7 EnergyArea

The class describes an area having energy production or consumption. The class is the basis for further specialization.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..1] ControlArea (ControlArea)	The control area specification that is used for the load forecast
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.10.8 InductionMotorLoad

Large three phase induction motor load.

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Attributes

name	type	note
customerCount	Integer	inherited from: EnergyConsumer
pfixed	ActivePower	inherited from: EnergyConsumer
pfixedPct	PerCent	inherited from: EnergyConsumer
qfixed	ReactivePower	inherited from: EnergyConsumer
qfixedPct	PerCent	inherited from: EnergyConsumer
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] LoadGroup (NonConformLoadGroup)	inherited from: NonConformLoad
0..*	[0..1] LoadResponse (LoadResponseCharacteristic)	inherited from: EnergyConsumer
1..*	[0..1] PowerCutZone (PowerCutZone)	inherited from: EnergyConsumer
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.10.9 Load

A generic equivalent for an energy consumer on a transmission or distribution voltage level. It may be under load management and also has cold load pick up characteristics.

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Attributes

name	type	note
feederLoadMgtFactor	PerCent	The feeder's contribution to load management
coldPickUpFactorQ	PerCent	The amount of nominal feeder reactive power that is picked up cold
coldPickUpFactorP	PerCent	The amount of nominal feeder active power that is picked up cold
phaseRatedCurrent	CurrentFlow	The rated individual phase current
loadAllocationFactor	Float	Permit assignment of loads on a participation factor basis. Given three equivalent loads with factors of 10, 25 and 15, a feeder load of 100 A could be allocated on the feeder as 20 A, 50 A and 30 A.
customerCount	Integer	inherited from: EnergyConsumer
pfixed	ActivePower	inherited from: EnergyConsumer
pfixedPct	PerCent	inherited from: EnergyConsumer
qfixed	ReactivePower	inherited from: EnergyConsumer
qfixedPct	PerCent	inherited from: EnergyConsumer
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] LoadGroup (ConformLoadGroup)	inherited from: ConformLoad
0..*	[0..1] LoadResponse (LoadResponseCharacteristic)	inherited from: EnergyConsumer
1..*	[0..1] PowerCutZone (PowerCutZone)	inherited from: EnergyConsumer
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource

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Mult from	[Mult] name (type)	note
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.10.10 LoadArea

The class is the root or first level in a hierarchical structure for grouping of loads for the purpose of load flow load scaling.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[1..*] SubLoadAreas (SubLoadArea)	The SubLoadAreas in the LoadArea
0..1	[0..1] ControlArea (ControlArea)	inherited from: EnergyArea
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.10.11 LoadGroup

The class is the third level in a hierarchical structure for grouping of loads for the purpose of load flow load scaling.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1..*	[1] SubLoadArea (SubLoadArea)	The SubLoadArea where the Loadgroup belongs
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.10.12 LoadResponseCharacteristic

Models the characteristic response of the load demand due to to changes in system conditions such as voltage and frequency. This is not related to demand response.

Attributes

name	type	note
exponentModel	Boolean	Indicates the exponential voltage dependency model (pVoltateExponent and qVoltageExponent) to be used. If false, the coeficient model (consisting of pConstantImpedance, pConstantCurrent, pConstantPower, qConstantImpedance, qConstantCurrent, and qConstantPower) is to be used.
pConstantCurrent	Float	Portion of active power load modeled as constant current. Used only if the useExponentModel is false. This value is normalized against the sum of pZ, pI, and pP.
pConstantImpedance	Float	Portion of active power load modeled as constant impedance. Used only if the useExponentModel is false. This value is normalized against the sum of pZ, pI, and pP.
pConstantPower	Float	Portion of active power load modeled as constant power. Used only if the useExponentModel is false. This value is normalized against the sum of pZ, pI, and pP.
pFrequencyExponent	Float	Exponent of per unit frequency effecting active power.
pVoltageExponent	Float	Exponent of per unit voltage effecting real power. This model used only when "useExponentModel" is true.
qConstantCurrent	Float	Portion of reactive power load modeled as constant current. Used only if the useExponentModel is false. This value is normalized against the sum of qZ, qI, and qP.
qConstantImpedance	Float	Portion of reactive power load modeled as constant impedance. Used only if the useExponentModel is false. This value is normalized against the sum of qZ, qI, and qP.
qConstantPower	Float	Portion of reactive power load modeled as constant power. Used only if the useExponentModel is false. This value is normalized against the sum of qZ, qI, and qP.
qFrequencyExponent	Float	Exponent of per unit frequency effecting reactive power.
qVoltageExponent	Float	Exponent of per unit voltage effecting reactive power. This model used only when "useExponentModel" is true.
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] EnergyConsumer (EnergyConsumer)	The set of loads that have the response characteristics
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.10.13 NonConformLoad

NonConformLoad represent loads that do not follow a daily load change pattern and changes are not correlated with the daily load change pattern.

Attributes

name	type	note
customerCount	Integer	inherited from: EnergyConsumer
pfixed	ActivePower	inherited from: EnergyConsumer
pfixedPct	PerCent	inherited from: EnergyConsumer
qfixed	ReactivePower	inherited from: EnergyConsumer
qfixedPct	PerCent	inherited from: EnergyConsumer
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] LoadGroup (NonConformLoadGroup)	Group of this ConformLoad
0..*	[0..1] LoadResponse (LoadResponseCharacteristic)	inherited from: EnergyConsumer
1..*	[0..1] PowerCutZone (PowerCutZone)	inherited from: EnergyConsumer
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource

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Mult from	[Mult] name (type)	note
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.10.14 NonConformLoadGroup

Loads that do not follow a daily and seasonal load variation pattern.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] EnergyConsumers (NonConformLoad)	Conform loads assigned to this ConformLoadGroup
1	[1..*] NonConformLoadSchedules (NonConformLoadSchedule)	The NonConformLoadSchedules in the NonConformLoadGroup
1..*	[1] SubLoadArea (SubLoadArea)	inherited from: LoadGroup
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.10.15 NonConformLoadSchedule

An active power (Y1-axis) and reactive power (Y2-axis) schedule (curves) versus time (X-axis) for non-conforming loads, e.g., large industrial load or power station service (where modeled).

Attributes

name	type	note
timeStep	Seconds	inherited from: RegularIntervalSchedule
endTime	AbsoluteDateTime	inherited from: RegularIntervalSchedule
startTime	AbsoluteDateTime	inherited from: BasicIntervalSchedule
value1Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value1Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
value2Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value2Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
mRID	String	inherited from: IdentifiedObject

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name	type	note
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1..*	[1] NonConformLoadGroup (NonConformLoadGroup)	The NonConformLoadGroup where the NonConformLoadSchedule belongs
0..*	[0..1] DayType (DayType)	inherited from: SeasonDayTypeSchedule
0..*	[0..1] Season (Season)	inherited from: SeasonDayTypeSchedule
1	[1..*] TimePoints (RegularTimePoint)	inherited from: RegularIntervalSchedule
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.10.16 PowerCutZone

An area or zone of the power system which is used for load shedding purposes.

Attributes

name	type	note
cutLevel1	PerCent	First level (amount) of load to cut as a percentage of total zone load
cutLevel2	PerCent	Second level (amount) of load to cut as a percentage of total zone load
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1..*] EnergyConsumers (EnergyConsumer)	An energy consumer is assigned to a power cut zone.
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.10.17 Season

A specified time period of the year, e.g., Spring, Summer, Fall, Winter.

Attributes

name	type	note
name	SeasonName	Name of the season
endDate	AbsoluteDateTime	Date season ends
startDate	AbsoluteDateTime	Date season starts

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] SeasonDayTypeSchedules (SeasonDayTypeSchedule)	Schedules that use this season

6.10.18 SeasonDayTypeSchedule

The schedule specialize RegularIntervalSchedule with type curve data for a specific type of day and season. This means that curves of this type cover a 24 h period.

Attributes

name	type	note
timeStep	Seconds	inherited from: RegularIntervalSchedule
endTime	AbsoluteDateTime	inherited from: RegularIntervalSchedule
startTime	AbsoluteDateTime	inherited from: BasicIntervalSchedule
value1Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value1Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
value2Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value2Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] DayType (DayType)	DayType for the Schedule
0..*	[0..1] Season (Season)	Season for the Schedule
1	[1..*] TimePoints (RegularTimePoint)	inherited from: RegularIntervalSchedule
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.10.19 SeasonName enumeration

Name of season.

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Enums

name	note
winter	
spring	
summer	
fall	

6.10.20 StationSupply

Station supply with load derived from the station output.

Attributes

name	type	note
customerCount	Integer	inherited from: EnergyConsumer
pfixed	ActivePower	inherited from: EnergyConsumer
pfixedPct	PerCent	inherited from: EnergyConsumer
qfixed	ReactivePower	inherited from: EnergyConsumer
qfixedPct	PerCent	inherited from: EnergyConsumer
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] LoadResponse (LoadResponseCharacteristic)	inherited from: EnergyConsumer
1..*	[0..1] PowerCutZone (PowerCutZone)	inherited from: EnergyConsumer
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource

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Mult from	[Mult] name (type)	note
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.10.21 SubLoadArea

The class is the second level in a hierarchical structure for grouping of loads for the purpose of load flow load scaling.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

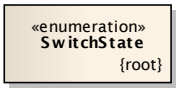
Association ends

Mult from	[Mult] name (type)	note
1..*	[1] LoadArea (LoadArea)	The LoadArea where the SubLoadArea belongs
1	[1..*] LoadGroups (LoadGroup)	The Loadgroups in the SubLoadArea
0..1	[0..1] ControlArea (ControlArea)	inherited from: EnergyArea
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.11 Outage

6.11.1 Outage package summary

An extension to the Core and Wires packages that models information on the current and planned network configuration. These entities are optional within typical network applications.



IEC 2044/11

Figure 56 – Datatypes

Figure 56 is documented as follows. This diagram shows the data types specific to the Outage package.

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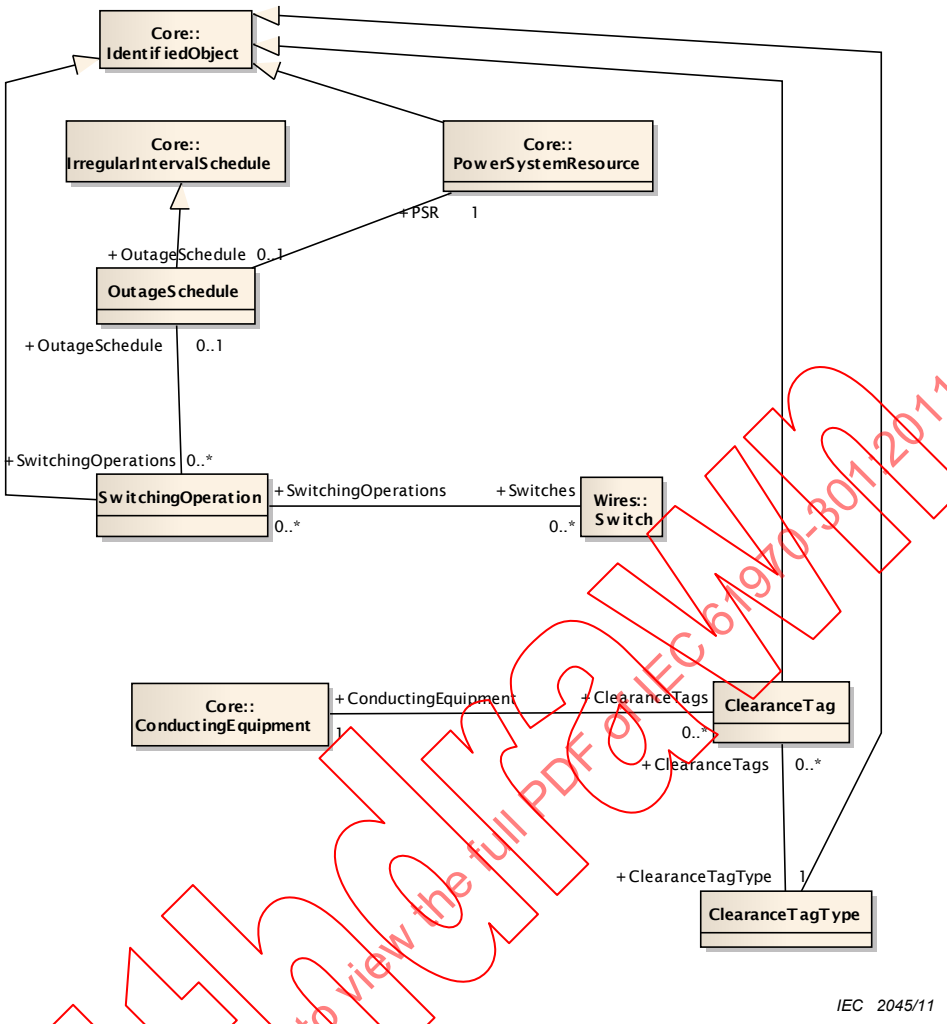

Figure 57 – Main

Figure 57 is documented as follows. This diagram shows all classes included in the Outage package as well as the key external classes that have associations with Outage classes.

6.11.2 ClearanceTag

A clearance tag that is used to authorize and schedule work on conducting equipment in the field. Tagged equipment is not available for commercial service.

Attributes

name	type	note
authorityName	String	The name of the person who is authorized to issue the tag
deenergizeReqFlag	Boolean	Set true if equipment must be deenergized
groundReqFlag	Boolean	Set true if equipment must be grounded
phaseCheckReqFlag	Boolean	Set true if equipment phasing must be checked
tagIssueTime	AbsoluteDateTime	The time at which the clearance tag was issued
workDescription	String	Description of the work to be performed
workEndTime	AbsoluteDateTime	The time at which the clearance tag is scheduled to be removed

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name	type	note
workStartTime	AbsoluteDateTime	The time at which the clearance tag is scheduled to be set
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] ClearanceTagType (ClearanceTagType)	The type of tag, depending on the purpose of the work to be performed and/or the type of supervisory control allowed.
0..*	[1] ConductingEquipment (ConductingEquipment)	Conducting equipment may have multiple clearance tags for authorized field work.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.11.3 ClearanceTagType

Type of ClearanceTag. Could indicate the type of work to be performed and/or the type of supervisory control.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[0..*] ClearanceTags (ClearanceTag)	The ClearanceTags currently being defined for this type
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.11.4 OutageSchedule

The period of time that a piece of equipment is out of service, for example for maintenance or testing, including the equipment's active power rating while under maintenance. The X-axis represents absolute time and the Y-axis represents the equipment's available rating while out of service.

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Attributes

name	type	note
startTime	AbsoluteDateTime	inherited from: BasicIntervalSchedule
value1Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value1Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
value2Unit	UnitSymbol	inherited from: BasicIntervalSchedule
value2Multiplier	UnitMultiplier	inherited from: BasicIntervalSchedule
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1] PSR (PowerSystemResource)	A power system resource may have an outage schedule.
0..1	[0..*] SwitchingOperations (SwitchingOperation)	An OutageSchedule may operate many switches.
1	[1..*] TimePoints (IrregularTimePoint)	inherited from: IrregularIntervalSchedule
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.11.5 SwitchingOperation

A SwitchingOperation is used to define individual switch operations for an OutageSchedule. This OutageSchedule may be associated with another item of Substation such as a Transformer, Line, or Generator, or with the Switch itself as a PowerSystemResource. A Switch may be referenced by many OutageSchedules.

Attributes

name	type	note
operationTime	AbsoluteDateTime	Time of operation in same units as OutageSchedule.xAxixUnits
newState	SwitchState	The switch position that shall result from this SwitchingOperation
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..*	[0..1] OutageSchedule (OutageSchedule)	An OutageSchedule may operate many switches.
0..*	[0..*] Switches (Switch)	A switch may be operated by many schedules.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.11.6 SwitchState enumeration

Possible states for a switch.

Enums

name	note
open	
close	

6.12 Protection

6.12.1 Protection package summary

An extension to the Core and Wires packages that models information for protection equipment such as relays. These entities are used within training simulators and distribution network fault location applications.

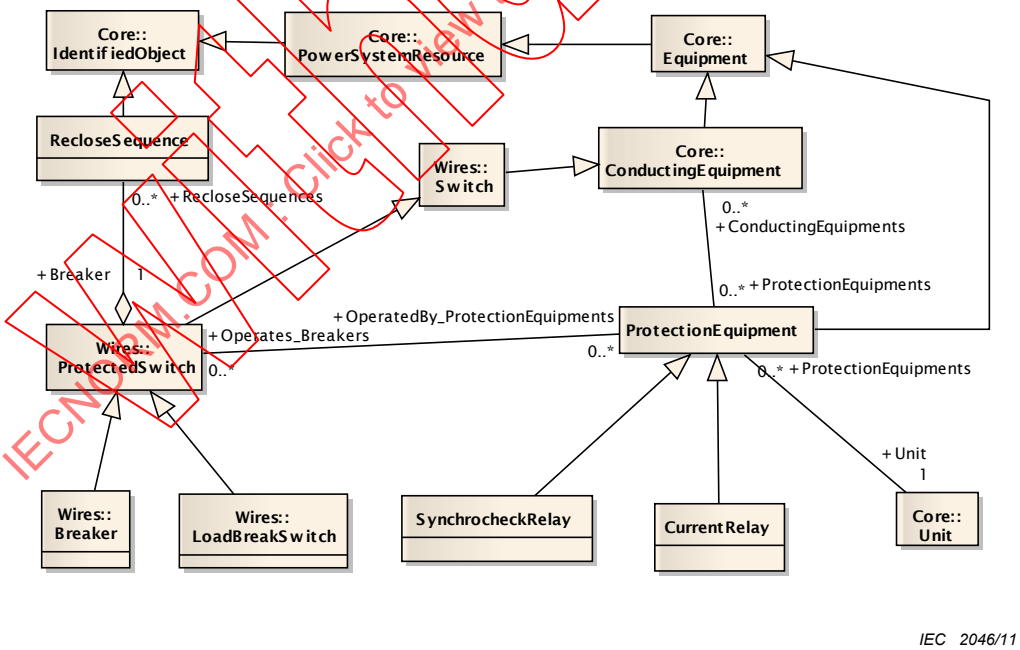

Figure 58 – Main

Figure 58 is documented as follows. This diagram shows all classes included in the Protection package as well as the key external classes that have associations with Protection classes.

6.12.2 CurrentRelay

A device that checks current flow values in any direction or designated direction.

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Attributes

name	type	note
currentLimit1	CurrentFlow	Current limit #1 for inverse time pickup
currentLimit2	CurrentFlow	Current limit #2 for inverse time pickup
currentLimit3	CurrentFlow	Current limit #3 for inverse time pickup
inverseTimeFlag	Boolean	Set true if the current relay has inverse time characteristic
timeDelay1	Seconds	Inverse time delay #1 for current limit #1
timeDelay2	Seconds	Inverse time delay #2 for current limit #2
timeDelay3	Seconds	Inverse time delay #3 for current limit #3
relayDelayTime	Seconds	inherited from: ProtectionEquipment
highLimit	Float	inherited from: ProtectionEquipment
lowLimit	Float	inherited from: ProtectionEquipment
powerDirectionFlag	Boolean	inherited from: ProtectionEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] ConductingEquipments (ConductingEquipment)	inherited from: ProtectionEquipment
0..*	[0..*] Operates_Breakers (ProtectedSwitch)	inherited from: ProtectionEquipment
0..*	[1] Unit (Unit)	inherited from: ProtectionEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.12.3 ProtectionEquipment

An electrical device designed to respond to input conditions in a prescribed manner and after specified conditions are met to cause contact operation or similar abrupt change in associated electric control circuits, or simply to display the detected condition. Protection equipment are associated with conducting equipment and usually operate circuit breakers.

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Attributes

name	type	note
relayDelayTime	Seconds	The time delay from detection of abnormal conditions to relay operation
highLimit	Float	The maximum allowable value
lowLimit	Float	The minimum allowable value
powerDirectionFlag	Boolean	Direction same as positive active power flow value
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] ConductingEquipments (ConductingEquipment)	Protection equipment may be used to protect specific conducting equipment. Multiple equipment may be protected or monitored by multiple protection equipment.
0..*	[0..*] Operates_Breakers (ProtectedSwitch)	Protected switches operated by this ProtectionEquipment.
0..*	[1] Unit (Unit)	The unit for the protection equipment.
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.12.4 RecloseSequence

A reclose sequence (open and close) is defined for each possible reclosure of a breaker.

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Attributes

name	type	note
recloseDelay	Seconds	Indicates the time lapse before the reclose step will execute a reclose.
recloseStep	Integer	Indicates the ordinal position of the reclose step relative to other steps in the sequence.
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] Breaker (ProtectedSwitch)	A breaker may have zero or more automatic reclosures after a trip occurs.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.12.5 SynchrocheckRelay

A device that operates when two AC circuits are within the desired limits of frequency, phase angle, and voltage, to permit or to cause the paralleling of these two circuits. Used to prevent the paralleling of non-synchronous topological islands.

Attributes

name	type	note
maxAngleDiff	AngleRadians	The maximum allowable voltage vector phase angle difference across the open device
maxFreqDiff	Frequency	The maximum allowable frequency difference across the open device
maxVoltDiff	Voltage	The maximum allowable difference voltage across the open device
relayDelayTime	Seconds	inherited from: ProtectionEquipment
highLimit	Float	inherited from: ProtectionEquipment
lowLimit	Float	inherited from: ProtectionEquipment
powerDirectionFlag	Boolean	inherited from: ProtectionEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] ConductingEquipments (ConductingEquipment)	inherited from: ProtectionEquipment
0..*	[0..*] Operates_Breakers (ProtectedSwitch)	inherited from: ProtectionEquipment
0..*	[1] Unit (Unit)	inherited from: ProtectionEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.13 Equivalents

6.13.1 Equivalents package summary

The equivalents package models equivalent networks.

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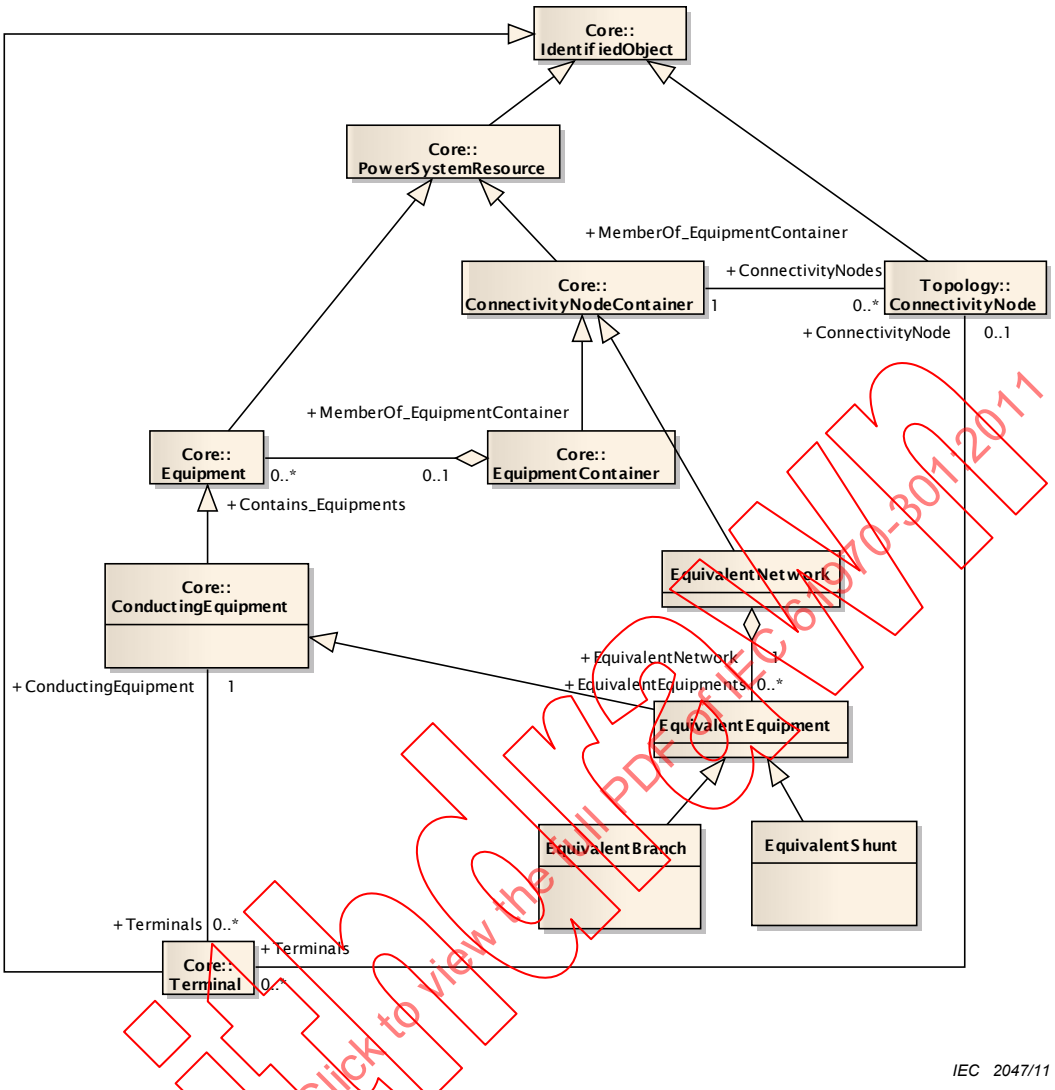

Figure 59 – Main

Figure 59 is not documented.

6.13.2 EquivalentBranch

The class represents equivalent branches.

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Attributes

name	type	note
r	Resistance	Positive sequence series resistance of the reduced branch
x	Reactance	Positive sequence series reactance of the reduced branch
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] EquivalentNetwork (EquivalentNetwork)	inherited from: EquivalentEquipment
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.13.3 EquivalentEquipment

The class represents equivalent objects that are the result of a network reduction. The class is the base for equivalent objects of different types.

Attributes

name	type	note
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject

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name	type	note
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] EquivalentNetwork (EquivalentNetwork)	The equivalent where the reduced model belongs
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.13.4 EquivalentNetwork

A class that represents an external meshed network that has been reduced to an electrically equivalent model. The ConnectivityNodes contained in the equivalent are intended to reflect internal nodes of the equivalent. The boundary Connectivity nodes where the equivalent connects outside itself are NOT contained by the equivalent.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
1	[0..*] EquivalentEquipments (EquivalentEquipment)	The associated reduced equivalents
1	[0..*] ConnectivityNodes (ConnectivityNode)	inherited from: ConnectivityNodeContainer
0..1	[0..*] TopologicalNode (TopologicalNode)	inherited from: ConnectivityNodeContainer
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.13.5 EquivalentShunt

The class represents equivalent shunts.

Attributes

name	type	note
b	Susceptance	Positive sequence shunt susceptance
g	Conductance	Positive sequence shunt conductance
phases	PhaseCode	inherited from: ConductingEquipment
normallyInService	Boolean	inherited from: Equipment
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] EquivalentNetwork (EquivalentNetwork)	inherited from: EquivalentEquipment
0..*	[0..1] BaseVoltage (BaseVoltage)	inherited from: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	inherited from: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	inherited from: ConductingEquipment
1	[0..*] Terminals (Terminal)	inherited from: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	inherited from: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	inherited from: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	inherited from: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource

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Mult from	[Mult] name (type)	note
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14 Meas

6.14.1 Meas package summary

Contains entities that describe dynamic measurement data exchanged between applications.

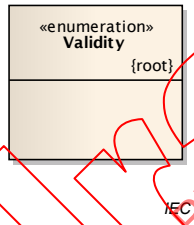

Figure 60 – Datatypes

Figure 60 is not documented.

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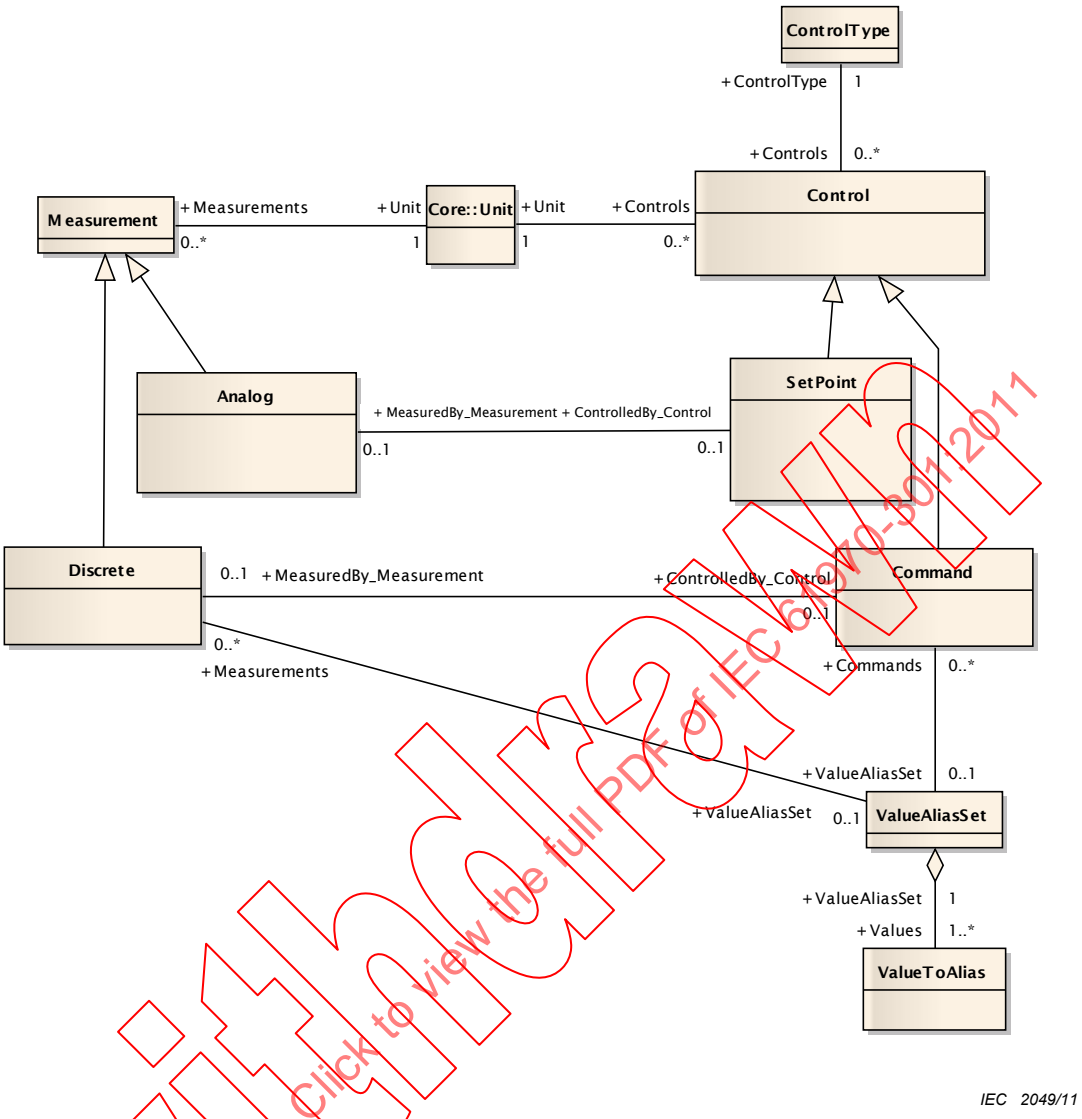

Figure 61 – Control

Figure 61 is documented as follows. This diagram shows all classes included in the Meas package.

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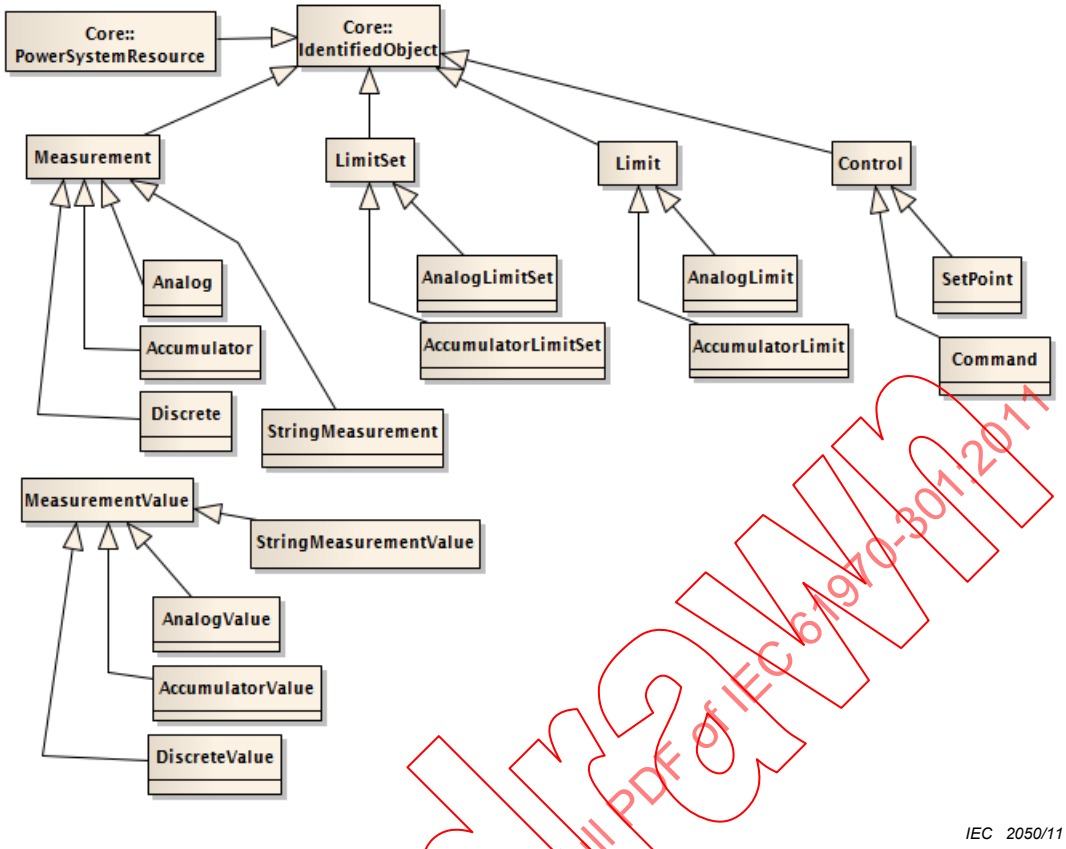

Figure 62 – InheritanceStructure

Figure 62 is documented as follows. This diagram shows the measurement classes inherit basic classes.

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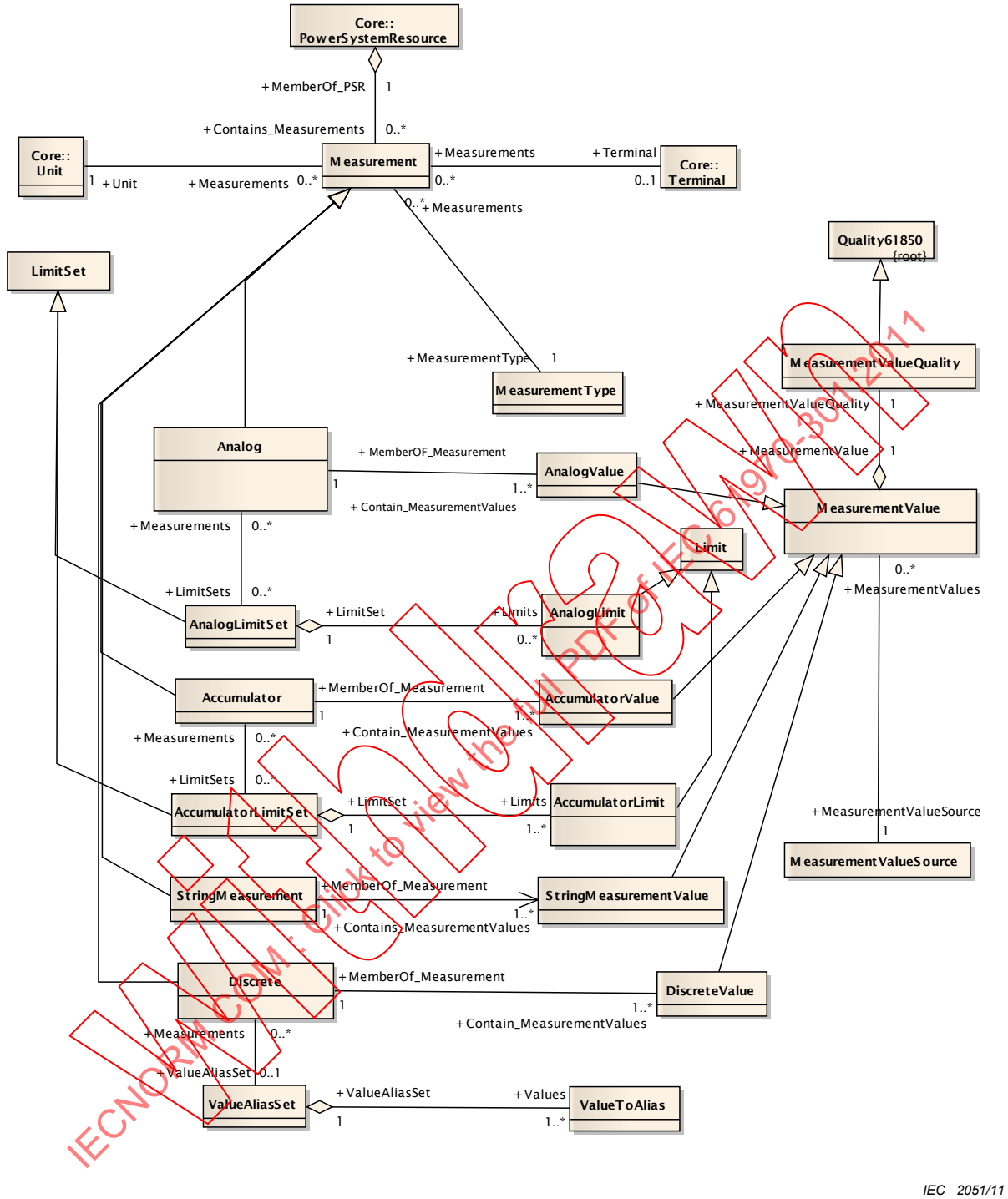

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Figure 63 – Measurement

Figure 63 is documented as follows. This diagram shows classes central to the Measurement package and connections to some external classes.

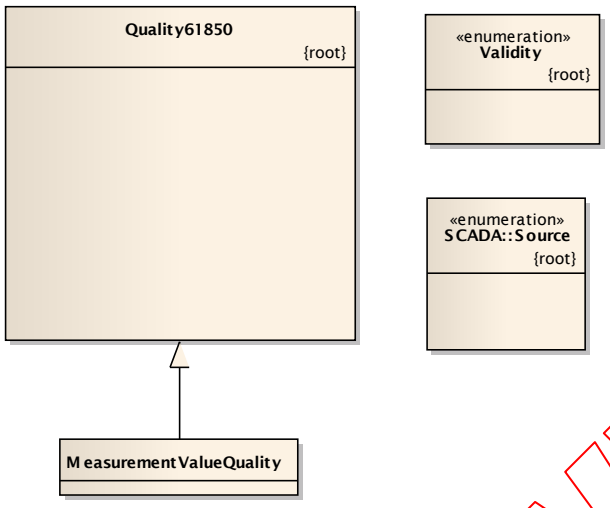

Figure 64 – Quality

Figure 64 is documented as follows. This diagram shows the details of the quality codes. The quality flags can be used also in other packages not only specific to MeasurementValues. A generalized Quality class is added and inherited into MeasurementValueQuality.

6.14.2 Accumulator

Accumulator represents an accumulated (counted) Measurement, e.g. an energy value.

Attributes

name	type	note
maxValue	Integer	Normal value range maximum for any of the MeasurementValue.values. Used for scaling, e.g. in bar graphs or of telemetered raw values.
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] LimitSets (AccumulatorLimitSet)	A measurement may have zero or more limit ranges defined for it.
1	[1..*] Contain_MeasurementValues (AccumulatorValue)	The values connected to this measurement.
0..*	[1] MeasurementType (MeasurementType)	inherited from: Measurement
0..*	[1] MemberOf_PSR (PowerSystemResource)	inherited from: Measurement
0..*	[0..1] Terminal (Terminal)	inherited from: Measurement
0..*	[1] Unit (Unit)	inherited from: Measurement
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.14.3 AccumulatorLimit

Limit values for Accumulator measurements.

Attributes

name	type	note
value	Integer	The value to supervise against. The value is positive.
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1..*	[1] LimitSet (AccumulatorLimitSet)	The set of limits
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.4 AccumulatorLimitSet

An AccumulatorLimitSet specifies a set of Limits that are associated with an Accumulator measurement.

Attributes

name	type	note
isPercentageLimits	Boolean	inherited from: LimitSet
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] Measurements (Accumulator)	The Measurements using the LimitSet
1	[1..*] Limits (AccumulatorLimit)	The limit values used for supervision of Measurements
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.5 AccumulatorValue

AccumulatorValue represents an accumulated (counted) MeasurementValue.

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Attributes

name	type	note
value	Integer	The value to supervise. The value is positive.
timeStamp	AbsoluteDateTime	inherited from: MeasurementValue
sensorAccuracy	PerCent	inherited from: MeasurementValue
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1..*	[1] MemberOf_Measurement (Accumulator)	Measurement to which this value is connected
1	[1] MeasurementValueQuality (MeasurementValueQuality)	inherited from: MeasurementValue
0..*	[1] MeasurementValueSource (MeasurementValueSource)	inherited from: MeasurementValue
1	[0..1] RemoteSource (RemoteSource)	inherited from: MeasurementValue
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.6 Analog

Analog represents an analog Measurement.

Attributes

name	type	note
maxValue	Float	Normal value range maximum for any of the MeasurementValue.values. Used for scaling, e.g. in bar graphs or of telemetered raw values.
minValue	Float	Normal value range minimum for any of the MeasurementValue.values. Used for scaling, e.g. in bar graphs or of telemetered raw values
normalValue	Float	Normal measurement value, e.g., used for percentage calculations.
positiveFlowIn	Boolean	If true then this measurement is an active power, reactive power or current with the convention that a positive value measured at the Terminal means power is flowing into the related PowerSystemResource.
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] LimitSets (AnalogLimitSet)	A measurement may have zero or more limit ranges defined for it.
1	[1..*] Contain_MeasurementValues (AnalogValue)	The values connected to this measurement.
0..1	[0..1] ControlledBy_Control (SetPoint)	The control variable associated with the measurement.
0..*	[1] MeasurementType (MeasurementType)	inherited from: Measurement
0..*	[1] MemberOf_PSR (PowerSystemResource)	inherited from: Measurement
0..*	[0..1] Terminal (Terminal)	inherited from: Measurement
0..*	[1] Unit (Unit)	inherited from: Measurement
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.7 AnalogLimit

Limit values for Analog measurements.

Attributes

name	type	note
value	Float	The value to supervise against
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] LimitSet (AnalogLimitSet)	The set of limits
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.8 AnalogLimitSet

An AnalogLimitSet specifies a set of Limits that are associated with an Analog measurement.

Attributes

name	type	note
isPercentageLimits	Boolean	inherited from: LimitSet
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..*	[0..*] Measurements (Analog)	The Measurements using the LimitSet
1	[0..*] Limits (AnalogLimit)	The limit values used for supervision of Measurements
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.9 AnalogValue

AnalogValue represents an analog MeasurementValue.

Attributes

name	type	note
value	Float	The value to supervise.
timeStamp	AbsoluteDateTime	inherited from: MeasurementValue
sensorAccuracy	PerCent	inherited from: MeasurementValue
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[0..*] AltGeneratingUnit (AltGeneratingUnitMeas)	The alternate generating unit for which this measurement value applies.
1	[0..*] AltTieMeas (AltTieMeas)	The usage of the measurement within the control area specification.
1..*	[1] MemberOf_Measurement (Analog)	Measurement to which this value is connected.
1	[1] MeasurementValueQuality (MeasurementValueQuality)	inherited from: MeasurementValue
0..*	[1] MeasurementValueSource (MeasurementValueSource)	inherited from: MeasurementValue
1	[0..1] RemoteSource (RemoteSource)	inherited from: MeasurementValue
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.10 Command

A Command is a discrete control used for supervisory control.

Attributes

name	type	note
value	Integer	The value representing the actuator output
normalValue	Integer	Normal value for Control.value e.g. used for percentage scaling
timeStamp	AbsoluteDateTime	inherited from: Control
operationInProgress	Boolean	inherited from: Control
mRID	String	inherited from: IdentifiedObject

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name	type	note
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..1] MeasuredBy_Measurement (Discrete)	The Measurement variable used for control.
0..*	[0..1] ValueAliasSet (ValueAliasSet)	The Commands using the set for translation.
0..*	[1] ControlType (ControlType)	inherited from: Control
1..*	[0..1] ControlledBy_RegulatingCondEq (RegulatingCondEq)	inherited from: Control
1	[0..1] RemoteControl (RemoteControl)	inherited from: Control
0..*	[1] Unit (Unit)	inherited from: Control
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.11 Control

Control is used for supervisory/device control. It represents control outputs that are used to change the state in a process, e.g. close or open breaker, a set point value or a raise lower command.

Attributes

name	type	note
timeStamp	AbsoluteDateTime	The last time a control output was sent
operationInProgress	Boolean	Indicates that a client is currently sending control commands that has not completed
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] ControlType (ControlType)	The type of Control
1..*	[0..1] ControlledBy_RegulatingCondEq (RegulatingCondEq)	Regulating device governed by this control output.
1	[0..1] RemoteControl (RemoteControl)	The remote point controlling the physical actuator.
0..*	[1] Unit (Unit)	The Unit for the Control.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.14.12 ControlType

Specifies the type of Control, e.g. BreakerOn/Off, GeneratorVoltageSetPoint, TieLineFlow etc. The ControlType.name shall be unique among all specified types and describe the type. The ControlType.aliasName is meant to be used for localization.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[0..*] Controls (Control)	The Controls having the ControlType
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.13 Discrete

Discrete represents a discrete Measurement, i.e. a Measurement representing discrete values, e.g. a Breaker position.

Attributes

name	type	note
maxValue	Integer	Normal value range maximum for any of the MeasurementValue.values. Used for scaling, e.g. in bar graphs or of telemetered raw values.
minValue	Integer	Normal value range minimum for any of the MeasurementValue.values. Used for scaling, e.g. in bar graphs or of telemetered raw values
normalValue	Integer	Normal measurement value, e.g., used for percentage calculations.
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..1] ControlledBy_Control (Command)	The Control variable associated with the Measurement.
1	[1..*] Contain_MeasurementValues (DiscreteValue)	The values connected to this measurement.
0..*	[0..1] ValueAliasSet (ValueAliasSet)	The ValueAliasSet used for translation of

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Mult from	[Mult] name (type)	note
		a MeasurementValue.value to a name
0..*	[1] MeasurementType (MeasurementType)	inherited from: Measurement
0..*	[1] MemberOf_PSR (PowerSystemResource)	inherited from: Measurement
0..*	[0..1] Terminal (Terminal)	inherited from: Measurement
0..*	[1] Unit (Unit)	inherited from: Measurement
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.14 DiscreteValue

DiscreteValue represents a discrete MeasurementValue.

Attributes

name	type	note
value	Integer	The value to supervise.
timeStamp	AbsoluteDateTime	inherited from: MeasurementValue
sensorAccuracy	PerCent	inherited from: MeasurementValue
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1..*	[1] MemberOf_Measurement (Discrete)	Measurement to which this value is connected.
1	[1] MeasurementValueQuality (MeasurementValueQuality)	inherited from: MeasurementValue
0..*	[1] MeasurementValueSource (MeasurementValueSource)	inherited from: MeasurementValue
1	[0..1] RemoteSource (RemoteSource)	inherited from: MeasurementValue
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.15 Limit

Specifies one limit value for a Measurement. A Measurement typically has several limits that are kept together by the LimitSet class. The actual meaning and use of a Limit instance (i.e., if it is an alarm or warning limit or if it is a high or low limit) is not captured in the Limit class. However the name of a Limit instance may indicate both meaning and use.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject

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name	type	note
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.16 LimitSet

Specifies a set of Limits that are associated with a Measurement. A Measurement may have several LimitSets corresponding to seasonal or other changing conditions. The condition is captured in the name and description attributes. The same LimitSet may be used for several Measurements. In particular percentage limits are used this way.

Attributes

name	type	note
isPercentageLimits	Boolean	Tells if the limit values are in percentage of normalValue or the specified Unit for Measurements and Controls.
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.17 Measurement

A Measurement represents any measured, calculated or non-measured non-calculated quantity. Any piece of equipment may contain Measurements, e.g. a substation may have temperature measurements and door open indications, a transformer may have oil temperature and tank pressure measurements, a bay may contain a number of power flow measurements and a Breaker may contain a switch status measurement.

The PSR - Measurement association is intended to capture this use of Measurement and is included in the naming hierarchy based on EquipmentContainer. The naming hierarchy typically has Measurements as leafs, e.g. Substation-VoltageLevel-Bay-Switch-Measurement.

Some Measurements represent quantities related to a particular sensor location in the network, e.g. a voltage transformer (PT) at a busbar or a current transformer (CT) at the bar between a breaker and an isolator. The sensing position is not captured in the PSR - Measurement association. Instead it is captured by the Measurement - Terminal association that is used to define the sensing location in the network topology. The location is defined by the connection of the Terminal to ConductingEquipment.

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Two possible paths exist:

1) Measurement-Terminal- ConnectivityNode-Terminal-ConductingEquipment
2) Measurement-Terminal-ConductingEquipment

Alternative 2) is the only allowed use.

When the sensor location is needed both Measurement-PSR and Measurement-Terminal are used. The Measurement-Terminal association is never used alone.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] MeasurementType (MeasurementType)	The type for the Measurement.
0..*	[1] MemberOf_PSR (PowerSystemResource)	The PowerSystemResource that contains the Measurement in the naming hierarchy.
0..*	[0..1] Terminal (Terminal)	One or more measurements may be associated with a terminal in the network.
0..*	[1] Unit (Unit)	The Unit for the Measurement.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.18 MeasurementType

Specifies the type of Measurement, e.g. IndoorTemperature, OutDoorTemperature, BusVoltage, GeneratorVoltage, LineFlow etc. The MeasurementType.name shall be unique among all specified types and describe the type. The MeasurementType.aliasName is meant to be used for localization.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
1	[0..*] Measurements (Measurement)	The measurements associated with the Type
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.19 MeasurementValue

The current state for a measurement. A state value is an instance of a measurement from a specific source. Measurements can be associated with many state values, each representing a different source for the measurement.

Attributes

name	type	note
timeStamp	AbsoluteDateTime	The time when the value was last updated
sensorAccuracy	PerCent	The limit, expressed as a percentage of the sensor maximum, that errors will not exceed when the sensor is used under reference conditions.
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[1] MeasurementValueQuality (MeasurementValueQuality)	A MeasurementValue has a MeasurementValueQuality associated with it.
0..*	[1] MeasurementValueSource (MeasurementValueSource)	A reference to the type of source that updates the MeasurementValue, e.g. SCADA, CCLink, manual, etc. User conventions for the names of sources are contained in the introduction to this document.
1	[0..1] RemoteSource (RemoteSource)	Link to the physical telemetered point associated with this measurement.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.20 MeasurementValueQuality

Measurement quality flags. Bits 0 to 10 are defined for substation automation in IEC 61850-7-3. Bits 11 to 15 are reserved for future expansion by that document. Bits 16 to 31 are reserved for EMS applications.

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Attributes

name	type	note
badReference	Boolean	inherited from: Quality61850
estimatorReplaced=false	Boolean	inherited from: Quality61850
failure	Boolean	inherited from: Quality61850
oldData	Boolean	inherited from: Quality61850
operatorBlocked=false	Boolean	inherited from: Quality61850
oscillatory	Boolean	inherited from: Quality61850
outOfRange	Boolean	inherited from: Quality61850
overFlow	Boolean	inherited from: Quality61850
source=PROCESS	Source	inherited from: Quality61850
suspect	Boolean	inherited from: Quality61850
test=false	Boolean	inherited from: Quality61850
validity=GOOD	Validity	inherited from: Quality61850

Association ends

Mult from	[Mult] name (type)	note
1	[1] MeasurementValue (MeasurementValue)	A MeasurementValue has a MeasurementValueQuality associated with it.

6.14.21 MeasurementValueSource

MeasurementValueSource describes the alternative sources updating a MeasurementValue. User conventions for how to use the MeasurementValueSource attributes are described in the introduction to this document.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1	[0..*] MeasurementValues (MeasurementValue)	The MeasurementValues updated by the source
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.22 Quality61850

Quality flags in this class are as defined in IEC 61850, except for estimatorReplaced, which has been included in this class for convenience.

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Attributes

name	type	note
badReference	Boolean	Measurement value may be incorrect due to a reference being out of calibration.
estimatorReplaced=false	Boolean	Value has been replaced by State Estimator. estimatorReplaced is not an IEC 61850 quality bit but has been put in this class for convenience.
failure	Boolean	This identifier indicates that a supervision function has detected an internal or external failure, e.g. communication failure.
oldData	Boolean	Measurement value is old and possibly invalid, as it has not been successfully updated during a specified time interval.
operatorBlocked=false	Boolean	Measurement value is blocked and hence unavailable for transmission.
oscillatory	Boolean	To prevent some overload of the communication, it is sensible to detect and suppress oscillating (fast changing) binary inputs. If a signal changes in a defined time (tosc) twice in the same direction (from 0 to 1 or from 1 to 0) then oscillation is detected and the detail quality identifier "oscillatory" is set. If it is detected, a configured numbers of transient changes could be passed by. In this time the validity status "questionable" is set. If after this defined numbers of changes the signal is still in the oscillating state, the value shall be set either to the opposite state of the previous stable value or to a defined default value. In this case, the validity status "questionable" is reset and "invalid" is set as long as the signal is oscillating. If it is configured such that no transient changes should be passed by, then the validity status "invalid" is set immediately in addition to the detail quality identifier "oscillatory" (used for status information only).
outOfRange	Boolean	Measurement value is beyond a predefined range of value.
overFlow	Boolean	Measurement value is beyond the capability of being represented properly. For example, a counter value overflows from maximum count back to a value of zero.
source=PROCESS	Source	Source gives information related to the origin of a value. The value may be acquired from the process, defaulted or substituted.
suspect	Boolean	A correlation function has detected that the value is not consistent with other values. Typically set by a network State Estimator.
test=false	Boolean	Measurement value is transmitted for test purposes.
validity=GOOD	Validity	Validity of the measurement value.

6.14.23 SetPoint

A SetPoint is an analog control used for supervisory control.

Attributes

name	type	note
value	Float	The value representing the actuator output.
maxValue	Float	Normal value range maximum for any of the Control.value. Used for scaling, e.g. in bar

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name	type	note
		graphs.
minValue	Float	Normal value range minimum for any of the Control.value. Used for scaling, e.g. in bar graphs.
normalValue	Float	Normal value for Control.value e.g. used for percentage scaling.
timeStamp	AbsoluteDateTime	inherited from: Control
operationInProgress	Boolean	inherited from: Control
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..1] MeasuredBy_Measurement (Analog)	The Measurement variable used for control
0..*	[1] ControlType (ControlType)	inherited from: Control
1..*	[0..1] ControlledBy_RegulatingCondEq (RegulatingCondEq)	inherited from: Control
1	[0..1] RemoteControl (RemoteControl)	inherited from: Control
0..*	[1] Unit (Unit)	inherited from: Control
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.24 StringMeasurement

StringMeasurement represents a measurement with values of type string.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
1	[1..*] Contains_MeasurementValues (StringMeasurementValue)	The values connected to this Measurement
0..*	[1] MeasurementType (MeasurementType)	inherited from: Measurement
0..*	[1] MemberOf_PSR (PowerSystemResource)	inherited from: Measurement
0..*	[0..1] Terminal (Terminal)	inherited from: Measurement
0..*	[1] Unit (Unit)	inherited from: Measurement
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.25 StringMeasurementValue

StringMeasurementValue represents a measurement value of type string.

Attributes

name	type	note
value	String	The value to supervise
timeStamp	AbsoluteDateTime	inherited from: MeasurementValue
sensorAccuracy	PerCent	inherited from: MeasurementValue
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1..*	[1] MemberOf_Measurement (StringMeasurement)	Measurement to which this value is connected
1	[1] MeasurementValueQuality (MeasurementValueQuality)	inherited from: MeasurementValue
0..*	[1] MeasurementValueSource (MeasurementValueSource)	inherited from: MeasurementValue
1	[0..1] RemoteSource (RemoteSource)	inherited from: MeasurementValue
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.26 Validity enumeration

Validity for MeasurementValue.

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Enums

name	note
GOOD	The value is marked good if no abnormal condition of the acquisition function or the information source is detected.
QUESTIONABLE	The value is marked questionable if a supervision function detects an abnormal behaviour, however the value could still be valid. The client is responsible for determining whether or not values marked "questionable" should be used.
INVALID	The value is marked invalid when a supervision function recognizes abnormal conditions of the acquisition function or the information source (missing or non-operating updating devices). The value is not defined under this condition. The mark invalid is used to indicate to the client that the value may be incorrect and shall not be used.

6.14.27 ValueAliasSet

Describes the translation of a set of values into a name and is intended to facilitate custom translations. Each ValueAliasSet has a name, description etc. A specific Measurement may represent a discrete state like Open, Closed, Intermediate etc. This requires a translation from the MeasurementValue.value number to a string, e.g. 0->"Invalid", 1->"Open", 2->"Closed", 3->"Intermediate". Each ValueToAlias member in ValueAliasSet.Value describes a mapping for one particular value to a name.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] Commands (Command)	The ValueAliasSet used for translation of a Control value to a name
0..1	[0..*] Measurements (Discrete)	The Measurements using the set for translation
1	[1..*] Values (ValueToAlias)	The ValueToAlias mappings included in the set
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.14.28 ValueToAlias

Describes the translation of one particular value into a name, e.g. 1->"Open".

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Attributes

name	type	note
value	Integer	The value that is mapped
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

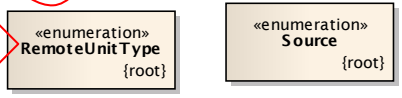
Mult from	[Mult] name (type)	note
1..*	[1] ValueAliasSet (ValueAliasSet)	The ValueAliasSet having the ValueToAlias mappings
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.15 SCADA

6.15.1 SCADA package summary

Contains entities to model information used by supervisory control and data acquisition (SCADA) applications. Supervisory control supports operator control of equipment, such as opening or closing a breaker. Data acquisition gathers telemetered data from various sources. The subtypes of the Telemetry entity deliberately match the UCA and IEC 61850 definitions.

This package also supports alarm presentation but it is not expected to be used by other applications.



IEC 2053/11

Figure 65 – Datatypes

Figure 65 is not documented.

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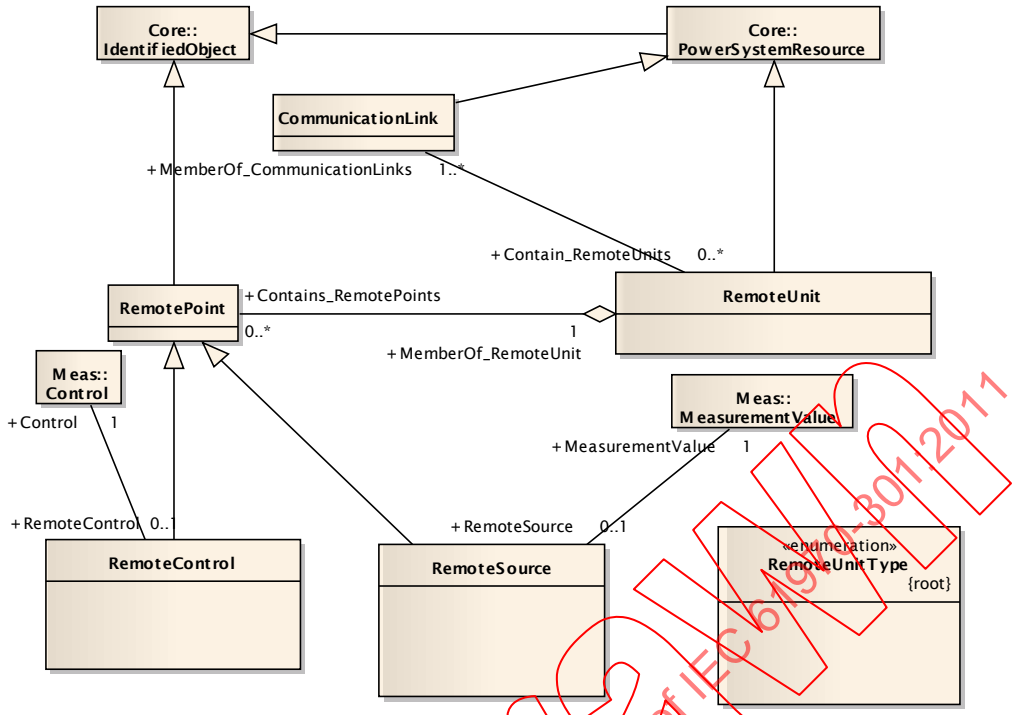

Figure 66 – Main

Figure 66 is documented as follows. This diagram shows all classes included in the SCADA package as well as the key external classes that have associations with SCADA classes.

6.15.2 CommunicationLink

The connection to remote units is through one or more communication links. Reduntant links may exist. The CommunicationLink class inherit PowerSystemResource. The intention is to allow CommunicationLinks to have Measurements. These Measurements can be used to model link status as operational, out of service, unit failure etc.

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Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
1..*	[0..*] Contain_RemoteUnits (RemoteUnit)	RTUs may be attached to communication links.
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.15.3 RemoteControl

Remote controls are outputs that are sent by the remote unit to actuators in the process.

Attributes

name	type	note
remoteControlled	Boolean	Set to true if the actuator is remotely controlled
actuatorMaximum	Float	The maximum set point value accepted by the remote control point
actuatorMinimum	Float	The minimum set point value accepted by the remote control point
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1] Control (Control)	The Control for the RemoteControl point.
0..*	[1] MemberOf_RemoteUnit (RemoteUnit)	inherited from: RemotePoint
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.15.4 RemotePoint

For a RTU remote points correspond to telemetered values or control outputs. Other units (e.g. control centers) usually also contain calculated values.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] MemberOf_RemoteUnit (RemoteUnit)	Remote unit this point belongs to
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.15.5 RemoteSource

Remote sources are state variables that are telemetered or calculated within the remote unit.

Attributes

name	type	note
sensorMaximum	Float	The maximum value the telemetry item can return
sensorMinimum	Float	The minimum value the telemetry item can return
scanInterval	Seconds	The time interval between scans
deadband	Float	The smallest change in value to be reported
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[1] MeasurementValue (MeasurementValue)	Link to the physical telemetered point associated with this measurement
0..*	[1] MemberOf_RemoteUnit (RemoteUnit)	inherited from: RemotePoint
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

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6.15.6 RemoteUnit

A remote unit can be a RTU, IED, substation control system, control center etc. The communication with the remote unit can be through various standard protocols (e.g. IEC 61850) or non standard protocols (e.g. DNP, RP570 etc.). A remote unit contain remote data points that might be telemetered, collected or calculated. The RemoteUnit class inherit PowerSystemResource. The intention is to allow RemotUnits to have Measurements. These Measurements can be used to model unit status as operational, out of service, unit failure etc.

Attributes

name	type	note
remoteUnitType	RemoteUnitType	Type of remote unit
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1..*] MemberOf_CommunicationLinks (CommunicationLink)	RTUs may be attached to communication links.
1	[0..*] Contains_RemotePoints (RemotePoint)	Remote points this Remote unit contains.
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.15.7 RemoteUnitType enumeration

Type of remote unit.

Enums

name	note
RTU	
SubstationControlSystem	
ControlCenter	
IED	

6.15.8 Source enumeration

Source gives information related to the origin of a value.

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Enums

name	note
PROCESS	The value is provided by input from the process I/O or being calculated from some function.
DEFAULTED	The value contains a default value.
SUBSTITUTED	The value is provided by input of an operator or by an automatic source.

6.16 ControlArea

6.16.1 ControlArea package summary

The ControlArea package models area specifications which can be used for a variety of purposes. The package as a whole models potentially overlapping control area specifications for the purpose of actual generation control, load forecast area load capture, or powerflow based analysis.

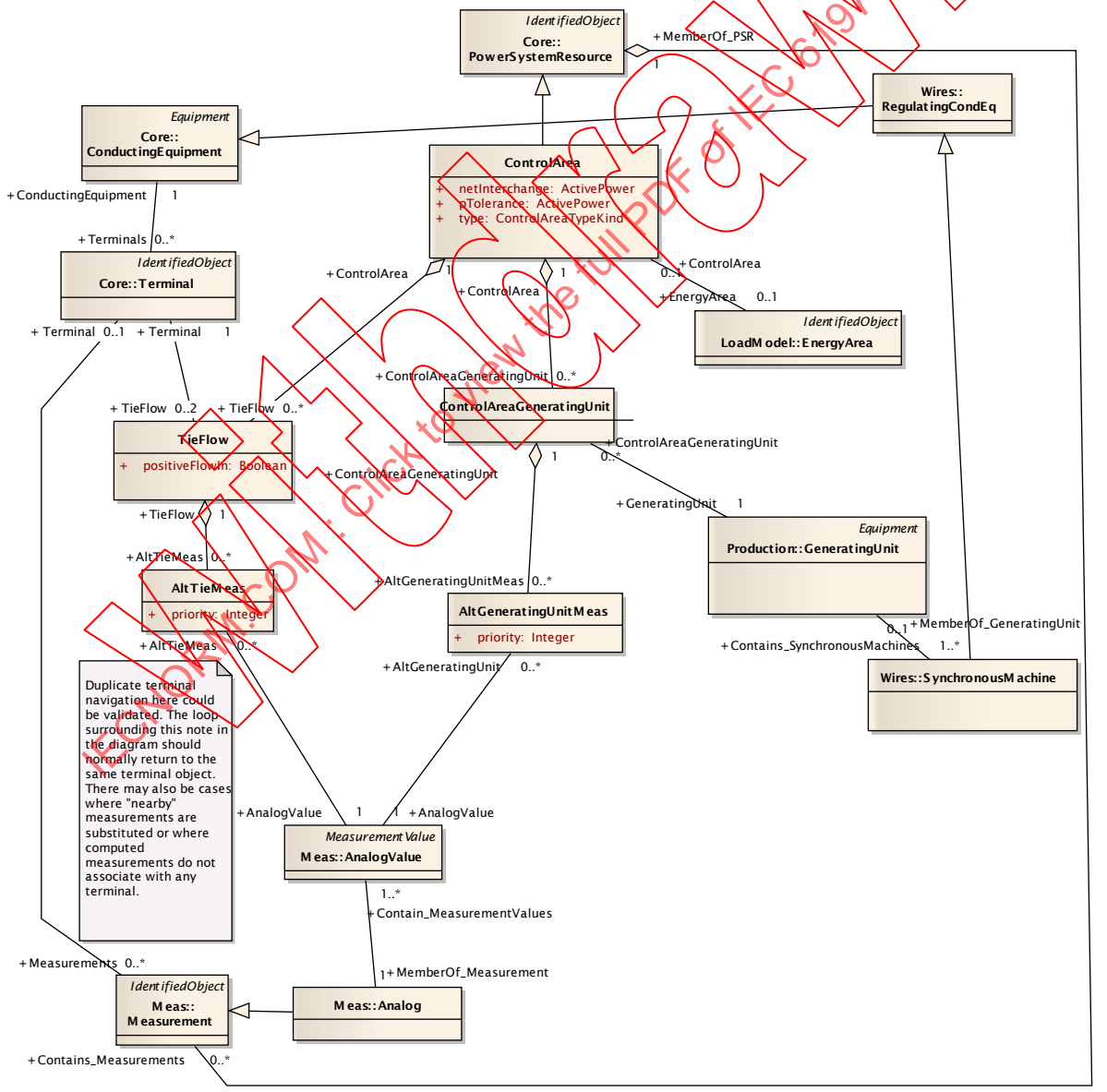

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Figure 67 – ControlArea

Figure 67 is documented as follows. This diagram shows control area specification and some related classes. The Terminal to AnalogValue linkages are shown for clarity in understanding the control area specificaiton. The GeneratingUnit to Terminal linkages are also show to illustrate how generation flows are specifically tied to the network.

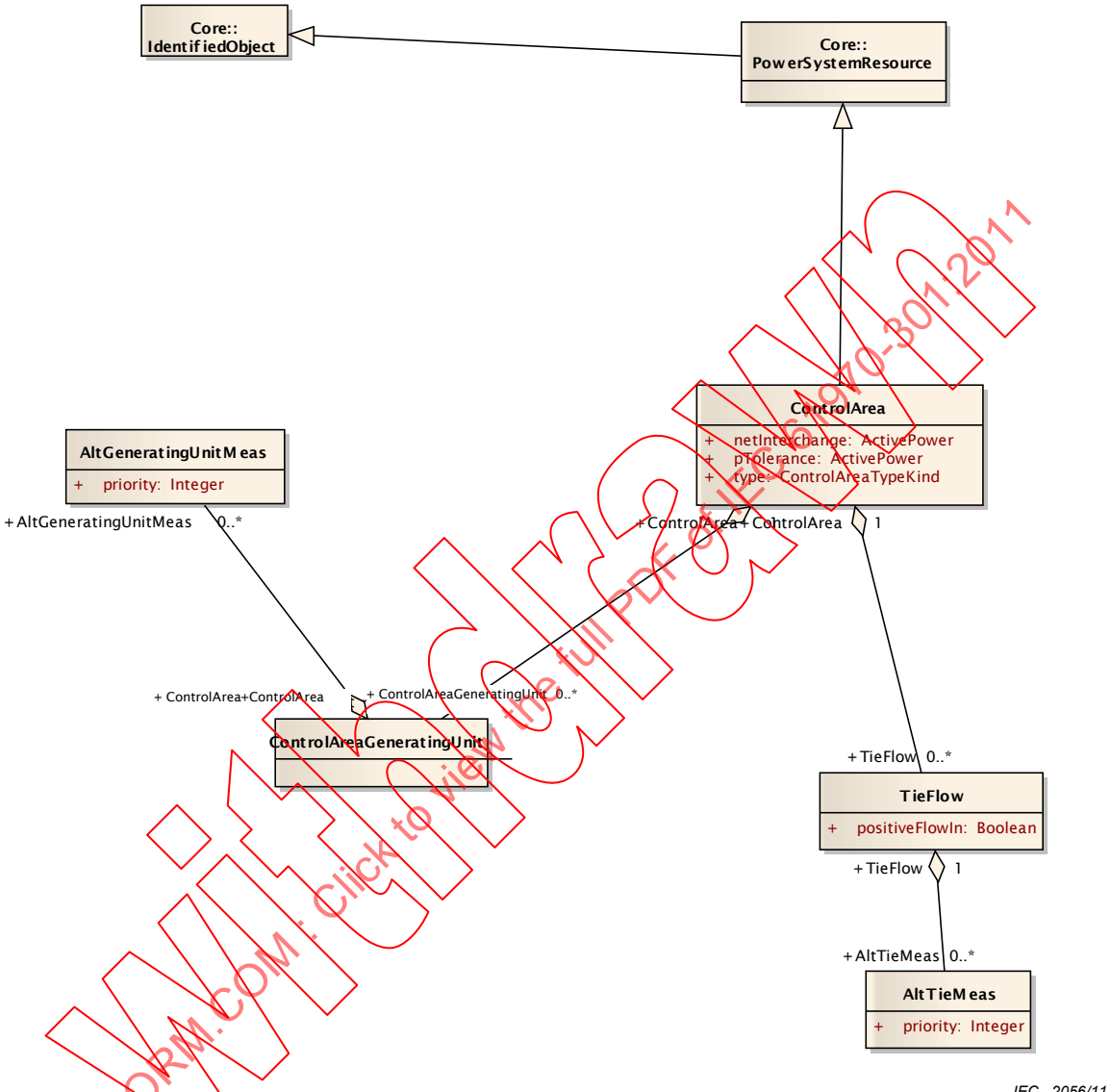

Figure 68 – ControlAreaInheritance

Figure 68 is documented as follows. Shows the inheritance of classes in this package.

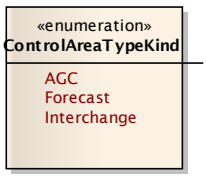

Figure 69 – Datatypes

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6.16.2 AltGeneratingUnitMeas

A prioritized measurement to be used for the generating unit in the control area specificaiton.

Attributes

name	type	note
priority	Integer	Priority of a measurement usage. Lower numbers have first priority.

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] AnalogValue (AnalogValue)	The specific analog value used as a source
0..*	[1] ControlAreaGeneratingUnit (ControlAreaGeneratingUnit)	The control area generating unit to which the prioritized measurement assignment is applied

6.16.3 AltTieMeas

A prioritized measurement to be used for the tie flow as part of the control area specification.

Attributes

name	type	note
priority	Integer	Priority of a measurement usage. Lower numbers have first priority.

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] AnalogValue (AnalogValue)	The specific analog value used as a source
0..*	[1] TieFlow (TieFlow)	The tie flow of the alternate measurements

6.16.4 ControlArea

A control area is a grouping of generating units and/or loads and a cutset of tie lines (as terminals) which may be used for a variety of purposes including automatic generation control, powerflow solution area interchange control specification, and input to load forecasting. Note that any number of overlapping control area specifications can be superimposed on the physical model.

Attributes

name	type	note
netInterchange	ActivePower	The specified positive net interchange into the control area
pTolerance	ActivePower	Active power net interchange tolerance
type	ControlAreaTypeKind	The type of control area definition used to determine if this is used for automatic generation control, for planning interchange control, or other purposes
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject

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name	type	note
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..1	[0..*] BusNameMarker (BusNameMarker)	BusNameMarker objects that belong to the control area
1	[0..*] ControlAreaGeneratingUnit (ControlAreaGeneratingUnit)	The generating unit specifications for the control area
0..1	[0..1] EnergyArea (EnergyArea)	The energy area that is forecast from this control area specification
1	[0..*] TieFlow (TieFlow)	The tie flows associated with the control area
0..1	[0..*] TopologicalNode (TopologicalNode)	The topological nodes included in the control area
0..*	[0..*] OperatedBy_Companies (Company)	inherited from: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	inherited from: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	inherited from: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	inherited from: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	inherited from: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	inherited from: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	inherited from: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.16.5 ControlAreaGeneratingUnit

A control area generating unit. This class is needed so that alternate control area definitions may include the same generating unit. Note only one instance within a control area should reference a specific generating unit.

Association ends

Mult from	[Mult] name (type)	note
1	[0..*] AltGeneratingUnitMeas (AltGeneratingUnitMeas)	The link to prioritized measurements for this GeneratingUnit.
0..*	[1] ControlArea (ControlArea)	The parent control area for the generating unit specifications.
0..*	[1] GeneratingUnit (GeneratingUnit)	The generating unit specified for this control area. Note that a control area should include a GeneratingUnit only once.

6.16.6 ControlAreaTypeKind enumeration

The type of control area.

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Enums

name	note
AGC	Used for automatic generation control
Forecast	Used for load forecast
Interchange	Used for interchange specification or control

6.16.7 TieFlow

A flow specification in terms of location and direction for a control area.

Attributes

name	type	note
positiveFlowIn	Boolean	The flow is positive into the terminal. A flow is positive if it is an import into the control area.

Association ends

Mult from	[Mult] name (type)	note
1	[0..*] AltTieMeas (AltTieMeas)	The primary and alternate tie flow measurements associated with the tie flow
0..*	[1] ControlArea (ControlArea)	The control area of the tie flows
0..2	[1] Terminal (Terminal)	The terminal to which this tie flow belongs

6.17 Contingency

6.17.1 Contingency package summary

Contingencies to be studied.

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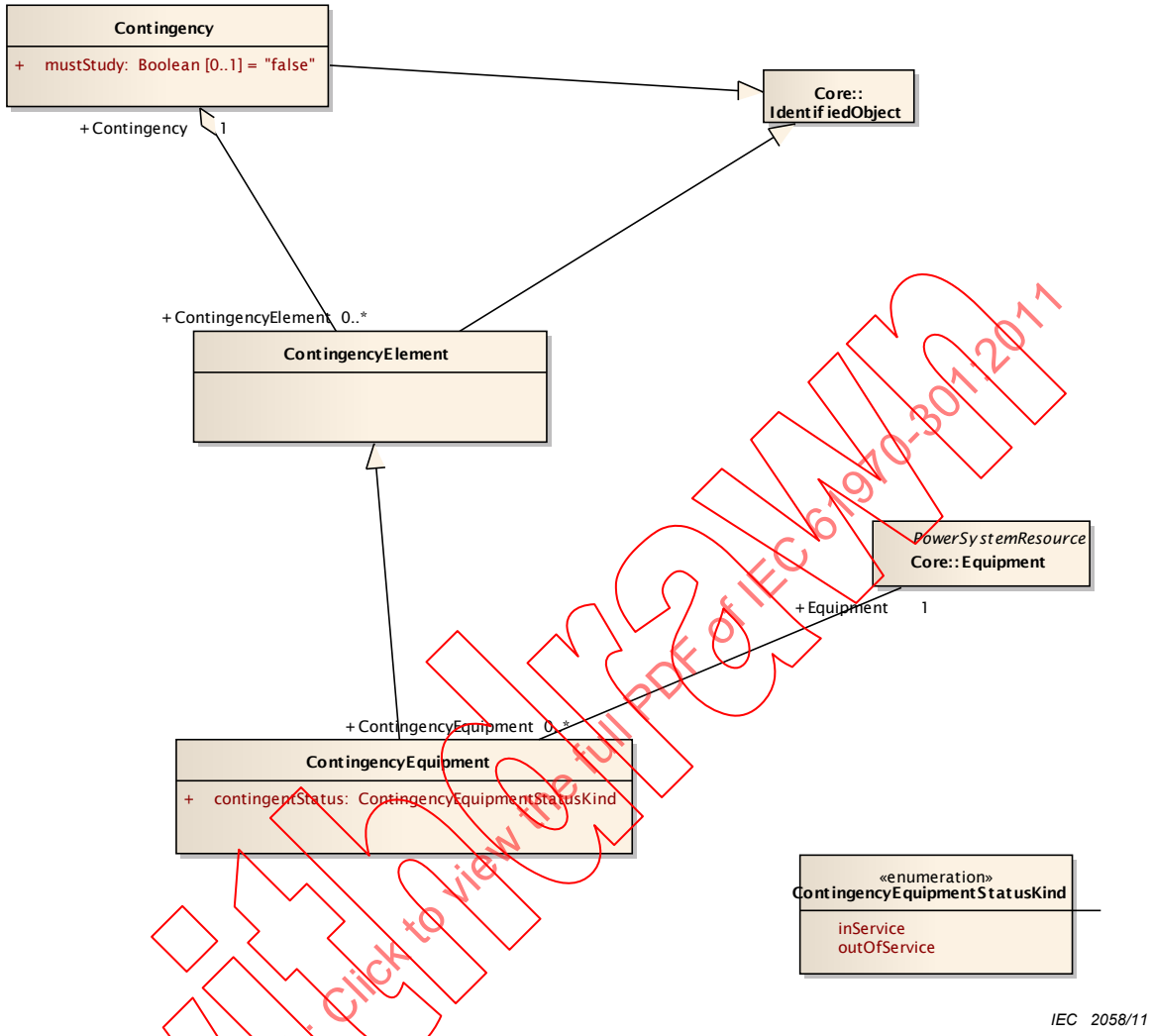

Figure 70 – Contingency

Figure 70 is not documented.

6.17.2 Contingency

An event threatening system reliability, consisting of one or more contingency elements.

Attributes

name	type	note
mustStudy="false"	Boolean	Set true if must study this contingency
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
1	[0..*] ContingencyElement (ContingencyElement)	A contingency can have any number of contingency elements.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.17.3 ContingencyElement

An element of a system event to be studied by contingency analysis, representing a change in status of a single piece of equipment.

Attributes

name	type	note
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

Association ends

Mult from	[Mult] name (type)	note
0..*	[1] Contingency (Contingency)	A contingency element belongs to one contingency.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.17.4 ContingencyEquipment

A equipment to which the in service status is to change such as a power transformer or AC line segment.

Attributes

name	type	note
contingentStatus	ContingencyEquipmentStatusKind	The status for the associated equipment when in the contingency state. This status is independent of the case to which the contingency is originally applied, but defines the equipment status when the contingency is applied.
mRID	String	inherited from: IdentifiedObject
name	String	inherited from: IdentifiedObject
localName	String	inherited from: IdentifiedObject
pathName	String	inherited from: IdentifiedObject
aliasName	String	inherited from: IdentifiedObject
description	String	inherited from: IdentifiedObject

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Association ends

Mult from	[Mult] name (type)	note
0..*	[1] Equipment (Equipment)	The single piece of equipment to which to apply the contingency
0..*	[1] Contingency (Contingency)	inherited from: ContingencyElement
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	inherited from: IdentifiedObject

6.17.5 ContingencyEquipmentStatusKind enumeration

Indicates the state which the contingency equipment is to be in when the contingency is applied.

Enums

name	note
inService	The equipment is in service.
outOfService	The equipment is to be taken out of service.

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Withdrawn

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SOMMAIRE

AVANT-PROPOS 272
INTRODUCTION 274
1 Domaine d'application 276
2 Références normatives 276
3 Termes et définitions 277
4 Spécification CIM 277
4.1 Notation de modélisation du CIM 277
4.2 Paquetages CIM 277
4.2.1 Vue générale des paquetages CIM 277
4.2.2 Domain 279
4.2.3 Core 280
4.2.4 OperationalLimits 280
4.2.5 Topology 280
4.2.6 Wires 280
4.2.7 Generation 280
4.2.8 LoadModel 280
4.2.9 Outage 281
4.2.10 Protection 281
4.2.11 Equivalents 281
4.2.12 Meas 281
4.2.13 SCADA 281
4.2.14 ControlArea 281
4.2.15 Contingency 281
4.3 Classes CIM et relations 281
4.3.1 Classes 281
4.3.2 Generalization 282
4.3.3 Association simple (Simple association) 283
4.3.4 Aggregation 284
4.4 Concepts du modèle CIM et exemples 284
4.4.1 Concepts 284
4.4.2 Hiérarchies d'appartenance, d'équipements et dénomination 285
4.4.3 Modèle de connectivité 286
4.4.4 Hiérarchie des héritages 290
4.4.5 Modèle du transformateur 291
4.4.6 Mesures et commandes 293
4.4.7 Modèle de commande de régulation 297
4.5 Conseils de modélisation 298
4.5.1 Modélisation pour modifications 298
4.5.2 Processus pour les amendements au CIM 298
4.5.3 Modifications apportées au modèle UML du CIM 299
4.5.4 Modifications apportées aux documents normatifs du CIM 299
4.5.5 Profils CIM 299
4.6 Outils de modélisation 299
4.7 Conventions d'implémentation pour les utilisateurs 300
4.7.1 Conventions au-delà de l'UML 300
4.7.2 Nombre des Terminal pour les objets ConductingEquipment 300
4.8 Exemples de modélisation CIM 300

IECNORM.COM : Click to view the full PDF of IEC 61970-301:2011
Withdrawn

5 Modèle détaillé 301
5.1 Vue générale 301
5.2 Contexte 301
6 Architecture des paquetages (normative) 303
6.1 IEC 61970 303
6.1.1 Résumé du paquetage IEC 61970 303
6.1.2 IEC 61970CIMVersion 303
6.2 Domain 304
6.2.1 Résumé du paquetage Domain 304
6.2.2 Type de données AbsoluteDate 308
6.2.3 Type de données AbsoluteDateTime 308
6.2.4 Type de données ActivePower 308
6.2.5 Type de données ActivePowerChangeRate 309
6.2.6 Type de données Admittance 309
6.2.7 Type de données AngleDegrees 309
6.2.8 Type de données AngleRadians 309
6.2.9 Type de données ApparentPower 309
6.2.10 Primitive Boolean 310
6.2.11 Type de données Capacitance 310
6.2.12 Type de données Conductance 310
6.2.13 Type de données CostPerEnergyUnit 310
6.2.14 Type de données CostRate 310
6.2.15 Énumération Currency 311
6.2.16 Type de données CurrentFlow 311
6.2.17 Type de données Damping 311
6.2.18 Primitive Float 312
6.2.19 Type de données FloatQuantity 312
6.2.20 Type de données Frequency 312
6.2.21 Type de données Hours 312
6.2.22 Type de données Impedance 312
6.2.23 Type de données Inductance 312
6.2.24 Primitive Integer 313
6.2.25 Type de données IntegerQuantity 313
6.2.26 Type de données KWActivePower 313
6.2.27 Type de données LongLength 313
6.2.28 Type de données Minutes 313
6.2.29 Énumération MonetaryAmountPerEnergyUnit 314
6.2.30 Énumération MonetaryAmountPerHeatUnit 314
6.2.31 Énumération MonetaryAmountRate 314
6.2.32 Type de données Money 314
6.2.33 Type de données PerCent 314
6.2.34 Type de données Pressure 314
6.2.35 Type de données PU 315
6.2.36 Type de données Reactance 315
6.2.37 Type de données ReactivePower 315
6.2.38 Type de données RealEnergy 315
6.2.39 Type de données Resistance 315
6.2.40 Type de données RotationSpeed 316
6.2.41 Type de données Seconds 316

IECNORM.COM : Click to view the full PDF of IEC 61970-301:2011
Withdrawn

6.2.42 Type de données ShortLength 316
6.2.43 Primitive String 316
6.2.44 Type de données StringQuantity 316
6.2.45 Type de données Susceptance 317
6.2.46 Type de données Temperature 317
6.2.47 Énumération UnitMultiplier 317
6.2.48 Énumération UnitSymbol 317
6.2.49 Type de données Voltage 318
6.2.50 Type de données VoltagePerReactivePower 318
6.2.51 Type de données Volume 319
6.2.52 Type de données WaterLevel 319
6.2.53 Type de données Weight 319
6.3 Core 319
6.3.1 Résumé du paquetage Core 319
6.3.2 BasePower 324
6.3.3 BaseVoltage 324
6.3.4 BasicIntervalSchedule 325
6.3.5 Baie 326
6.3.6 Énumération BreakerConfiguration 327
6.3.7 Énumération BusbarConfiguration 327
6.3.8 Company 327
6.3.9 Énumération CompanyType 327
6.3.10 ConductingEquipment 328
6.3.11 ConnectivityNodeContainer 329
6.3.12 Curve 329
6.3.13 CurveData 330
6.3.14 Énumération CurveStyle 330
6.3.15 Equipment 331
6.3.16 EquipmentContainer 331
6.3.17 GeographicalRegion 332
6.3.18 IdentifiedObject 333
6.3.19 IrregularIntervalSchedule 334
6.3.20 IrregularTimePoint 334
6.3.21 ModelingAuthority 335
6.3.22 ModelingAuthoritySet 335
6.3.23 OperatingParticipant 336
6.3.24 OperatingShare 336
6.3.25 Énumération PhaseCode 337
6.3.26 PowerSystemResource 338
6.3.27 PsrList 338
6.3.28 PSRType 339
6.3.29 RegularIntervalSchedule 339
6.3.30 RegularTimePoint 340
6.3.31 ReportingGroup 341
6.3.32 ReportingSuperGroup 341
6.3.33 SubGeographicalRegion 342
6.3.34 Substation 342
6.3.35 Terminal 343
6.3.36 Unit 344

IECNORM.COM : Click to view the full PDF of IEC 61970-301:2011
Withdrawn

6.3.37 VoltageLevel 345
6.4 OperationalLimits 346
6.4.1 Résumé du paquetage OperationalLimits 346
6.4.2 ActivePowerLimit 347
6.4.3 ApparentPowerLimit 348
6.4.4 BranchGroup 348
6.4.5 BranchGroupTerminal 349
6.4.6 CurrentLimit 349
6.4.7 OperationalLimit 350
6.4.8 Énumération OperationalLimitDirectionKind 350
6.4.9 OperationalLimitSet 350
6.4.10 OperationalLimitType 351
6.4.11 VoltageLimit 351
6.5 Topology 352
6.5.1 Résumé du paquetage Topology 352
6.5.2 BusNameMarker 357
6.5.3 ConnectivityNode 357
6.5.4 TopologicalIsland 358
6.5.5 TopologicalNode 358
6.6 Wires 360
6.6.1 Résumé du paquetage Wires 360
6.6.2 ACLineSegment 369
6.6.3 Breaker (disjoncteur) 370
6.6.4 BusbarSection 371
6.6.5 CompositeSwitch 372
6.6.6 Type de données CompositeSwitchType 373
6.6.7 Conductor 373
6.6.8 ConductorType 374
6.6.9 Connector (connecteur) 375
6.6.10 Énumération CoolantType 376
6.6.11 DCLineSegment 376
6.6.12 Disconnector (sectionneur) 377
6.6.13 EnergyConsumer 378
6.6.14 EnergySource 379
6.6.15 FrequencyConverter 380
6.6.16 Fuse 381
6.6.17 Ground 382
6.6.18 GroundDisconnector 383
6.6.19 HeatExchanger (échangeur de chaleur) 384
6.6.20 Jumper 385
6.6.21 Junction 386
6.6.22 Line 387
6.6.23 LoadBreakSwitch 388
6.6.24 MutualCoupling 389
6.6.25 Type de données OperatingMode 390
6.6.26 Plant 390
6.6.27 PowerTransformer 390
6.6.28 ProtectedSwitch 391
6.6.29 ReactiveCapabilityCurve 392

IECNORM.COM : Click to view the full PDF of IEC 61970-301:2011
Withdrawn

6.6.30 RectifierInverter 393
6.6.31 RegulatingCondEq 394
6.6.32 RegulatingControl 395
6.6.33 Énumération RegulatingControlModeKind 396
6.6.34 RegulationSchedule 397
6.6.35 SeriesCompensator 397
6.6.36 ShuntCompensator 398
6.6.37 StaticVarCompensator 400
6.6.38 Énumération SVCControlMode 401
6.6.39 Switch (organe de coupure) 401
6.6.40 SynchronousMachine 403
6.6.41 Énumération SynchronousMachineOperatingMode 405
6.6.42 Énumération SynchronousMachineType 405
6.6.43 TapChanger 405
6.6.44 Énumération TapChangerKind 407
6.6.45 Énumération TransformerControlMode 407
6.6.46 Énumération TransformerCoolingType 407
6.6.47 TransformerWinding 407
6.6.48 VoltageControlZone 409
6.6.49 Énumération WindingConnection 410
6.6.50 WindingTest 410
6.6.51 Énumération WindingType 411
6.6.52 WireArrangement 411
6.6.53 WireType 412
6.7 Génération– Résumé du paquetage Generation 413
6.8 Production 413
6.8.1 Résumé du paquetage Production 413
6.8.2 AirCompressor 418
6.8.3 CAESPlant 419
6.8.4 Type de données Classification 420
6.8.5 CogenerationPlant 420
6.8.6 CombinedCyclePlant 421
6.8.7 Type de données CostPerHeatUnit 421
6.8.8 Type de données Emission 422
6.8.9 EmissionAccount 422
6.8.10 EmissionCurve 423
6.8.11 Énumération EmissionType 424
6.8.12 Énumération EmissionValueSource 424
6.8.13 FossilFuel 424
6.8.14 FuelAllocationSchedule 425
6.8.15 Énumération FuelType 426
6.8.16 GeneratingUnit 426
6.8.17 Énumération GeneratorControlMode 429
6.8.18 Énumération GeneratorControlSource 429
6.8.19 Énumération GeneratorOperatingMode 430
6.8.20 GenUnitOpCostCurve 430
6.8.21 GenUnitOpSchedule 431
6.8.22 GrossToNetActivePowerCurve 431
6.8.23 HeatInputCurve 432

IECNORM.COM : Click to view the full PDF of IEC 61970-301:2011
Withdrawn

6.8.24 Type de données HeatRate 433
6.8.25 HeatRateCurve 433
6.8.26 Énumération HydroEnergyConversionKind 434
6.8.27 HydroGeneratingEfficiencyCurve 434
6.8.28 HydroGeneratingUnit 435
6.8.29 Énumération HydroPlantType 437
6.8.30 HydroPowerPlant 437
6.8.31 HydroPump 439
6.8.32 HydroPumpOpSchedule 440
6.8.33 IncrementalHeatRateCurve 440
6.8.34 InflowForecast 441
6.8.35 LevelVsVolumeCurve 442
6.8.36 NuclearGeneratingUnit 442
6.8.37 PenstockLossCurve 444
6.8.38 Énumération PenstockType 445
6.8.39 Reservoir 445
6.8.40 ShutdownCurve 446
6.8.41 Énumération SpillwayGateType 447
6.8.42 StartIgnFuelCurve 447
6.8.43 StartMainFuelCurve 448
6.8.44 StartRampCurve 448
6.8.45 StartupModel 449
6.8.46 SteamSendoutSchedule 450
6.8.47 Énumération SurgeTankCode 451
6.8.48 TailbayLossCurve 451
6.8.49 TargetLevelSchedule 452
6.8.50 ThermalGeneratingUnit 452
6.9 GenerationDynamics 455
6.9.1 Résumé du paquetage GenerationDynamics 455
6.9.2 Énumération BoilerControlMode 456
6.9.3 BWRSteamSupply 456
6.9.4 CombustionTurbine 457
6.9.5 CTTempActivePowerCurve 458
6.9.6 DrumBoiler 459
6.9.7 FossilSteamSupply 460
6.9.8 HeatRecoveryBoiler 462
6.9.9 HydroTurbine 463
6.9.10 PrimeMover 464
6.9.11 PWRSteamSupply 465
6.9.12 SteamSupply 466
6.9.13 SteamTurbine 466
6.9.14 Subcritical 468
6.9.15 Supercritical 469
6.9.16 Énumération TurbineType 470
6.10 LoadModel 470
6.10.1 Résumé du paquetage LoadModel 470
6.10.2 ConformLoad 472
6.10.3 ConformLoadGroup 473
6.10.4 ConformLoadSchedule 473

IECNORM.COM : Click to view the full PDF of IEC 61970-301:2011
Withdrawn

6.10.5 CustomerLoad 474
6.10.6 DayType 475
6.10.7 EnergyArea 475
6.10.8 InductionMotorLoad 476
6.10.9 Load 477
6.10.10 LoadArea 478
6.10.11 LoadGroup 478
6.10.12 LoadResponseCharacteristic 479
6.10.13 NonConformLoad 480
6.10.14 NonConformLoadGroup 481
6.10.15 NonConformLoadSchedule 482
6.10.16 PowerCutZone 482
6.10.17 Season 483
6.10.18 SeasonDayTypeSchedule 484
6.10.19 Énumération SeasonName 484
6.10.20 StationSupply 485
6.10.21 SubLoadArea 486
6.11 Outage 486
6.11.1 Résumé du paquetage Outage 486
6.11.2 ClearanceTag 487
6.11.3 ClearanceTagType 488
6.11.4 OutageSchedule 488
6.11.5 SwitchingOperation 489
6.11.6 Énumération SwitchState 490
6.12 Protection 490
6.12.1 Résumé du paquetage Protection 490
6.12.2 CurrentRelay 491
6.12.3 ProtectionEquipment 492
6.12.4 RecloseSequence 493
6.12.5 SynchrocheckRelay 493
6.13 Equivalents 494
6.13.1 Résumé du paquetage Equivalents 494
6.13.2 EquivalentBranch 495
6.13.3 EquivalentEquipment 496
6.13.4 EquivalentNetwork 497
6.13.5 EquivalentShunt 498
6.14 Meas 499
6.14.1 Résumé du paquetage Meas 499
6.14.2 Accumulator 502
6.14.3 AccumulatorLimit 503
6.14.4 AccumulatorLimitSet 503
6.14.5 AccumulatorValue 504
6.14.6 Analog 504
6.14.7 AnalogLimit 505
6.14.8 AnalogLimitSet 506
6.14.9 AnalogValue 506
6.14.10 Command 507
6.14.11 Commande 508
6.14.12 ControlType 508

IECNORM.COM : Click to view the full PDF of IEC 61970-301:2011
Withdrawn

6.14.13 Discrete 509
6.14.14 DiscreteValue 509
6.14.15 Limit 510
6.14.16 LimitSet 511
6.14.17 Measurement 511
6.14.18 MeasurementType 512
6.14.19 MeasurementValue 513
6.14.20 MeasurementValueQuality 513
6.14.21 MeasurementValueSource 514
6.14.22 Quality61850 515
6.14.23 SetPoint 516
6.14.24 StringMeasurement 516
6.14.25 StringMeasurementValue 517
6.14.26 Énumération Validity 518
6.14.27 ValueAliasSet 518
6.14.28 ValueToAlias 519
6.15 SCADA 519
6.15.1 Résumé du paquetage SCADA 519
6.15.2 CommunicationLink 520
6.15.3 RemoteControl 521
6.15.4 RemotePoint 522
6.15.5 RemoteSource 522
6.15.6 RemoteUnit 523
6.15.7 Énumération RemoteUnitType 523
6.15.8 Énumération Source 524
6.16 ControlArea 524
6.16.1 Résumé du paquetage ControlArea 524
6.16.2 AltGeneratingUnitMeas 526
6.16.3 AltTieMeas 527
6.16.4 ControlArea 527
6.16.5 ControlAreaGeneratingUnit 528
6.16.6 Énumération ControlAreaTypeKind 529
6.16.7 TieFlow 529
6.17 Contingency 529
6.17.1 Résumé du paquetage Contingency 529
6.17.2 Contingency 530
6.17.3 ContingencyElement 531
6.17.4 ContingencyEquipment 531
6.17.5 Énumération ContingencyEquipmentStatusKind 532
Bibliographie 533

Figure 1 – Diagramme du paquetage CIM IEC 61970-301 279
Figure 2 – Exemple de généralisation 283
Figure 3 – Exemple d'association simple 284
Figure 4 – Exemple d'agrégation 284
Figure 5 – Conteneurs Equipment 286
Figure 6 – Modèle de connectivité 287
Figure 7 – Exemple de réseau simple 289

IECNORM.COM : Click to view the full PDF of IEC 61970-301:2011
Withdrawn

Figure 8 – Connectivité d'un réseau simple modélisé avec la Topologie du CIM 289
Figure 9 – Hiérarchie des héritages de Equipment 291
Figure 10 – Modèle de Transformateur 292
Figure 11 – Navigation de PSR à MeasurementValue 294
Figure 12 – Placement de Measurement 297
Figure 13 – Modèle de commande de régulation 298
Figure 14 – Paquetages de haut niveau du CIM 301
Figure 15 – Main (c'est-à-dire Représentation principale) 303
Figure 16 – CombinedDatatypes 304
Figure 17 – BasicDatatypes 304
Figure 18 – ElectricityDatatypes 305
Figure 19 – EnumeratedUnitDatatypes 306
Figure 20 – GeneralDatatypes 307
Figure 21 – MonetaryDatatypes 307
Figure 22 – TimeDatatypes 308
Figure 23 – Reporting 320
Figure 24 – Main 321
Figure 25 – CurveSchedule 322
Figure 26 – Datatypes 322
Figure 27 – DocumentationExampleAggregation 323
Figure 28 – DocumentationExampleAssociation 323
Figure 29 – Ownership 324
Figure 30 – OperationalLimits 346
Figure 31 – BranchGroup 347
Figure 32 – TopologicalNodeTerminal 353
Figure 33 – TopologyMeasRelations 354
Figure 34 – TopologyReporting 355
Figure 35 – Main 356
Figure 36 – DocumentationExampleInheritance 360
Figure 37 – MutualCoupling 361
Figure 38 – Datatypes 362
Figure 39 – InheritanceHierarchy 363
Figure 40 – LineModel 364
Figure 41 – NamingHierarchyPart1 365
Figure 42 – NamingHierarchyPart2 366
Figure 43 – RegulatingEquipment 367
Figure 44 – TransformerModel 368
Figure 45 – VoltageControl 369
Figure 46 – Main (c'est-à-dire Représentation principale) 413
Figure 47 – Nuclear 414
Figure 48 – Main 415
Figure 49 – Datatypes 416
Figure 50 – Hydro 417

IECNORM.COM : Click to view the full PDF of IEC 61970-301:2011
Withdrawn

Figure 51 – Thermal 418
Figure 52 – Main 455
Figure 53 – Datatypes 455
Figure 54 – Main (c'est-à-dire Représentation principale) 471
Figure 55 – Datatypes 471
Figure 56 – Datatypes 486
Figure 57 – Main 487
Figure 58 – Main (c'est-à-dire Représentation principale) 490
Figure 59 – Main (c'est-à-dire Représentation principale) 495
Figure 60 – Datatypes 499
Figure 61 – Control 499
Figure 62 – InheritanceStructure 500
Figure 63 – Measurement 501
Figure 64 – Quality 502
Figure 65 – Datatypes 519
Figure 66 – Main 520
Figure 67 – ControlArea 525
Figure 68 – ControlAreaInheritance 526
Figure 69 – Datatypes 526
Figure 70 – Contingency 530

Tableau 1 – Convention de dénomination de MeasurementType (types de mesure) 295
Tableau 2 – Conventions de dénomination de MeasurementValueSource (source de mesure) 296

IECNORM.COM : Click to view the full PDF of IEC 61970-301:2011
Withdrawn

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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INTERFACE DE PROGRAMMATION D'APPLICATION POUR SYSTÈME DE GESTION D'ÉNERGIE (EMS-API) –

Partie 301: Base de modèle d'information commun (CIM)

AVANT-PROPOS

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La Norme internationale CEI 61970-301 a été établie par le comité d'études 57 de la CEI: Gestion des systèmes de puissance et échanges d'informations associés.

Cette troisième édition annule et remplace la deuxième édition, parue en 2009. Cette troisième édition constitue une révision technique.

Les principales modifications par rapport à la deuxième édition sont les suivantes:

- des modèles de commande de régulation ont été ajoutés avec une nouvelle classe RegulatingControl qui permet de modéliser de multiples équipements participant à un plan de régulation;
- nouveau paquetage "OperationalLimits" pour les caractéristiques nominales des équipements;

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- ajout d'une spécification relative à la propriété partielle;
- la classe LoadResponseCharacteristic a été renforcée pour mieux modéliser la réponse caractéristique de la charge en raison de changements de conditions système telles que la tension et la fréquence;
- nouveau paquetage ControlArea ajouté avec des spécifications relatives à la prévision des charges et à l'échange entre zones;
- des propositions pour le projet "CIM for Planning" de l'EPRI (Electric power research institute) ont été incorporées dans le but de prendre en charge l'échange de modèles de planification;
- une spécification pour la surveillance des “interfaces” de "branch group" a été ajoutée;
- le modèle de commutateur combiné (« Composite switch ») a été modifié afin de mieux modéliser les cas d'utilisation de la distribution;
- des extensions ont été ajoutées pour prendre en charge powerflow “case input” afin que les profils ne soient pas obligés d'utiliser des barèmes fixés en fonction du temps et une connectivité détaillée (via le nouveau modèle "bus-branch"(topologie nodale));
- nouveau paquetage Equivalents ajouté pour modéliser des réseaux équivalents;
- nouveau paquetage Contingency ajouté pour gérer les contingences;
- divers changements éditoriaux pour mettre au net le modèle UML;
- les unités non-SI ont été changes en unités SI.

Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
57/1136/FDIS	57/1167/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Cette publication a été rédigée selon les Directives ISO/CEI, Partie 2.

Une liste de toutes les parties de la série CEI 61970, sous le titre général *Interface de programmation d'application pour système de gestion d'énergie (EMS-API),* peut être consultée sur le site web de la CEI.

Le comité a décidé que le contenu de cette publication ne sera pas modifié avant la date de stabilité indiquée sur le site web de la CEI sous "http://webstore.iec.ch" dans les données relatives à la publication recherchée. A cette date, la publication sera

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- amendée.

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INTRODUCTION

Cette norme est l'une des différentes parties de la série de normes CEI 61970 qui définissent une interface de programmation d'application (API) pour un système de gestion d'énergie (EMS, c'est-à-dire energy management system). La présente norme a été initialement fondée sur les travaux réalisés dans le cadre du projet de recherche (RP-3654-1) sur les API de centres de conduite (CCAPI) de l'EPRI. Le projet CCAPI de l'EPRI avait principalement pour objet de

- réduire les coûts et le temps nécessaires à l'ajout de nouvelles applications à un EMS;
- protéger l'investissement dans les applications existantes qui fonctionnent efficacement dans un EMS.

Le principal but de la série de normes CEI 61970 est de produire les normes destinées à faciliter l'intégration d'applications EMS développées de façon indépendante par différents fournisseurs, entre des systèmes EMS complets développés de façon indépendante ou entre un système EMS et d'autres systèmes concernés par différents aspects de l'exploitation d'un système électrique, tels que les systèmes de gestion de la distribution (DMS, c'est-à-dire distribution management system) ou de la production. Cela s'effectue par la définition d'interfaces de programmation d'applications (API) normalisées pour permettre à ces applications ou systèmes d'accéder aux données publiques et d'échanger des informations indépendamment de la façon dont ces informations sont représentées en interne.

Le CIM spécifie la sémantique de cette API. Les spécifications des composants d'interface (CIS, c'est-à-dire component interface specification), qui sont contenues dans d'autres parties des normes CEI 61970, précisent le contenu des messages échangés.

Le CIM est un modèle abstrait représentant tous les objets principaux d'une entreprise de distribution d'électricité habituellement nécessaires pour modéliser les opérations d'une entreprise d'électricité. Ce modèle inclut les classes et les attributs publics de ces objets, ainsi que les relations entre eux.

Les objets représentés dans le CIM sont de nature abstraite et peuvent être utilisés dans une large gamme d'applications. L'utilisation du CIM n'est pas limitée à son application dans un EMS. Il convient que cette norme soit comprise comme un outil permettant l'intégration dans tout domaine où un modèle commun de réseau est nécessaire pour faciliter l'interopérabilité et la compatibilité de connexion entre des applications et des systèmes indépendants de toute implémentation particulière.

La présente norme définit la base du modèle d'information commun (CIM) constituée d'un ensemble de paquetages qui offrent une vue logique des aspects fonctionnels d'un système de gestion de l'énergie (EMS, c'est-à-dire energy management system) incluant SCADA (supervisory control and data acquisition). D'autres domaines fonctionnels sont normalisés dans des documents CEI distincts qui augmentent et référencent la présente norme CIM de base. Par exemple, la CEI 61968-11 traite des modèles de distribution et référence la présente norme CIM de base. Alors qu'il existe plusieurs normes de la CEI qui traitent des différentes parties du CIM, un seul modèle d'information normalisé unifié comprenant le CIM est derrière tous ces documents normatifs individuels.

La Commission Électrotechnique Internationale (CEI) attire l'attention sur le fait qu'il est déclaré que la conformité avec les dispositions du présent document peut impliquer l'utilisation d'un brevet concernant une mise en œuvre gérée par ordinateur d'un modèle de système de puissance orienté objet dans une base de données relationnelle. À ce titre, elle n'est en conflit avec aucun développement modèle logique de système de puissance incluant le modèle d'information commun (CIM), lorsque la mise en œuvre du modèle n'est pas définie.

La CEI ne prend pas position quant à la preuve, à la validité et à la portée de ces droits de propriété.

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L'ISO (www.iso.org/patents) et la CEI (http://patents.iec.ch) maintiennent des bases des données, consultables en ligne, des droits de propriété pertinents à leurs normes. Les utilisateurs sont encourages à consulter ces bases de données pour obtenir l'information la plus récente concernant les droits de propriété.

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INTERFACE DE PROGRAMMATION D'APPLICATION POUR SYSTÈME DE GESTION D'ÉNERGIE (EMS-API) –

Partie 301: Base de modèle d'information commun (CIM)

1 Domaine d'application

La présente partie de la CEI 61970 traite du modèle d'information commun (CIM), un modèle abstrait qui représente tous les objets principaux d'une entreprise de service public de distribution d'électricité habituellement impliqués dans les opérations de l'entreprise.

Les classes d'objets représentées dans le CIM sont de nature abstraite et peuvent être utilisées dans une large gamme d'applications. L'utilisation du CIM n'est pas limitée à son application dans un EMS. Il convient que cette norme soit comprise comme un outil permettant l'intégration dans tout domaine où un modèle commun de réseau est nécessaire pour faciliter l'interopérabilité et la compatibilité de connexion entre des applications et des systèmes indépendants de toute implémentation particulière.

En fournissant une façon normalisée de représenter des réseaux électriques comme classes et attributs d'objets ainsi que leurs relations, le CIM facilite l'intégration des applications EMS développées de façon indépendante par différents fournisseurs, entre des systèmes EMS complets développés de façon indépendante ou entre un système EMS et d'autres systèmes concernés par différents aspects des opérations d'un réseau électrique tels que la gestion de la production ou de la distribution. Le système SCADA (supervisory control and data acquisition) est modélisé dans toute la mesure nécessaire pour prendre en charge la simulation des systèmes énergétiques et la communication entre des centres de commande. Le CIM facilite l'intégration en définissant un langage commun (c'est-à-dire une sémantique et une syntaxe) fondé sur le modèle CIM pour permettre à ces applications ou systèmes d'accéder aux données publiques et d'échanger des informations indépendamment de la représentation interne de ces informations.

A cause de la taille du CIM complet, les classes objet qui le composent sont regroupées en un certain nombre de paquetages logiques, qui représentent chacun une certaine partie du système électrique modélisé. Les collections de ces paquetages sont fournies progressivement sous forme de Normes internationales distinctes. La présente Norme internationale particulière spécifie un ensemble de base de paquetages qui offrent une vue logique sur les aspects fonctionnels des informations relatives à un système de gestion de l'énergie (EMS) d'une entreprise de service public de distribution d'électricité qui sont partagées par toutes les applications. D'autres normes spécifient des aspects plus spécifiques du modèle qui ne sont nécessaires qu'à certaines applications. Le Paragraphe 4.2 définit le découpage actuel des paquetages dans les documents normatifs.

2 Références normatives

Les documents de référence suivants sont indispensables pour l'application du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

CEI 61850 (toutes les parties), *Réseaux et systèmes de communication dans les postes*

CEI 61850-7-4:2010, *Communication networks and systems for power utility automation – Part 7-4: Basic communication structure – Compatible logical node classes and data object classes* (disponible en anglais seulement)

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CEI 61968 (toutes les parties), *Application integration at electric utilities – System interfaces for distribution management*

CEI 61970-2, *Energy management system application program interface (EMS-API) – Glossary* (disponible en anglais seulement)

ISO 8601:2004, *Éléments de données et formats d'échange – Échange d'information – Représentation de la date et de l'heure*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions de la CEI 61970-2 s'appliquent avec les suivants.

NOTE Se référer à la CEI 60050, Vocabulaire Électrotechnique International, pour les définitions du glossaire général.

3.1
système de gestion d'énergie
EMS (en anglais *energy management system*)
système informatique comprenant une plateforme logicielle offrant les services de support de base et un ensemble d'applications offrant les fonctionnalités requises pour le bon fonctionnement des installations de production et de transport d'électricité afin d'assurer la sécurité adéquate d'approvisionnement énergétique à un coût minimal

3.2
interface de programmation d'application
API (en anglais *application program interface*)
ensemble des fonctions publiques qu'offre un composant exécutable d'application pour être utilisées par d'autres composants exécutables d'application

4 Spécification CIM

4.1 Notation de modélisation du CIM

Le CIM est défini en utilisant des techniques de modélisation orientées objet. Plus précisément, la spécification du CIM utilise la notation du langage de modélisation unifié (UML) qui définit le CIM comme un groupe de paquetages.

Chaque paquetage du CIM contient un ou plusieurs diagrammes de classe montrant sous forme graphique toutes les classes de ce paquetage et leurs relations. Chaque classe est ensuite définie de façon textuelle en mettant l'accent sur ses attributs et ses relations avec d'autres classes.

La notation UML est décrite dans les documents de l'object management group (OMG) et dans plusieurs autres manuels édités.

4.2 Paquetages CIM

4.2.1 Vue générale des paquetages CIM

Le CIM est fractionné en un ensemble de paquetages. Un paquetage est un moyen général permettant de grouper des éléments liés à un modèle. Il n'y a aucune signification sémantique spécifique. Les paquetages ont été choisis pour simplifier la conception, la compréhension et la révision du modèle. Le modèle d'information commun se compose de l'ensemble complet de paquetages. Des entités peuvent avoir des associations dépassant les limites de plusieurs paquetages. Chaque application utilisera des informations représentées dans plusieurs paquetages.

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Le CIM complet est fractionné en groupes de paquetages afin de les gérer et maintenir commodément. Ces groupes sont affectés à des groupes de travail différents au sein du comité d'études 57.

Les paquetages pour le groupe de travail 13 (WG13) comprennent:

a) IEC 61970-301 c'est-à-dire la CEI 61970-301 (le présent document) avec les paquetages suivants:
   - Domain (c'est-à-dire domaine)
   - Core (c'est-à-dire cœur)
   - OperationalLimits (c'est-à-dire limites opérationnelles)
   - Topology (c'est-à-dire topologie)
   - Wires (c'est-à-dire fils)
   - Generation (c'est-à-dire production)
   - Generation.GenerationDynamics
   - Generation.Production
   - LoadModel (c'est-à-dire modèle de charge)
   - Outage (c'est-à-dire interruption de service)
   - Protection
   - Equivalents
   - Meas (c'est-à-dire mesures)
   - SCADA
   - ControlArea (c'est-à-dire zone de contrôle)
   - Contingency (c'est-à-dire contingence)
b) les paquetages traitant des opérations du marché, telles que la planification de l'énergie, les finances et les réserves.

Les paquetages du WG14 dans la série de normes CEI 61968 décrivent des parties supplémentaires du CIM qui traitent d'autres vues logiques des opérations d'une entreprise de service public, y compris la gestion du patrimoine, des emplacements, des activités, des clients, de la documentation et des travaux, et des modèles de réseau spécifiques à la distribution.

Il est à noter que les limites du paquetage n'impliquent pas de limites pour une application. Une application peut utiliser des entités CIM de différents paquetages. Il est également prévu que des paquetages du CIM en dehors de ceux du présent document auront des dépendances avec certains des paquetages décrits dans le présent document, et en particulier les paquetages Domain et Core, même si d'autres dépendances existeront aussi.

La Figure 1 représente les paquetages définis pour la base de CIM de la CEI 61970-301 et leurs relations de dépendance. Les lignes en pointillé indiquent une relation de dépendance, la flèche allant du paquetage dépendant vers le paquetage dont il dépend.

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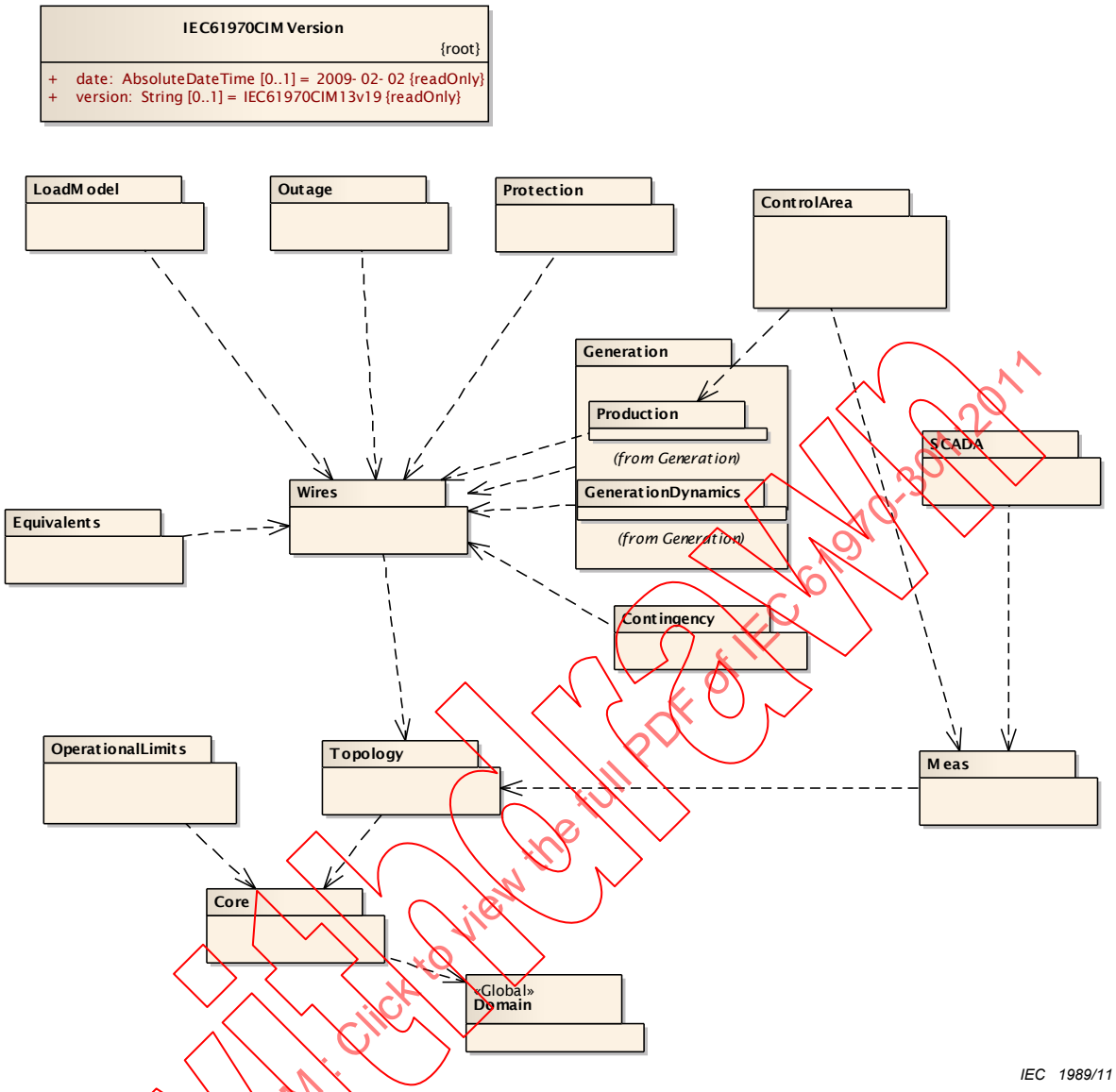

Figure 1 – Diagramme du paquetage CIM IEC 61970-301

Les paragraphes ci-après résument le contenu de chaque paquetage du CIM. L'Article 6 contient la spécification pour chacun des paquetages du CIM.

NOTE Le contenu du CIM défini dans la présente spécification a été créé automatiquement à partir de la version IEC 61970CIM13v19 du modèle électronique UML du CIM, qui est disponible auprès du groupe des utilisateurs du CIM.

4.2.2 Domain

Le paquetage Domain est une bibliothèque de données regroupant les grandeurs et les unités qui définissent les types de données des attributs (propriétés) pouvant être repris par n'importe quelle classe dans n'importe quel autre paquetage.

Ce paquetage définit les types de données essentiels, comprenant les unités de mesures et les valeurs autorisées. Chaque type de données comporte un attribut de valeur et une unité de mesure facultative, précisée comme étant une variable fixe initialisée d'après la description textuelle de l'unité de mesure. Les valeurs des unités ("units") sous forme de chaîne de caractères peuvent être spécifiques à un pays ou à un client. Des valeurs types

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sont données. Les valeurs autorisées pour les énumérations sont répertoriées entre accolades dans la documentation de l'attribut utilisant la syntaxe de contrainte UML. Les longueurs de chaînes de caractère (string lengths) sont répertoriées dans le texte descriptif à l'endroit requis.

4.2.3 Core

Contient les entités centrales PowerSystemResource (c'est-à-dire composant du système électrique) et ConductingEquipment (c'est-à-dire équipement conducteur) partagées par toutes les applications plus les collections communes de ces entités. Toutes les applications ne nécessitent pas toutes les entités Core. Ce paquetage ne dépend d'aucun autre paquetage (à l'exception du paquetage Domain), mais en revanche la plupart des autres paquetages ont des associations et des généralisations qui dépendent de ce paquetage.

4.2.4 OperationalLimits

Le paquetage OperationalLimits modélise une spécification des limites associées à des entités d'équipement et autres entités opérationnelles.

4.2.5 Topology

Extension du paquetage Core qui, associé à la classe Terminal (c'est-à-dire borne), modélise la Connectivity (connectivité), à savoir la définition physique de la façon dont les équipements sont connectés ensemble. De plus, il modélise la Topology, à savoir la définition logique de la façon dont un équipement est connecté via des interrupteurs fermés. La définition du paquetage Topology est indépendante des autres caractéristiques électriques.

4.2.6 Wires

Extension des paquetages Core et Topology qui modélise les informations relatives aux caractéristiques électriques des réseaux Transport et Distribution. Ce paquetage est utilisé par des applications de réseau telles que State Estimation, Load Flow et Optimal Power Flow.

4.2.7 Generation

Generation est divisé en deux paquetages séparés, Production et Generation, qui sont décrits ci-dessous.

4.2.7.1 Generation.Production

Le paquetage Production se charge des classes décrivant différents types de génératrices. Ces classes fournissent également des informations relatives au coût de production, utilisées pour répartir selon des critères économiques, la demande entre les unités engagées et pour calculer les quantités de réserve.

4.2.7.2 Generation.GenerationDynamics

Le paquetage GenerationDynamics se compose de machines motrices, comme les turbines ou les chaudières, utiles pour la simulation et à des fins éducatives.

4.2.8 LoadModel

Ce paquetage est chargé de la modélisation des consommateurs d'énergie, de la charge du système sous forme de courbes et de données de courbe associées. Des circonstances particulières pouvant affecter la charge, telles que les saisons et les types de jour, sont également traitées ci-après.

Ces informations sont utilisées par Load Forecasting (prévision de la charge) et Load Management (gestion de la charge).

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4.2.9 Outage

Extension des paquetages Core (cœur) et Wires (fils) qui modélise les informations relatives à la configuration réseau planifiée et actuelle. Ces entités sont en option sur les applications réseau classiques.

4.2.10 Protection

Extension des paquetages Core (cœur) et Wires (fils) qui modélise les informations relatives à l'équipement de protection tel que les relais. Ces entités sont utilisées sur des simulateurs de formation et des applications de localisation de défauts sur un réseau de distribution.

4.2.11 Equivalents

Le paquetage Equivalents modélise les réseaux équivalents.

4.2.12 Meas

Comprend des entités décrivant des données de mesure dynamiques partagées par les applications.

4.2.13 SCADA

Contient des entités pour modéliser les informations utilisées par les applications de commande de surveillance et acquisition de données (SCADA, supervisory control and data acquisition). La commande de surveillance prend en charge la commande de l'équipement par l'opérateur, telle que l'ouverture ou la fermeture d'un disjoncteur. L'acquisition de données rassemble les données télémétrées provenant de diverses sources. Les sous-types de l'entité Telemetry concordent délibérément avec les définitions de la CEI 61850.

Ce paquetage prend également en charge la présentation d'alarmes mais n'est pas censé être utilisé par d'autres applications.

4.2.14 ControlArea

Le paquetage ControlArea modélise les spécifications relatives aux zones, qui peuvent être utilisées à des fins diverses. Le paquetage dans son ensemble modélise les spécifications de zones de conduite qui se chevauchent potentiellement, à des fins de réglage de production réel, de saisie de charge dans des zones de prévision de charge, ou d'analyse basée sur le flux de puissance.

4.2.15 Contingency

Contingences à étudier.

4.3 Classes CIM et relations

4.3.1 Classes

Le ou les diagrammes de classe de chaque paquetage CIM représentent toutes les classes du paquetage et leurs relations. Lorsque des relations existent avec des classes dans d'autres paquetages, ces classes sont également représentées avec une note identifiant le paquetage auquel la classe appartient.

Les classes et les objets modélisent ce qui se trouve dans un réseau électrique et qui doit être représenté de la même façon pour les applications EMS. Une classe est une description d'un objet réel, tel qu'un transformateur électrique, un générateur ou une charge, qui doit être représenté comme faisant partie du modèle complet de réseau électrique dans un EMS. Parmi les autres types d'objets figurent des éléments tels que les programmes et les mesures que des applications EMS doivent également traiter, analyser et enregistrer. De tels objets

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nécessitent une représentation commune pour atteindre les objectifs de compatibilité de connexion et d'interopérabilité de la norme EMS-API. Un objet particulier dans un réseau électrique ayant une identité unique est modélisé comme une instance de la classe à laquelle il appartient.

Il convient également de noter que le CIM est défini pour faciliter l'échange de données. Comme défini dans le présent document, les entités du CIM n'ont pas de comportement. Afin de rendre le CIM aussi générique que possible, il est fortement souhaitable d'en simplifier la configuration pour des implémentations spécifiques. Il est, en général, plus facile de modifier la valeur ou le domaine d'un attribut que de changer la définition d'une classe. Ces principes impliquent qu'il convient que le CIM évite d'avoir à définir de trop nombreux sous-types spécifiques de classes. Au contraire, le CIM définit des classes génériques avec des attributs donnant le nom du type. Des applications peuvent alors utiliser cette information pour représenter par un exemple des types d'objet spécifiques, le cas échéant. Des applications peuvent avoir besoin d'informations supplémentaires pour définir l'ensemble de types valides et de relations.

Les classes comportent des attributs qui décrivent les caractéristiques des objets. Chaque classe du CIM contient les attributs décrivant et identifiant une instance spécifique de la classe. Seuls les attributs d'intérêt public pour les applications EMS sont inclus dans les descriptions de classes.

Chaque attribut possède un type qui identifie le type d'attribut dont il s'agit. Les attributs typiques sont de type integer (nombre entier), float (flottant), boolean (booléen), string (chaîne) et enumeration (énumération), qui sont appelés types primitifs. Cependant, de nombreux types supplémentaires sont définis comme partie intégrante de la spécification CIM. Par exemple, ShuntCompensator a un attribut "maxU" du type Voltage (c'est-à-dire tension). La définition des types de données est contenue dans le paquetage Domain décrit en 4.2.2. Les stéréotypes Primitive, enumeration et Datatype de l'UML sont ajoutés aux classes utilisées comme types. Le stéréotype Datatype est utilisé avec une sémantique spécifique du CIM pour un triplet d'attributs {value, unit, multiplier}, qui implique une mise en correspondance personnalisée avec des artefacts de sérialisation tels que RDFS, OWL et XSD. Les classes ayant ces stéréotypes ne participent pas à des relations de généralisation ou d'association et sont simplement utilisées comme types pour des attributs.

Tous les attributs du CIM sont implicitement facultatifs en ce sens que les profils utilisant le CIM peuvent les éliminer tous.

Les relations entre les classes révèlent la façon dont elles sont structurées l'une par rapport à l'autre. Les classes CIM sont reliées de différentes façons, comme décrit dans les paragraphes ci-dessous.

4.3.2 Generalization

Une généralisation est une relation entre une classe générale et une classe plus spécifique. La classe la plus spécifique ne peut contenir que des informations supplémentaires. Par exemple, un PowerTransformer (c'est-à-dire transformateur de puissance) est un type spécifique de Equipment (c'est-à-dire d'équipement). L'association de type Generalization permet à une classe spécifique d'hériter d'attributs et de relations de toutes les classes plus générales situées au-dessus d'elle.

La Figure 2 est un exemple de généralisation. Dans cet exemple tiré du paquetage Wires, un Breaker (c'est-à-dire disjoncteur) est un type plus spécifique de ProtectedSwitch (c'est-à-dire commutateur protégé), qui à son tour est un type plus spécifique de Switch (c'est-à-dire commutateur), qui est un type plus spécifique de ConductingEquipment (c'est-à-dire équipement conducteur), etc. Un PowerTransformer (c'est-à-dire transformateur de puissance) est un autre type plus spécifique de Equipment. Remarquer que PowerSystemResource hérite de la classe IdentifiedObject (c'est-à-dire objet identifié) qui n'est pas sur le diagramme.

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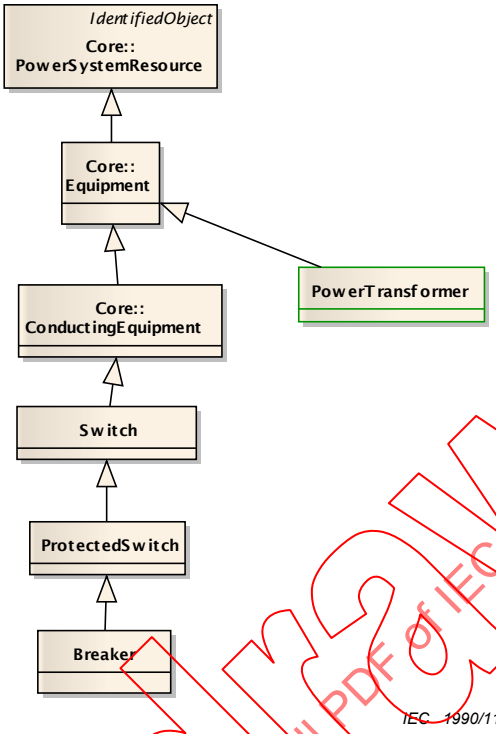

Figure 2 – Exemple de généralisation

4.3.3 Association simple (Simple association)

Une association est une connexion conceptuelle entre des classes. Chaque association a deux “extrémités d'association”. Les “extrémités d'association” étaient appelées “rôles” avant la spécification UML 2.0. Chaque extrémité d'association décrit le rôle que la classe cible (c'est-à-dire la classe *vers* laquelle l'extrémité d'association part) a en relation avec la classe source (c'est-à-dire la classe *à partir de* laquelle l'extrémité d'association part). La coutume est d'attribuer aux extrémités d'association le nom de la classe cible avec ou sans un qualifieur. Chaque extrémité d'association possède aussi une cardinalité/multiplicité, qui est une indication du nombre d'objets qui peuvent prendre part à la relation décrite. Dans le CIM, les associations ne sont pas nommées, seules les extrémités d'association sont nommées. Par exemple dans le CIM, il existe une association entre un BaseVoltage et un VoltageLevel (voir la Figure 3 qui vient du paquetage Wires). La multiplicité est montrée aux deux extrémités de l'association. Dans cet exemple, un objet VoltageLevel (c'est-à-dire niveau de tension) peut faire référence à 1 BaseVoltage (c'est-à-dire tension de base), et un BaseVoltage peut être référencé par 0 ou plus d'objets VoltageLevel.

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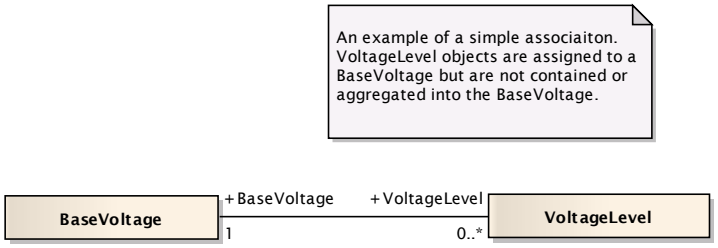


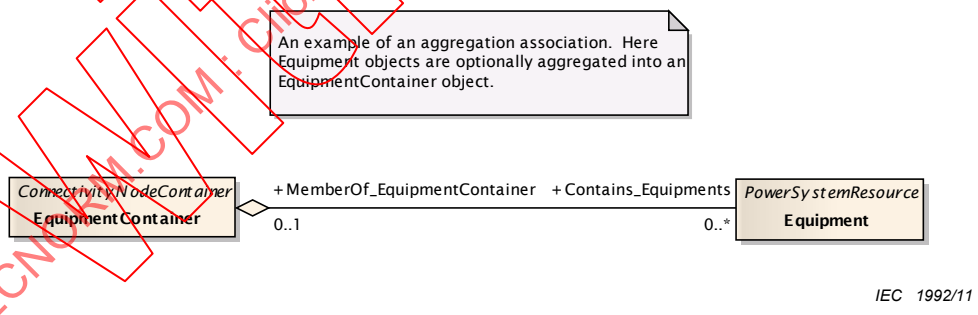
Légende

Anglais	Français
An example of a simple association. VoltageLevel objects are assigned to a BaseVoltage but are not contained or aggregated into the BaseVoltage.	Un exemple d'association simple. Des objets VoltageLevel sont affectés à BaseVoltage mains ne sont ni contenus ni agrégés dans le BaseVoltage.

Figure 3 – Exemple d'association simple

4.3.4 Aggregation

Aggregation (c'est-à-dire agrégation) est un cas spécial d'association. L'agrégation indique que la relation entre les classes est une sorte de relation classe entière/classe partielle où la classe entière "consists of" (se compose de) ou "contains" (contient) la classe partielle, et cette classe partielle est une "part of" (partie de) la classe entière. La classe partielle n'hérite pas de la classe entière comme dans la généralisation. La Figure 4 illustre une agrégation entre la classe EquipmentContainer (c'est-à-dire Conteneur d'équipements) et la classe Equipment, qui provient du paquetage Core. Comme montré, un Equipment peut être membre de zéro ou un seul objet EquipmentContainer, mais un objet EquipmentContainer peut contenir n'importe quel nombre d'objets Equipment.



Légende

Anglais	Français
An example of an aggregation association. Here Equipment objects are optionally aggregated into an EquipmentContainer object.	Un exemple d'association d'agrégation. Ici, des objets Equipment sont facultativement agrégés en un objet EquipmentContainer.

Figure 4 – Exemple d'agrégation

4.4 Concepts du modèle CIM et exemples

4.4.1 Concepts

Les classes, les attributs, les types et les relations du CIM sont spécifiés dans les Articles 5 et 6. L'Article 6 comprend une description complète du modèle de la base du CIM de la CEI 61970-301. Afin d'aider à comprendre comment interpréter le CIM, certains concepts-clés de modèle utilisés dans le CIM sont présentés et décrits dans les paragraphes suivants.

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4.4.2 Hiérarchies d'appartenance, d'équipements et dénomination

4.4.2.1 Structure de l'appartenance

La Figure 5 montre le concept de conteneurs d'équipement (EquipmentContainer) pour former des hiérarchies dans le CIM. Les conteneurs d'équipement sont un moyen de regrouper et de nommer des équipements se trouvant, typiquement, dans un poste (substation). Comme on le constate *de visu*, les conteneurs offrent une certaine souplesse d'utilisation pour se plier aux différents usages internationaux, ainsi qu'aux différences trouvées habituellement entre les postes de transport et de distribution. Bay (c'est-à-dire une baie), VoltageLevel (c'est-à-dire un niveau de tension), Substation (c'est-à-dire un poste), Line (c'est-à-dire une ligne) et Plant (c'est-à-dire une centrale) sont tous des types de EquipmentContainers. En général, un Bay est contenu dans un VoltageLevel spécifique, qui à son tour est contenu dans un Substation. Les Substation et les Line peuvent être contenus dans des SubGeographicRegion (c'est-à-dire des sous-régions géographiques) et GeographicRegion (c'est-à-dire des régions géographiques).

Une hiérarchie d'appartenance est utilisée avec la classe IdentifiedObject pour créer une désignation hiérarchique destinée à décrire la consommation humaine. Une hiérarchie est utilisée spécifiquement pour nommer les équipements selon leur fonction dans le système électrique. Il s'agit de la hiérarchie de dénomination fonctionnelle. Outre les noms fonctionnels, d'autres identifications communes sont les numéros de série des biens. Le nom fonctionnel diffère d'un numéro de série en ce qu'il renvoie à la fonction d'une position ou localisation particulière d'un équipement dans le système électrique. Quel que soit l'élément spécifique d'équipement physique qui est placé en un endroit, le nom fonctionnel est le même mais le numéro de série varie en fonction de l'équipement physique actuellement utilisé.

4.4.2.2 Classe IdentifiedObject

La classe IdentifiedObject contenu dans le paquetage Core est héritée par tous les objets PowerSystemResource et de nombreuses autres classes. Cette classe contient six attributs à utiliser pour nommer tous les objets PowerSystemRessource. L'objectif est qu'il convient d'assigner des valeurs à chacun des attributs d'une manière cohérente avec la définition des attributs.

Les éléments qui suivent sont des définitions et conventions concernant les modalités d'utilisation des attributs IdentifiedObject pour nommer les objets PowerSystemResource (pour plus de détails, se référer à la documentation concernant IdentifiedObject et ses attributs à l'Article 6):

- name: Un nom en texte libre.
- localName: Un nom court local de l'instance. Les objets qui sont structurés en une hiérarchie de dénomination fonctionnelle gardent ce nom local à tous les niveaux de la hiérarchie. Le nom doit être unique pour les objets contenus par le même parent.
- pathName: Les objets qui sont structurés en une hiérarchie de dénomination fonctionnelle ont un pathName (chemin d'accès) qui contient tous les IdentifiedObject.localName (c'est-à-dire nom local d'objet identifié) allant de l'objet à la racine. Le pathName est alors une concaténation de tous ces noms en remontant de l'objet feuille à la racine de la hiérarchie d'appartenance, de manière semblable à un chemin d'accès pour un fichier. Par exemple, si le node (c'est-à-dire nœud) « A » contient le node « B » qui contient le node « C », alors le pathName pour le node « C » peut apparaître comme étant « A.B.C ». Le type des caractères de délimitation utilisés entre les localName (c'est-à-dire noms locaux) n'est pas spécifié mais est du ressort de l'implémentation locale.
- aliasName (c'est-à-dire pseudonyme): Un nom en texte libre de l'instance. Cet attribut peut aussi être utilisé pour la localisation.
- description: Une description en format libre de l'instance.
- mRID (Master Resource ID): Un identificateur lisible par une machine et unique au niveau global pour une instance d'objet.

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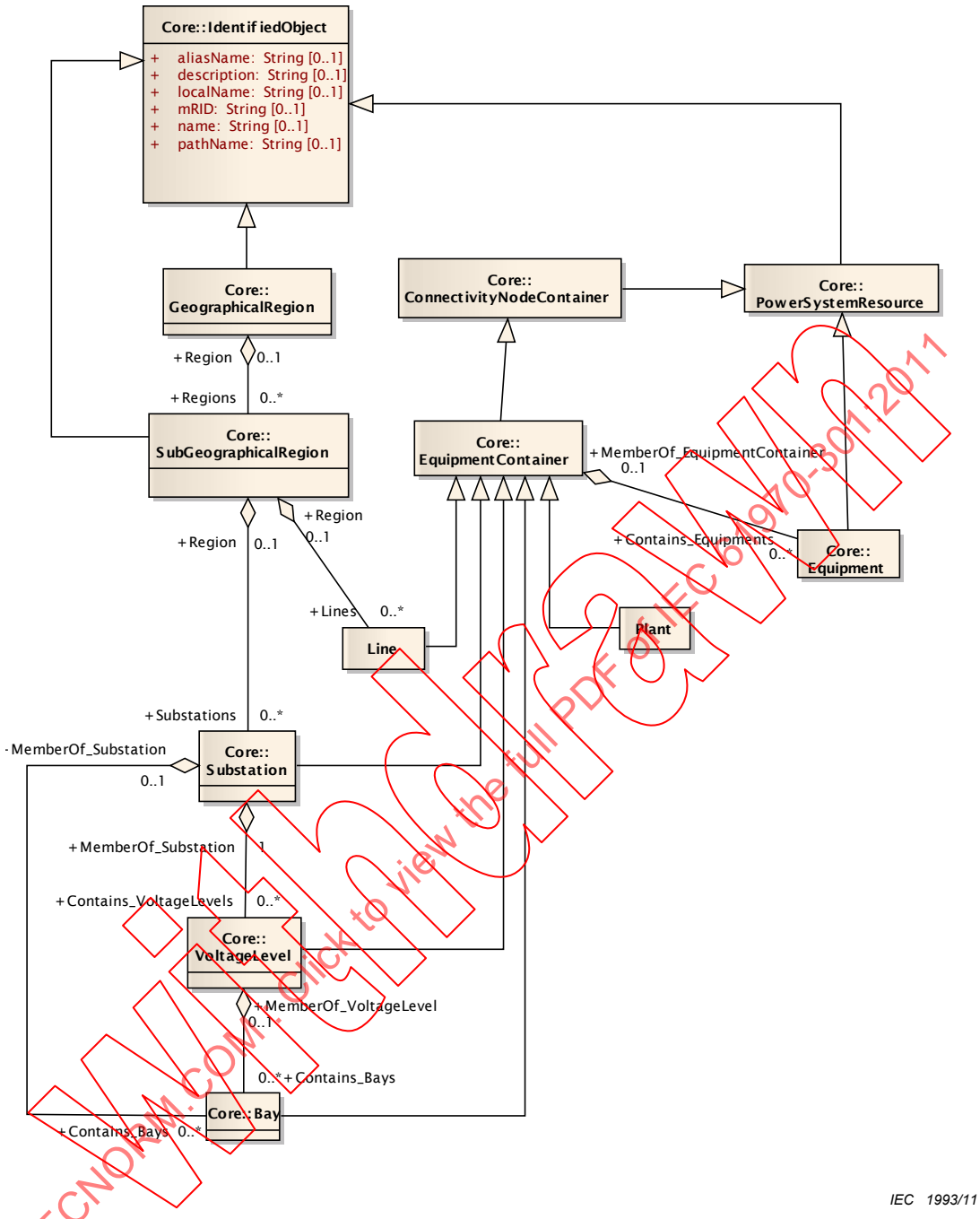

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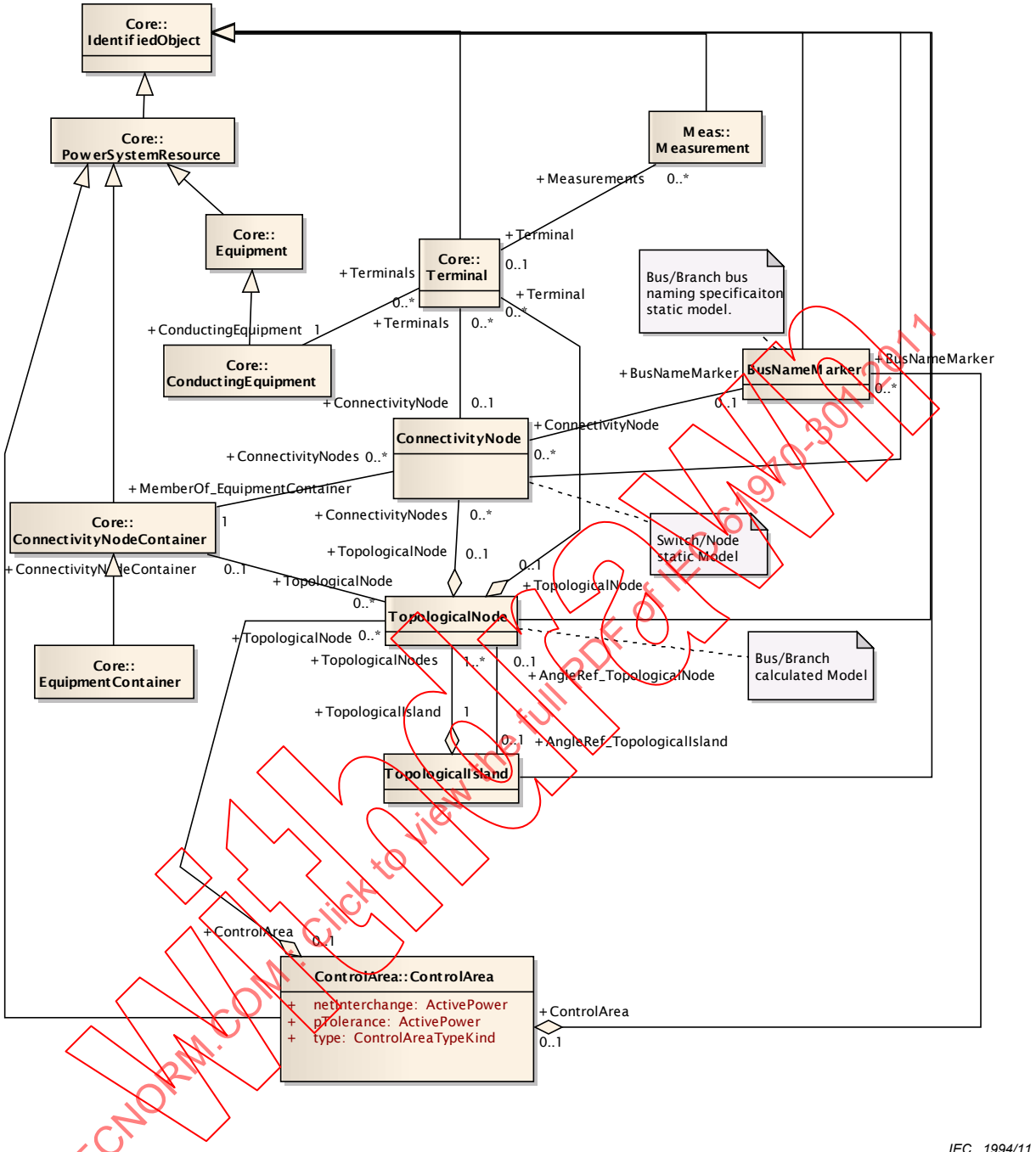
Figure 5 – Conteneurs Equipment

Les diagrammes NamingHierarchyPart1 (c'est-à-dire Partie 1 de la hiérarchie de dénomination) et NamingHierarchyPart2 (c'est-à-dire Partie 2 de la hiérarchie de dénomination) dans les paquetages Wires montrent la hiérarchie de dénomination fonctionnelle (pour les détails, se référer à la documentation du paquetage Wires donnée à l'Article 6).

4.4.3 Modèle de connectivité

4.4.3.1 Description de la connectivité

La Figure 6 montre le diagramme de classe Topology qui modélise la connectivité entre différents types de ConductingEquipment. Elle inclut également une partie du diagramme de classe du paquetage Meas traitant des mesures pour illustrer la façon dont les mesures sont associées aux équipements conducteurs.



Légende

Anglais	Français
Bus/Branch bus naming specification static model.	Modèle statique de spécification de dénomination de topologie nodale
Switch/Node static model	Modèle statique Commutateur/Nœud
Bus/Branch calculated model	Modèle calculé en topologie nodale

Figure 6 – Modèle de connectivité

Pour modéliser la connectivité, les classes Terminal (borne) et ConnectivityNode (c'est-à-dire nœud de connectivité) ont été définies. Un Terminal appartient à un ConductingEquipment, mais un ConductingEquipment peut avoir un nombre quelconque de Terminal (bornes). Chaque Terminal peut être connecté à un ConnectivityNode qui est un point où les terminaux des équipements conducteurs sont connectés ensemble avec une impédance nulle. Un ConnectivityNode peut avoir un nombre quelconque de bornes connectées et peut être

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membre d'un TopologicalNode (c'est-à-dire nœud topologique) (à savoir un bus) qui est membre d'un TopologicalIsland (c'est-à-dire îlot topologique). Les TopologicalNode et TopologicalIsland sont créés comme résultat d'un programme qui prend en compte la topologie existante et les positions réelles des commutateurs.

Il est possible d'échanger des messages impliquant directement TopologicalNode et contournant les détails de ConnectivityNode en utilisant l'association TopologicalNode à Terminal. Cela est souvent utile pour les échanges impliquant des modèles de topologie nodale qui ne contiennent pas typiquement des détails relatifs aux commutateurs.

Les EquipmentContainers, qui sont une spécialisation d'un ConnectivityNodeContainer (c'est-à-dire Conteneur de nœud de connectivité), peuvent avoir zéro, un ou plusieurs ConnectivityNodes. Les associations ConductingEquipment – Terminal et Terminal – ConnectivityNode permettent de représenter la topologie d'un réseau électrique réel. Pour chaque Terminal connecté à un ConnectivityNode, les associations des autres Terminal au même ConnectivityNode identifient le ou les objets ConductingEquipment qui sont connectés électriquement. Une connectivité similaire, au niveau de détail "topologie nodale", peut être exprimée à l'aide de TopologicalNode au lieu du ConnectivityNode.

Pour modéliser les valeurs analogiques telles que la tension et la puissance, chaque Terminal a une association avec une classe Measurement du paquetage Meas. Comme ne le montre pas la Figure 6, un objet Measurement est associé à au moins un objet MeasurementValue (c'est-à-dire valeur de mesure). Chaque MeasurementValue est une instance de mesure d'une source spécifique, par exemple une mesure télémétrée. Dans un contexte d'étude, les valeurs de mesure seraient au contraire établies à partir d'une source de calcul.

L'Article 6 contient une description complète de chaque classe de la Figure 6 avec la définition de tous les attributs et de toutes les relations pris en charge dans chaque classe.

4.4.3.2 Exemple de connectivité et d'emboîtement

Pour illustrer comment le modèle de connectivité et le modèle d'emboîtement peuvent être représentés comme des objets, un petit exemple est présenté à la Figure 7. L'exemple montre une ligne de transport avec une jonction en T entre deux postes et un poste avec deux niveaux de tension et un transformateur entre eux. La ligne de transport contient deux câbles différents. Un des niveaux de tension est montré avec une section de jeux de barres contenant un seul jeu de barres et deux baies de commutation très simples connectées au jeu de barres.

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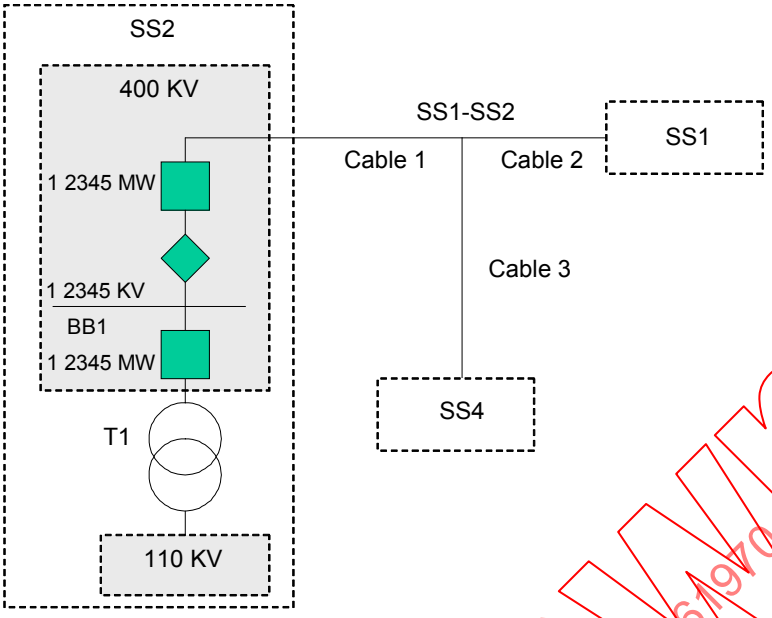

Figure 7 – Exemple de réseau simple

La Figure 8 montre comment la connectivité est modélisée dans le CIM ainsi qu'une façon (mais pas nécessairement la seule) dont l'emboîtement est modélisé pour le diagramme de la Figure 8. Les carrés ombrés représentent les EquipmentContainers, et les carrés blancs les ConductingEquipments. Un ombrage plus sombre indique que l'EquipmentContainer est plus haut dans la hiérarchie d'emboîtement (à savoir, Substation est le plus haut, VoltageLevel vient ensuite, etc.). Les cercles blancs représentent les ConnectivityNodes, et les petits cercles noirs les Terminal. Un Terminal appartient à un ConductingEquipment, et un ConnectivityNode appartient à un EquipmentContainer. Cela signifie que les frontières (ou points de contact) entre ConductingEquipments sont leurs Terminal interconnectés via les ConnectivityNode.

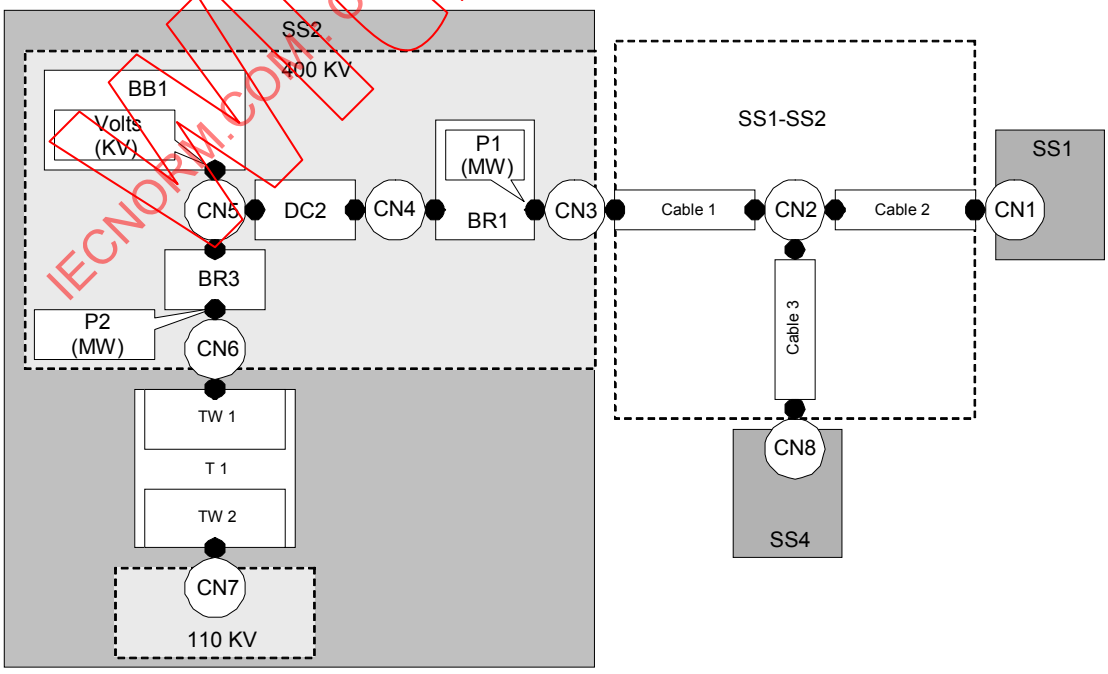

Figure 8 – Connectivité d'un réseau simple modélisé avec la topologie du CIM

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La Line (c'est-à-dire ligne) SS1-SS2 contient trois ACLineSegments (Cable1, Cable2, et Cable3) et le ConnectivityNode (CN2) associé pour modéliser une jonction en T, qui assure une connexion à SS4. Cela n'est qu'une façon dont cette configuration pourrait être modélisée. Chaque ACLineSegment a deux Terminal. Cable1 est connecté à CN3 et CN2 via ces Terminal. CN3 est contenu par VoltageLevel 400 kV. Le disjoncteur ("Breaker") BR1 a deux bornes dont l'une est connectée à CN3.

Les Measurements sont représentés par des bulles carrées où les flèches pointent vers un Terminal. P1 est connecté au Terminal de droite appartenant au Breaker BR1. Noter que P1 est tracé dans la boîte représentant BR1. C'est parce qu'un Measurement peut appartenir à un PowerSystemResource (PSR), comme c'est le cas avec BR1. P2 est tracé dans le VoltageLevel 400 kV, ce qui signifie qu'il appartient au VoltageLevel 400 kV et non à BR3.

4.4.4 Hiérarchie des héritages

La Figure 9 montre une vue générale de la hiérarchie des héritages modélisée dans le CIM. Cette vue générale qui est incluse comme l'un des diagrammes du paquetage Wires couvre en fait la plupart des paquetages du CIM.

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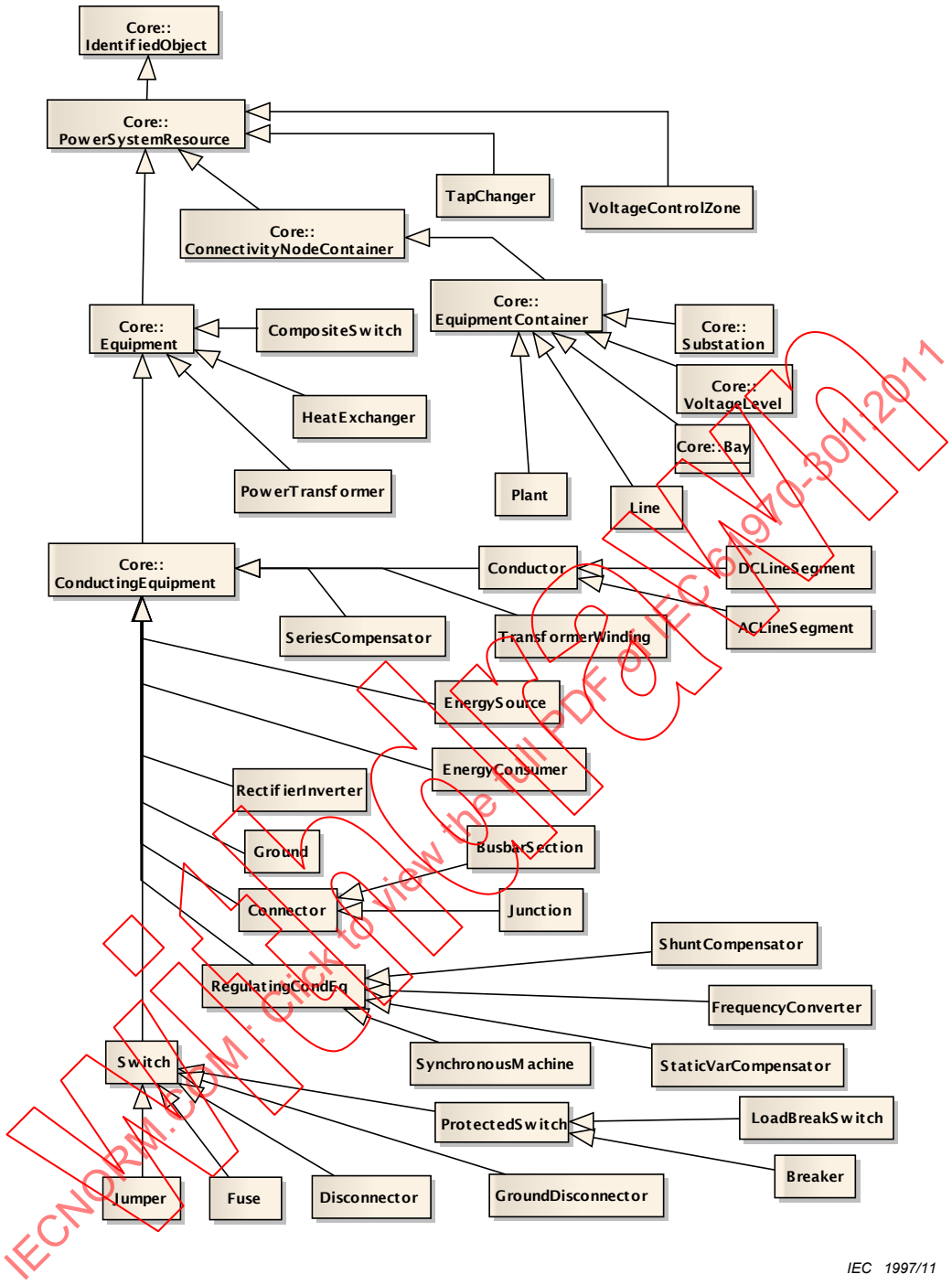

Figure 9 – Hiérarchie des héritages de Equipment

4.4.5 Modèle du transformateur

La Figure 10 montre une partie du diagramme de classe Wires qui modélise un dispositif PowerTransformer (c'est-à-dire Transformateur de puissance).

Comme le montre la figure, un PowerTransformer est une classe spécialisée d'Equipment, elle-même classe spécialisée de PowerSystemResource au même titre qu'un ConductingEquipment et un TapChanger. C'est ce que montre l'utilisation de la relation de type généralisation qui utilise une flèche pour indiquer la classe générale et permet au PowerTransformer d'hériter d'attributs à la fois de Equipment et de PowerSystemResource.

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Un PowerTransformer a également une relation au TransformerWinding (c'est-à-dire enroulement de transformateur) qui est modélisé par une relation de type agrégation utilisant un symbole en forme de losange pour montrer la relation de la classe partielle à la classe entière. Comme le montre la figure, un PowerTransformer peut avoir (ou contenir) un ou plusieurs TransformerWindings mais un TransformerWinding ne peut appartenir qu'à (ou être membre de) un seul PowerTransformer.

Le TransformerWinding a également d'autres relations:

- une relation de généralisation avec le ConductingEquipment;
- une relation d'association avec la classe WindingTest (test d'enroulement) telle qu'un objet TransformerWinding peut être TestedFrom (testé à partir) de 0, 1 ou plus objets WindingTest;
- une relation d'agrégation avec la classe TapChanger telle qu'un objet TransformerWinding peut avoir 0, 1 ou plus objets TapChanger qui lui soit associés.

L'Article 6 contient une description complète de chaque classe de la Figure 10 avec la définition de tous les attributs et de toutes les relations pris en charge dans chaque classe.

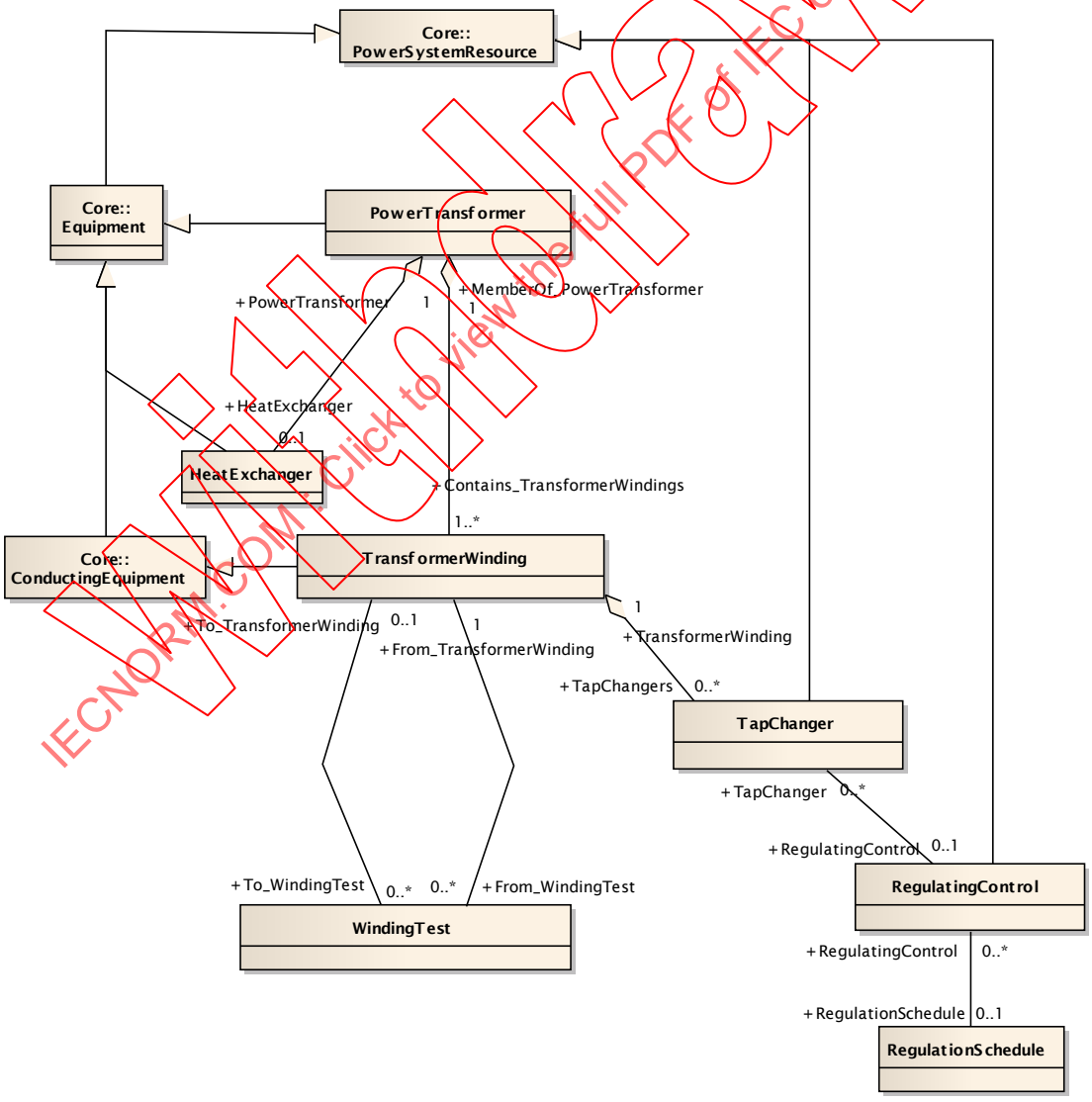

Figure 10 – Modèle de transformateur

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4.4.6 Mesures et commandes

4.4.6.1 Vue générale des mesures

Les Measurement (mesures) sont utilisées pour représenter les variables d'état qui peuvent être rencontrées dans des processus industriels. Chaque processus industriel a ses types spécifiques de mesures. Un système de puissance a typiquement des flux de puissance, des tensions, des positions (par exemple, disjoncteurs, sectionneurs), des indicateurs de défauts (pression atmosphérique, pression d'huile, surchauffe, etc.), des compteurs (par exemple, énergie), etc.

Le nom "Measurement" semblerait indiquer que toutes les variables d'état seraient mesurées. Tel n'est pas toujours strictement le cas car de nombreuses mesures sont calculées par des fonctions SCADA ou EMS/DMS, comme les calculs d'estimateur d'état ou de répartition, par exemple. Par conséquent, une mesure peut avoir un certain nombre de valeurs alternatives (par exemple, fournies manuellement, télémétrées, estimées par état, optimisées, etc.). Cela est pris en charge par les modèles Measurement et MeasurementValue dans le paquetage Meas.

4.4.6.2 Vue générale des commandes

Les commandes sont utilisées pour représenter les variables de commande. Les variables de commande du système de puissance sont typiquement des points de consigne, des commandes de montée-descente, des commandes de sélection avant exécution et des commandes marche/arrêt, etc. Le paquetage Meas prend en charge les variables de commande avec le modèle Control (c'est-à-dire Commande).

4.4.6.3 Utilisation des classes liées à la classe Measurement

Un PowerSystemResource (PSR) peut avoir zéro à plusieurs mesures qui lui sont associées en contenant une ou plusieurs mesures. Chaque Measurement peut contenir une ou plusieurs valeurs de mesure. Le respect des conseils suivants permettra aux applications de naviguer et de retrouver les valeurs de mesure requises de manière cohérente (voir Figure 11).

a) Les Measurement d'un PowerSystemResource sont classés par MeasurementType (c'est-à-dire type de mesure).

b) Les MeasurementValues (c'est-à-dire valeurs de mesure) d'un Measurement sont classés par MeasurementValueSource (c'est-à-dire source de valeur de mesure).

   MeasurementType[1] hérite de IdentifiedObject. Les valeurs à utiliser pour MeasurementType.name, MeasurementType.aliasName et MeasurementType.description sont données au Tableau 1.

c) MeasurementValueSource hérite aussi de IdentifiedObject. Les valeurs à utiliser pour MeasurementValueSource.name et MeasurementValueSource.description sont données au Tableau 2. Ce tableau donne un certain nombre de noms de source qui doivent être utilisés là où c'est possible. Cependant, les noms exacts devant être utilisés pour des applications spécifiques sont définis dans le document correspondant CEI 61970 Spécifications des composants d'interface (*component interface specifications CIS*).

d) Les tableaux peuvent être étendus pour des besoins propriétaires. Les noms ajoutés doivent commencer par un nom unique (par exemple, le nom de la compagnie) et un caractère «souligné» ("underscore"). Exemple: xyz_AverageTemperature.

e) ValueAliasSet (ensemble de pseudonymes de valeurs) est utilisé pour les mesures discrètes et décrit les correspondances des valeurs aux noms symboliques. Des protocoles de communication différents (par exemple pour les RTU (c'est-à-dire Remote Units, à savoir unités distantes) et pour les centres de conduite tels que ICCP (c'est-à-dire Intelligent Customer Contact Platform, à savoir plate-forme intelligente de relations avec l'abonné) ou ELCOM) utilisent des codages de données différents. Un

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[1] MeasurementType diffère de Unit, qui fait partie du paquetage Domain décrite en 4.2.2. MeasurementType décrit "ce qui" est mesuré plutôt que l'unité de mesure, y compris l'échelle, qui est du ressort de Unit.

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système peut avoir une mise en correspondance à l'échelle du système pour toutes les valeurs Discrete (c'est-à-dire discrètes) ou regrouper les valeurs Discrete et effectuer la mise en correspondance par groupe. La création d'une seule mise en correspondance à l'échelle du système qui couvrirait des protocoles de communication existants ne relève pas du domaine d'application de la présente spécification.

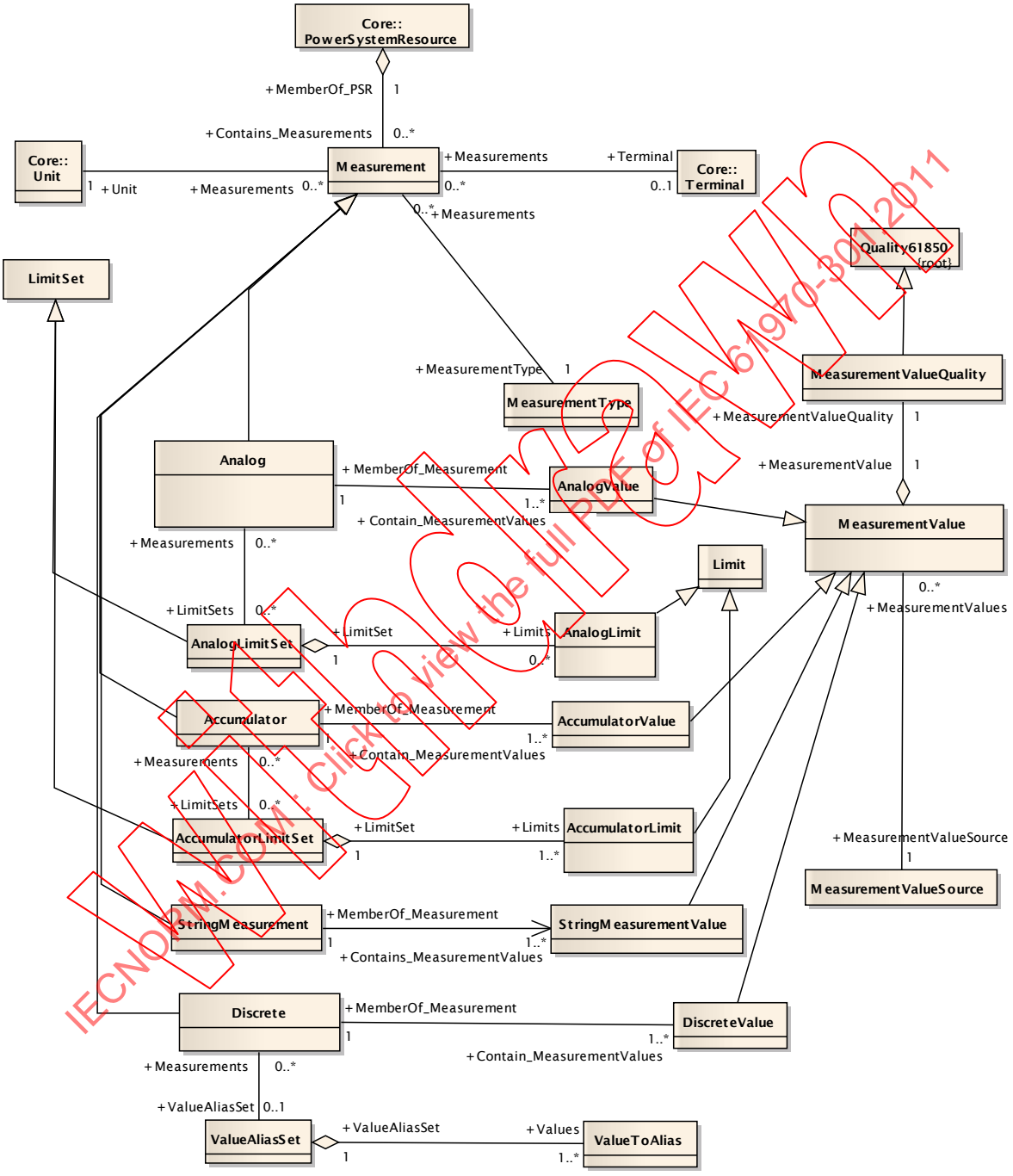

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Figure 11 – Navigation de PSR à MeasurementValue

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Tableau 1 – Convention de dénomination de MeasurementType (types de mesure)

name (c'est-à-dire nom)	aliasName (c'est-à-dire pseudonyme)	description
Current	Amp	Courant (efficace) d'un circuit non triphasé
ThreePhaseCurrent	AvAmps	Courant total (efficace) dans un circuit triphasé
PhaseCurrent	A	Courant de phase mesuré
Frequency	Hz	Fréquence
PowerFactor	PwrFact	Facteur de puissance non alloué à une phase
ThreePhasePowerFactor	TotPF	Facteur de puissance moyen dans un circuit triphasé
ThreePhaseApparentPower	TotVA	Puissance apparente totale dans un circuit triphasé
ThreePhaseReactivePower	TotVAr	Puissance réactive totale dans un circuit triphasé
ThreePhaseActivePower	TotW	Puissance réelle totale dans un circuit triphasé
ApparentPower	VoltAmp	Puissance apparente dans un circuit non triphasé
ReactivePower	VoltAmpr	Puissance réactive dans un circuit non triphasé
Voltage	Vol	Tension (efficace) non allouée à une phase
ActivePower	Watt	Puissance réelle dans un circuit non triphasé
Pressure	Pres	Pression
Temperature	Tmp	Température
Angle	Ang	Angle entre la tension et le courant
ApparentEnergy	TotVAh	Énergie apparente
ReactiveEnergy	TotVArh	Énergie réactive
ActiveEnergy	TotWh	Énergie réelle
Automatic	Auto	Fonctionnement automatique (non manuel)
LocalOperation	Loc	Fonctionnement local (non à distance)
SwitchPosition	Pos	Position du commutateur [2bits= intermediate,open,closed,ignore]
TapPosition	TapPos	Position de la prise d'un transformateur de puissance ou d'un déphaseur
Operation Count	OperCnt	Opération de comptage - en général pour les commutations

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Le Tableau 1 décrit divers types de mesures également définies dans la CEI 61850. Les colonnes du Tableau 1 ont les significations suivantes:

- name (MeasurementType.name) est le nom du type de mesure selon la CEI 61970.
- aliasName (MeasurementType.aliasName) est le nom affecté aux données dans la CEI 61850. (Se référer à l'Article 6 de la CEI 61850-7-4, sémantique du nom d'objet de donnée).
- description (MeasurementType.description) des données.

Il doit être noté que le Tableau 1 est une liste non exhaustive et que la correspondance entre mesures telles que définies dans un centre de conduite et un poste n'est pas triviale.

Tableau 2 – Conventions de dénomination de MeasurementValueSource (source de mesure)

nom	description
SCADA	Valeurs télémesurées reçues d'un système SCADA local
CCLink	Valeur reçue d'un centre de conduite distant par l'intermédiaire de TASE.2 ou autre protocole
Operator	Valeur entrée par un opérateur (toujours maintenu manuellement, le PSR n'est pas connecté à un “RTU” (unité terminale distante))
Estimated	Valeur mise à jour par un estimateur d'état
PowerFlow	Valeur mise à jour par un Powerflow (calcul de répartition)
Forecasted	Valeur qui est planifiée ou prévisionnelle
Calculated	Valeur calculée à partir d'autres valeurs de mesure (par exemple, une somme)
Allocated	Valeur calculée par un allocateur de charge

En respectant ces conventions:

- chaque instance de Measurement représente une grandeur technique d'un PowerSystemResource;
- chaque MeasurementValue d'un Measurement représente une valeur pour la grandeur technique, fournie par une source unique;
- l'attribut source de MeasurementValueQuality indique alors si la source a vraiment fourni la valeur courante ou bien si elle est une valeur de substitution ou une valeur par défaut.

4.4.6.4 Rattachement des Measurement

Comme mentionné dans le paragraphe précédent et comme montré à la Figure 11, les Measurement sont contenus par un PowerSystemResource. Cela est suffisant pour des Measurement qui ne sont pas reliés à la connectivité, par exemple la température, le poids, la taille.

Pour spécifier l'emplacement d'un Measurement dans le réseau, il est utilisé une association à Terminal. Des exemples sont les flux de puissance, les tensions et les courants. Les tensions (Voltage) n'ont pas de sens et peuvent être attachées en fonction de l'emplacement du capteur. Les flux ont un sens et doivent être attachés de façon à ce que le sens du flux soit évident d'après le placement.

La Figure 12 montre deux exemples de placement de Measurements.

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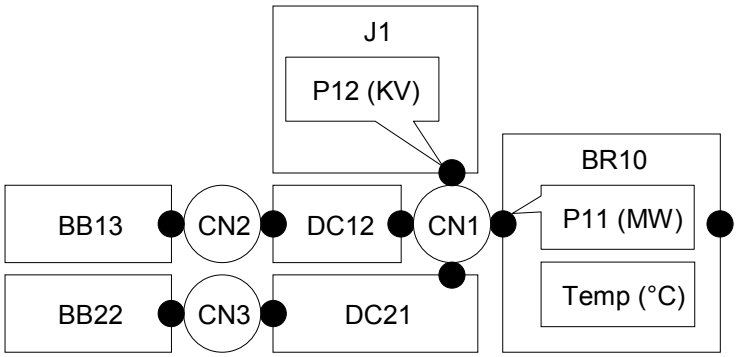

Figure 12 – Placement de Measurement

P12 est un Measurement de tension qui mesure la tension à la jonction J1. P12 est topologiquement relié au ConnectivityNode CN1 via le Terminal de la jonction J1. P11 est un Measurement qui mesure le flux traversant le disjoncteur BR10 du côté connecté au ConnectivityNode CN1. P11 est topologiquement relié au ConnectivityNode CN1 via le Terminal gauche du disjoncteur BR10. Temp est un Measurement qui mesure la température du disjoncteur. Comme la température n'est pas reliée à la connectivité, elle n'a pas de relation avec un Terminal – elle appartient seulement au disjoncteur BR10.

4.4.7 Modèle de commande de régulation

La commande de régulation, telle qu'une commande de tension automatique dans des générateurs ou à une commande de prise de tension dans des transformateurs est modélisée en utilisant une classe nommée RegulationControl (c'est-à-dire commande de régulation). La classe RegulatingControl fournit la fonctionnalité permettant de modéliser de multiples équipements participant à un plan de régulation. Ces plans de régulation peuvent être physiques ou mis en œuvre manuellement dans le fonctionnement réel du système d'énergie, mais ils sont reflétés dans les modèles utilisés à des fins d'analyse des systèmes de puissance. La Figure 13 montre comment les classes RegulatingCondEq et TapChanger peuvent participer à la régulation.

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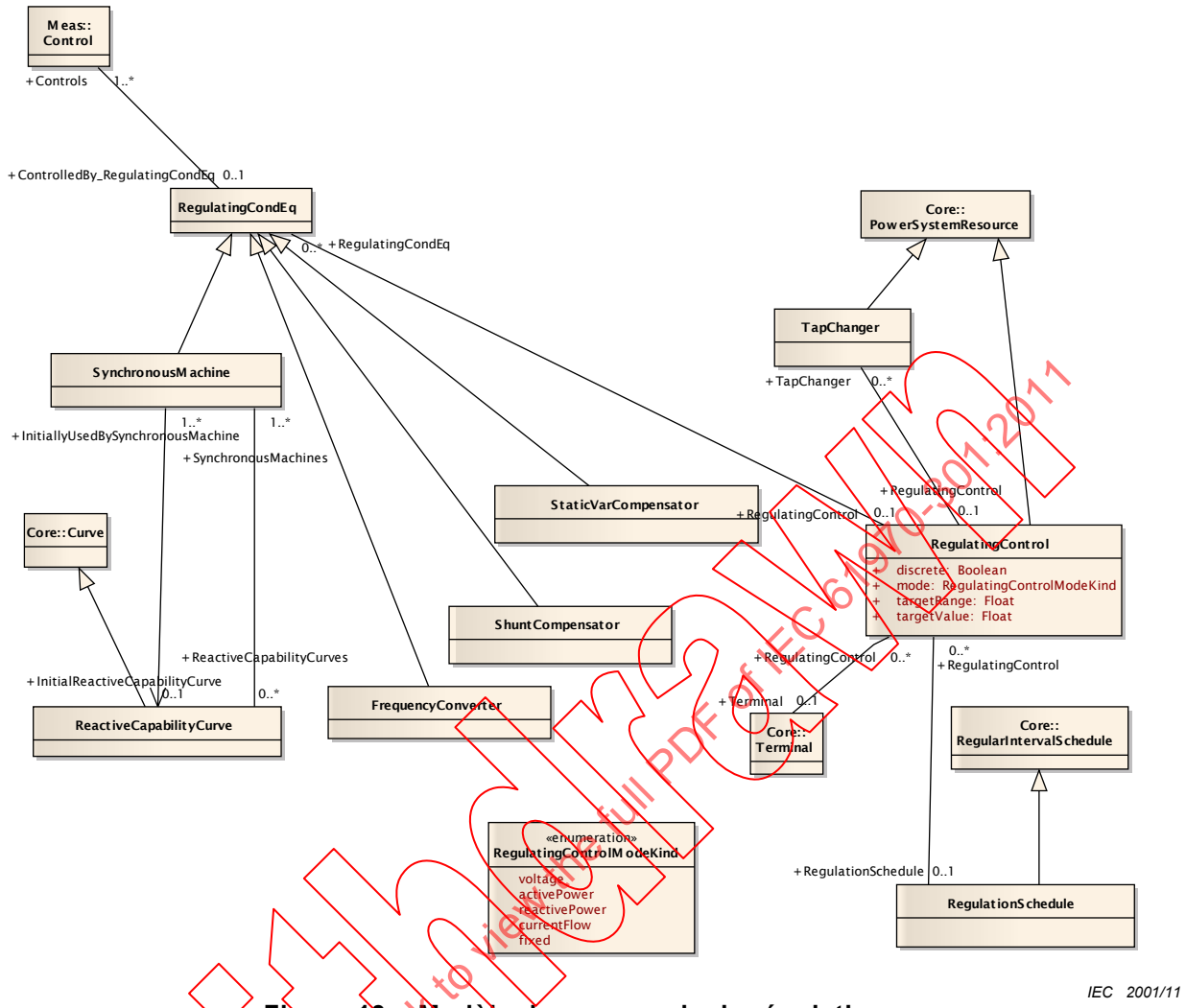

Figure 13 – Modèle de commande de régulation

4.5 Conseils de modélisation

4.5.1 Modélisation pour modifications

Les paragraphes ci-après proposent des conseils sur la façon de maintenir et étendre le CIM.

Le CIM est destiné à contenir les classes et les attributs qui seront échangés sur des interfaces publiques entre des applications principales. L'objectif est de ne conserver, autant que possible, que les caractéristiques génériques à partir desquelles une implémentation détaillée peut être extraite. Il est, en général, plus facile de modifier la valeur ou le domaine d'un attribut que de modifier une définition de classe. Cela rend le modèle plus solide, car il peut supporter une plus large classe d'exigences, et plus stable, car il est possible de gérer de nouvelles exigences sans avoir à modifier le modèle.

4.5.2 Processus pour les amendements au CIM

Il peut être souhaitable d'amender le CIM pour réviser le modèle ou pour étendre le CIM afin de modéliser des éléments additionnels d'un système électrique. Le processus recommandé pour ces amendements est le suivant.

a) Préparer un cas d'utilisation (Use Case) qui décrit les changements souhaités. Il convient que cela inclue les changements proposés aux diagrammes de classes concernés avec illustration des classes, attributs et associations nouveaux ou révisés.

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b) Les cas d'utilisationsont ensuite examinés par le groupe de travail approprié de la CEI, qui va décider s'il convient que les changements demandés soient traités en tant que révisions de la norme CIM courante, ou s'il convient qu'ils soient traités comme des amendements privés sans conséquence pour la norme.

c) Les propositions d'amendements acceptés par le groupe de travail seront ajoutées à la liste des sujets majeurs et le moment venu, une nouvelle version du modèle CIM sera préparée et une mise à jour de la spécification CIM appropriée sera faite.

4.5.3 Modifications apportées au modèle UML du CIM

Du point de vue de la modélisation, lorsque le CIM est étendu, l'approche consiste à partir du modèle UML de CIM existant. Les extensions peuvent être ajoutées de plusieurs façons disponibles avec UML, mais dans tous les cas, la bonne approche est d'examiner le modèle courant et de déterminer la meilleure extension à partir des diagrammes de classes existants. Les extensions peuvent prendre une des formes suivantes, de la plus simple à la plus complexe:

- ajouter des attributs ou associations supplémentaires à des classes préexistantes;
- ajouter de nouvelles classes qui sont des spécialisations classes préexistantes;
- ajouter de nouvelles classes à l'aide d'associations avec des classes préexistantes.

L'objectif principal est de réutiliser au maximum le CIM. Du point de vue des paquetages, il convient que les extensions soient faites aux paquetages existants chaque fois que c'est possible. Si les extensions comprennent un nouveau domaine d'application, il convient d'envisager de créer un nouveau paquetage pour les additions, mais en créant toujours les nécessaires associations au paquetage préexistant, en gardant à l'esprit que bien qu'un nouveau paquetage soit créé, le CIM continue d'être un seul modèle.

4.5.4 Modifications apportées aux documents normatifs du CIM

D'un point de vue documentaire, lorsque le CIM est étendu, une décision doit être prise quant à la question de savoir si les changements constituent des mises à jour de documents normatifs sur le CIM ou si une nouvelle spécification Partie 3xx est nécessaire. Dans les deux cas, les extensions deviendront une partie de la norme CEI sur le CIM.

4.5.5 Profils CIM

Une implémentation du CIM ne doit pas nécessairement inclure toutes les classes, attributs et associations de la norme CIM pour être conforme à la norme CIM. Des profils peuvent être définis pour spécifier quels éléments doivent être inclus (éléments obligatoires) pour une utilisation particulière du CIM, ainsi que ceux qui sont facultatifs. Ces profils sont définis dans la série de normes Partie 4xx.

Un exemple est le profil pour échanger des modèles de système de puissance. Ce profil spécifie comment le CIM doit être utilisé pour échanger des modèles de système de puissance en XML et il spécifie aussi les classes, attributs et associations, obligatoires et facultatifs, devant être pris en charge pour cette utilisation du CIM. Les profils peuvent être maintenus à l'aide d'outils tels que l'outil open source (c'est-à-dire de source ouverte) CIMTool, disponible à l'adresse http://www.CIMTool.org.

4.6 Outils de modélisation

Les éditions précédentes du CIM avaient été créées et maintenues à l'aide de Rational ROSE[2], mais la présente version a été construite à l'aide du produit Enterprise Architect[3]. Le

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2 Rational ROSE est l'appellation commerciale d'un produit précédemment distribué par IBM. Cette information est donnée à l'intention des utilisateurs du présent document et ne signifie nullement que la CEI approuve ou recommande l'emploi exclusif du produit ainsi désigné.

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modèle UML du CIM complet existe sous la forme d'un fichier de projet Enterprise Architect et peut être visualisé avec cet outil, y compris les diagrammes de classe et les descriptions des classes, des attributs, des types et des relations. La visualisation du CIM de cette façon offre une interface de navigation graphique qui permet de visualiser toutes les données de spécification du CIM par simple pointer-cliquer sur le diagramme de classe dans chaque paquetage. Une visionneuse gratuite est disponible auprès de Sparx Systems.

Idéalement, le modèle d'informations du CIM est indépendant de tout outil UML spécifique, bien que l'expérience ait montré que les échanges entre des outils différents soient souvent loin d'être parfaits. En attendant la réalité de l'interopérabilité des outils, les futures modifications apportées à la spécification du CIM, débouchant sur de nouvelles versions de la présente norme, seront incorporées en premier lieu dans la description du projet Enterprise Architect pour garantir une source unique pour les données de modèle CIM.

L'Article 6 du présent document a été généré automatiquement en utilisant un outil accessible au public appelé CIMinEA qui utilise les interfaces d'automatisation de Microsoft Word et d'Enterprise Architect et le format et les styles normalisés de la CEI.

4.7 Conventions d'implémentation pour les utilisateurs

4.7.1 Conventions au-delà de l'UML

Ces paragraphes ci-après proposent des conventions d'utilisateur recommandées pour l'utilisation du CIM dans l'implémentation des systèmes réels.

4.7.2 Nombre des Terminal pour les objets ConductingEquipment

Les ConductingEquipments (équipements conducteurs) suivants ont deux bornes: ACLineSegment, DCLineSegment, Jumper (c'est-à-dire cavalier), Fuse (c'est-à-dire coupe-circuit à fusibles), Breaker, Disconnector (c'est-à-dire sectionneur), LoadBreakSwitch (c'est-à-dire commutateur à coupure en charge), SeriesCompensator (c'est-à-dire compensateur série). Toutes les autres classes feuilles ConductingEquipment ont une seule borne.

4.8 Exemples de modélisation CIM

Des modèles de systèmes électriques ont été créés de plusieurs façons à partir du modèle UML du CIM. Le premier exemple est une version du schéma RDF (Resource Description Framework, c'est-à-dire cadre général pour la description des ressources) du CIM, qui utilise XML (extensible markup language) pour décrire un modèle de réseau de système de puissance. La CEI 61970-501 et d'autres normes de profil en développement sont utilisées pour spécifier le format d'échange de modèles. Des versions de schémas RDF du CIM ont été utilisées pour créer les fichiers de modèles XML de réseaux réels pour des tests d'interopérabilité. Une version de schéma RDF du CIM est générée à partir du fichier de modèle UML du CIM en utilisant des outils logiciels basés sur une spécification de schéma RDF du CIM.

Il convient de noter qu'une version de schéma RDF du CIM est du niveau métadonnées plutôt qu'une instanciation d'un réseau réel. Cependant, des fichiers de modélisation complets de réseaux avec tous les éléments du réseau ainsi que leurs connexions électriques peuvent être générés par des fournisseurs utilisant des outils d'exportation propriétaires, puis importés ensuite par d'autres systèmes avec un outil similaire, qui est utilisé pour remplir une base de données technique locale sur le réseau. Des exemples de ces modèles XML du CIM sont

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3 Enterprise Architect est l'appellation commerciale d'un produit distribué par Sparx Systems. Cette information est donnée à l'intention des utilisateurs du présent document et ne signifie nullement que la CEI approuve ou recommande l'emploi exclusif du produit ainsi désigné.

notamment les fichiers Siemens 100 bus model, Areva 60 bus model et ABB 40 bus model[4] utilisés pour des essais d'interopérabilité XML du CIM.

5 Modèle détaillé

5.1 Vue générale

Le modèle d'information commun (CIM) représente une vue logique complète des informations d'un système de gestion de l'énergie. Cette définition inclut les classes et les attributs publics ainsi que leurs relations. Les paragraphes suivants décrivent comment l'Article 6 est structuré. L'Article 6 est généré automatiquement à partir du modèle CIM maintenu avec les outils décrits en 4.6.

5.2 Contexte

Le CIM est fractionné en sous-paquetages. Le paquetage Domain définit des types de données (datatypes) utilisés par les autres paquetages. Le paquetage Generation est subdivisé en deux paquetages: Production et GenerationDynamics Les classes au sein des paquetages sont énumérées alphabétiquement. Les attributs natifs d'une classe sont énumérés en premier, suivis des attributs hérités, dans l'ordre de profondeur d'héritage, puis suivis du nom d'attribut. Les associations natives sont énumérées en premier pour chaque classe, suivies, dans l'ordre de profondeur d'héritage, des associations héritées, suivies, dans l'ordre alphabétique, du nom de classe, suivi, dans l'ordre alphabétique, du nom d'extrémité d'association. Les associations sont décrites selon le rôle de chaque classe participant à l'association. Les extrémités d'association sont énumérées dans la classe à chaque extrémité d'une association.

La Figure 14 montre les paquetages de haut niveau inclus dans le présent document.

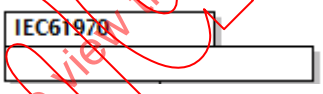

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Figure 14 – Paquetages de haut niveau du CIM

Pour chaque paquetage, le modèle d'information de chaque classe est entièrement décrit. Les informations relatives aux attributs et extrémités d'association pour les attributs natifs et hérités sont énumérées comme ci-dessous. Pour tous les éventuels attributs ou extrémités d'association hérités, la colonne "note" contiendra le texte indiquant que les attributs sont hérités d'une classe spécifique. La colonne "note" pour les attributs natifs et extrémités d'associations contient la description réelle.

Attributs

nom	type	note
native1	Float	Un attribut natif virgule flottante de la classe est décrit ici
native2	ActivePower	Documentation pour un autre attribut natif du type ActivePower
name	Float	Hérité de la classe IdentifiedObject

[4] Siemens 100 bus model, Areva 60 bus model et ABB 40 bus model sont les appellations commerciales de produits distribués par Siemens, Areva et ABB. Cette information est donnée à l´intention des utilisateurs de la présente Norme internationale et ne signifie nullement que la CEI approuve ou recommande l´emploi exclusif du produit ainsi désigné. Des produits équivalents peuvent être utilisés s'il est démontré qu'ils conduisent aux mêmes résultats.

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Dans le tableau Attributs, dans certains cas, un attribut est une constante, auquel cas l'expression "(const)" est ajoutée dans la colonne nom du tableau d'attributs. Dans ces cas, l'attribut a normalement une valeur initiale aussi qui est précédée du signal «égal» et accolé au nom d'attribut.

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de la classe IdentifiedObject
0..*	[0..*] OperatedBy_Companies (Company)	hérité de la classe PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	Hérité de la classe PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	Hérité de la classe PowerSystemResource

Dans le Tableau Extrémités d'association, la première colonne décrit la multiplicité à l'autre extrémité de l'association (c'est-à-dire, la multiplicité de la classe pour laquelle des extrémités d'association sont décrites). La multiplicité de l'extrémité d'association elle-même est incluse entre crochets. Le nom de l'extrémité d'association est répertorié en texte en clair. La classe à l'autre extrémité de l'association est donnée entre des parenthèses. Une multiplicité zéro indique une association facultative. Une multiplicité «*» indique que n'importe quel nombre est autorisé. Par exemple, une multiplicité [1..*] indique qu'une plage allant de 1 à n'importe quel nombre plus grand est autorisée.

Lorsqu'une classe est enumeration (c'est-à-dire une énumération), le Tableau Attributs est remplacé par le Tableau Enums comme montré ci-dessous, car les libellés enumeration n'ont pas de type. Il n'y a pas de libellés enumeration hérités pour une classe enumeration.

Enums

nom	note
native1	Il s'agit de la première valeur enumeration native.
native2	Il s'agit de la deuxième valeur enumeration native.
native3	Il n'y a typiquement pas d'attributs hérités pour les énumérations.

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6 Architecture des paquetages (normative)

6.1 IEC 61970

6.1.1 Résumé du paquetage IEC 61970

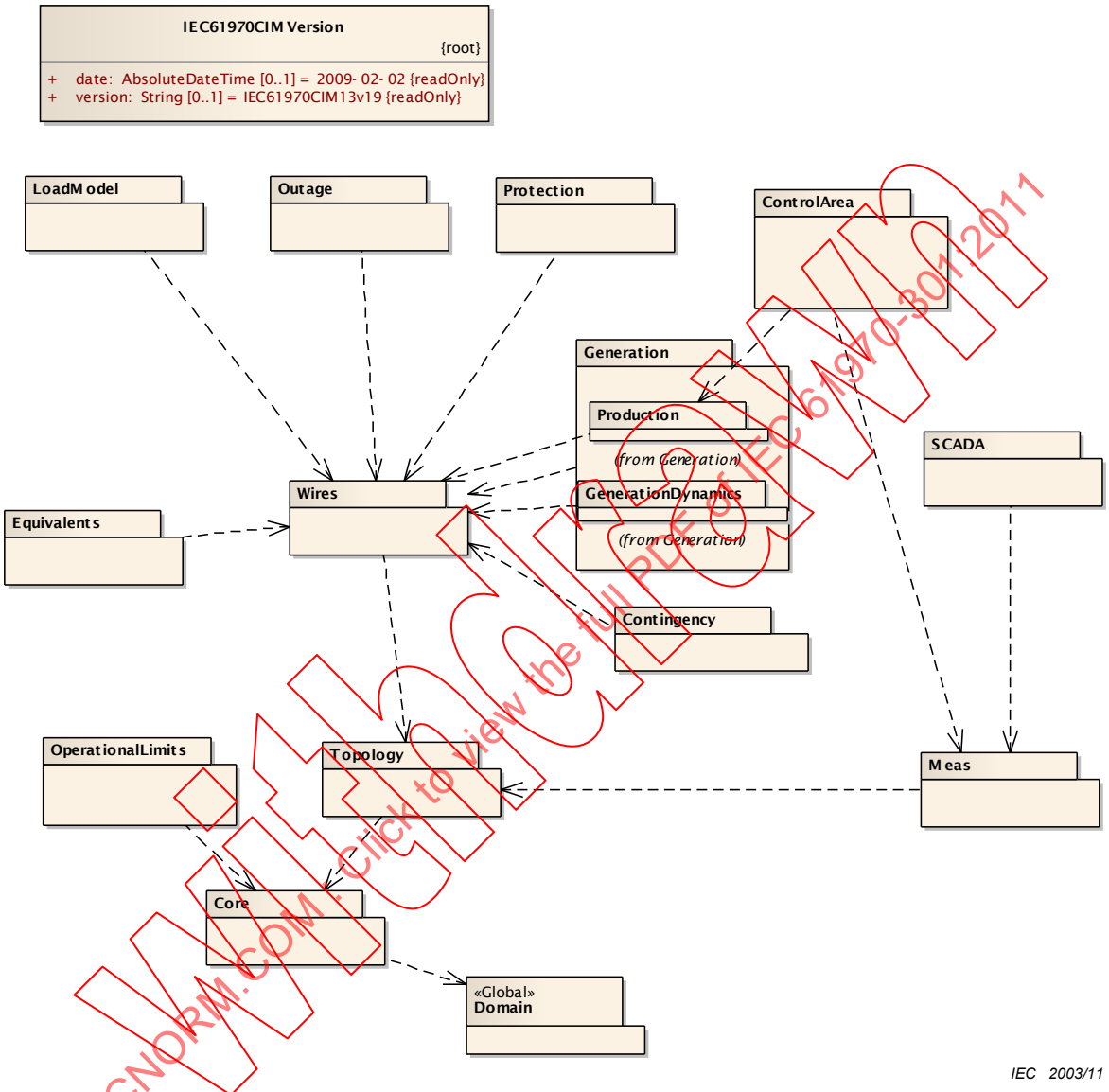

Figure 15 – Main (c'est-à-dire Représentation principale)

La Figure 15 est documentée comme suit. Ce diagramme montre tous les paquetages 61970 et leurs dépendances logiques.

6.1.2 IEC 61970CIMVersion

Il s'agit du numéro de version CIM de la CEI 61970 assigné à ce fichier de modèle UML.

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Attributs

nom	type	note
date=2009-02-02 (const)	AbsoluteDateTime	La forme est AAAA-MM-JJ par exemple le 5 janvier 2009 est 2009-01-05.
version=IEC 61970CIM13v19 (const)	String	La forme est IEC 61970CIMXXvYY où XX est la version principale du paquetage CIM et YY la version secondaire. Par exemple IEC 61970CIM13v18.

6.2 Domain

6.2.1 Résumé du paquetage Domain

Le paquetage Domain est une bibliothèque de données regroupant les quantités et les unités qui définissent les types de données des attributs (propriétés) pouvant être repris par n'importe quelle classe dans n'importe quel autre paquetage.

Ce paquetage définit les types de données essentiels, comprenant les unités de mesures et les valeurs autorisées. Chaque type de données comporte un attribut de valeur et une unité de mesure facultative, précisée comme étant une variable fixe initialisée d'après la description textuelle de l'unité de mesure. Les valeurs des unités ("units") sous forme de chaîne de caractères peuvent être spécifiques à un pays ou à un client. Des valeurs types sont données. Les valeurs autorisées pour les énumérations sont répertoriées entre accolades dans la documentation de l'attribut utilisant la syntaxe de la contrainte UML. Les longueurs de chaînes de caractère (string lengths) sont répertoriées dans le texte descriptif à l'endroit requis.

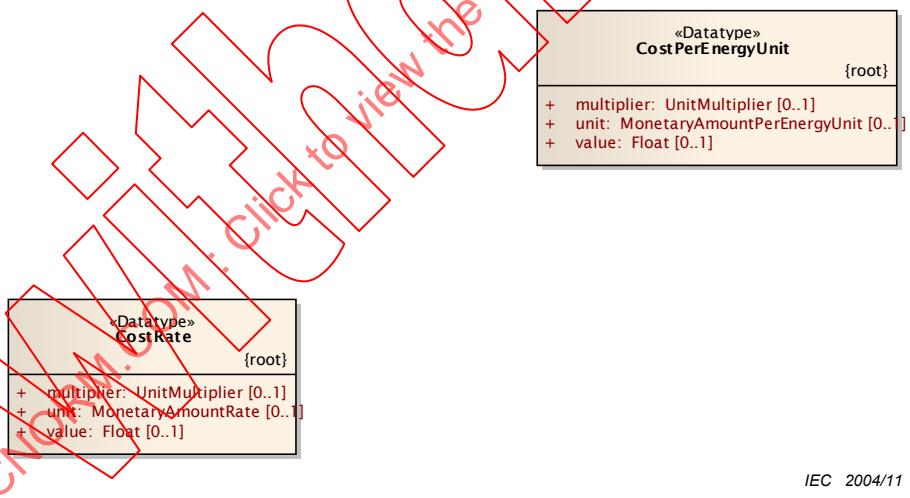

Figure 16 – CombinedDatatypes

La Figure 16 est documentée comme suit. Ce diagramme comprend les types de données qui sont combinés à d'autres types de données dans d'autres diagrammes.

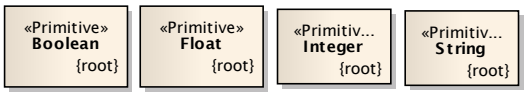

Figure 17 – BasicDatatypes

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La Figure 17 est documentée comme suit. Ce diagramme montre les types de données fondamentaux qui sont la base de tous les autres types de données.

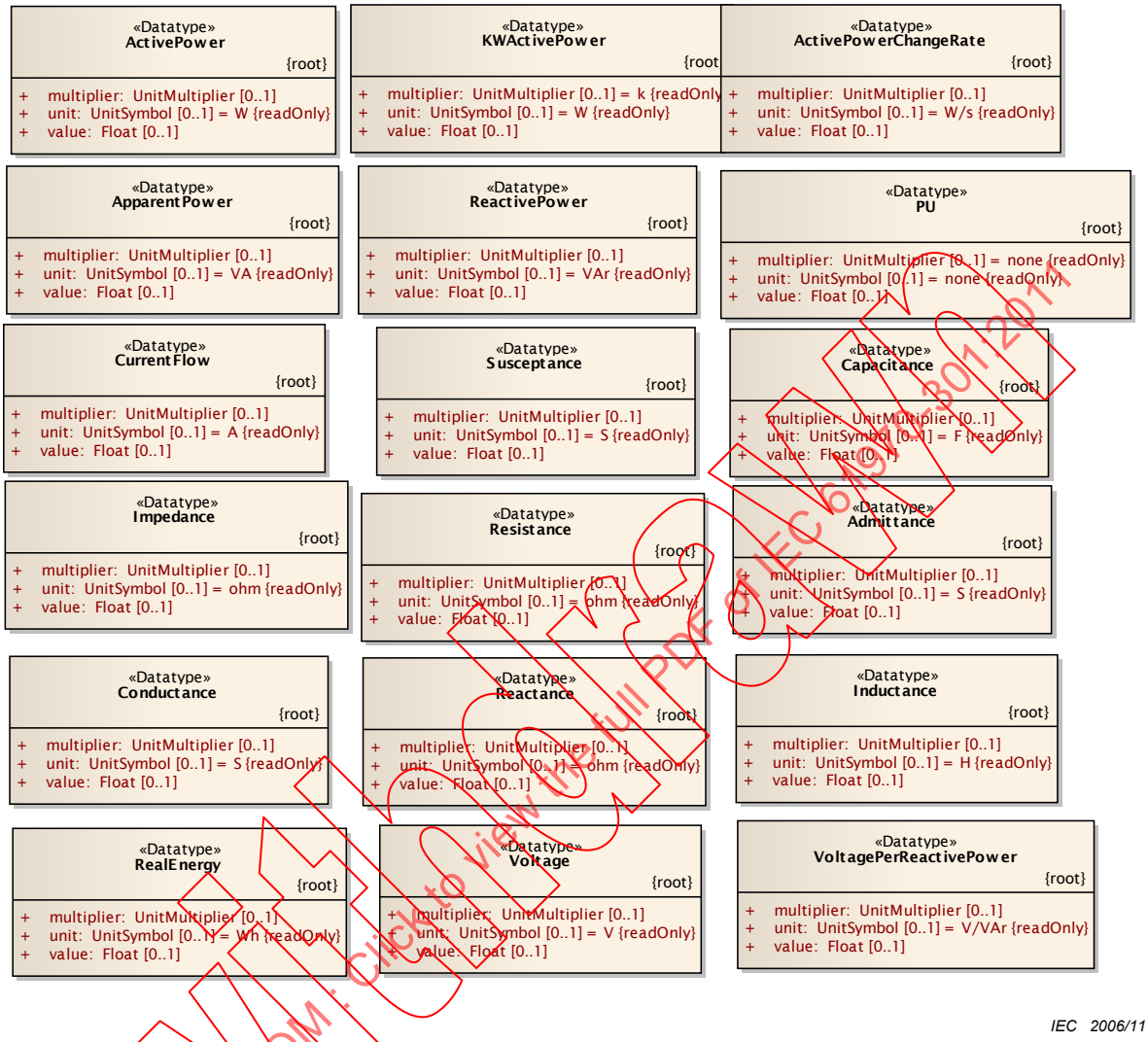

Figure 18 – ElectricityDatatypes

La Figure 18 est documentée comme suit. Ce diagramme montre les types de données liés à l'électricité.

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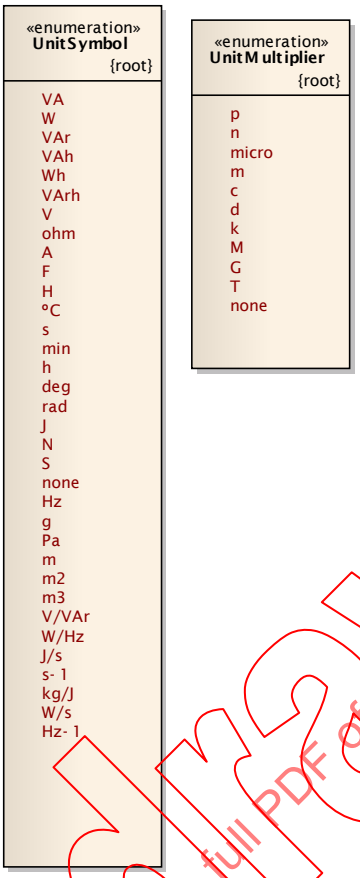

Figure 19 – EnumeratedUnitDatatypes

La Figure 19 est documentée comme suit. Ce diagramme montre les types de données énumérés liés au système d'unités SI.

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Figure 20 – GeneralDatatypes

La Figure 20 est documentée comme suit. Ce diagramme montre des types de données liés aux généralités.

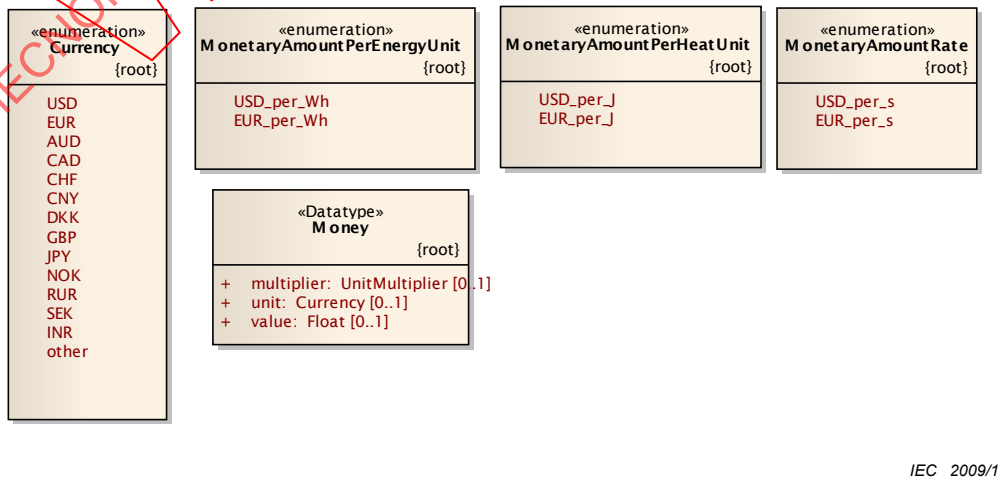

Figure 21 – MonetaryDatatypes

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La Figure 21 est documentée comme suit. Ce diagramme montre les types de données liés à la monnaie.

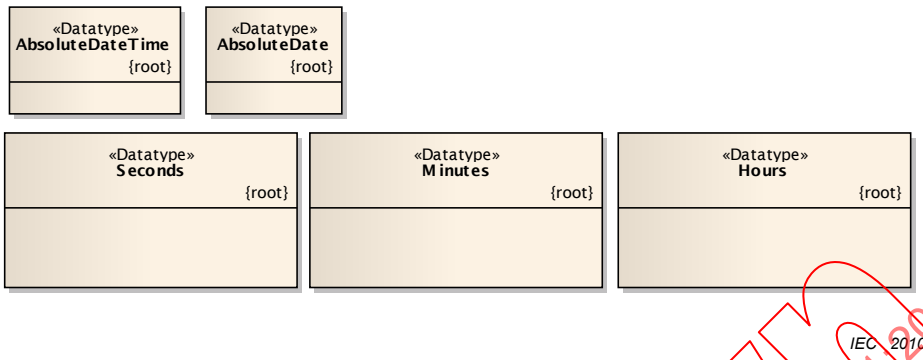

Figure 22 – TimeDatatypes

La Figure 22 est documentée comme suit. Ce diagramme montre les types de données liés au temps.

6.2.2 Type de données AbsoluteDate

Date et heure sous la forme "aaaa-mm-jj", qui est conforme à l'ISO 8601. Le fuseau horaire TUC est spécifié comme étant "aaa-mm-jj".

Attributs

nom	type	note
value	String	Représentation de la date en chaîne de caractères, se référer à la description de la classe.

6.2.3 Type de données AbsoluteDateTime

Date et heure sous la forme "aaaa-mm-jjThh:mm:ss.sss", qui est conforme à l'ISO 8601. Le fuseau horaire TUC est spécifié sous la forme "aaaa-mm-jjThh:mm:ss.sssZ". Un temps TUC par rapport à un fuseau horaire local est spécifié sous la forme "aaaa-mm-jjThh:mm:ss.sss-hh:mm".

AbsoluteDateTime peut être utilisé aussi bien pour le temps de calendrier, par exemple 2007-02-07T10:30, que pour le temps relatif, par exemple 10:30.

Attributs

nom	type	note
value	String	Représentation de la date et de l'heure en chaîne de caractères, se référer à la description de la classe.

6.2.4 Type de données ActivePower

Produit de la valeur RMS (valeur efficace) de la tension et de la valeur RMS de l'élément en phase du courant.

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Attributs

nom	type	note
value	Float	
unit=W (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.5 Type de données ActivePowerChangeRate

Attributs

nom	type	note
value	Float	
unit=W/s (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.6 Type de données Admittance

Rapport courant/tension.

Attributs

nom	type	note
value	Float	
unit=S (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.7 Type de données AngleDegrees

Mesure d'un angle en degrés.

Attributs

nom	type	note
value	Float	
unit=deg (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.8 Type de données AngleRadians

Déphasage en radians.

Attributs

nom	type	note
value	Float	
unit=rad (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.9 Type de données ApparentPower

Produit de la valeur RMS (moyenne quadratique) de la tension et de la valeur RMS du courant.

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Attributs

nom	type	note
value	Float	
unit=VA (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.10 Primitive Boolean

Un type avec l'espace de valeurs "true" (c'est-à-dire, vrai) et "false" (c'est-à-dire, faux).

6.2.11 Type de données Capacitance

Un farad, l'unité type, est la capacité d'un condensateur pour lequel une charge de 1 coulomb produit une différence de potentiel de 1 V entre ses bornes.

Attributs

nom	type	note
value	Float	
unit=F (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.12 Type de données Conductance

Facteur par lequel doit être multipliée la tension pour obtenir la puissance correspondante perdue dans un circuit. Partie réelle de l'admittance.

Attributs

nom	type	note
value	Float	
unit=S (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.13 Type de données CostPerEnergyUnit

Coût, en unités monétaires, par quantité d'énergie électrique produite.

Attributs

nom	type	note
value	Float	
unit	MonetaryAmountPerEnergyUnit	
multiplier	UnitMultiplier	

6.2.14 Type de données CostRate

Coût par heure de temps écoulé, en unités monétaires.

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Attributs

nom	type	note
value	Float	
unit	MonetaryAmountRate	
multiplier	UnitMultiplier	

6.2.15 Énumération Currency

Devises monétaires. Excuses pour cette énumération non exhaustive.

Enums

nom	note
USD	Dollar US
EUR	Euro européen
AUD	Dollar australien
CAD	Dollar canadien
CHF	Franc suisse
CNY	Yuan renminbi chinois
DKK	Couronne danoise
GBP	Livre britannique
JPY	Yen japonais
NOK	Couronne norvégienne
RUR	Rouble russe
SEK	Couronne suédoise
INR	Roupie indienne
Autre	Autre type de devise

6.2.16 Type de données CurrentFlow

Intensité de courant électrique (positif dans le sens ConductingEquipement vers ConnectivityNode).

Attributs

nom	type	note
value	Float	
unit=A (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.17 Type de données Damping

Variation de puissance active par unité avec une fréquence par unité référencée dans la base de puissance apparente du système. Valeurs types comprises entre 1,0 et 2,0.

Attributs

nom	type	note
value	Float	
unit=Hz-1 (const)	UnitSymbol	
multiplier	UnitMultiplier	

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6.2.18 Primitive Float

Un nombre à virgule flottante. La plage est indéterminée et n'est pas limitée.

6.2.19 Type de données FloatQuantity

Grandeur avec valeur Float (c'est-à-dire flottante) et informations associées relatives aux unités.

Attributs

nom	type	note
value	Float	
unit	UnitSymbol	
multiplier	UnitMultiplier	

6.2.20 Type de données Frequency

Cycles par seconde.

Attributs

nom	type	note
value	Float	
unit=Hz (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.21 Type de données Hours

Temps, en heures.

Attributs

nom	type	note
value	Float	
unit=h (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.22 Type de données Impedance

Rapport tension/courant.

Attributs

nom	type	note
value	Float	
unit=ohm (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.23 Type de données Inductance

Inductance.

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Attributs

nom	type	note
value	Float	
unit=H (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.24 Primitive Integer

Un nombre entier. La plage est indéterminée et n'est pas limitée.

6.2.25 Type de données IntegerQuantity

Grandeur avec valeur integer (c'est-à-dire entière) et informations associées relatives aux unités.

Attributs

nom	type	note
value	Integer	
unit	UnitSymbol	
multiplier	UnitMultiplier	

6.2.26 Type de données KWActivePower

Puissance active, en kilowatts.

Attributs

nom	type	note
value	Float	
unit=W (const)	UnitSymbol	
multiplier=k (const)	UnitMultiplier	

6.2.27 Type de données LongLength

Unité longue de longueur.

Attributs

nom	type	note
value	Float	
unit=m (const)	UnitSymbol	
multiplier=k (const)	UnitMultiplier	

6.2.28 Type de données Minutes

Temps en minutes.

Attributs

nom	type	note
value	Float	
unit=min (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

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6.2.29 Énumération MonetaryAmountPerEnergyUnit

Montant monétaire par unité d'énergie.

Enums

nom	note
USD_per_Wh	
EUR_per_Wh	

6.2.30 Énumération MonetaryAmountPerHeatUnit

Montant monétaire par joule.

Enums

nom	note
USD_per_J	
EUR_per_J	

6.2.31 Énumération MonetaryAmountRate

Montant monétaire par seconde.

Enums

nom	note
USD_per_s	
EUR_per_s	

6.2.32 Type de données Money

Quantité d'argent.

Attributs

nom	type	note
value	Float	
unit	Currency	
multiplier	UnitMultiplier	

6.2.33 Type de données PerCent

Normalement 0 à 100 sur une base définie.

Attributs

nom	type	note
value	Float	Normalement 0 à 100 sur une base définie.
unit=none (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.34 Type de données Pressure

Pression en Pascals.

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Attributs

nom	type	note
value	Float	
unit=Pa (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.35 Type de données PU

Par unité - valeur négative ou positive se référant à une base définie. Valeurs généralement comprises entre – 10 et +10.

Attributs

nom	type	note
value	Float	
unit=none (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.36 Type de données Reactance

Réactance (partie imaginaire de l'impédance), à une fréquence nominale.

Attributs

nom	type	note
value	Float	
unit=ohm (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.37 Type de données ReactivePower

Produit de la valeur RMS (valeur efficace de la tension et de la valeur RMS de la composante en quadrature du courant.

Attributs

nom	type	note
value	Float	
unit=VAr (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.38 Type de données RealEnergy

Énergie électrique réelle.

Attributs

nom	type	note
value	Float	
unit=Wh (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.39 Type de données Resistance

Résistance (partie réelle de l'impédance).

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Attributs

nom	type	note
value	Float	
unit=ohm (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.40 Type de données RotationSpeed

Nombre de tours par seconde.

Attributs

nom	type	note
value	Float	
unit=s-1 (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.41 Type de données Seconds

Temps, en secondes.

Attributs

nom	type	note
value	Float	Temps, en secondes.
unit=s (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.42 Type de données ShortLength

Unité courte de longueur.

Attributs

nom	type	note
value	Float	
unit=m (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.43 Primitive String

Une chaîne constituée d'une séquence de caractères 8 bits. Le codage de caractères est UTF-8. La longueur de la chaîne est indéterminée et illimitée.

6.2.44 Type de données StringQuantity

Grandeur avec valeur chaîne de caractères(lorsque peu importe qu'il s'agisse d'une intégrale ou d'un nombre à virgule flottante) et les informations associées relatives aux unités.

Attributs

nom	type	note
value	String	
unit	UnitSymbol	
multiplier	UnitMultiplier	

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6.2.45 Type de données Susceptance

Partie imaginaire de l'admittance.

Attributs

nom	type	note
value	Float	
unit=S (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.46 Type de données Temperature

Valeur de température en degrés Celsius.

Attributs

nom	type	note
value	Float	
unit=°C (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.2.47 Énumération UnitMultiplier

Les multiplicateurs d'unité définis pour le CIM.

Enums

nom	note
p	Pico 10**–12
n	Nano 10**–-9
micro	Micro 10**–6
m	Milli 10**–3
c	Centi 10**–2
d	Déci 10**–1
k	Kilo 10**3
M	Méga 10**6
G	Giga 10**9
T	Téra 10**12
Aucun	

6.2.48 Énumération UnitSymbol

Les unités définies en vue de leur utilisation dans le CIM.

Enums

nom	note
VA	Puissance apparente en volts ampères
W	Puissance active en watts
VAr	Puissance réactive en volts ampères réactifs
VAh	Énergie apparente en volts ampères heures
Wh	Énergie réelle en wattheures

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nom	note
VArh	Énergie réactive en volts ampères réactifs heures
V	Tension en volts
ohm	Résistance en ohms
A	Courant en ampères
F	Capacité en farads
H	Inductance en henrys
°C	Température relative en degrés Celsius
s	Temps en secondes
min	Temps en minutes
h	Temps en heures
deg	Angle plan en degrés
rad	Angle plan en radians
J	Énergie en joules
N	Force en newtons
S	Conductance en siemens
none	Grandeur sans dimension, par exemple: compte, par unité, etc.
Hz	Fréquence en hertz
g	Masse en grammes
Pa	Pression en pascals (N/m2)
m	Longueur en mètres
m2	Surface en mètres carrés
m3	Volume en mètres cubes
V/VAr	Volts par volt ampère réactif
W/Hz	Watts par hertz
J/s	Joules par seconde
s–1	par seconde
kg/J	Masse par énergie
W/s	Watts par seconde
Hz–1	par Hertz

6.2.49 Type de données Voltage

Tension électrique.

Attributs

nom	type	note
value	Float	
unit=V (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.50 Type de données VoltagePerReactivePower

Variation de la tension avec la puissance réactive.

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Attributs

nom	type	note
value	Float	
unit=V/VAr (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.51 Type de données Volume

Volume.

Attributs

nom	type	note
value	Float	
unit=m3 (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.52 Type de données WaterLevel

Niveau d'eau présente dans le réservoir par rapport à une référence de type niveau moyen de la mer.

Attributs

nom	type	note
value	Float	
unit=m (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.2.53 Type de données Weight

Le poids d'un objet.

Attributs

nom	type	note
value	Float	
unit=g (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.3 Core

6.3.1 Résumé du paquetage Core

Contient les entités centrales PowerSystemResource et ConductingEquipment partagées par toutes les applications plus les collections communes de ces entités. Toutes les applications ne nécessitent pas toutes les entités Core. Ce paquetage ne dépend d'aucun autre paquetage (à l'exception du paquetage Domain), mais en revanche, la plupart des autres paquetages ont des associations et des généralisations qui dépendent de ce paquetage.

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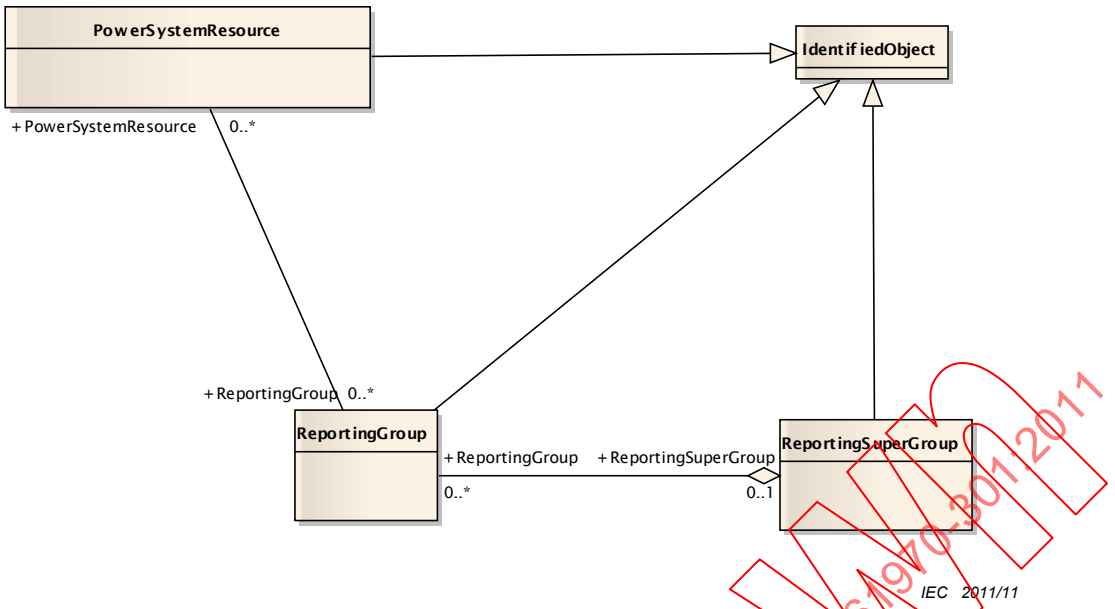

Figure 23 – Reporting

La Figure 23 n'est pas documentée.

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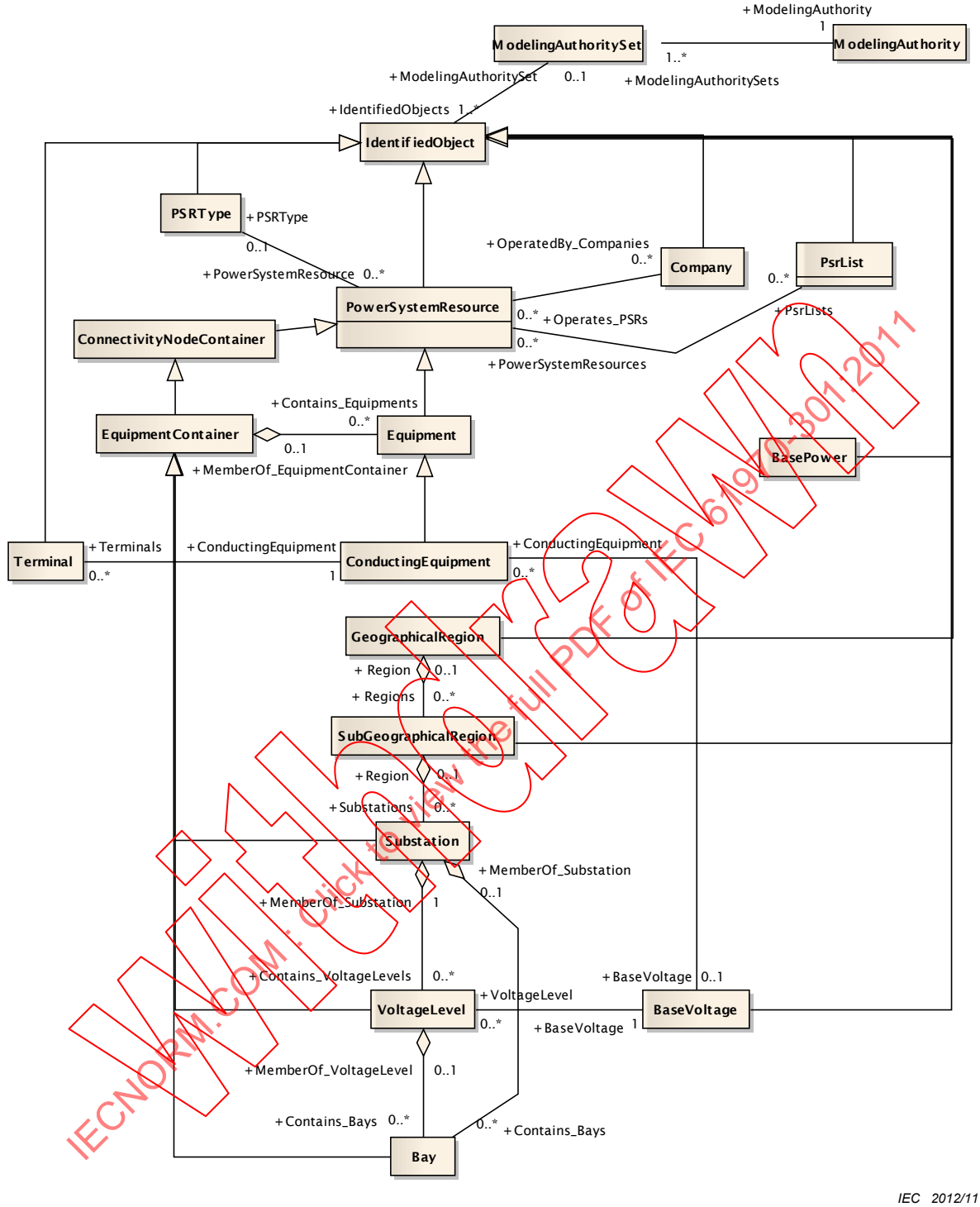

Figure 24 – Main

La Figure 24 est documentée comme suit. Ce diagramme est conçu pour montrer toutes les classes nécessaires à toute application du CIM pour modéliser des systèmes de transport ou de production.

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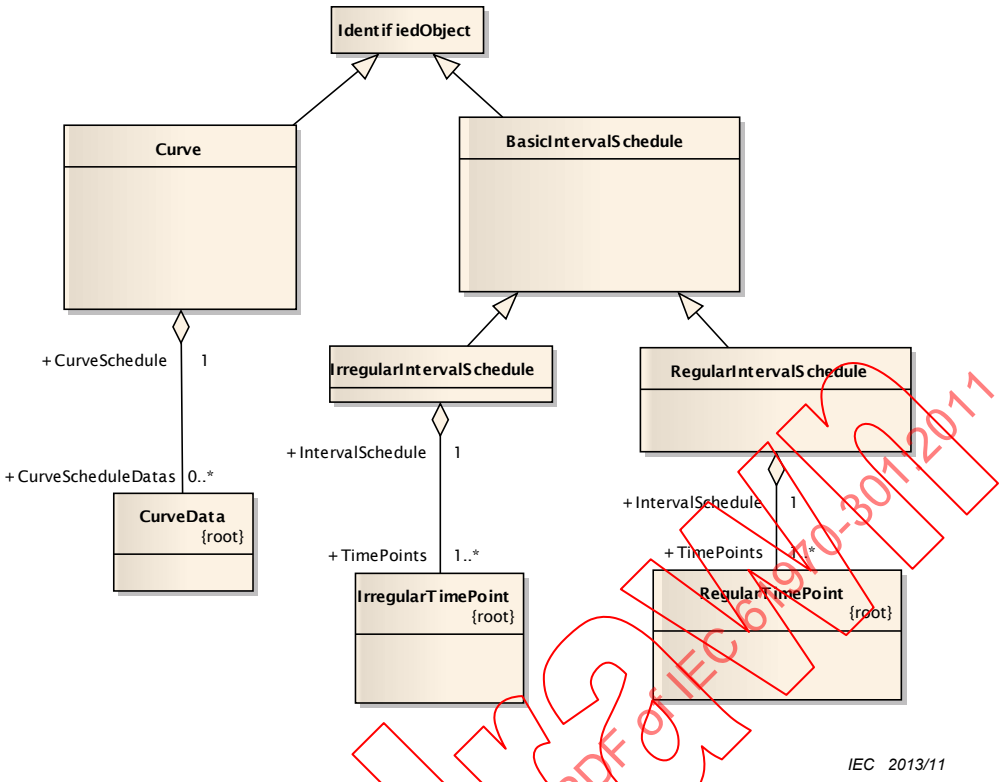

Figure 25 – CurveSchedule

La Figure 25 n'est pas documentée.

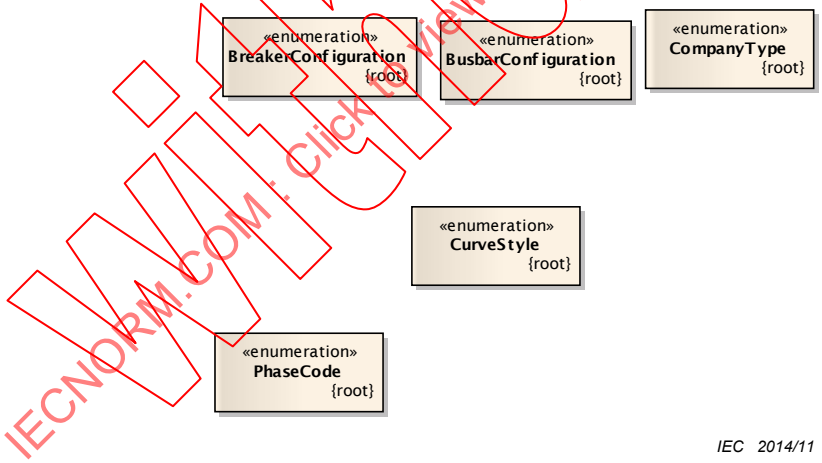

Figure 26 – Datatypes

La Figure 26 est documentée comme suit. Ce diagramme montre les types de données spécifiques au paquetage Core.

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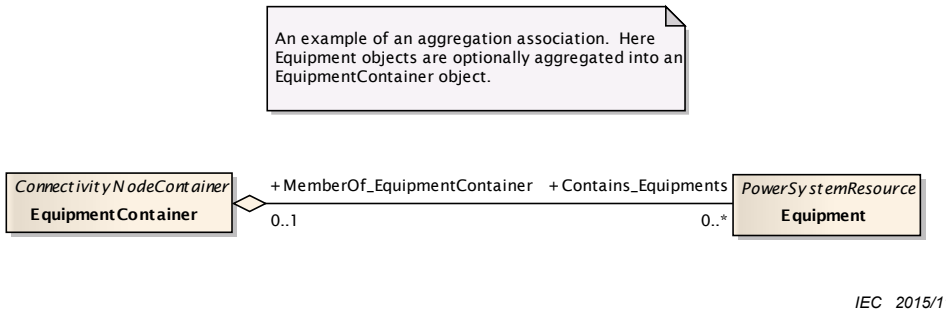
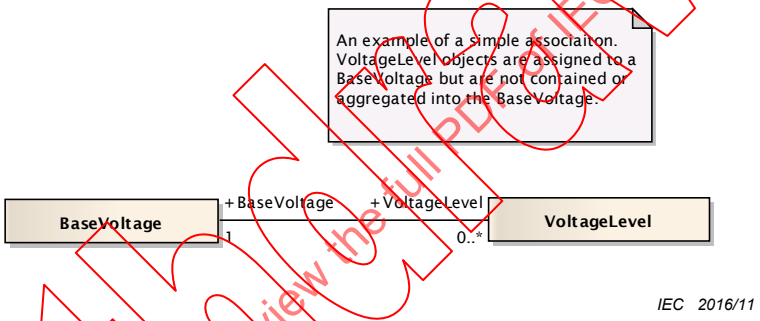


Légende

Anglais	Français
An example of an aggregation association. Here Equipment objects are optionally aggregated into an EquipmentContainer object.	Un exemple d'association d'agrégation. Ici, des objets Equipment sont facultativement agrégés dans un objet EquipmentContainer.

Figure 27 – DocumentationExampleAggregation

La Figure 27 n'est pas documentée.



Légende

Anglais	Français
An example of a simple association. VoltageLevel objects are assigned to a BaseVoltage but are not contained or aggregated into the BaseVoltage.	Un exemple d'association simple. Des objets VoltageLevel sont affectés à un BaseVoltage mais ne sont ni contenus ni agrégés dans le BaseVoltage.

Figure 28 – DocumentationExampleAssociation

La Figure 28 est documentée comme suit. Ce diagramme est un exemple utilisé à des fins de documentation. Il montre comment une association simple et une association d'agrégation sont exprimées dans les diagrammes UML.

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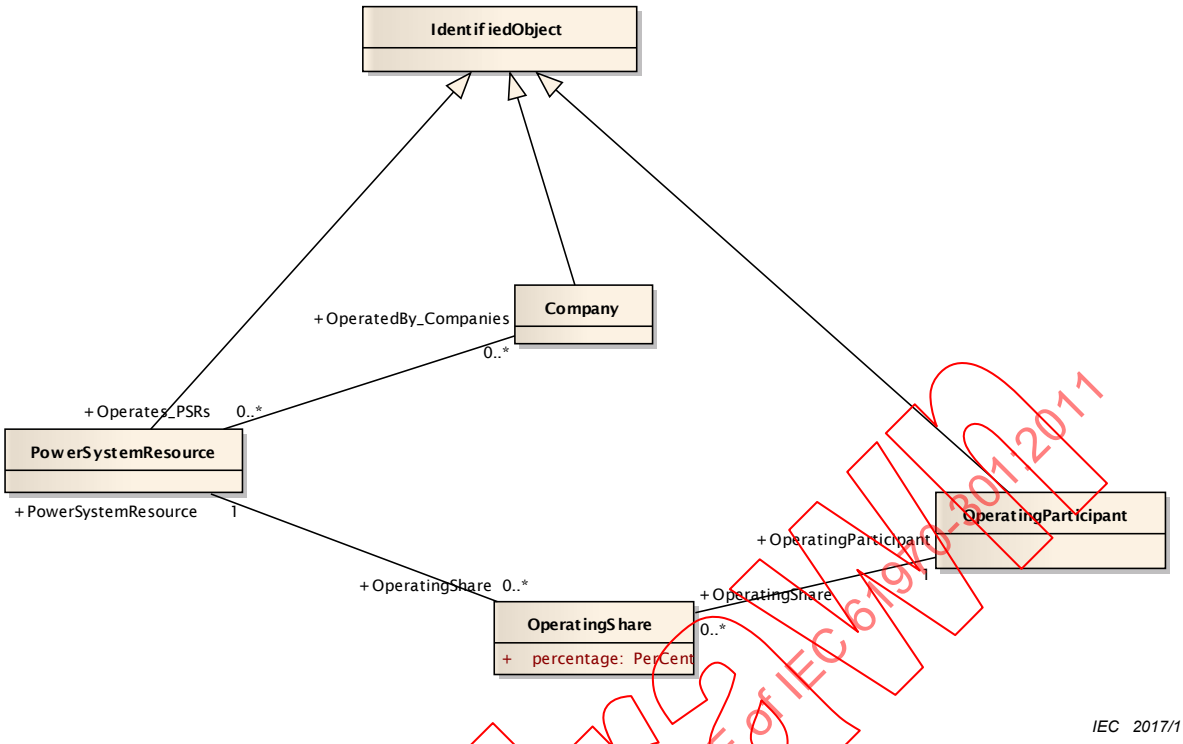

Figure 29 – Ownership

La Figure 29 n'est pas documentée.

6.3.2 BasePower

La classe BasePower définit la puissance de base dans les calculs par unité.

Attributs

nom	type	note
basePower	ApparentPower	Définition de la puissance de base
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.3 BaseVoltage

Collection de BaseVoltages (tensions de base) qui est utilisée pour vérifier que BusbarSection.BaseVoltage et d'autres attributs de tension du CIM ont une valeur existante dans la collection.

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Attributs

nom	type	note
isDC	Boolean	Si true (c'est-à-dire vrai), il s'agit d'une tension de base en courant continu et les éléments affectés à cette tension de base sont aussi associés à des fonctionnalités en courant continu. False (c'est-à-dire faux) indique le courant alternatif.
nominalVoltage	Voltage	Tension de base du PowerSystemResource
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[0..*] ConductingEquipment (ConductingEquipment)	Utiliser l'association à un Conducting Equipment seulement dans le cas où un conteneur VoltageLevel n'est pas utilisé.
1	[0..*] VoltageLevel (VoltageLevel)	Les VoltageLevel (c'est-à-dire les niveaux de tension) ont ce BaseVoltage (c'est-à-dire cette tension de base).
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.4 BasicIntervalSchedule

Programme de valeurs à des instants donnés.

Attributs

nom	type	note
startTime	AbsoluteDateTime	L'heure pour le premier TimePoint
value1Unit	UnitSymbol	Unités de mesure pour value1
value1Multiplier	UnitMultiplier	Multiplicateur pour value1
value2Unit	UnitSymbol	Unités de mesure pour value2
value2Multiplier	UnitMultiplier	Multiplicateur pour value2
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.5 Baie

Collection de Power System Ressource (au sein d'un poste donné) comprenant équipement conducteur, relais de protection, mesures et télémétrie.

Attributs

nom	type	note
bayEnergyMeasFlag	Boolean	Indique la présence/l'absence de mesures d'énergie.
bayPowerMeasFlag	Boolean	Indique la présence/l'absence de mesures de puissance active/réactive.
breakerConfiguration	BreakerConfiguration	Configuration de l'organe de coupure
busBarConfiguration	BusbarConfiguration	Configuration du jeu de barres
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] MemberOf_Substation (Substation)	L'association est utilisée dans la hiérarchie de dénomination.
0..*	[0..1] MemberOf_VoltageLevel (VoltageLevel)	L'association est utilisée dans la hiérarchie de dénomination.
0..1	[0..*] Contains_Equipments (Equipment)	hérité de: EquipmentContainer
1	[0..*] ConnectivityNodes (ConnectivityNode)	hérité de: ConnectivityNodeContainer
0..1	[0..*] TopologicalNode (TopologicalNode)	hérité de: ConnectivityNodeContainer
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

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6.3.6 Énumération BreakerConfiguration

Disposition de commutation pour Bay.

Enums

nom	note
singleBreaker	
breakerAndAHalf	
doubleBreaker	
noBreaker	

6.3.7 Énumération BusbarConfiguration

Disposition du jeu de barres pour Bay.

Enums

nom	note
singleBus	
doubleBus	
mainWithTransfer	
ringBus	

6.3.8 Company

Une société est une entité juridique qui possède et exploite des réseaux électriques et est impliquée dans des contrats d'échange et de transport.

Attributs

nom	type	note
companyType	CompanyType	Type de company (c'est-à-dire d'entreprise)
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..*] Operates_PSRs (PowerSystemResource)	Les PowerSystemResource que l'entreprise exploite
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.9 Énumération CompanyType

Type de société.

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Enums

nom	note
pool	
municipal	
isPrivate	

6.3.10 ConductingEquipment

Parties de composant de réseau électrique conçues pour transporter du courant ou connectées de façon à assurer la conduction. Un ConductingEquipment (équipement conducteur) est contenu dans un EquipmentContainer (conteneur d'équipement) qui peut être un Substation (poste), ou un VoltageLevel ou un Bay dans un poste.

Attributs

nom	type	note
phases	PhaseCode	Décrit les phases supportées par un équipement conducteur.
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] BaseVoltage (BaseVoltage)	Utiliser l'association à un Conducting Equipment seulement dans le cas où un conteneur VoltageLevel n'est pas utilisé.
1	[0..*] ClearanceTags (ClearanceTag)	L'équipement conducteur peut comporter plusieurs marqueurs de consignation pour la tâche autorisée sur le terrain.
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	Le dispositif de protection peut être utilisé pour protéger un équipement conducteur spécifique. De multiples équipements peuvent être protégés ou supervisés par plusieurs dispositifs de protection.
1	[0..*] Terminals (Terminal)	ConductingEquipment a 1 ou 2 bornes qui peuvent être connectées à d'autres bornes de ConductingEquipment via des ConnectivityNode (nœuds de connectivité).
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource

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Mult à partir de	[Mult] nom (type)	note
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.11 ConnectivityNodeContainer

Une classe de base pour tous les objets qui peuvent contenir des ConnectivityNode ou des TopologicalNode.

Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1	[0..*] ConnectivityNodes (ConnectivityNode)	Nœuds de connectivité contenus dans ce conteneur
0..1	[0..*] TopologicalNode (TopologicalNode)	Les nœuds topologiques qui appartiennent à ce conteneur de nœuds de connectivité
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.12 Curve

Relation entre une variable indépendante (axe X) et une ou deux variables dépendantes (axe Y1 et axe Y2). Les courbes peuvent également servir de programmes.

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Attributs

nom	type	note
curveStyle	CurveStyle	Style ou forme de la courbe
xUnit	UnitSymbol	Unités de mesure de l'axe des X
xMultiplier	UnitMultiplier	Multiplicateur pour l'axe X
y1Unit	UnitSymbol	Unités de mesure de l'axe des Y1
y1Multiplier	UnitMultiplier	Multiplicateur pour l'axe Y1
y2Unit	UnitSymbol	Unités de mesure de l'axe des Y2
y2Multiplier	UnitMultiplier	Multiplicateur pour l'axe Y2
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1	[0..*] CurveScheduleDatas (CurveData)	Valeurs de données du point définissant une courbe
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.13 CurveData

Valeurs de point de données pour définir une courbe ou un programme.

Attributs

nom	type	note
xvalue	Float	La valeur de données de la variable de l'axe X, en fonction des unités de l'axe X
y1value	Float	La valeur de données de la première variable de l'axe Y, en fonction des unités de l'axe Y
y2value	Float	La valeur de données de la deuxième variable de l'axe Y (s'il y en a une), en fonction des unités de l'axe Y

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[1] CurveSchedule (Curve)	La courbe Curve définie par ces CurveData (c'est-à-dire ces données de courbe)

6.3.14 Énumération CurveStyle

Style ou forme de la courbe.

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Enums

nom	note
constantYValue	
straightLineYValues	
rampYValue	
formula	

6.3.15 Equipment

Les éléments d'un composant de réseau électrique qui sont des dispositifs matériels, électroniques ou mécaniques.

Attributs

nom	type	note
normallyInService	Boolean	L'équipement est normalement en service
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1	[0..*] ContingencyEquipment (ContingencyEquipment)	L'élément de contingence associé à l'équipement.
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	L'association est utilisée dans la hiérarchie de dénomination.
1	[0..*] OperationalLimitSet (OperationalLimitSet)	Les jeux de limites d'équipement associés à l'équipement.
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.16 EquipmentContainer

Une entité de modélisation pour donner une classe racine à toutes les classes Equipment.

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Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[0..*] Contains_Equipments (Equipment)	L'association est utilisée dans la hiérarchie de dénomination.
1	[0..*] ConnectivityNodes (ConnectivityNode)	hérité de: ConnectivityNodeContainer
0..1	[0..*] TopologicalNode (TopologicalNode)	hérité de: ConnectivityNodeContainer
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.17 GeographicalRegion

Une région géographique d'un modèle de réseau de système de puissance.

Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[0..*] Regions (SubGeographicalRegion)	L'association est utilisée dans la hiérarchie de dénomination.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.18 IdentifiedObject

Il s'agit d'une classe racine qui offre des attributs de dénomination communs à toutes les classes nécessitant des attributs de dénomination.

Attributs

nom	type	note
mRID	String	Un Modeling Authority (c'est-à-dire une autorité de modélisation) émet des mRID. Sachant que chaque Modeling Authority a un identificateur unique et que cet identificateur fait partie du mRID, donc le mRID est unique au niveau global.
name	String	Le name (c'est-à-dire nom) est un nom en texte libre de l'objet lisible par l'homme. Il peut ne pas être unique et peut ne pas se corréler à une hiérarchie de dénomination.
localName	String	Le localName (c'est-à-dire nom local) est un nom de l'objet lisible par l'homme. Il est utilisé uniquement avec des objets organisés en hiérarchie de dénomination. La hiérarchie de dénomination la plus simple comporte juste un seul parent (la racine), ce qui correspond à une hiérarchie de dénomination plate. Cependant, la hiérarchie de dénomination comporte en général plusieurs niveaux, par exemple Substation, VoltageLevel, Equipment, etc. Les fils de même parent ont des noms qui sont uniques entre eux. Si l'exigence d'unicité ne peut pas être satisfaite, IdentifiedObject.localName ne doit pas être utilisé, utiliser plutôt IdentifiedObject.name.
pathName	String	Le pathName (chemin d'accès) est un nom unique dans le système composé de tous les IdentifiedObject.localName dans un chemin de hiérarchie de dénomination allant de l'objet jusqu'à la racine.
aliasName	String	aliasName est un nom de l'objet en texte libre lisible par l'homme en remplacement de IdentifiedObject.name. Il peut ne pas être unique et peut ne pas se corréler à une hiérarchie de dénomination.
description	String	La description est un texte libre lisible par l'homme décrivant ou nommant l'objet. Il peut ne pas être unique et peut ne pas se corréler à une hiérarchie de dénomination.

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	Un IdentifiedObject appartient à un ModelingAuthoritySet dans le but de définir un groupe de données maintenues par le même Modeling Authority (c'est-à-dire la même autorité de modélisation).

6.3.19 IrregularIntervalSchedule

Le programme comporte plusieurs TimePoint où le temps entre eux varie.

Attributs

nom	type	note
startTime	AbsoluteDateTime	hérité de: BasicIntervalSchedule
value1Unit	UnitSymbol	hérité de: BasicIntervalSchedule
value1Multiplier	UnitMultiplier	hérité de: BasicIntervalSchedule
value2Unit	UnitSymbol	hérité de: BasicIntervalSchedule
value2Multiplier	UnitMultiplier	hérité de: BasicIntervalSchedule
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1	[1..*] TimePoints (IrregularTimePoint)	Valeurs de données du point définissant une courbe
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.20 IrregularTimePoint

Des TimePoints pour un programme où le temps entre les points varie.

Attributs

nom	type	note
time	Seconds	Le temps est rapporté au BasicTimeSchedule.startTime.
value1	Float	La première valeur au temps indiqué. La signification de la valeur est définie par la classe héritant du IrregularIntervalSchedule.
value2	Float	La deuxième valeur au temps indiqué. La signification de la valeur est définie par la classe héritant du IrregularIntervalSchedule.

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1..*	[1] IntervalSchedule (IrregularIntervalSchedule)	Un IrregularTimePoint appartient à un IrregularIntervalSchedule.

6.3.21 ModelingAuthority

Un ModelingAuthority est une entité chargée de fournir et maintenir les données définissant un ensemble spécifique d'objets dans un modèle de réseau.

Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1	[1..*] ModelingAuthoritySets (ModelingAuthoritySet)	Un autorité de modélisation (ModelingAuthority) fournit et maintient les données. de définition d'un sous-ensemble d'objets d'un modèle de réseau.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.22 ModelingAuthoritySet

Un ensemble d'autorité de modélisation est un groupe d'objets dans un modèle de réseau où les données sont fournies et maintenues par le même Modeling authority (c'est-à-dire la même autorité de modélisation).

Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[1..*] IdentifiedObjects (IdentifiedObject)	Un IdentifiedObject appartient à un ModelingAuthoritySet dans le but de définir un groupe de données maintenues par le même Modeling authority (c'est-à-dire la même autorité de modélisation).
1..*	[1] ModelingAuthority (ModelingAuthority)	Un ensemble d'autorité de modélisation (ModelingAuthority) fournit et maintient les données . de définition d'un sous-ensemble d'objets d'un modèle de réseau.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.23 OperatingParticipant

Un opérateur de multiples objets PowerSystemResource. Noter que plusieurs OperatingParticipant peuvent exploiter le même objet PowerSystemResource. Cela peut être utilisé pour modéliser des unités détenues en copropriété où chaque propriétaire agit selon une quote-part contractuelle.

Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1	[0..*] OperatingShare (OperatingShare)	Les quotes-parts d'exploitation d'un participant opérateur. Un participant opérateur peut être réutilisé pour un nombre quelconque de PSR.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.24 OperatingShare

Spécifie la relation contractuelle entre un PowerSystemResource et un participant au contrat.

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Attributs

nom	type	note
percentage	PerCent	Propriété en pourcentage pour ce dispositif. Le pourcentage indique la part de possession en pourcentage du PSROwner (c'est-à-dire, le propriétaire de PSR) dans le PowerSystemResource. Il convient que la possession totale en pourcentage d'un PowerSystemResource soit égale à 100 %.

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[1] OperatingParticipant (OperatingParticipant)	Le lien à un propriétaire et ses attributs de liaison comme possession en pourcentage. Il convient que le pourcentage de possession soit de 100 % au total pour tous les propriétaires d'un PowerSystemResource, mais un PSROwner peut posséder n'importe quel pourcentage de n'importe quel nombre d'objets PowerSystemResource.
0..*	[1] PowerSystemResource (PowerSystemResource)	Le PowerSystemResource auquel les attributs s'appliquent. Il convient que la possession totale en pourcentage de tous les propriétaires d'un PowerSystemResource soit égale à 100 %.

6.3.25 Énumération PhaseCode

Énumération des identificateurs de phase.

Enums

nom	note
ABCN	
ABC	
ABN	
ACN	
BCN	
AB	
AC	
BC	
AN	
BN	
CN	
A	
B	
C	
N	

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6.3.26 PowerSystemResource

Un composant du réseau électrique peut être soit un élément d'équipement tel qu'un Switch (organe de coupure), un EquipmentContainer (c'est-à-dire conteneur d'équipements) contenant beaucoup d'éléments d'équipements individuels tel qu'un Substation, ou une entité opérationnelle telle qu'une Company (entreprise) ou une SubControlArea (sous-zone de contrôle) . Cela permet l'imbrication de collections de PowerSystemResources à l'intérieur d'autres PowerSystemResources. Par exemple un Switch (c'est-à-dire commutateur) peut être membre d'un Substation et un Substation peut être membre d'une division d'une Company.

Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..*] OperatedBy_Companies (Company)	Un composant de réseau électrique peut faire partie d'une ou de plusieurs entreprises.
1	[0..*] Contains_Measurements (Measurement)	Les Measurements qui sont incluses dans la hiérarchie de dénomination où le PSR est l'élément conteneur.
1	[0..*] OperatingShare (OperatingShare)	Le lien à n'importe quel nombre d'objets de quote-part d'opérateur.
1	[0..1] OutageSchedule (OutageSchedule)	Un composant de réseau électrique peut avoir un programme d'indisponibilité.
0..*	[0..*] PsrLists (PsrList)	
0..*	[0..1] PSRType (PSRType)	PSRType (classification personnalisée) pour ce PowerSystemResource.
0..*	[0..*] ReportingGroup (ReportingGroup)	Groupes de reporting auxquels appartient ce PSR.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.27 PsrList

Liste arbitraire de PowerSystemResources. Peut être utilisée à diverses fins, y compris le regroupement pour la génération de rapports.

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Attributs

nom	type	note
typePSRList	String	Type de Power System Ressource contenues dans cette liste
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..*] PowerSystemResources (PowerSystemResource)	
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.28 PSRType

Instances de classification de la même classe, par exemple ACLineSegments (segments de ligne en courant alternatif) aériens et souterrains. Ce mécanisme de classification est destiné à procurer de la flexibilité au-delà du domaine de la présente norme, c'est-à-dire à apporter une personnalisation qui n'est pas dans la norme.

Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[0..*] PowerSystemResource (PowerSystemResource)	Ressources de réseau électrique classées avec ce PSRType
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.29 RegularIntervalSchedule

Le programme comporte plusieurs TimePoints pour lesquels le temps entre eux est constant.

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Attributs

nom	type	note
timeStep	Seconds	Le temps entre chaque paire de RegularTimePoints consécutifs
endTime	AbsoluteDateTime	L'heure pour le dernier Time Point
startTime	AbsoluteDateTime	hérité de: BasicIntervalSchedule
value1Unit	UnitSymbol	hérité de: BasicIntervalSchedule
value1Multiplier	UnitMultiplier	hérité de: BasicIntervalSchedule
value2Unit	UnitSymbol	hérité de: BasicIntervalSchedule
value2Multiplier	UnitMultiplier	hérité de: BasicIntervalSchedule
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1	[1..*] TimePoints (RegularTimePoint)	Valeurs de données du point définissant une courbe
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.30 RegularTimePoint

Des TimePoint pour un programme où le temps entre les points est constant.

Attributs

nom	type	note
sequenceNumber	Integer	La position du RegularTimePoint dans la séquence. Noter que les Time Point peuvent ne pas être séquentiels, c'est-à-dire que des Time Point peuvent être omis. Le temps réel pour un RegularTimePoint est calculé en multipliant le RegularIntervalSchedule.timeStep avec le RegularTimePoint.sequenceNumber et en ajoutant le BasicIntervalSchedule.startTime.
value1	Float	La première valeur au temps indiqué. La signification de la valeur est définie par la classe héritant du RegularIntervalSchedule.
value2	Float	La deuxième valeur au temps indiqué. La signification de la valeur est définie par la classe héritant du RegularIntervalSchedule.

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1..*	[1] IntervalSchedule (RegularIntervalSchedule)	Un RegularTimePoint appartient à un RegularIntervalSchedule.

6.3.31 ReportingGroup

Un groupe de reporting est utilisé pour divers groupements ad-hoc utilisés pour la production de rapports.

Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[0..*] BusNameMarker (BusNameMarker)	Les BusNameMarkers qui appartiennent à ce groupe de reporting
0..*	[0..*] PowerSystemResource (PowerSystemResource)	Les PSR qui appartiennent à ce groupe de reporting
0..*	[0..1] ReportingSuperGroup (ReportingSuperGroup)	Supergroupe de reporting auquel ce groupe de reporting appartient
0..1	[0..*] TopologicalNode (TopologicalNode)	Les TopologicalNode (nœuds topologiques) qui appartiennent à ce groupe de reporting
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.32 ReportingSuperGroup

Un supergroupe de reporting regroupe des groupes de reporting pour un rapport de niveau plus haut.

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Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[0..*] ReportingGroup (ReportingGroup)	Groupes de reporting qui sont regroupés sous ce groupe de groupes
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.33 SubGeographicalRegion

Un sous-ensemble d'une région géographique d'un modèle de réseau de système de puissance.

Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] Region (GeographicalRegion)	L'association est utilisée dans la hiérarchie de dénomination.
0..1	[0..*] Lines (Line)	Une ligne Line peut être contenue par une SubGeographical Region.
0..1	[0..*] Substations (Substation)	L'association est utilisée dans la hiérarchie de dénomination.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.34 Substation

Collection d'équipements dans d'autres buts que la production ou l'utilisation, à travers lesquels passe de l'énergie électrique en vrac dans le but de commuter ou de modifier ses caractéristiques.

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Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[0..*] Contains_Bays (Bay)	L'association est utilisée dans la hiérarchie de dénomination.
0..*	[0..1] Region (SubGeographicalRegion)	L'association est utilisée dans la hiérarchie de dénomination.
1	[0..*] Contains_VoltageLevels (VoltageLevel)	L'association est utilisée dans la hiérarchie de dénomination.
0..1	[0..*] Contains_Equipments (Equipment)	hérité de: EquipmentContainer
1	[0..*] ConnectivityNodes (ConnectivityNode)	hérité de: ConnectivityNodeContainer
0..1	[0..*] TopologicalNode (TopologicalNode)	hérité de: ConnectivityNodeContainer
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.35 Terminal

Point de connexion électrique à une partie d'un équipement conducteur. Les Terminals (bornes) sont connectés sur des points de connexion physiques appelés "Connectivity nodes" (nœuds de connectivité).

Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1	[0..*] BranchGroupTerminal (BranchGroupTerminal)	Les BranchGroupTerminals orientées pour lesquelles la borne est surveillée.
0..*	[1] ConductingEquipment (ConductingEquipment)	ConductingEquipment a 1 ou 2 bornes qui peuvent être connectées à d'autres bornes de Conducting Equipment via des ConnectivityNode (nœuds de connectivité).
0..*	[0..1] ConnectivityNode (ConnectivityNode)	Les bornes s'interconnectent avec une impédance nulle à un nœud. Les Measurements sur un nœud s'appliquent à toutes ses bornes.
0..1	[0..*] Measurements (Measurement)	
1	[0..*] HasFirst_MutualCoupling (MutualCoupling)	Couplages mutuels associés avec la branche comme première branche.
1	[0..*] HasSecond_MutualCoupling (MutualCoupling)	Couplages mutuels avec la branche associée comme première branche.
0..1	[0..*] OperationalLimitSet (OperationalLimitSet)	Les ensembles de limites opérationnelles qui s'appliquent spécifiquement à cette borne. D'autres ensembles de limites opérationnelles peuvent s'appliquer à cette borne par le truchement d'une association à Equipment.
0..1	[0..*] RegulatingControl (RegulatingControl)	La borne est régulée par une commande.
1	[0..2] TieFlow (TieFlow)	Les flux d'interconnexion de zone de commande auxquels cette borne est associée.
0..*	[0..1] TopologicalNode (TopologicalNode)	Le nœud topologique associé à la borne. Il peut être utilisé comme remplacement d'un chemin de nœuds de connectivité allant jusqu'au nœud topologique, éliminant donc la nécessité de modéliser les nœuds de connectivité dans certains cas. Remarquer que si les nœuds de connectivité sont présents dans le modèle, cette association ne serait probablement pas utilisée.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.36 Unit

Représente les unités des grandeurs mesurées. Le Unit.name doit être unique parmi toutes les grandeurs spécifiées et décrit la grandeur. Le Unit.aliasName est prévu pour des particularisations locales.

Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1	[0..*] Controls (Control)	Les Controls (commandes) ayant l'unité Unit.
1	[0..*] Measurements (Measurement)	Les mesures Measurements ayant l'unité Unit
1	[0..*] ProtectionEquipments (ProtectionEquipment)	
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.3.37 VoltageLevel

Ensemble d'équipements à un même niveau de tension, constituant un ensemble de commutation. L'équipement consiste typiquement en disjoncteurs, jeux de barre, dispositifs d'instrumentation, de contrôle, de régulation et de protection, de même que des regroupements de ce type de constituants.

Attributs

nom	type	note
highVoltageLimit	Voltage	La tension limite haute du jeu de barres
lowVoltageLimit	Voltage	La tension limite basse du jeu de barres
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[1] BaseVoltage (BaseVoltage)	La tension de base utilisée pour tous les équipements dans le VoltageLevel.
0..1	[0..*] Contains_Bays (Bay)	L'association est utilisée dans la hiérarchie de dénomination.
0..*	[1] MemberOf_Substation (Substation)	L'association est utilisée dans la hiérarchie de dénomination.
0..1	[0..*] Contains_Equipments (Equipment)	hérité de: EquipmentContainer
1	[0..*] ConnectivityNodes (ConnectivityNode)	hérité de: ConnectivityNodeContainer
0..1	[0..*] TopologicalNode (TopologicalNode)	hérité de: ConnectivityNodeContainer
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource

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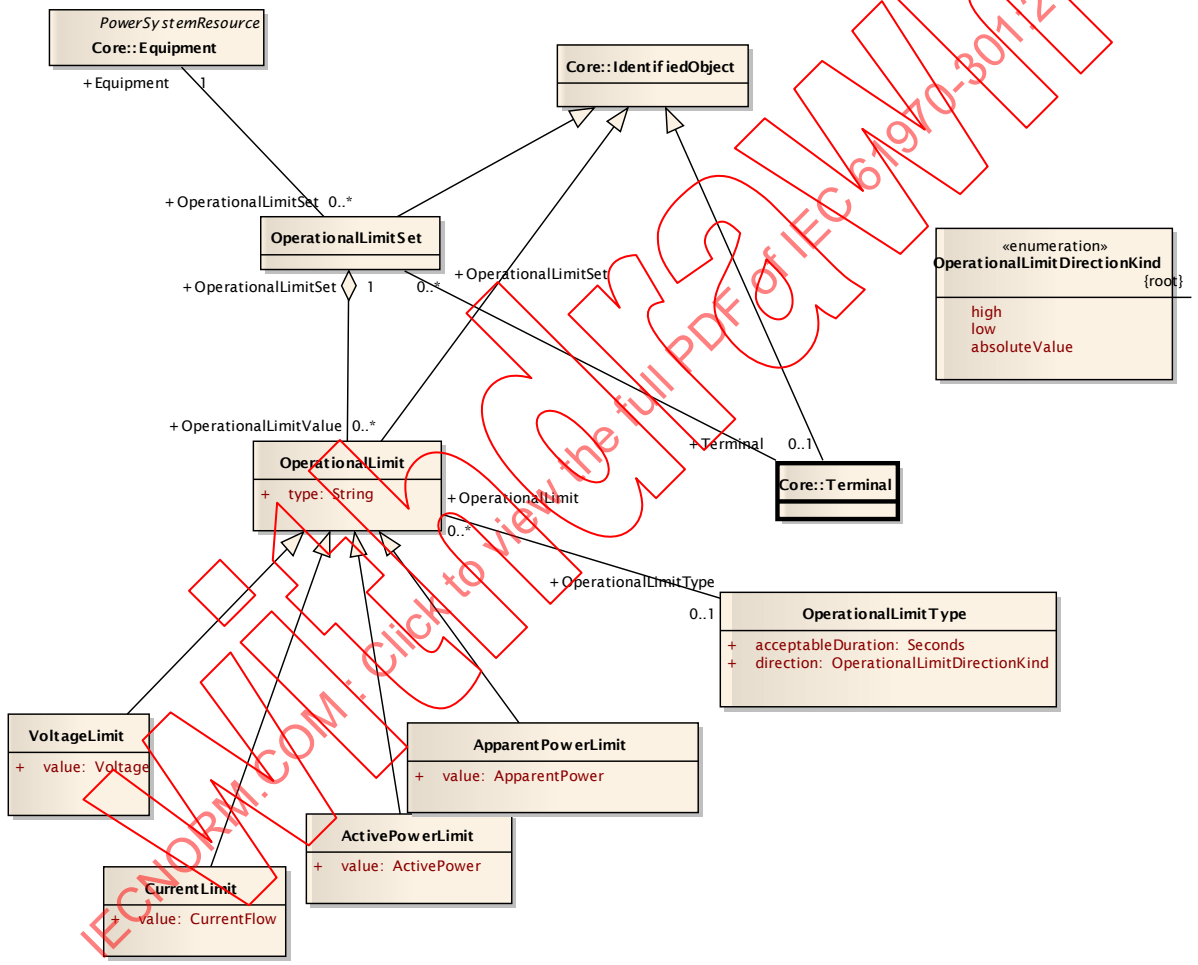
Mult à partir de	[Mult] nom (type)	note
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.4 OperationalLimits

6.4.1 Résumé du paquetage OperationalLimits

Le paquetage OperationalLimits modélise une spécification des limites associées à des entités d'équipement et autres entités opérationnelles.



IEC 2018/11

Figure 30 – OperationalLimits

La Figure 30 est documentée comme suit. Limites opérationnelles telles qu'elles se rattachent dans le modèle central.

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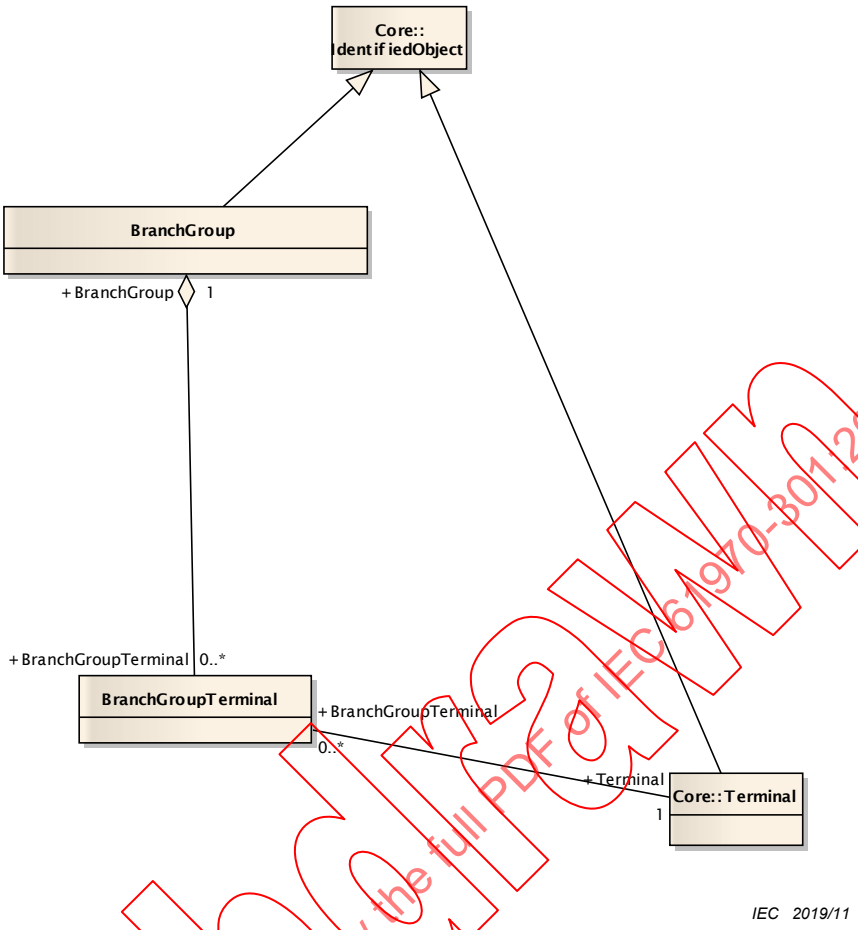

Figure 31 – BranchGroup

La Figure 31 n'est pas documentée.

6.4.2 ActivePowerLimit

Limite sur le flux de puissance active.

Attributs

nom	type	note
value	ActivePower	Valeur de la limite de puissance active
type	String	hérité de: OperationalLimit
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[1] OperationalLimitSet (OperationalLimitSet)	hérité de: OperationalLimit
0..*	[0..1] OperationalLimitType (OperationalLimitType)	hérité de: OperationalLimit
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.4.3 ApparentPowerLimit

Limite de puissance apparente.

Attributs

nom	type	note
value	ApparentPower	La limite de puissance apparente
type	String	hérité de: OperationalLimit
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[1] OperationalLimitSet (OperationalLimitSet)	hérité de: OperationalLimit
0..*	[0..1] OperationalLimitType (OperationalLimitType)	hérité de: OperationalLimit
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.4.4 BranchGroup

Un groupe de bornes de branches dont la sommation des flux orientés doit être surveillée. Un groupe de branches peut ne pas former un ensemble de coupure du réseau.

Attributs

nom	type	note
maximumActivePower	ActivePower	Le flux maximal de puissance active
maximumReactivePower	ReactivePower	Le flux maximal de puissance réactive
minimumActivePower	ActivePower	Le flux minimal de puissance active
minimumReactivePower	ReactivePower	Le flux minimal de puissance réactive
monitorActivePower	Boolean	Surveiller le flux de puissance active
monitorReactivePower	Boolean	Surveiller le flux de puissance réactive
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject

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nom	type	note
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1	[0..*] BranchGroupTerminal (BranchGroupTerminal)	Les bornes de BranchGroups orientées à sommer
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.4.5 BranchGroupTerminal

Un flux spécifique de bornes orienté pour un groupe de branches.

Attributs

nom	type	note
positiveFlowIn	Boolean	S'il est mis à true (c'est-à-dire vrai), le flux pénétrant dans la borne est sommé. S'il est mis à false (c'est-à-dire faux), le flux sortant de la borne est sommé.

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[1] BranchGroup (BranchGroup)	Le BranchGroup auquel appartiennent les bornes de groupe de branches orientées
0..*	[1] Terminal (Terminal)	La borne devant être sommée

6.4.6 CurrentLimit

Limite opérationnelle sur le courant.

Attributs

nom	type	note
value	CurrentFlow	Limite sur le flux de courant
type	String	hérité de: OperationalLimit
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[1] OperationalLimitSet (OperationalLimitSet)	hérité de: OperationalLimit
0..*	[0..1] OperationalLimitType (OperationalLimitType)	hérité de: OperationalLimit
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.4.7 OperationalLimit

Une valeur associée à une sorte spécifique de limite.

Attributs

nom	type	note
type	String	Utilisé pour spécifier les niveaux high/low (c'est-à-dire haut/bas) et les niveaux limites
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[1] OperationalLimitSet (OperationalLimitSet)	Jeu de limites auquel les valeurs limites appartiennent
0..*	[0..1] OperationalLimitType (OperationalLimitType)	Le type de limite associé à cette limite
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.4.8 Énumération OperationalLimitDirectionKind

Le sens d'une limite opérationnelle.

Enums

nom	note
high	La limite et une limite haute. Si elle est appliquée auflux d'une borne, le sens positif est celui pénétrant dans la borne.
low	La limite et une limite basse. Si elle est appliquée au flux d'une borne, le sens positif est celui pénétrant dans la borne.
absoluteValue	Si la valeur absolue de la valeur surveillée est supérieure à la valeur limite, la limite est violée. En fait, la limite est à la fois une limite haute et sa valeur négative une limite basse.

6.4.9 OperationalLimitSet

Jeu de limites associées à un équipement. Les jeux de limites pourraient s'appliquer à une température spécifique, ou à une saison par exemple. Un jeu de limites peut contenir des sévérités différentes pour les niveaux limites qui s'appliqueraient au même équipement. Le

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jeu peut contenir des limites de types différents telles que limites de puissance apparente et limites de courant ou bien limites de tension haute et basse qui sont logiquement appliquées ensemble comme un jeu.

Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[1] Equipment (Equipment)	L'équipement auquel le jeu de limites s'applique.
1	[0..*] OperationalLimitValue (OperationalLimit)	Valeurs des limites opérationnelles.
0..*	[0..1] Terminal (Terminal)	La borne spécifiquement associée à ce jeu de limites opérationnelles. Si aucune borne n'est associée, toutes les bornes de l'équipement sont sous-entendues.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.4.10 OperationalLimitType

Un type de limite. La signification d'une limite spécifique est décrie dans cette classe.

Attributs

nom	type	note
acceptableDuration	Seconds	La durée acceptable nominale de la limite. Les limites sont communément exprimées en termes de limites temporelles pour lesquelles la limite est normalement acceptable. La durée acceptable réelle d'une limite spécifique dépend d'autres facteurs locaux tels que la température ou la vitesse du vent.
direction	OperationalLimitDirectionKind	Le sens de la limite.

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[0..*] OperationalLimit (OperationalLimit)	Les limites opérationnelles associées à ce type de limite

6.4.11 VoltageLimit

La limite opérationnelle appliquée à la tension.

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Attributs

nom	type	note
value	Voltage	Limite sur la tension. La limite haute ou basse dépend du OperatoinalLimit.limitKind
type	String	hérité de: OperationalLimit
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[1] OperationalLimitSet (OperationalLimitSet)	hérité de: OperationalLimit
0..*	[0..1] OperationalLimitType (OperationalLimitType)	hérité de: OperationalLimit
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.5 Topology

6.5.1 Résumé du paquetage Topology

Extension du paquetage Core qui, associé à la classe Terminal, modélise la Connectivity (connectivité), soit la définition physique de la façon dont les équipements sont connectés ensemble. De plus, il modélise la Topology, soit la définition logique de la façon dont un équipement est connecté via des organes de coupure fermés. La définition de Topology est indépendante des autres caractéristiques électriques.

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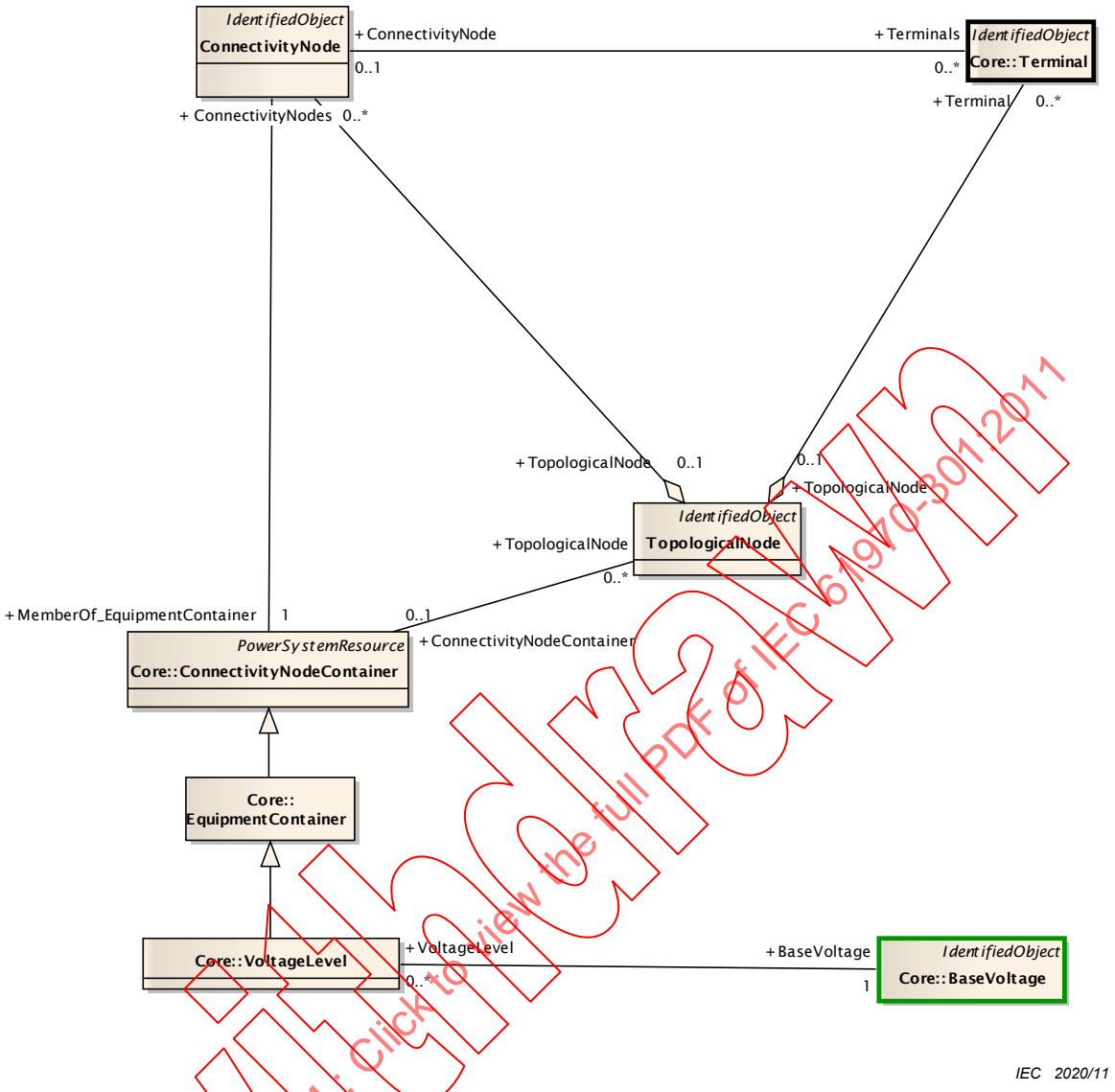

Figure 32 – TopologicalNodeTerminal

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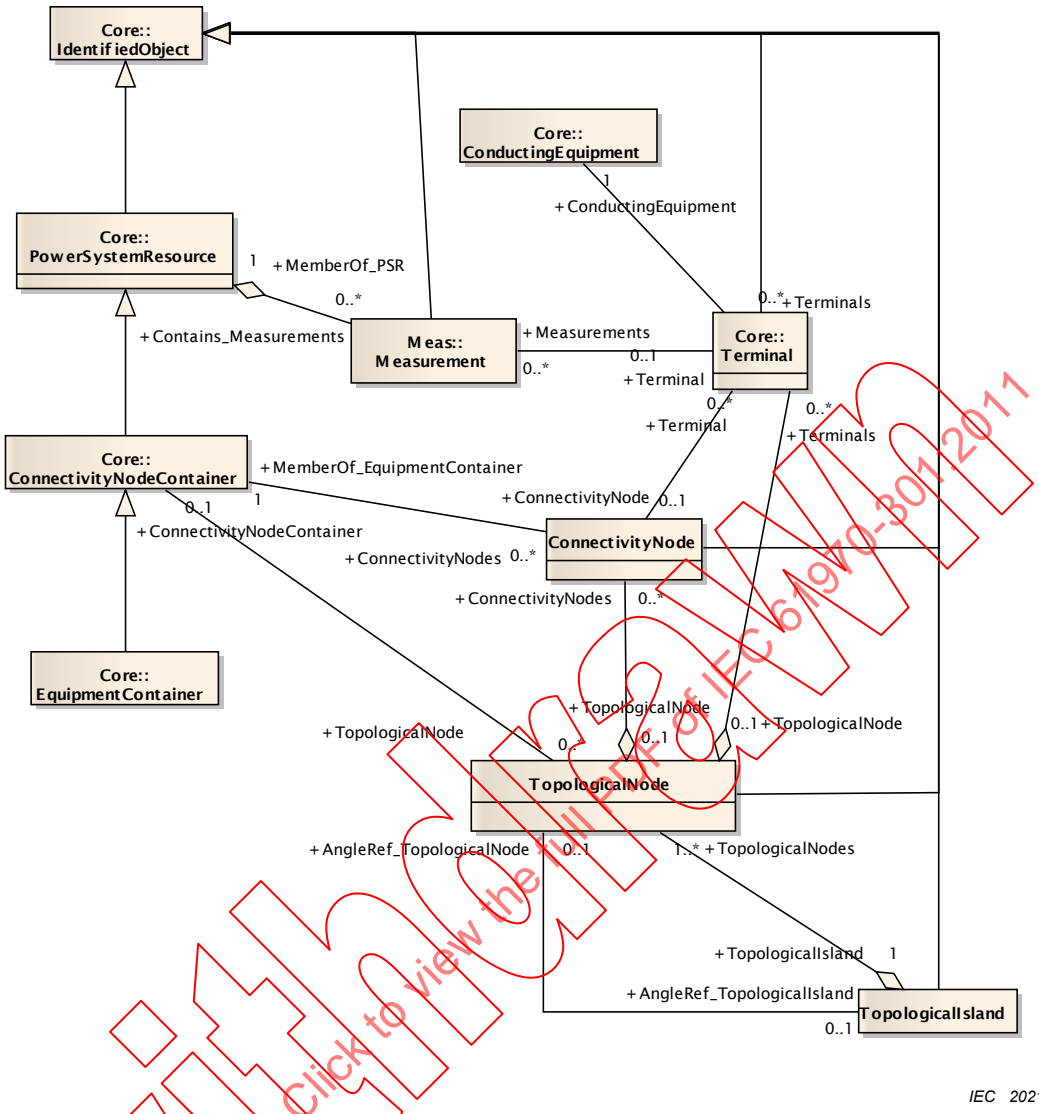

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Figure 33 – TopologyMeasRelations

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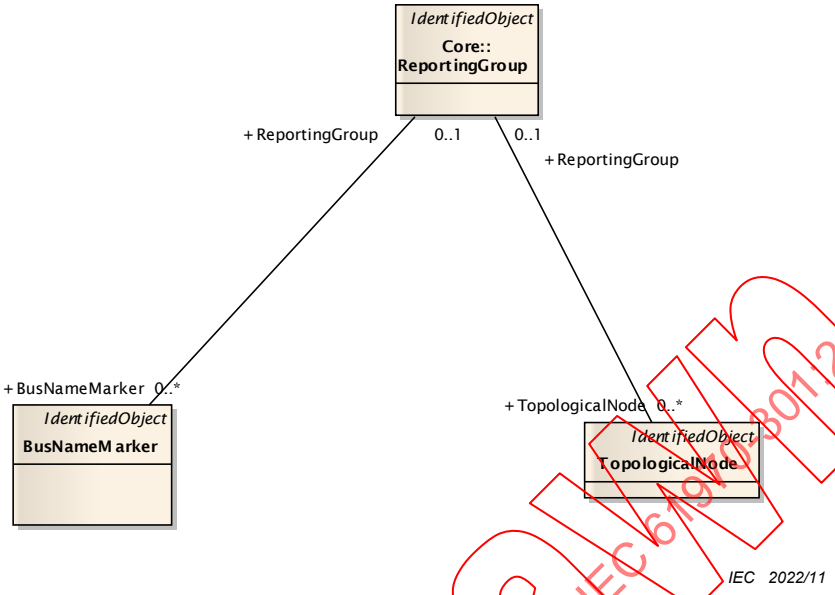

Figure 34 – TopologyReporting

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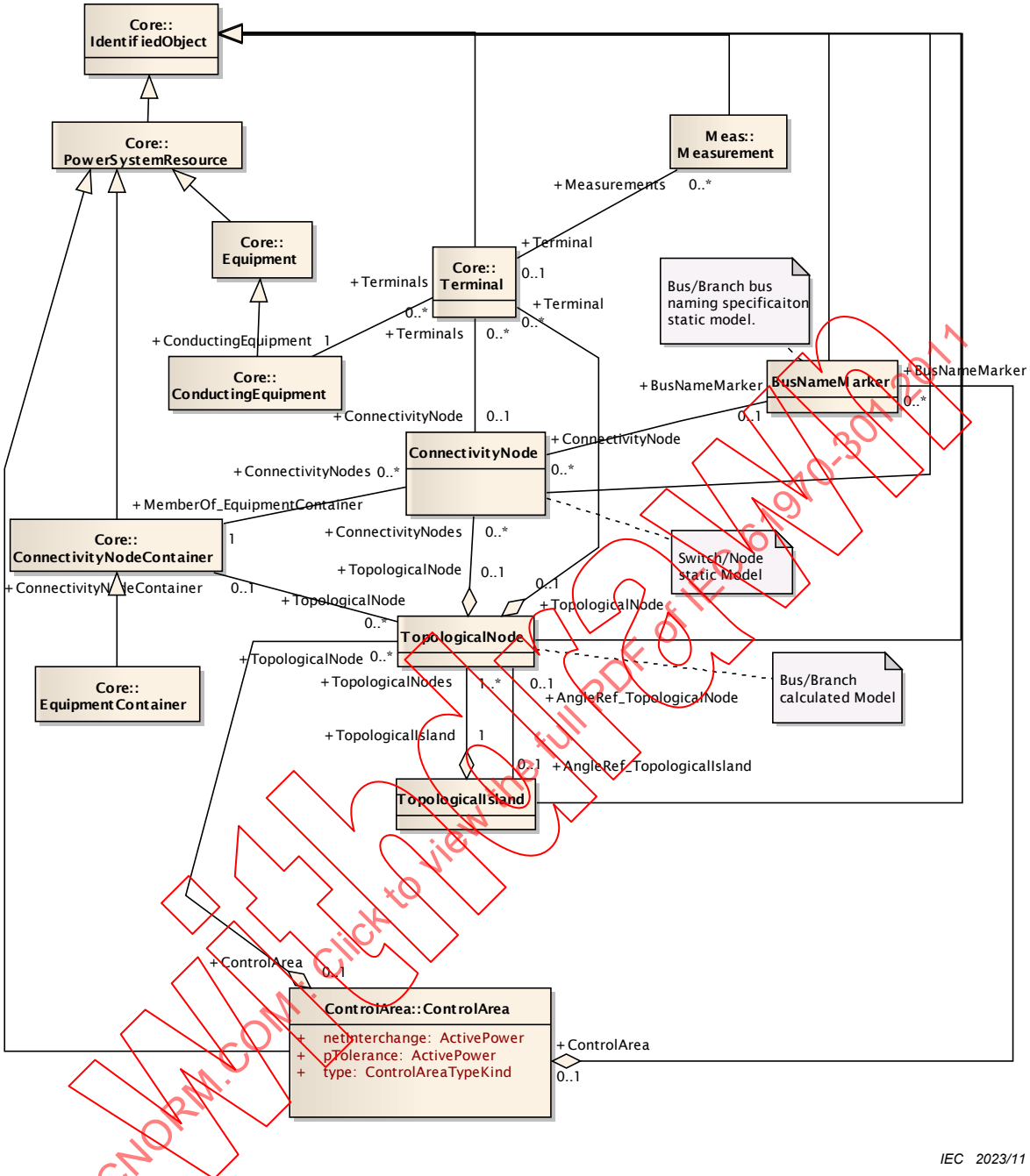

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Légende

Anglais	Français
Bus/Branch bus naming specificatIon static model.	Modèle statique de spécification de dénomination de topologie nodale
Switch/Node static model	Modèle statique Commutateur/Nœud
Bus/Branch calculated model	Modèle calculé de topolologie nodale

Figure 35 – Main

La Figure 35 est documentée comme suit. Ce diagramme montre toutes les classes incluses dans le paquetage Topology de même que les classes-clés externes, qui ont des associations avec des classes Topology.

6.5.2 BusNameMarker

Utilisé pour appliquer les noms normalisés d'utilisateur à des bus de topologie. Typiquement utilisé pour la génération de cas "topologie nodale". Associé à un ou plusieurs ConnectivityNode qui sont normalement une partie du nom du bus. Les ConnectivityNode associés sont à relier par des commutateurs sans retenue. Pour une configuration de poste en réseau bouclé, tous les nœuds de connectivité de jeux de barres dans l'anneau sont typiquement associés. Pour un disjoncteur et un demi-schéma, les deux jeux de barres seraient associés. Pour un réseau bouclé, tous les jeux de barres seraient associés. Pour une configuration "rectiligne" de jeux de barres, seul le nœud de connectivité au niveau du jeu de barres serait associé.

Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[0..*] ConnectivityNode (ConnectivityNode)	La liste des nœuds qui ont le même nom de bus dans la topologie normale. Remarquer qu'il convient que cette liste de ConnectivityNode soit reliée par des objets dérivés de Switch qui sont normalement fermés.
0..*	[0..1] ControlArea (ControlArea)	La zone de commande qui inclut le BusNameMarker (c'est-à-dire marqueur de nom de bus).
0..*	[0..1] ReportingGroup (ReportingGroup)	Le groupe de reporting auquel ce BusNameMarker appartient.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.5.3 ConnectivityNode

Les Connectivity nodes (nœuds de connectivité) sont des points où les bornes d'un équipement conducteur sont connectées avec une impédance nulle.

Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] BusNameMarker (BusNameMarker)	Le nom associé du noeud topologique (TopologicalNode) contenant le ConnectivityNode est dérivé par un algorithme qui utilise le marqueur de nom de bus.
0..*	[1] MemberOf_EquipmentContainer (ConnectivityNodeContainer)	Conteneur de ce noeud de connectivité
0..1	[0..*] Terminals (Terminal)	Les bornes s'interconnectent avec une impédance nulle à un nœud. Les mesures sur un nœud s'appliquent à toutes ses bornes.
0..*	[0..1] TopologicalNode (TopologicalNode)	Plusieurs ConnectivityNode(s) peuvent s'associer pour ne former qu'un seul TopologicalNode, selon l'état actuel du réseau.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.5.4 TopologicalIsland

Sous-ensemble du réseau électriquement connecté. Les Topological islands (îlots topologiques) peuvent changer en même temps que l'état du réseau change (c'est-à-dire des organe de coupures de déconnexion, des disjoncteurs, etc. changent l'état).

Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[0..1] AngleRef_TopologicalNode (TopologicalNode)	La référence angulaire de l'îlot. Normalement, il y a un TopologicalNode qui est sélectionné comme référence angulaire pour chaque îlot. D'autres schémas de référence existent et, donc, l'association est facultative.
1	[1..*] TopologicalNodes (TopologicalNode)	Un nœud topologique appartient à un îlot topologique.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.5.5 TopologicalNode

Un ensemble de noeuds de connectivité qui, dans l'état courant du réseau, sont reliés ensemble par n'importe quel sorte de commutateurs fermés, y compris des cavaliers. Les

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nœuds topologiques peuvent changer en même temps que l'état du réseau change (c'est-à-dire que des organes de coupure, des disjoncteurs, etc. changent l'état).

Attributs

nom	type	note
energized	Boolean	True (c'est-à-dire vrai) si le nœud est energized (c'est-à-dire alimenté en énergie)
loadCarrying	Boolean	True (c'est-à-dire Vrai) si le nœud transporte une charge
netInjectionP	ActivePower	Puissance active d'injection nette
netInjectionQ	ReactivePower	Puissance réactive d'injection nette
observabilityFlag	Boolean	État d'observabilité du nœud
phaseAngle	AngleRadians	Déphasage du nœud
voltage	Voltage	Tension du nœud
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[0..*] ConnectivityNodes (ConnectivityNode)	Plusieurs ConnectivityNode(s) peuvent s'associer pour ne former qu'un seul TopologicalNode, selon l'état actuel du réseau.
0..*	[0..1] ConnectivityNodeContainer (ConnectivityNodeContainer)	Le conteneur de nœuds de connectivité auquel le nœud de connectivité appartient.
0..*	[0..1] ControlArea (ControlArea)	La ControlArea (zone de commande) qui inclut le noeud.
0..*	[0..1] ReportingGroup (ReportingGroup)	Le groupe de reporting auquel le nœud topologique appartient.
0..1	[0..*] Terminal (Terminal)	Les bornes associées au nœud topologique. Il peut être utilisé à la place d'un chemin de nœuds de connectivité allant jusqu'à la borne, éliminant donc la nécessité de modéliser les nœuds de connectivité dans certains cas. Remarquer que si les nœuds de connectivité sont présents dans le modèle, cette association ne serait probablement pas utilisée.
0..1	[0..1] AngleRef_TopologicalIsland (TopologicalIsland)	L'îlot pour lequel le nœud est une référence angulaire. Normalement, il y a un nœud référence angulaire pour chaque îlot.
1..*	[1] TopologicalIsland (TopologicalIsland)	Un TopologicalNode (nœud topologique) appartient à unTopologicalIsland (îlot) topologique.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

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6.6 Wires

6.6.1 Résumé du paquetage Wires

Extension des paquetages Core and Topology qui modélise les informations des caractéristiques électriques des réseaux transport et distribution. Ce paquetage est utilisé par des applications de réseau telles que State Estimation, Load Flow et Optimal Power Flow.

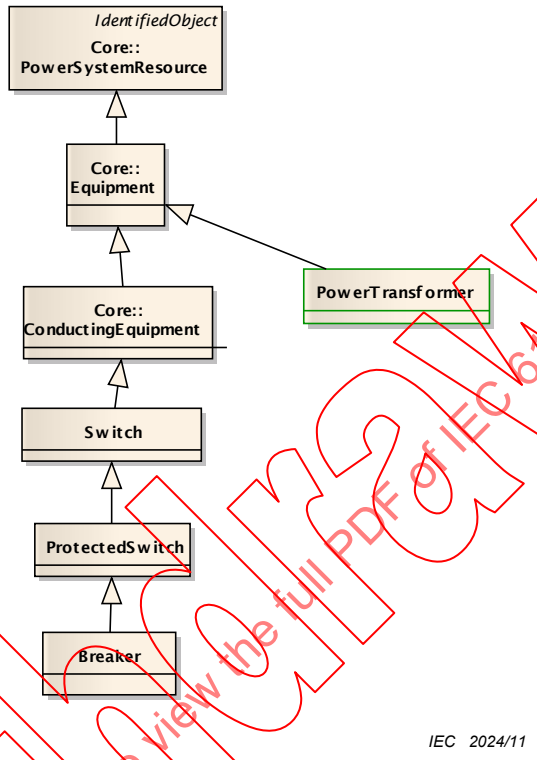

Figure 36 – DocumentationExampleInheritance

La Figure 36 est documentée comme suit. Elle montre un exemple de relations d'héritage dans UML. Ce diagramme sert seulement à venir à l'appui de figures dans la documentation.

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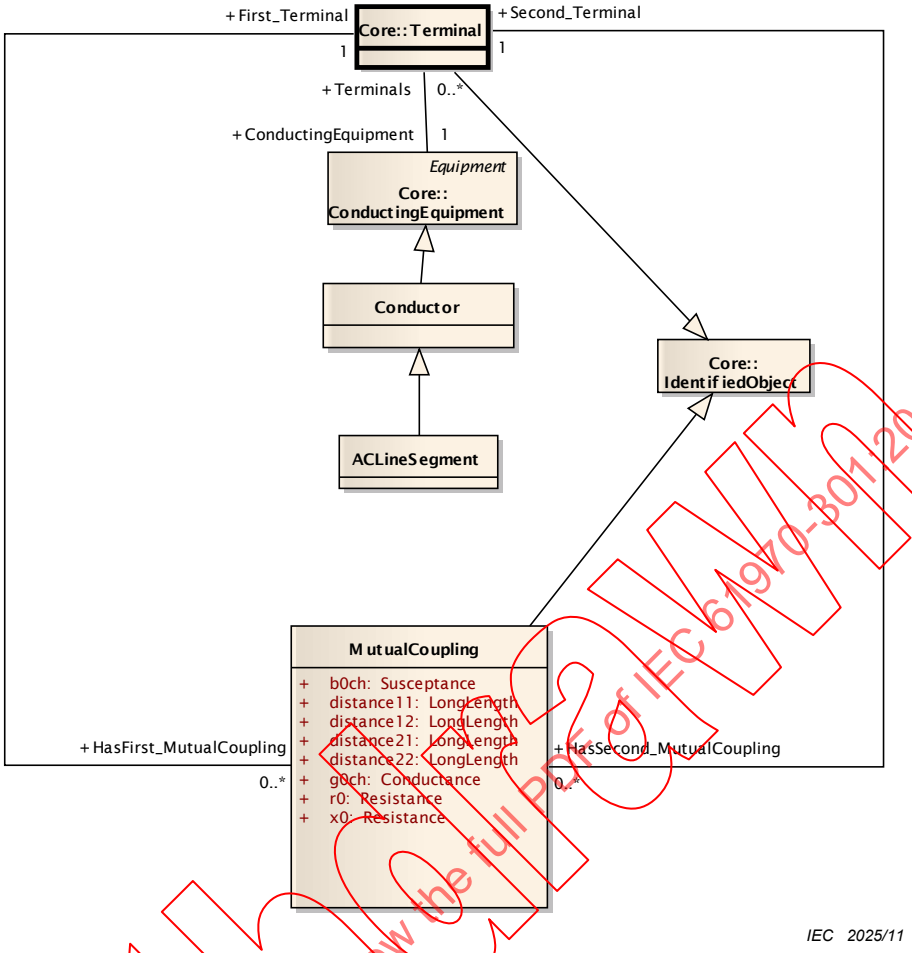

Figure 37 – MutualCoupling

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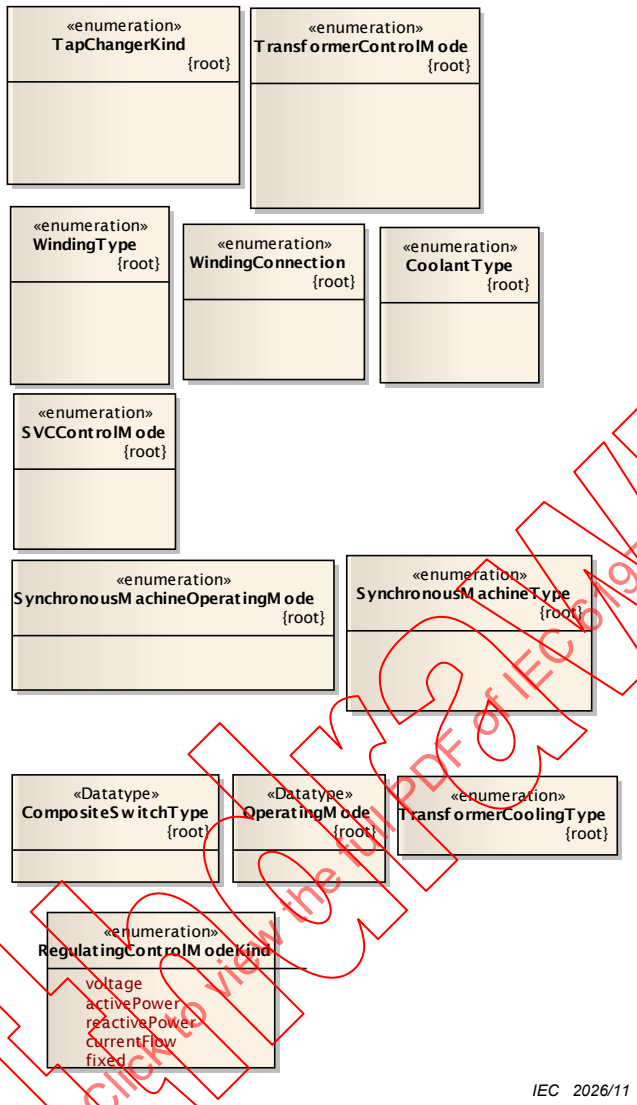

Figure 38 – Datatypes

La Figure 38 est documentée comme suit. Ce diagramme montre les types de données spécifiques au paquetage Wires.

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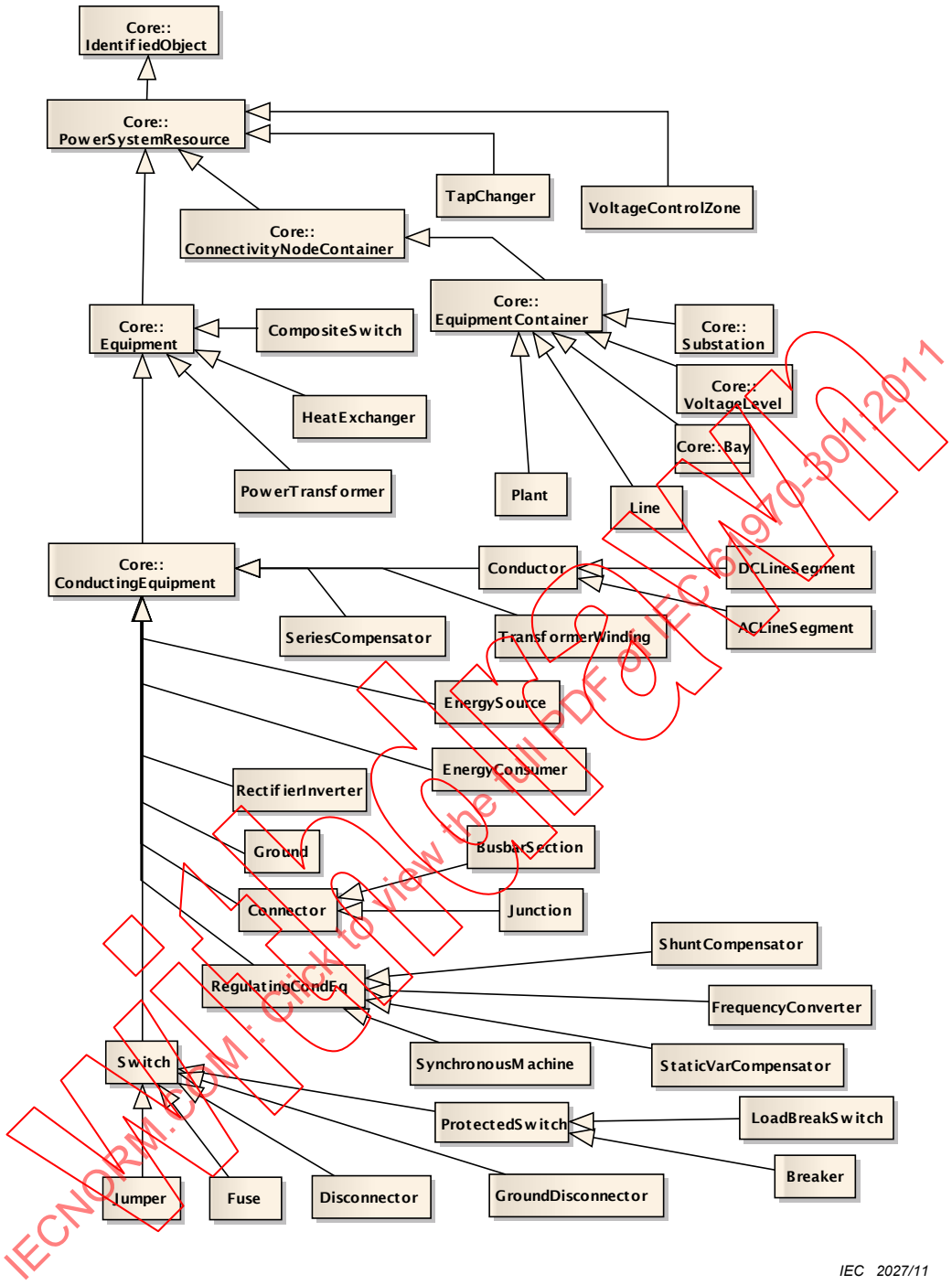

Figure 39 – InheritanceHierarchy

La Figure 39 est documentée comme suit. Ce diagramme décrit les relations d'héritage entre des classes de Wire ou liées à celui-ci.

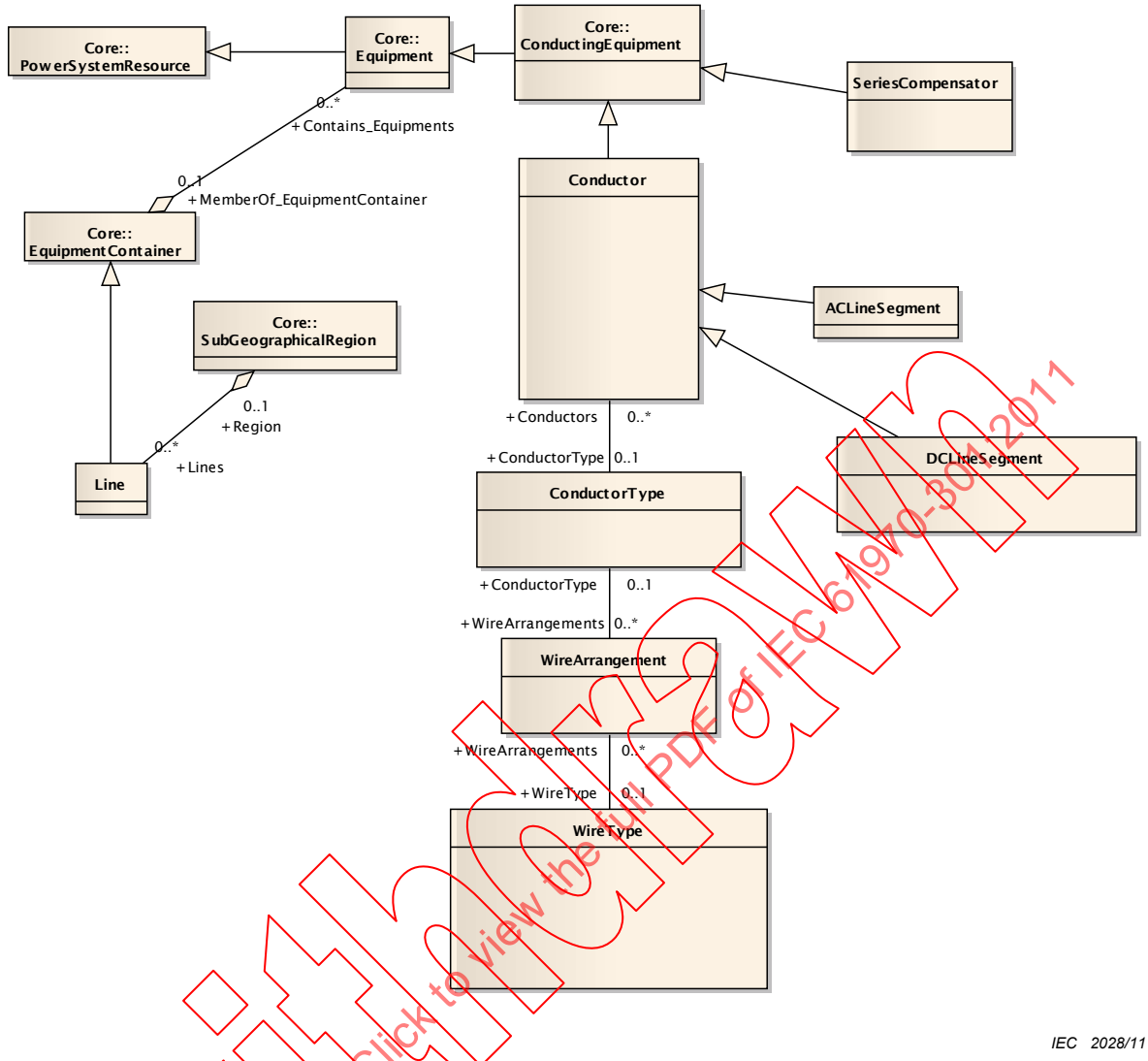

Figure 40 – LineModel

La Figure 40 est documentée comme suit. Ce diagramme montre toutes les classes liées au modèle de lignes de transport.

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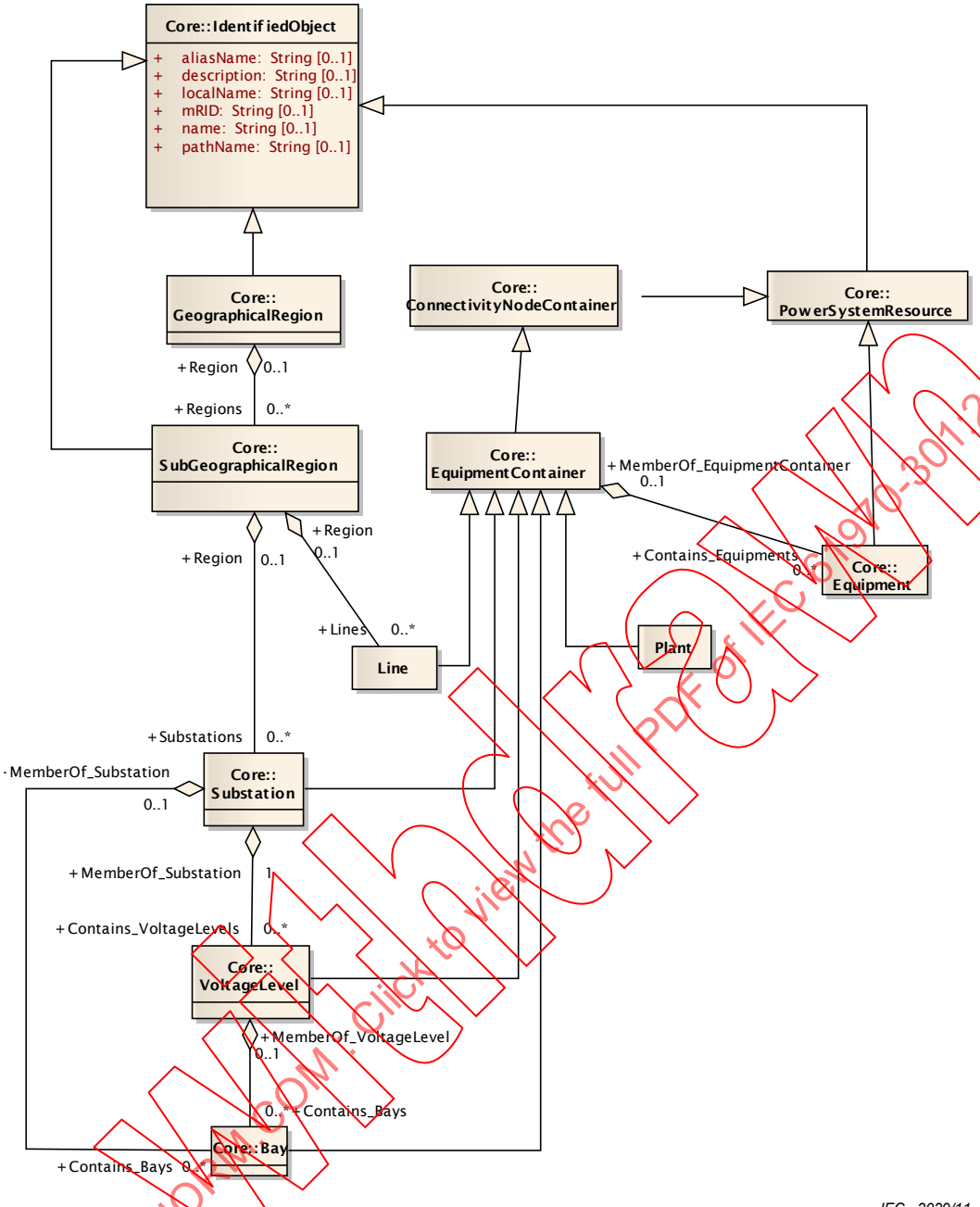

Figure 41 – NamingHierarchyPart1

La Figure 41 est documentée comme suit. Le diagramme montre la partie supérieure de la hiérarchie de dénomination. La hiérarchie est une façon d'organiser et de nommer l'équipement. Par conséquent, elle est intimement liée à l' IdentifiedObject et à ses attributs. La classe Equipment est en outre spécialisée en de nombreux sous-types qui sont tous contenus par les sous-classes de EquipmentContainer.

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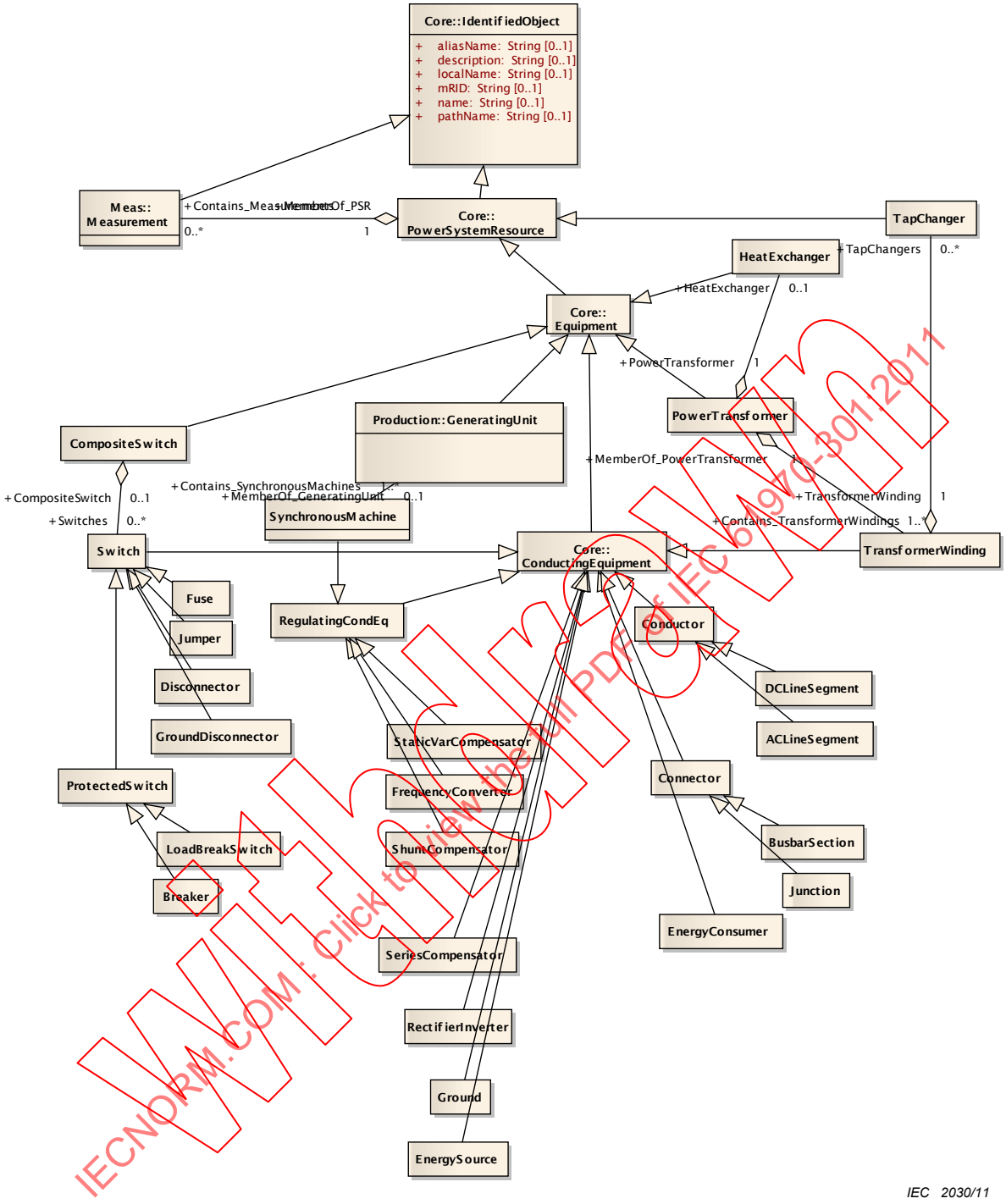

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Figure 42 – NamingHierarchyPart2

La Figure 42 est documentée comme suit. Le diagramme montre la partie inférieure de la hiérarchie de dénomination. Il montre comment la classe Equipment est en outre spécialisée en de nombreux sous-types qui sont tous contenus par les sous-classes de EquipmentContainer. Pour les sous-classes du conteneur d'équipement, se référer à la partie 1 du diagramme.

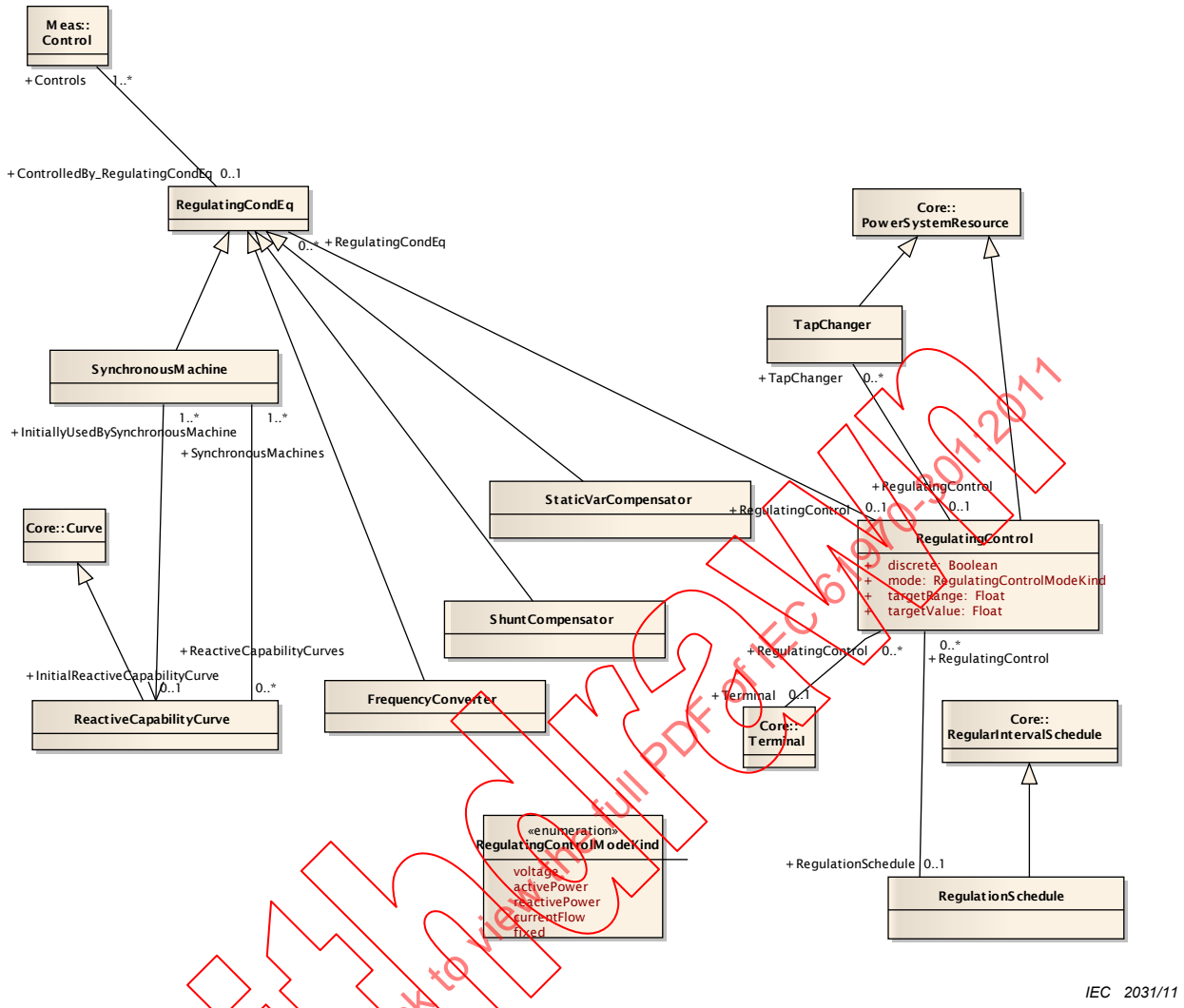

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Figure 43 – RegulatingEquipment

La Figure 43 est documentée comme suit. Le diagramme montre toutes les classes liées à l'équipement de régulation et à la compensation de puissance réactive.

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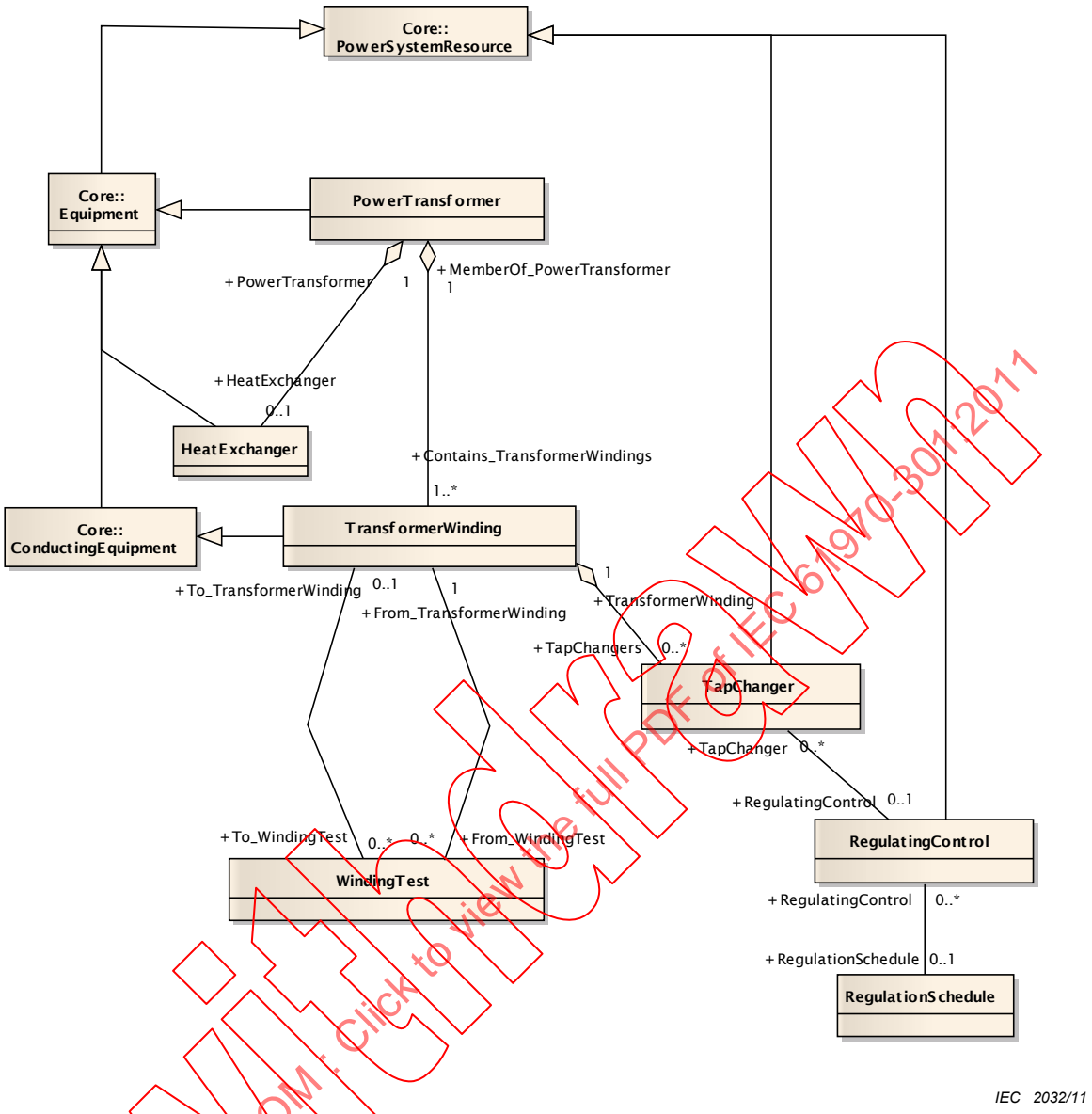

Figure 44 – TransformerModel

La Figure 44 est documentée comme suit. Ce diagramme montre toutes les classes liées au modèle de transformateurs.

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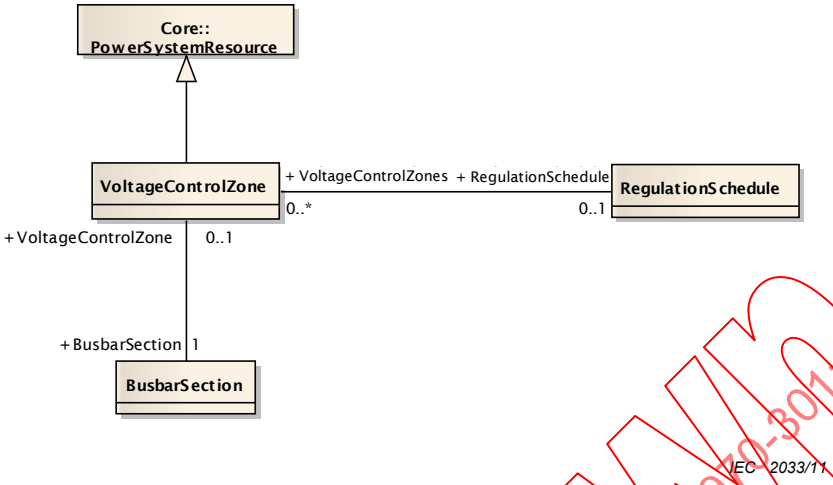

Figure 45 – VoltageControl

La Figure 45 est documentée comme suit. Ce diagramme montre toutes les classes liées à la régulation régionale de tension.

6.6.2 ACLineSegment

Un fil ou une combinaison de fils ayant des caractéristiques électriques cohérentes, et formant un seul système électrique, utilisé pour transporter du courant alternatif entre des points du réseau.

Attributs

nom	type	note
b0ch	Susceptance	hérité de: Conductor
bch	Susceptance	hérité de: Conductor
g0ch	Conductance	hérité de: Conductor
gch	Conductance	hérité de: Conductor
length	LongLength	hérité de: Conductor
r	Resistance	hérité de: Conductor
r0	Resistance	hérité de: Conductor
x	Reactance	hérité de: Conductor
x0	Reactance	hérité de: Conductor
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] ConductorType (ConductorType)	hérité de: Conductor
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.3 Breaker (disjoncteur)

Dispositif de commutation mécanique capable d'établir, de transporter et d'interrompre des courants dans des conditions normales de circuit et aussi d'établir, de transporter pendant une durée déterminée et d'interrompre des courants dans des conditions anormales spécifiées de circuit, par exemple celles d'un court-circuit.

Attributs

nom	type	note
ratedCurrent	CurrentFlow	Courant de coupure nominal sur défaut.
inTransitTime	Seconds	Le délai de transition de l'état ouvert à l'état fermé.
normalOpen	Boolean	hérité de: Switch
switchOnCount	Integer	hérité de: Switch
switchOnDate	AbsoluteDateTime	hérité de: Switch
retained	Boolean	hérité de: Switch
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..*] OperatedBy_ProtectionEquipments (ProtectionEquipment)	hérité de: ProtectedSwitch
1	[0..*] RecloseSequences (RecloseSequence)	hérité de: ProtectedSwitch
0..*	[0..1] CompositeSwitch (CompositeSwitch)	hérité de: Switch
0..*	[0..*] SwitchingOperations (SwitchingOperation)	hérité de: Switch
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.4 BusbarSection

Conducteur, ou groupe de conducteurs, ayant une impédance négligeable, servant à connecter un autre équipement conducteur au sein d'un seul poste.

Les mesures de tension sont habituellement obtenues à partir de VoltageTransformers (transformateurs de tension) connectés à des sections de jeu de barres. Une section de jeu de barres peut avoir plusieurs bornes physiques mais, pour l'analyse, elle est modélisée avec une seule borne logique.

Attributs

nom	type	note
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1	[0..1] VoltageControlZone (VoltageControlZone)	Une VoltageControlZone (zone de contrôle de la tension) est contrôlée par une BusbarSection (section de jeu de barres) déterminée.
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.5 CompositeSwitch

Modèle d'un ensemble de Switches (commutateurs) individuels compris dans la même armoire et si possible, avec des verrouillages qui restreignent la combinaison des positions de commutation. On peut les trouver généralement dans des réseaux électriques de distribution en moyenne tension.

Un CompositeSwitch peut représenter un (Ring-Main-Unit (RMU)) ou un appareillage de commutation monté par bloc, avec des dispositifs internes primaires tels qu'un jeu de barres interne plus 3 ou 4 interrupteurs internes qui peuvent être individuellement ouverts ou fermés. Un CompositeSwitch et un ensemble de Switches qu'il contient peuvent aussi être utilisés pour représenter un commutateur à plusieurs positions, par exemple un commutateur qui peut connecter un circuit à la Terre (Ground), à l'air (Open), ou à une barre omnibus (Busbar).

Attributs

nom	type	note
compositeSwitchType	CompositeSwitchType	Un code alphanumérique qui peut être utilisé comme référence pour une information supplémentaire telle que la description du schéma de verrouillage ("interlocking scheme"), s'il y en a un.
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject

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Withdrawn

nom	type	note
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[0..*] Switches (Switch)	Switches contenus dans ce commutateur combiné Composite switch
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.6 Type de données CompositeSwitchType

Un code alphanumérique qui peut être utilisé comme référence pour une information supplémentaire telle que la description du schéma de verrouillage ("interlocking scheme"), s'il y en a un.

Attributs

nom	type	note
value	String	

6.6.7 Conductor

Combinaison de matériau conducteur ayant des caractéristiques électriques cohérentes et formant un seul système électrique, utilisé pour transporter du courant entre des points dans le réseau.

Attributs

nom	type	note
b0ch	Susceptance	Susceptance shunt homopolaire (de chargement), uniformément répartie, de la section de ligne complète.
bch	Susceptance	Susceptance shunt directe (de chargement), uniformément répartie, de la section de ligne complète.
g0ch	Conductance	Conductance shunt homopolaire (de chargement), uniformément répartie, de la section de ligne complète.
gch	Conductance	Conductance shunt directe (de chargement), uniformément répartie, de la section de ligne complète.
length	LongLength	Longueur du segment pour calculer les

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nom	type	note
		capacités d'une section de ligne.
r	Resistance	Résistance série directe de la section de ligne complète.
r0	Resistance	Résistance série homopolaire de la section de ligne complète.
x	Reactance	Réactance série directe de la section de ligne complète.
x0	Reactance	Réactance série homopolaire de la section de ligne complète.
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] ConductorType (ConductorType)	Des sections de conducteur sont physiquement décrites par un type de conducteur
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.8 ConductorType

Fil ou câble conducteur (selon les spécifications de l'IEEE). Un type spécifique de fil ou de combinaison de fils non isolés les uns des autres, approprié pour transporter du courant électrique. Il peut être dénudé ou isolé.

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Attributs

nom	type	note
sheathResistance	Resistance	Résistance de la gaine des câbles conducteurs
sheathReactance	Reactance	Réactance de la gaine des câbles conducteurs
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[0..*] Conductors (Conductor)	Des sections de conducteur sont physiquement décrites par un type de conducteur.
0..1	[0..*] WireArrangements (WireArrangement)	Un ConductorType (type de conducteur) se compose de fils pouvant être configurés de plusieurs façons.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.9 Connector (connecteur)

Conducteur, ou groupe de conducteurs, d'une impédance négligeable, servant à connecter un autre équipement conducteur au sein d'un seul poste et qui sont modélisés avec une seule borne logique.

Attributs

nom	type	note
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment

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Mult à partir de	[Mult] nom (type)	note
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.10 Énumération CoolantType

Méthode de refroidissement d'une machine.

Enums

nom	note
air	
hydrogenGas	
water	

6.6.11 DCLineSegment

Fil ou combinaison de fils non isolés les uns des autres, ayant des caractéristiques électriques cohérentes, utilisés pour transporter du courant continu entre des points dans la section courant continu du réseau.

Attributs

nom	type	note
dcSegmentInductance	Inductance	Inductance du segment de ligne courant continu
dcSegmentResistance	Resistance	Résistance du segment de ligne courant continu
b0ch	Susceptance	hérité de: Conductor
bch	Susceptance	hérité de: Conductor
g0ch	Conductance	hérité de: Conductor
gch	Conductance	hérité de: Conductor
length	LongLength	hérité de: Conductor
r	Resistance	hérité de: Conductor
r0	Resistance	hérité de: Conductor
x	Reactance	hérité de: Conductor
x0	Reactance	hérité de: Conductor
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject

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nom	type	note
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] ConductorType (ConductorType)	hérité de: Conductor
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.12 Disconnector (sectionneur)

Dispositif de commutation mécanique exploité manuellement ou par un moteur utilisé pour changer les connexions dans un circuit ou pour isoler un circuit ou un équipement d'une source d'électricité. Il est conseillé d'ouvrir ou de fermer les circuits quand un courant négligeable est interrompu ou produit.

Attributs

nom	type	note
normalOpen	Boolean	hérité de: Switch
switchOnCount	Integer	hérité de: Switch
switchOnDate	AbsoluteDateTime	hérité de: Switch
retained	Boolean	hérité de: Switch
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject

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nom	type	note
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] CompositeSwitch (CompositeSwitch)	hérité de: Switch
0..*	[0..*] SwitchingOperations (SwitchingOperation)	hérité de: Switch
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.13 EnergyConsumer

Consommateur générique d'énergie: point de consommation sur le modèle de système électrique.

Attributs

nom	type	note
customerCount	Integer	Nombre de clients individuels représentés par cette Demand (demande).
pfixed	ActivePower	Puissance active de la charge dont la grandeur est fixe.
pfixedPct	PerCent	Puissance active fixe exprimée en pourcentage de la puissance active fixe du groupe de charge.
qfixed	ReactivePower	Puissance réactive de la charge dont la grandeur est fixe.
qfixedPct	PerCent	Puissance réactive fixe exprimée en pourcentage de la puissance réactive fixe du groupe de charge.
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject

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nom	type	note
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] LoadResponse (LoadResponseCharacteristic)	La caractéristique de réponse de charge pour cette charge.
1..*	[0..1] PowerCutZone (PowerCutZone)	Un consommateur d'énergie est affecté à une zone de coupure de puissance.
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.14 EnergySource

Équivalent générique pour un fournisseur d'énergie sur un niveau de tension de transport ou de distribution.

Attributs

nom	type	note
xn	Reactance	Réactance inverse de Thevenin
rn	Resistance	Résistance inverse de Thevenin
nominalVoltage	Voltage	Tension nominale phase à phase
x	Reactance	Réactance directe de Thevenin
r	Resistance	Résistance directe de Thevenin
voltageAngle	AngleRadians	Déphasage d'un circuit à phase ouvert
voltageMagnitude	Voltage	Valeur de la tension phase à phase d'un circuit ouvert
x0	Reactance	Réactance homopolaire de Thevenin

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nom	type	note
r0	Resistance	Résistance homopolaire de Thevenin
activePower	ActivePower	Charge de source haute tension
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.15 FrequencyConverter

Un dispositif pour convertir une fréquence en une autre (par exemple, fréquence F1 en F2) comprend une paire d'instances FrequencyConverter. L'une convertit de F1 en CC (courant continu), l'autre de CC en F2.

Attributs

nom	type	note
frequency	Frequency	Fréquence du côté CA (courant alternatif).
maxP	ActivePower	La puissance active maximale du côté CC à laquelle il convient que le convertisseur de fréquence fonctionne.
maxU	Voltage	La tension maximale du côté CC à laquelle il convient que le convertisseur de fréquence fonctionne.
minP	ActivePower	La puissance active minimale du côté CC à

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nom	type	note
		laquelle il convient que le convertisseur de fréquence fonctionne.
minU	Voltage	La tension minimale du côté CC à laquelle il convient que le convertisseur de fréquence fonctionne.
operatingMode	OperatingMode	Mode de fonctionnement du convertisseur de fréquence
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[1..*] Controls (Control)	hérité de: RegulatingCondEq
0..*	[0..1] RegulatingControl (RegulatingControl)	hérité de: RegulatingCondEq
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.16 Fuse

Dispositif de protection contre les surintensités avec un fusible à ouverture de circuit qui est chauffé et rompu quand une surintensité le traverse. Un fusible est considéré comme un organe de coupure parce qu'il interrompt le courant.

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Attributs

nom	type	note
ampRating	CurrentFlow	Courant de coupure nominal sur défaut
normalOpen	Boolean	hérité de: Switch
switchOnCount	Integer	hérité de: Switch
switchOnDate	AbsoluteDateTime	hérité de: Switch
retained	Boolean	hérité de: Switch
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] CompositeSwitch (CompositeSwitch)	hérité de: Switch
0..*	[0..*] SwitchingOperations (SwitchingOperation)	hérité de: Switch
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.17 Ground

Point commun pour connecter un équipement conducteur mis à la terre tel que des condensateurs-shunts. Le modèle de réseau peut avoir plus d'une mise à la terre.

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Attributs

nom	type	note
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.18 GroundDisconnector

Un dispositif mécanique de commutation, motorisé ou opéré manuellement, utilisé pour isoler un circuit ou un équipement de Ground (terre).

Attributs

nom	type	note
normalOpen	Boolean	hérité de: Switch
switchOnCount	Integer	hérité de: Switch
switchOnDate	AbsoluteDateTime	hérité de: Switch
retained	Boolean	hérité de: Switch
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject

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Withdrawn

nom	type	note
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] CompositeSwitch (CompositeSwitch)	hérité de: Switch
0..*	[0..*] SwitchingOperations (SwitchingOperation)	hérité de: Switch
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.19 HeatExchanger (échangeur de chaleur)

Équipement pour le refroidissement de l'équipement électrique et l'extraction de chaleur.

Attributs

nom	type	note
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[1] PowerTransformer (PowerTransformer)	Un transformateur peut comporter un HeatExchanger (échangeur de chaleur).
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.20 Jumper

Courte section de conducteur avec une impédance négligeable pouvant être enlevée et remplacée manuellement si le circuit n'est plus alimenté. Il est à noter que les branches d'impédance nulle peuvent être modélisées par un ACLineSegment (c'est-à-dire segment de ligne de courant alternatif) avec un ConductorType (c'est-à-dire type de conducteur) d'impédance nulle.

Attributs

nom	type	note
normalOpen	Boolean	hérité de: Switch
switchOnCount	Integer	hérité de: Switch
switchOnDate	AbsoluteDateTime	hérité de: Switch
retained	Boolean	hérité de: Switch
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] CompositeSwitch (CompositeSwitch)	hérité de: Switch
0..*	[0..*] SwitchingOperations (SwitchingOperation)	hérité de: Switch
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.21 Junction

Point auquel un ou plusieurs équipements conducteurs sont connectés avec une résistance homopolaire.

Attributs

nom	type	note
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment

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Mult à partir de	[Mult] nom (type)	note
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.22 Line

Composant d'un système s'étendant entre des postes adjacents ou d'un poste vers un point d'interconnexion adjacent.

Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] Region (SubGeographicalRegion)	Une Line (ligne) peut être contenue par une SubGeographical Region.
0..1	[0..*] Contains_Equipments (Equipment)	hérité de: EquipmentContainer
1	[0..*] ConnectivityNodes (ConnectivityNode)	hérité de: ConnectivityNodeContainer
0..1	[0..*] TopologicalNode (TopologicalNode)	hérité de: ConnectivityNodeContainer
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource

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Mult à partir de	[Mult] nom (type)	note
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.23 LoadBreakSwitch

Dispositif de commutation mécanique capable de produire, transporter et interrompre des courants en conditions normales de fonctionnement.

Attributs

nom	type	note
ratedCurrent	CurrentFlow	Intensité de courant maximal qu'un fil ou câble peut supporter dans des conditions thermiques énoncées
normalOpen	Boolean	hérité de: Switch
switchOnCount	Integer	hérité de: Switch
switchOnDate	AbsoluteDateTime	hérité de: Switch
retained	Boolean	hérité de: Switch
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..*] OperatedBy_ProtectionEquipments (ProtectionEquipment)	hérité de: ProtectedSwitch
1	[0..*] RecloseSequences (RecloseSequence)	hérité de: ProtectedSwitch
0..*	[0..1] CompositeSwitch (CompositeSwitch)	hérité de: Switch
0..*	[0..*] SwitchingOperations (SwitchingOperation)	hérité de: Switch
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource

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Mult à partir de	[Mult] nom (type)	note
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.24 MutualCoupling

Cette classe représente le couplage mutuel de ligne homopolaire.

Attributs

nom	type	note
b0ch	Susceptance	Susceptance shunt de couplage mutuel homopolaire (de chargement), uniformément répartie, de la section de ligne complète
distance11	LongLength	Distance entre la première borne spécifiée de la ligne et le début de la région couplée
distance12	LongLength	Distance entre la première borne spécifiée de la ligne et la fin de la région couplée
distance21	LongLength	Distance entre la deuxième borne spécifiée de la ligne et le début de la région couplée
distance22	LongLength	Distance entre la deuxième borne spécifiée de la ligne et la fin de la région couplée
g0ch	Conductance	Conductance shunt de couplage mutuel homopolaire (de chargement), uniformément répartie, de la section de ligne complète
r0	Resistance	Couplage d'impédance mutuel homopolaire entre branches, résistance
x0	Resistance	Couplage d'impédance mutuel homopolaire entre branches, réactance
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[1] First_Terminal (Terminal)	La borne de départ pour le calcul des distances le long de la première branche du couplage mutuel. Normalement, le couplage mutuel MutualCoupling ne serait utilisé que pour des bornes de segments de ligne CA (c'est-à-dire en courant alternatif). Il convient que les première et seconde bornes d'un couplage mutuel pointent des segments de ligne CA différents.

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Mult à partir de	[Mult] nom (type)	note
0..*	[1] Second_Terminal (Terminal)	La borne de départ pour le calcul des distances le long de la deuxième branche du couplage mutuel.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.25 Type de données OperatingMode

Nom littéral d'un mode opératoire.

Attributs

nom	type	note
value	String	

6.6.26 Plant

Un Plant (c'est-à-dire une centrale) est une collection d'équipements utilisés à des fins de production.

Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[0..*] Contains_Equipments (Equipment)	hérité de: EquipmentContainer
1	[0..*] ConnectivityNodes (ConnectivityNode)	hérité de: ConnectivityNodeContainer
0..1	[0..*] TopologicalNode (TopologicalNode)	hérité de: ConnectivityNodeContainer
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.27 PowerTransformer

Appareil électrique constitué de deux enroulements couplés ou plus, avec ou sans cœur magnétique, destiné à introduire un couplage mutuel entre les circuits électriques. Les

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transformateurs peuvent être utilisés pour contrôler la tension et le déplacement de phase (flux de puissance active).

Attributs

nom	type	note
bmagSat	PerCent	Susceptance d'aimantation du shunt central dans la zone de saturation
magBaseU	Voltage	Tension de référence à laquelle les mesures de saturation d'aimantation ont été effectuées
magSatFlux	PerCent	Niveau de flux au coude de la courbe de saturation et d'aimantation du cœur
phases	PhaseCode	Décrit les phases supportées par un transformateur de puissance
transfCoolingType	TransformerCoolingType	Type de refroidissement du transformateur.
normalIlyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1	[0..1] HeatExchanger (HeatExchanger)	Un transformateur peut comporter un échangeur de chaleur.
1	[1..*] Contains_TransformerWindings (TransformerWinding)	Un transformateur comporte des enroulements.
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.28 ProtectedSwitch

Un ProtectedSwitch (c'est-à-dire un commutateur protégé) est un dispositif de commutation qui peut être actionné par ProtectionEquipment (c'est-à-dire l'équipement de protection).

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Attributs

nom	type	note
normalOpen	Boolean	hérité de: Switch
switchOnCount	Integer	hérité de: Switch
switchOnDate	AbsoluteDateTime	hérité de: Switch
retained	Boolean	hérité de: Switch
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..*] OperatedBy_ProtectionEquipments (ProtectionEquipment)	Les équipements de protection qui font fonctionner ce ProtectedSwitch.
1	[0..*] RecloseSequences (RecloseSequence)	Un disjoncteur peut avoir une ou plusieurs refermetures automatiques après un déclenchement.
0..*	[0..1] CompositeSwitch (CompositeSwitch)	hérité de: Switch
0..*	[0..*] SwitchingOperations (SwitchingOperation)	hérité de: Switch
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.29 ReactiveCapabilityCurve

Courbe enveloppe nominale de puissance réactive en fonction de la puissance active de la machine synchrone, en mode générateur et moteur. Il existe, pour chaque valeur de puissance active, une valeur limite supérieure et inférieure correspondante de la puissance

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Withdrawn

réactive. Traditionnellement, il y aura une courbe distincte pour chaque état du fluide de refroidissement, tel que la pression de l'hydrogène. Les valeurs de l'axe Y1 représentent le minimum de la puissance réactive alors que les valeurs de l'axe Y2 représentent le maximum de la puissance réactive.

Attributs

nom	type	note
coolantTemperature	Temperature	Température du fluide de refroidissement de la machine (par exemple l'air ambiant ou l'eau de circulation du stator)
hydrogenPressure	Pressure	Pression du fluide de refroidissement à base d'hydrogène
curveStyle	CurveStyle	hérité de: Curve
xUnit	UnitSymbol	hérité de: Curve
xMultiplier	UnitMultiplier	hérité de: Curve
y1Unit	UnitSymbol	hérité de: Curve
y1Multiplier	UnitMultiplier	hérité de: Curve
y2Unit	UnitSymbol	hérité de: Curve
y2Multiplier	UnitMultiplier	hérité de: Curve
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[1..*] InitiallyUsedBySynchronousMachine (SynchronousMachine)	Machines synchrones utilisant cette courbe comme courbe par défaut.
0..*	[1..*] SynchronousMachines (SynchronousMachine)	Machines synchrones utilisant cette courbe.
1	[0..*] CurveScheduleDatas (CurveData)	hérité de: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.30 RectifierInverter

Équipement de conversion alternatif/continu bidirectionnel pouvant être utilisé pour contrôler le courant continu, la tension continue, le flux d'énergie continue ou l'angle d'amorçage.

Attributs

nom	type	note
ratedU	Voltage	Tension de base primaire du redresseur/onduleur.
bridges	Integer	Nombre de ponts.
commutatingReactance	Reactance	Réactance de commutation, sur la fréquence du bus alternatif.
commutatingResistance	Resistance	Résistance de commutation.

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nom	type	note
compoundResistance	Resistance	Résistance compound.
minCompoundVoltage	Voltage	Tension continue compoundée minimale.
frequency	Fréquence	Fréquence du côté CA (courant alternatif)
maxP	ActivePower	La puissance active maximale du côté CC à laquelle il convient que le convertisseur fonctionne.
minP	ActivePower	La puissance active minimale du côté CC à laquelle il convient que le convertisseur fonctionne.
maxU	Voltage	La tension maximale du côté CC à laquelle il convient que le convertisseur fonctionne.
minU	Voltage	La tension minimale du côté CC à laquelle il convient que le convertisseur fonctionne.
operatingMode	OperatingMode	Mode de fonctionnement du convertisseur.
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.31 RegulatingCondEq

RegulatingCondEq (équipement conducteur de régulation) est un type de ConductingEquipment (équipement conducteur) pouvant régler les Measurements (mesures) et comporter un RegulationSchedule (programme de régulation).

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Attributs

nom	type	note
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[1..*] Controls (Control)	Les sorties de commande utilisées pour commander effectivement un dispositif de régulation, par exemple la magnétisation d'une machine synchrone ou l'actionneur disjoncteur d'une batterie de condensateurs.
0..*	[0..1] RegulatingControl (RegulatingControl)	copie à partir de ...
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.32 RegulatingControl

Spécifie un ensemble d'équipements qui fonctionnent ensemble pour commander une grandeur de système électrique telle que la tension ou le flux.

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Attributs

nom	type	note
mode	RegulatingControlModeKind	Le mode de commande de régulation actuellement disponible. La présente spécification permet de déterminer le genre de régulation sans la nécessité d'obtenir les unités à partir d'un programme.
targetRange	Float	Il s'agit de la plage cible d'entrée de cas. Elle exécute la même fonction que l'attribut value2 sur le programme de régulation dans le cas où les programmes ne sont pas utilisés. Cette valeur a les unités appropriées à l' attribut de mode.
targetValue	Float	La valeur cible spécifiée pour "case input". Cette valeur peut être utilisée pour la valeur cible sans utilisation de programmes. Cette valeur a les unités appropriées à l' attribut de mode.
discrete	Boolean	La régulation est effectuée dans un mode discret.
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[0..*] RegulatingCondEq (RegulatingCondEq)	L'équipement participant à la commande de régulation.
0..*	[0..1] RegulationSchedule (RegulationSchedule)	Programme pour cette commande de régulation.
0..1	[0..*] TapChanger (TapChanger)	Les changeurs de prise participant à la régulation.
0..*	[0..1] Terminal (Terminal)	La borne associée à cette commande de régulation.
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.33 Énumération RegulatingControlModeKind

Le genre de modèle de régulation. Par exemple: tension de régulation, puissance réactive, puissance active, etc.

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Enums

nom	note
voltage	La tension est spécifiée.
activePower	La puissance active est spécifiée.
reactivePower	La puissance réactive est spécifiée.
currentFlow	L'intensité est spécifiée.
fixed	Le mode de régulation est fixe et donc ne régule pas.

6.6.34 RegulationSchedule

Modèle prédéfini sur une longue durée pour une variable commandée, par exemple la tension du jeu de barres.

Attributs

nom	type	note
lineDropCompensation	Boolean	Indicateur indiquant que la compensation de perte de ligne doit être appliquée
lineDropR	Resistance	Résistance de perte de ligne
lineDropX	Reactance	Réactance de perte de ligne
timeStep	Seconds	hérité de: RegularIntervalSchedule
endTime	AbsoluteDateTime	hérité de: RegularIntervalSchedule
startTime	AbsoluteDateTime	hérité de: BasicIntervalSchedule
value1Unit	UnitSymbol	hérité de: BasicIntervalSchedule
value1Multiplier	UnitMultiplier	hérité de: BasicIntervalSchedule
value2Unit	UnitSymbol	hérité de: BasicIntervalSchedule
value2Multiplier	UnitMultiplier	hérité de: BasicIntervalSchedule
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[0..*] RegulatingControl (RegulatingControl)	Les commandes de régulation qui ont ce Schedule (c'est-à-dire ce programme).
0..1	[0..*] VoltageControlZones (VoltageControlZone)	Une VoltageControlZone (zone de contrôle de la tension) peut comporter un programme de régulation de tension.
1	[1..*] TimePoints (RegularTimePoint)	hérité de: RegularIntervalSchedule
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.35 SeriesCompensator

Un compensateur série est un condensateur ou une bobine de réactance série ou une ligne de transport en courant alternatif sans susceptance de charge.

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Attributs

nom	type	note
r	Resistance	Résistance directe
x	Reactance	Réactance directe
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.36 ShuntCompensator

Condensateur-shunt ou bobine de réactance ou batterie commutable de condensateurs-shunts ou de bobines de réactance. Une section d'un compensateur shunt est un condensateur ou une bobine de réactance individuel(le). Les valeurs négatives de mVArPerSection et nominalMVAr indiquent que le compensateur est une bobine de réactance.

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Attributs

nom	type	note
aVRDelay	Seconds	Durée, en secondes, nécessaire au dispositif pour être connecté ou déconnecté par une régulation automatique de tension (AVR, automatic voltage regulation).
b0PerSection	Susceptance	Susceptance shunt homopolaire (chargement), par section.
g0PerSection	Conductance	Conductance shunt homopolaire (chargement), par section
maximumSections	Integer	Pour une batterie de condensateurs, nombre maximal de sections qui peuvent être commutées.
maxU	Voltage	Tension maximale à laquelle il convient que la batterie de condensateurs fonctionne.
minU	Voltage	Tension minimale à laquelle il convient que la batterie de condensateurs fonctionne.
nomQ	ReactivePower	Sortie nominale de puissance réactive de la batterie de condensateurs à la tension nominale. Il convient que ce nombre soit positif.
nomU	Voltage	Tension nominale à laquelle la puissance réactive nominale a été mesurée. Il convient qu'elle soit normalement différente d'au plus 10 % de la tension à laquelle le condensateur est connecté au réseau.
normalSections	Integer	Pour une batterie de condensateurs, nombre normal de sections commutées. Il convient que ce nombre corresponde à la puissance réactive nominale (nomQ).
reactivePerSection	ReactivePower	Pour une batterie de condensateurs, taille en puissance réactive de chaque section commutable à la tension nominale.
switchOnCount	Integer	Compteur de mise en route depuis la dernière initialisation ou réinitialisation du compteur de condensateur.
switchOnDate	AbsoluteDateTime	Date et moment où la batterie de condensateurs a été activée pour la dernière fois.
voltageSensitivity	VoltagePerReactivePower	Sensibilité de tension nécessaire au dispositif pour réguler la tension du bus en tension par puissance réactive.
yPerSection	Admittance	Pour une batterie de condensateurs, admittance de chaque section commutable. Calculée en utilisant la puissance réactive par section et corrigée de la tension du réseau.
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[1..*] Controls (Control)	hérité de: RegulatingCondEq
0..*	[0..1] RegulatingControl (RegulatingControl)	hérité de: RegulatingCondEq
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.37 StaticVarCompensator

Installation proposant une puissance réactive parallèle variable et modulable. Le SVC consiste généralement en un transformateur abaisseur, un filtre, un réacteur commandé par thyristor et des bras de condensateur commutés par thyristor.

Le SVC peut fonctionner dans le mode de sortie MVar fixe ou dans le mode de commande de tension. Dans le mode de commande de tension, la sortie du SVC sera proportionnelle à l'écart de tension au niveau du bus commandé par rapport au point de consigne de la tension. La pente caractéristique du SVC définit la proportion. Si la tension au niveau du bus commandé est égale au point de consigne de la tension, la sortie MVar du SVC est nulle.

Attributs

nom	type	note
capacitiveRating	Reactance	Puissance réactive capacitive disponible maximale.
inductiveRating	Reactance	Puissance réactive inductive disponible maximale.
sVCControlMode	SVCControlMode	Mode de commande du SVC.
slope	VoltagePerReactivePower	La pente de la caractéristique d'un SVC définit comment la sortie de puissance réactive change proportionnellement à la différence entre la tension régulée du bus et le point de consigne de la tension.
voltageSetPoint	Voltage	La sortie de puissance réactive du SVC est proportionnelle à la différence entre la tension au bus régulé et le point de consigne de la tension (voltage set point). Lorsque la tension du bus régulé est égale au point de consigne de

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nom	type	note
		la tension, la sortie de puissance réactive est nulle.
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[1..*] Controls (Control)	hérité de: RegulatingCondEq
0..*	[0..1] RegulatingControl (RegulatingControl)	hérité de: RegulatingCondEq
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.38 Énumération SVCControlMode

Mode de commande du compensateur de VAr statique.

Enums

nom	note
reactivePower	
voltage	
off (hors service)	

6.6.39 Switch (organe de coupure)

Appareil générique visant à établir ou à interrompre le courant, ou les deux, dans un ou plusieurs circuits électriques.

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Attributs

nom	type	note
normalOpen	Boolean	L'attribut est utilisé dans des cas où aucun Measurement (c'est-à-dire mesure) pour la valeur de statut n'est présent. Si le Switch a une mesure de statut, alors Discrete.normalValue est censé correspondre au Switch.normalOpen.
switchOnCount	Integer	Compteur de mise en route depuis la dernière initialisation ou réinitialisation du Switch.
switchOnDate	AbsoluteDateTime	Date et heure de la dernière mise en route du Switch.
retained	Boolean	La branche est retenue dans un modèle en topologie nodale.
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] CompositeSwitch (CompositeSwitch)	Commutateur composite auquel appartient ce Switch.
0..*	[0..*] SwitchingOperations (SwitchingOperation)	Un organe de coupure peut être actionné par plusieurs programmes.
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

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6.6.40 SynchronousMachine

Appareil électromécanique fonctionnant de façon synchrone avec le réseau. Il s'agit d'une machine unique opérant comme une génératrice, comme un condensateur synchrone ou comme une pompe.

Attributs

nom	type	note
aVRToManualLag	Seconds	Retard requis pour le passage de la régulation de tension automatique (AVR) à Manuel pour une infraction MVAr de retard de phase.
aVRToManualLead	Seconds	Retard requis pour le passage de la régulation de tension automatique (AVR) à Manuel pour une infraction MVAr d'avance de phase.
baseQ	ReactivePower	Valeur par défaut de la puissance réactive de base. Cette valeur représente la puissance réactive initiale pouvant être utilisée par toute fonction d'application.
condenserP	ActivePower	Puissance active consommée lors du fonctionnement en mode condensateur.
coolantCondition	Float	Température ou pression du milieu du fluide de refroidissement.
coolantType	CoolantType	Méthode de refroidissement de la machine.
damping	Damping	Coefficient du couple d'amortissement, constante proportionnelle qui, lorsqu'elle est multipliée par la vitesse angulaire des pôles du rotor relative au champ magnétique (fréquence), se traduit par le couple d'amortissement.
inertia	PU	Énergie stockée dans le rotor lorsqu'il fonctionne à une vitesse nominale. Cette valeur est utilisée dans le référentiel électrique d'accélération pour les programmes de simulateur de formation des exploitants.
manualToAVR	Seconds	Retard requis pour le passage de Manuel à AVR (régulation automatique de tension). Cette valeur est utilisée dans le référentiel électrique d'accélération pour les programmes de calcul de répartition.
maxQ	ReactivePower	Limite maximale de la puissance réactive. Il s'agit de la limite maximale (constructeur) de la tranche.
maxU	Voltage	Limite de tension maximale de la tranche.
minQ	ReactivePower	Limite de puissance réactive minimale de la tranche.
minU	Voltage	Limite de tension minimale de la tranche.
operatingMode	SynchronousMachineOperatingMode	Mode de fonctionnement courant.
qPercent	PerCent	Pourcentage de la commande réactive coordonnée qui provient de cette machine.
r	Resistance	Résistance directe de la machine synchrone.
r0	Resistance	Résistance homopolaire de la machine synchrone.
r2	Resistance	Résistance inverse.
ratedS	ApparentPower	Puissance apparente nominale constructeur de la tranche.
referencePriority	Integer	Priorité de la tranche pour la sélection de bus de référence. 0 = don t care c'est-à-dire peu importe (par défaut) 1 = plus haute priorité. 2 est moins que 1 et ainsi de suite.

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nom	type	note
type	SynchronousMachineType	Modes dans lesquels cette machine synchrone peut fonctionner.
x	Reactance	Réactance directe de la machine synchrone.
x0	Reactance	Réactance homopolaire de la machine synchrone.
x2	Reactance	Réactance inverse.
xDirectSubtrans	Reactance	Réactance subtransitoire longitudinale, également appelée X"d.
xDirectSync	Reactance	Réactance synchrone longitudinale: quotient, pour une machine fonctionnant à une vitesse nominale, de la valeur permanente du composant alternatif de la tension d'induit, produit par le flux longitudinal dû au courant d'induit longitudinal et de la valeur du composant alternatif de ce courant. (Xd)
xDirectTrans	Reactance	Réactance transitoire longitudinale, également appelée X'd.
xQuadSubtrans	Reactance	Réactance subtransitoire transversale, également appelée X"q.
xQuadSync	Reactance	Réactance synchrone transversale (Xq): rapport entre le composant de la tension réactive d'induit, due au composant transversal du courant d'induit, et le composant du courant, selon des répartitions de modes à l'équilibre et à une fréquence nominale.
xQuadTrans	Reactance	Réactance transitoire transversale, également appelée X'q.
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1..*	[0..1] MemberOf_GeneratingUnit (GeneratingUnit)	Une machine synchrone peut fonctionner comme génératrice et devenir par conséquent un élément de l'unité de production.
1	[0..1] Drives_HydroPump (HydroPump)	La machine synchrone entraîne la turbine qui déplace l'eau de bas en haut. Le sens de rotation de la machine pour le pompage peut être identique ou non à celui utilisé pour la production.
0..*	[0..*] DrivenBy_PrimeMover (PrimeMover)	Machines motrices qui entraînent ce SynchronousMachine (c'est-à-dire cette machine synchrone).
1..*	[0..1] InitialReactiveCapabilityCurve (ReactiveCapabilityCurve)	La courbe ReactiveCapabilityCurve par défaut pour ête utilisée par un SynchronousMachine.
1..*	[0..*] ReactiveCapabilityCurves (ReactiveCapabilityCurve)	Toutes les courbes de capacité réactive

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Mult à partir de	[Mult] nom (type)	note
		pour ce SynchronousMachine.
0..1	[1..*] Controls (Control)	hérité de: RegulatingCondEq
0..*	[0..1] RegulatingControl (RegulatingControl)	hérité de: RegulatingCondEq
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.41 Énumération SynchronousMachineOperatingMode

Mode de fonctionnement de la machine synchrone.

Enums

nom	note
generator	
condenser	

6.6.42 Énumération SynchronousMachineType

Type de la machine synchrone.

Enums

nom	note
generator	
condenser	
generator_or_condenser	

6.6.43 TapChanger

Mécanisme de modification des positions des prises de réglage.

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Attributs

nom	type	note
highStep	Integer	Position de la prise la plus élevée possible en partant de neutre.
initialDelay	Seconds	Pour un changeur de prise en charge, retard de fonctionnement initial du régleur (première modification).
lowStep	Integer	Position de prise la plus basse possible (retardée à neutre).
neutralStep	Integer	Position neutre de prise pour cet enroulement.
neutralU	Voltage	Tension à laquelle l'enroulement fonctionne selon un réglage neutre.
normalStep	Integer	Position de prise utilisée dans le fonctionnement “normal” du réseau pour cet enroulement. Régleur “Fixed” (fixe) indique le réglage matériel actuel.
stepPhaseShiftIncrement	AngleDegrees	Déphasage par position du changeur. Une valeur positive indique un déphasage positif depuis l'enroulement où la prise est située jusqu'à l'autre enroulement (pour un transformateur à deux enroulements).
stepVoltageIncrement	PerCent	Augmentation d'un pas de prise du changeur, exprimée en pourcentage de la tension nominale, par position de changeur.
subsequentDelay	Seconds	Pour un changeur de prise en charge, délai de fonctionnement supplémentaire du changeur de prise (deuxième modification et modifications suivantes).
tculControlMode	TransformerControlMode	Pour un changeur de prise en charge, le mode de commande du changeur de prise.
type	TapChangerKind	Le type du changeur de charge. Indique la capacité du transformateur pour exécuter diverses tâches de régulation. Le changeur de prise doit aussi être associé à l'objet RegulationControl avant qu'une régulation soit possible.
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] RegulatingControl (RegulatingControl)	
0..*	[1] TransformerWinding (TransformerWinding)	Un enroulement de transformateur peut comporter des changeurs de prises, distincts pour la tension et pour le déphasage.
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource

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Mult à partir de	[Mult] nom (type)	note
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.44 Énumération TapChangerKind

Type du changeur de prise du transformateur. Indique les capacités du changeur de prise indépendamment du mode de fonctionnement.

Enums

nom	note
fixed	Non susceptible de commande. Cela est aussi indiqué par l'absence d'association de TapChanger à un RegulatingControl.
voltageControl	Capable de commande de la tension.
phaseControl	Capable de commande de la phase.
voltageAndPhaseControl	Capable de commande de la tension et de la phase.

6.6.45 Énumération TransformerControlMode

Modes de commande pour un transformateur.

Enums

nom	note
off (hors service)	Commande d'arrêt
local	Commande locale
volt	Commande de tension
active	Commande du flux de puissance active
reactive	Commande du flux de puissance réactive

6.6.46 Énumération TransformerCoolingType

Type de refroidissement du transformateur.

6.6.47 TransformerWinding

Un enroulement est associé à chaque borne définie pour un transformateur (ou déphaseur).

Attributs

nom	type	note
b	Susceptance	Susceptance de branche magnétique (B mag).
b0	Susceptance	Susceptance de branche magnétique homopolaire.
connectionType	WindingConnection	Le type de connexion de l'enroulement.
emergencyS	ApparentPower	La puissance apparente pouvant être supportée par l'enroulement dans des conditions d'urgence.

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nom	type	note
g	Conductance	Conductance de branche magnétique (G mag).
g0	Conductance	Conductance de branche magnétique homopolaire.
grounded	Boolean	Positionné si l'enroulement est mis à la terre.
insulationU	Voltage	Tension nominale au niveau d'isolement de base.
r	Resistance	Résistance série directe de l'enroulement.
r0	Resistance	Résistance série homopolaire de l'enroulement.
ratedS	ApparentPower	Puissance apparente nominale normale de l'enroulement.
ratedU	Voltage	Tension nominale (phase-phase) de l'enroulement, généralement identique à la tension neutre.
rground	Resistance	Résistance de mise à la terre via un transformateur de mise à la terre connecté.
shortTermS	ApparentPower	Puissance apparente pouvant être supportée par l'enroulement sur une courte période.
windingType	WindingType	Le type d'enroulement.
x	Reactance	Réactance série directe de l'enroulement.
x0	Reactance	Réactance série homopolaire de l'enroulement.
xground	Reactance	Réactance de mise à la terre via un transformateur de mise à la terre connecté.
phases	PhaseCode	hérité de: ConductingEquipment
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1..*	[1] MemberOf_PowerTransformer (PowerTransformer)	Un transformateur comporte des enroulements.
1	[0..*] TapChangers (TapChanger)	Un enroulement de transformateur peut comporter des régleurs, distincts pour la tension et pour le déphasage. Si un TransformerWinding n'a pas un TapChanger associé, l'enroulement est supposé être à prise fixe.
1	[0..*] From_WindingTest (WindingTest)	Les essais d'enroulement de transformateur pour lesquels l'enroulement du transformateur (borne) participe en qualité de partie "from" (c'est-à-dire, de départ) de l'essai.
0..1	[0..*] To_WindingTest (WindingTest)	Les essais d'enroulement pour lesquels l'enroulement du transformateur (borne) participe en qualité d'extrémité "to" (c'est-à-dire, de destination) de l'essai.
0..*	[0..1] BaseVoltage (BaseVoltage)	hérité de: ConductingEquipment

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Mult à partir de	[Mult] nom (type)	note
1	[0..*] ClearanceTags (ClearanceTag)	hérité de: ConductingEquipment
0..*	[0..*] ProtectionEquipments (ProtectionEquipment)	hérité de: ConductingEquipment
1	[0..*] Terminals (Terminal)	hérité de: ConductingEquipment
1	[0..*] ContingencyEquipment (ContingencyEquipment)	hérité de: Equipment
0..*	[0..1] MemberOf_EquipmentContainer (EquipmentContainer)	hérité de: Equipment
1	[0..*] OperationalLimitSet (OperationalLimitSet)	hérité de: Equipment
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.48 VoltageControlZone

Section du réseau électrique déterminée pour contrôler la tension secondaire. Une zone de contrôle de la tension consiste en une collection de postes avec une section de jeu de barres déterminée dont la tension sera contrôlée.

Attributs

nom	type	note
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[1] BusbarSection (BusbarSection)	Une VoltageControlZone (zone de contrôle de la tension) est contrôlée par une BusbarSection (section de jeu de barres) déterminée.
0..*	[0..1] RegulationSchedule (RegulationSchedule)	Une VoltageControlZone (zone de contrôle de la tension) peut comporter un programme de régulation de tension.
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource

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Mult à partir de	[Mult] nom (type)	note
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.49 Énumération WindingConnection

Type de connexion d'enroulement.

Enums

nom	note
D	Delta
O	I grec (montage étoile)
Z	Zigzag

6.6.50 WindingTest

Données d'essai d'enroulement matériel pour les paires enroulement/régleur d'un transformateur (ou déphaseur). Ces données d'essai peuvent être utilisées pour dériver d'autres attributs de modèles de transformateur ou de déphaseur spécifiques.

Attributs

nom	type	note
excitingCurrent	PerCent	Courant d'excitation en essai de circuit ouvert, exprimé en pourcentage du courant nominal, à la tension nominale.
fromTapStep	Integer	Nombre de régleurs de l'enroulement “from” (départ) de la paire d'essai.
leakageImpedance	Impedance	Impédance de fuite mesurée pour l'enroulement “from”, l'enroulement “to” étant en court-circuit et tous les autres en circuit ouvert. L'impédance de fuite est exprimée en unités, basées sur les valeurs nominales de puissance apparente et de tension de l'enroulement "from".
loadLoss	KWActivePower	Pertes en kW dues à la charge (enroulement "to" en court-circuit) sur le résultat de l'essai.
noLoadLoss	KWActivePower	Non pertes kW dues à la charge (enroulement "to" en circuit ouvert) sur le résultat de l'essai.
phaseShift	AngleDegrees	Déphasage mesuré sur l'enroulement “to” en circuit ouvert, l'enroulement "from" étant à la tension nominale de l'enroulement "from" et tous les autres en circuit ouvert.
toTapStep	Integer	Nombre de régleurs de l'enroulement “to” de la paire d'essai.
voltage	Voltage	Tension mesurée sur l'enroulement “to” en circuit ouvert, l'enroulement "from" étant à la tension nominale de l'enroulement “from” et tous les autres en circuit ouvert.
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject

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nom	type	note
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[1] From_TransformerWinding (TransformerWinding)	Enroulement à partir duquel l'essai a été effectué.
0..*	[0..1] To_TransformerWinding (TransformerWinding)	Enroulement vers lequel le test a été effectué. Remarquer que bien que le côté "from" (c'est-à-dire, de départ) de l'essai soit exigé, le côté "to" (c'est-à-dire, de destination) n'est pas toujours exigé.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.51 Énumération WindingType

Type d'enroulement.

Enums

nom	note
primary	
secondary	
tertiary	
quaternary	

6.6.52 WireArrangement

Identification, espacement et configuration des fils d'un ConductorType (c'est-à-dire type conducteur) en fonction de leur type.

Attributs

nom	type	note
mountingPointX	Integer	Point de montage du fil n° Un
mountingPointY	Integer	Point de montage du fil n° Un
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[0..1] ConductorType (ConductorType)	Un ConductorType (c'est-à-dire type de conducteur) se compose de fils pouvant être configurés de plusieurs façons.
0..*	[0..1] WireType (WireType)	Un WireType (c'est-à-dire type de fil) est assemblé à un emplacement spécifique dans un WireArrangement (c'est-à-dire une disposition de fil).
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.6.53 WireType

Fil conducteur (selon les spécifications de l'IEEE). Type spécifique de fil ou de combinaison de fils, non isolés les uns des autres, capable de transporter le courant électrique.

Attributs

nom	type	note
phaseConductorCount	Integer	Nombre de brins conducteurs du faisceau (symétrique) (1 à 12).
phaseConductorSpacing	ShortLength	Distance entre brins conducteurs dans un faisceau (symétrique).
ratedCurrent	CurrentFlow	Intensité de courant maximal qu'un fil ou câble peut supporter dans des conditions thermiques énoncées.
gMR	ShortLength	Geometric mean radius (rayon moyen géométrique). Si le conducteur est remplacé par un tube clos et fin de rayon GMR, sa réactance est alors identique à celle du conducteur réel.
radius	ShortLength	Rayon du conducteur.
resistance	Resistance	Résistance linéique (par unité de longueur) du conducteur.
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[0..*] WireArrangements (WireArrangement)	Un WireType (c'est-à-dire type de fil) est assemblé à un emplacement spécifique dans un WireArrangement (c'est-à-dire une disposition de fil).
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

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6.7 Génération – Résumé du paquetage Generation

Ce paquetage contient des paquetages qui portent de l'information pour les applications Gestion de la production (“Unit Commitment"), Dispatching économiques des unités de production thermiques et hydrauliques ("Economic Dispatch of Hydro and Thermal Generating Units"), Prévision de la charge ("Load Forecasting"), Conduite automatique de production (Automatic Generation Control), et Modélisation d'unité pour les simulateurs d'entraînement (Unit Modeling for Dynamic Training Simulator).

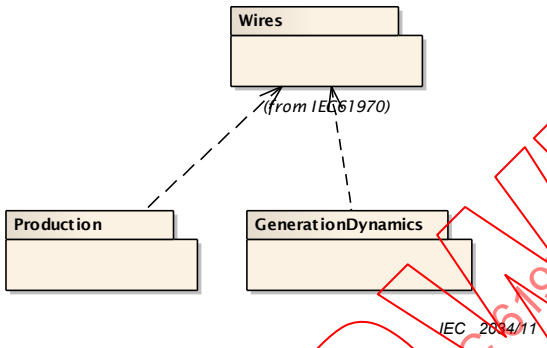

Figure 46 – Main (c'est-à-dire représentation principale)

La Figure 46 est documentée comme suit. Le diagramme montre les deux paquetages du "main" décrivant Generation et leurs relations avec le paquetage Wires.

6.8 Production

6.8.1 Résumé du paquetage Production

Le paquetage production se charge des classes décrivant différents types de génératrices. Ces classes fournissent également des informations relatives au coût de production, utilisées pour répartir, selon des critères économiques, la demande entre les unités engagées et pour calculer les quantités de réserve.

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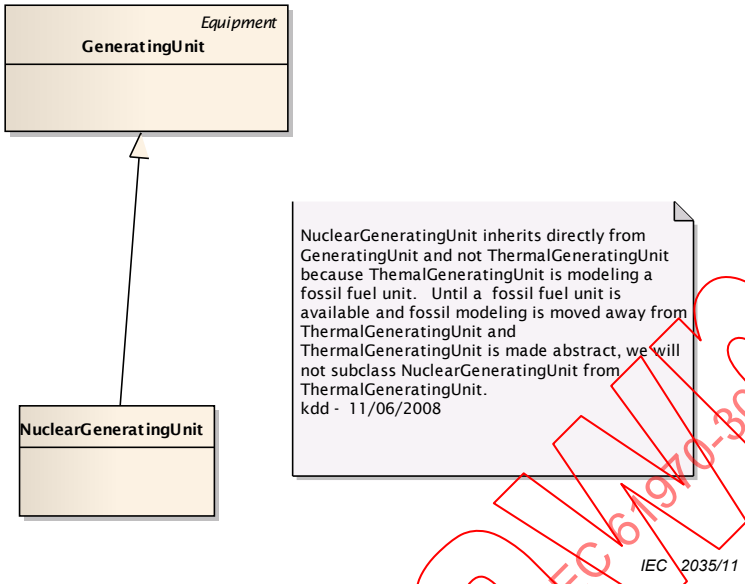

Légende

Anglais	Français
NuclearGeneratingUnit inherits directly from GeneratingUnit and not ThermalGeneratingUnit because ThemalGeneratingUnit is modeling a fossil fuel unit. Until a fossil fuel unit is available and fossil modeling is moved away from ThermalGeneratingUnit and ThermalGeneratingUnit is made abstract, we will not subclass NuclearGeneratingUnit from ThermalGeneratingUnit. kdd - 11/06/2008	NuclearGeneratingUnit hérite directement de GeneratingUnit et non de ThermalGeneratingUnit car ThemalGeneratingUnit modélise une unité de combustible fossile. Tant qu'une unité de combustible fossile n'est pas disponible et la modélisation de fossile n'est pas éloignée de ThermalGeneratingUnit et ThermalGeneratingUnit n'est pas rendu abstrait, nous ne ferons pas de NuclearGeneratingUnit une sous-classe de ThermalGeneratingUnit. kdd - 11/06/2008

Figure 47 – Nuclear

La Figure 47 n'est pas documentée.

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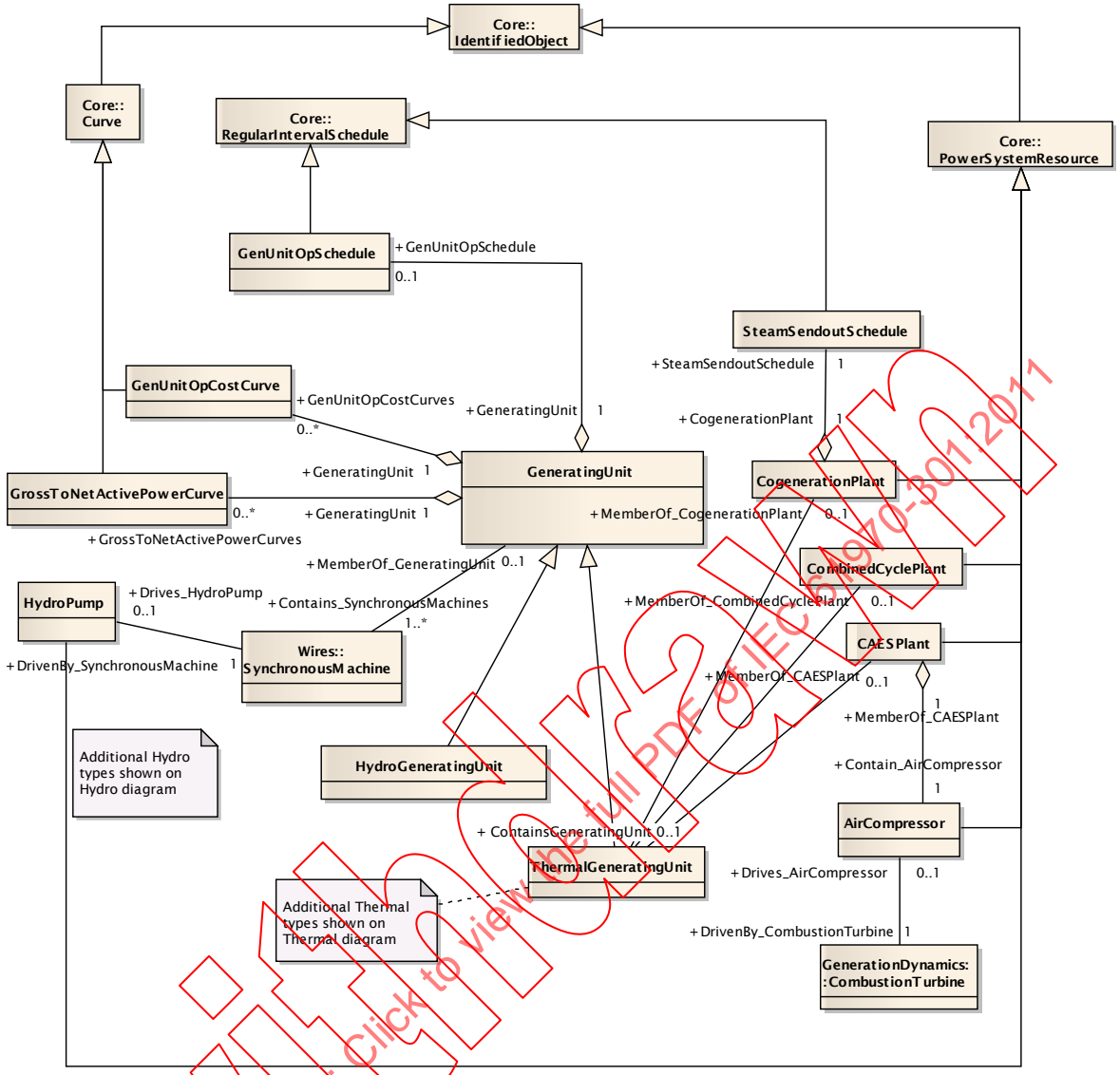

IEC 2036/11

Légende

Anglais	Français
Additional Hydro types shown on Hydro diagram	Types Hydro supplémentaires montrés sur le diagramme Hydro
Additional Thermal types shown on Thermal diagram	Types Thermal supplémentaires montrés sur le diagramme Thermal

Figure 48 – Main

La Figure 48 est documentée comme suit. Ce diagramme montre toutes les classes incluses dans le paquetage Production qui sont nécessaires à la production Thermal (thermique) et aussi Hydro (hydraulique). Elle montre aussi les classes-clés externes qui ont des associations avec les classes de Production.

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Figure 49 – Datatypes

La Figure 49 est documentée comme suit. Ce diagramme montre les types de données spécifiques au paquetage Production.

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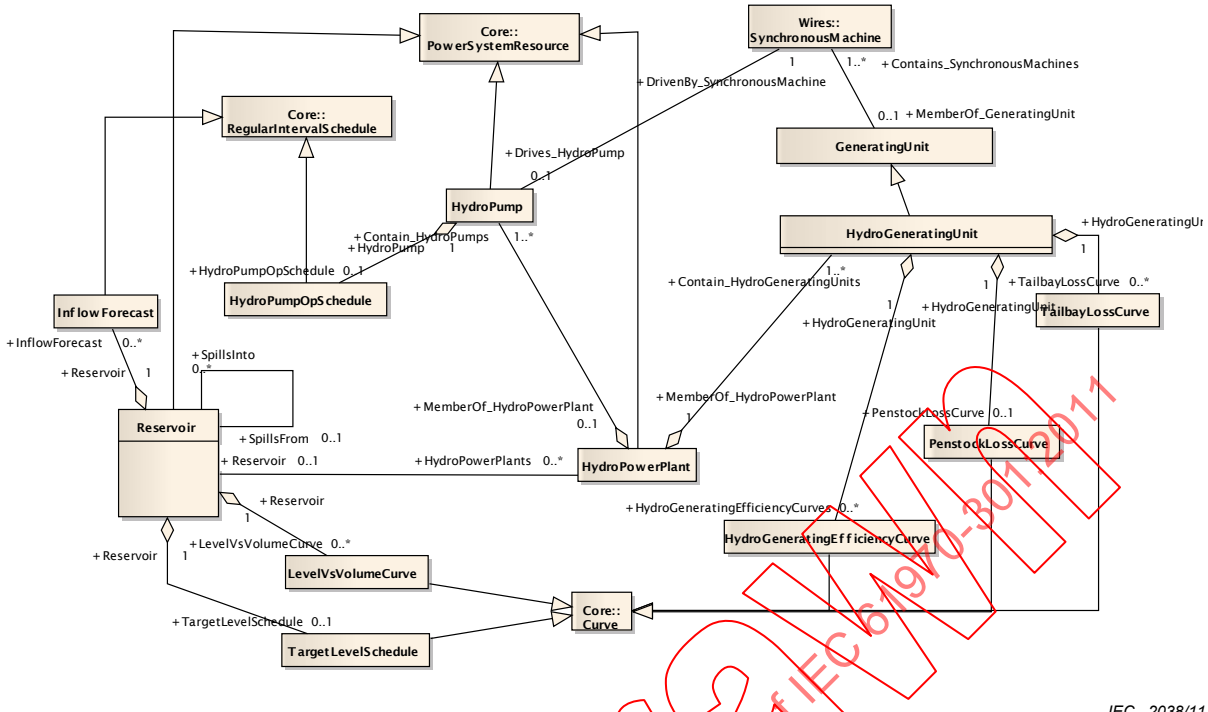

Figure 50 – Hydro

La Figure 50 est documentée comme suit. Ce diagramme montre toutes les classes incluses dans le paquetage Hydro de même que les classes-clés externes, qui ont des associations avec des classes Hydro.

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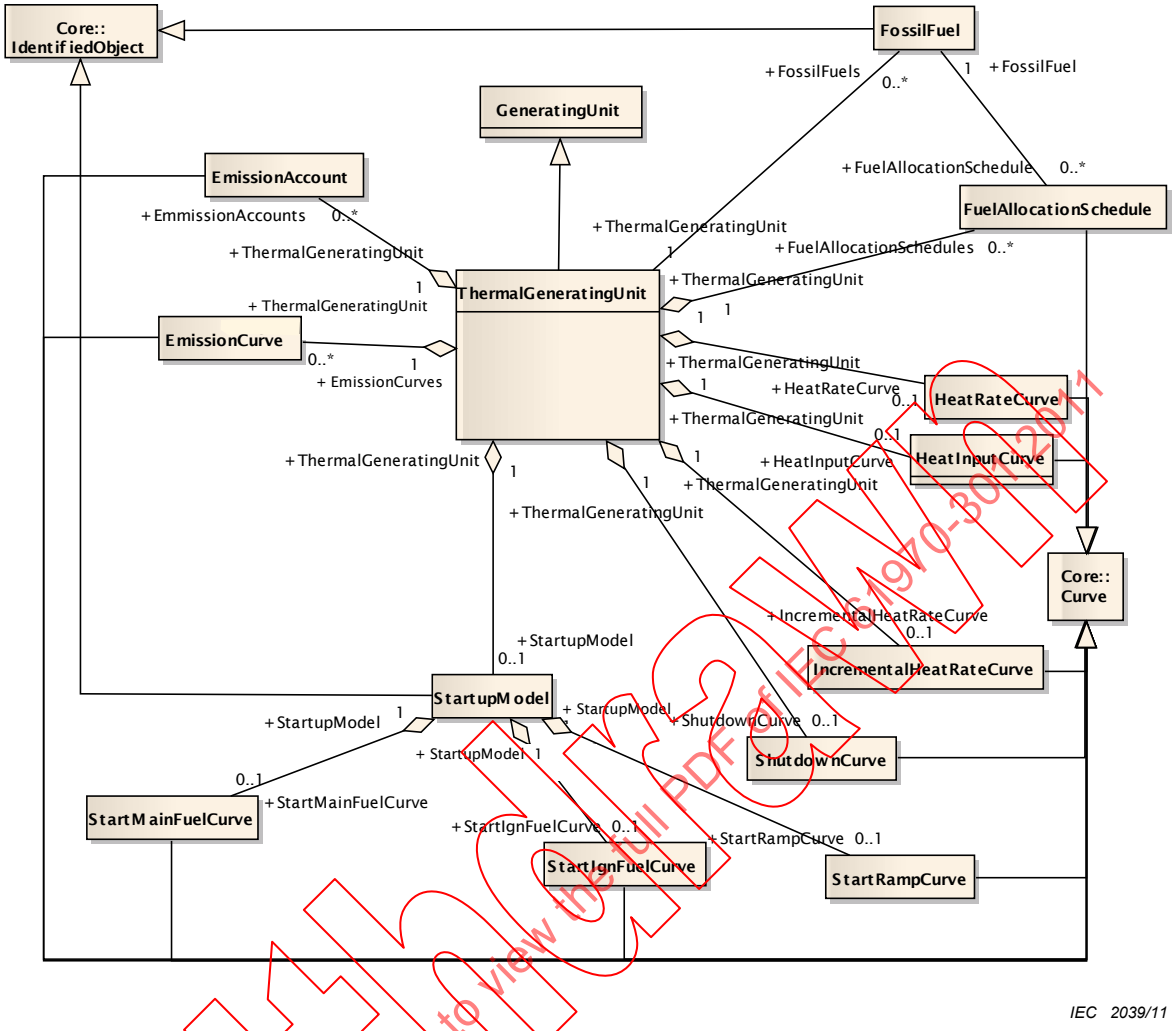

Figure 51 – Thermal

La Figure 51 est documentée comme suit. Ce diagramme montre toutes les classes incluses dans le paquetage Thermal de même que les classes-clés externes, qui ont des associations avec des classes Thermal.

6.8.2 AirCompressor

Compresseur d'air de la turbine à combustion qui fait partie intégrante d'une centrale CAES (compressed air energy storage, accumulation d'énergie d'air comprimé).

Attributs

nom	type	note
airCompressorRating	Float	Donnée nominale du compresseur d'air CAES
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1	[1] MemberOf_CAESPlant (CAESPlant)	Un compresseur d'air peut faire partie d'une centrale de stockage d'énergie sous forme d'air comprimé.
0..1	[1] DrivenBy_CombustionTurbine (CombustionTurbine)	Un compresseur d'air CAES est entraîné par une turbine à combustion.
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.8.3 CAESPlant

Centrale d'accumulation d'énergie sous forme d'air comprimé (CAES, compressed air energy storage).

Attributs

nom	type	note
energyStorageCapacity	RealEnergy	La capacité nominale d'accumulation d'énergie
ratedCapacityP	ActivePower	Capacité génératrice nominale brute de la centrale CAES
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1	[1] Contain_AirCompressor (AirCompressor)	Un compresseur d'air peut faire partie d'une centrale de stockage d'énergie sous forme d'air comprimé.
0..1	[0..1] Contain_ThermalGeneratingUnit (ThermalGeneratingUnit)	Une unité de production thermique peut faire partie d'une centrale d'accumulation d'énergie sous forme d'air comprimé.
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource

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Mult à partir de	[Mult] nom (type)	note
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.8.4 Type de données Classification

1..n, où 1 est la priorité la plus détaillée, la plus importante, etc.

Attributs

nom	type	note
value	Integer	
unit=none (const)	UnitSymbol	
multiplier=none (const)	UnitMultiplier	

6.8.5 CogenerationPlant

Ensemble d'unités de production thermique pour la production d'énergie électrique et de vapeur à usage industriel (généralement vapeur de sortie des turbines à vapeur). La vapeur évacuée est généralement utilisée dans un but industriel ou pour le chauffage et la ventilation urbains.

Attributs

nom	type	note
cogenHPSendoutRating	Float	Émission de vapeur à haute pression
cogenHPSteamRating	Float	Caractéristique nominale de vapeur à haute pression
cogenLPSendoutRating	Float	Émission de vapeur à basse pression
cogenLPSteamRating	Float	Caractéristique nominale de vapeur à basse pression
ratedP	ActivePower	Puissance active de sortie nominale de la centrale de cogénération
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1	[1] SteamSendoutSchedule (SteamSendoutSchedule)	Une centrale de cogénération comporte un programme d'évacuation de vapeur.
0..1	[0..*] Contain_ThermalGeneratingUnits (ThermalGeneratingUnit)	Une unité de production thermique peut faire partie d'une centrale de cogénération.

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Mult à partir de	[Mult] nom (type)	note
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.8.6 CombinedCyclePlant

Ensemble de turbines à combustion et de turbines à vapeur dans lesquelles la chaleur évacuée des turbines à combustion est récupérée pour générer de la vapeur destinée aux turbines à vapeur, entraînant ainsi un accroissement global de l'efficacité de la centrale.

Attributs

nom	type	note
combCyclePlantRating	ActivePower	Puissance active de sortie nominale de la centrale à cycle combiné
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..1	[0..*] Contain_ThermalGeneratingUnits (ThermalGeneratingUnit)	Une unité de production thermique peut faire partie d'une centrale à cycle combiné.
0..*	[0..*] OperatedBy_Companies (Company)	hérité de: PowerSystemResource
1	[0..*] Contains_Measurements (Measurement)	hérité de: PowerSystemResource
1	[0..*] OperatingShare (OperatingShare)	hérité de: PowerSystemResource
1	[0..1] OutageSchedule (OutageSchedule)	hérité de: PowerSystemResource
0..*	[0..*] PsrLists (PsrList)	hérité de: PowerSystemResource
0..*	[0..1] PSRType (PSRType)	hérité de: PowerSystemResource
0..*	[0..*] ReportingGroup (ReportingGroup)	hérité de: PowerSystemResource
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.8.7 Type de données CostPerHeatUnit

Coût, en unités monétaires, par quantité de chaleur générée.

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Attributs

nom	type	note
value	Float	
unit	MonetaryAmountPerHeatUnit	
multiplier	UnitMultiplier	

6.8.8 Type de données Emission

Quantité d'émission par capacité calorifique de chaleur du combustible.

Attributs

nom	type	note
value	Float	
unit=kg/J (const)	UnitSymbol	
multiplier	UnitMultiplier	

6.8.9 EmissionAccount

Comptes de suivi de l'utilisation et crédits d'émissions alloués aux unités de production thermique. Une unité peut avoir zéro ou plusieurs comptes d'émissions et elle peut, généralement, avoir un compte pour le suivi d'utilisation et un autre pour le suivi des crédits.

Attributs

nom	type	note
emissionType	EmissionType	Type d'émission, par exemple, dioxyde de soufre (SO2). Le y1AxisUnits de la courbe contient les unités de mesure (par exemple kg) tandis que emissionType est le type d'émission (par exemple dioxyde de soufre).
emissionValueSource	EmissionValueSource	Source de la valeur d'émission.
curveStyle	CurveStyle	hérité de: Curve
xUnit	UnitSymbol	hérité de: Curve
xMultiplier	UnitMultiplier	hérité de: Curve
y1Unit	UnitSymbol	hérité de: Curve
y1Multiplier	UnitMultiplier	hérité de: Curve
y2Unit	UnitSymbol	hérité de: Curve
y2Multiplier	UnitMultiplier	hérité de: Curve
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

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Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[1] ThermalGeneratingUnit (ThermalGeneratingUnit)	Une unité de production thermique peut comporter un ou plusieurs rapports d'autorisation d'émission.
1	[0..*] CurveScheduleDatas (CurveData)	hérité de: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.8.10 EmissionCurve

Relation entre le taux d'émission de l'unité exprimé en unités de masse par heure (axe Y) et la puissance active de sortie (axe X) pour un type d'émission donné. Cette courbe ne s'applique que lorsqu'un seul type de combustible est brûlé.

Attributs

nom	type	note
emissionContent	Emission	Quantité d'émission par quantité de combustible brûlé.
emissionType	EmissionType	Type d'émission qui fournit également l'unité de mesure du taux de production. Le y1AxisUnits de la courbe contient les unités de mesure (par exemple kg) tandis que emissionType est le type d'émission (par exemple dioxyde de soufre).
isNetGrossP	Boolean	L'indicateur est mis à true (c'est-à-dire vrai) lorsque la sortie est exprimée en puissance active nette.
curveStyle	CurveStyle	hérité de: Curve
xUnit	UnitSymbol	hérité de: Curve
xMultiplier	UnitMultiplier	hérité de: Curve
y1Unit	UnitSymbol	hérité de: Curve
y1Multiplier	UnitMultiplier	hérité de: Curve
y2Unit	UnitSymbol	hérité de: Curve
y2Multiplier	UnitMultiplier	hérité de: Curve
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[1] ThermalGeneratingUnit (ThermalGeneratingUnit)	Une unité de production thermique peut comporter une ou plusieurs courbes d'émission.
1	[0..*] CurveScheduleDatas (CurveData)	hérité de: Curve

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Mult à partir de	[Mult] nom (type)	note
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.8.11 Énumération EmissionType

Le type d'émission.

Enums

nom	note
sulfurDioxide	
carbonDioxide	
nitrogenOxide	
hydrogenSulfide	
chlorine	
carbonDisulfide	

6.8.12 Énumération EmissionValueSource

Source de la valeur d'émission.

Enums

nom	note
measured	
calculated	

6.8.13 FossilFuel

Combustible fossile consommé par les unités de production thermique non nucléaires (par exemple: charbon, fioul, gaz).

Attributs

nom	type	note
fossilFuelType	FuelType	Type de combustible fossile tel que le charbon, le fioul ou le gaz.
fuelCost	CostPerHeatUnit	Le coût en termes de pouvoir calorifique pour le type de combustible donné.
fuelDispatchCost	CostPerHeatUnit	Coût du combustible utilisé pour le dispatching économique comprenant les éléments suivants: coût du combustible, coût du transport et coût de la maintenance supplémentaire.
fuelEffFactor	PU	Facteur d'efficacité du combustible (par unité) en termes d'énergie réelle absorbée.
fuelHandlingCost	CostPerHeatUnit	Coût de manipulation et de traitement associé à ce combustible.
fuelHeatContent	Float	Quantité de chaleur par poids (ou par volume) du type de combustible donné.
fuelMixture	PerCent	Quantité relative du type de combustible donné lorsque plusieurs combustibles sont consommés.
fuelSulfur	PU	La partie du combustible des crédits de pollution par unité de capacité calorifique.

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nom	type	note
highBreakpointP	ActivePower	Niveau de sortie en puissance active de l'unité auquel le type de combustible donné est démarré. Ce combustible (fioul par exemple) est parfois utilisé pour remplacer le combustible de base (charbon par exemple) à des niveaux élevés de sortie de puissance active.
lowBreakpointP	ActivePower	Niveau de sortie en puissance active de l'unité auquel le type de combustible donné est arrêté. Ce combustible (fioul par exemple) est parfois utilisé pour stabiliser le combustible de base (charbon par exemple) à de faibles niveaux de sortie de puissance active.
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
1	[0..*] FuelAllocationSchedule (FuelAllocationSchedule)	Un programme d'attribution du combustible doit comporter un combustible fossile.
0..*	[1] ThermalGeneratingUnit (ThermalGeneratingUnit)	Une unité de production thermique peut comporter un ou plusieurs combustibles fossiles.
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.8.14 FuelAllocationSchedule

Quantité de combustible d'un type donné attribué à la consommation sur une période déterminée.

Attributs

nom	type	note
fuelAllocationEndDate	AbsoluteDateTime	Heure et date de fin du programme d'attribution du combustible.
fuelAllocationStartDate	AbsoluteDateTime	Heure et date de début du programme d'attribution du combustible.
fuelType	FuelType	Type de combustible, indique également l'unité de mesure correspondante.
maxFuelAllocation	Float	Quantité maximale de combustible attribuée à la consommation pour la période programmée.
minFuelAllocation	Float	Quantité minimale de combustible attribuée à la consommation pour la période programmée, sur la base, par exemple, d'un contrat "à prendre tel quel ou à payer".
curveStyle	CurveStyle	hérité de: Curve
xUnit	UnitSymbol	hérité de: Curve
xMultiplier	UnitMultiplier	hérité de: Curve
y1Unit	UnitSymbol	hérité de: Curve

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nom	type	note
y1Multiplier	UnitMultiplier	hérité de: Curve
y2Unit	UnitSymbol	hérité de: Curve
y2Multiplier	UnitMultiplier	hérité de: Curve
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

Extrémités d'association

Mult à partir de	[Mult] nom (type)	note
0..*	[1] FossilFuel (FossilFuel)	Un programme d'attribution du combustible doit comporter un combustible fossile.
0..*	[1] ThermalGeneratingUnit (ThermalGeneratingUnit)	Une unité de production thermique peut comporter un ou plusieurs programmes d'attribution de combustibles.
1	[0..*] CurveScheduleDatas (CurveData)	hérité de: Curve
1..*	[0..1] ModelingAuthoritySet (ModelingAuthoritySet)	hérité de: IdentifiedObject

6.8.15 Énumération FuelType

Type de combustible.

Enums

nom	note
coal	
oil	
gas	

6.8.16 GeneratingUnit

Machine synchrone ou ensemble de machines synchrones pour la conversion de la puissance mécanique en puissance à courant alternatif. Des machines individuelles dans un ensemble peuvent être, par exemple, définies dans un but de programmation alors qu'un seul signal de contrôle est dérivé pour l'ensemble. Dans ce cas, un GeneratingUnit (une unité de production) pour chaque membre de l'ensemble et un GeneratingUnit supplémentaire correspondant à l'ensemble pourraient être définis.

Attributs

nom	type	note
allocSpinResP	ActivePower	Capacité planifiée non utilisée (réserve tournante) qui peut être utilisée pour absorber une charge d'urgence.
autoCntrlMarginP	ActivePower	Capacité planifiée non utilisée permettant d'absorber les à-coups de la régulation automatique.
baseP	ActivePower	Pour les unités commandables, cette valeur représente le point de fonctionnement

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nom	type	note
		économique de base en puissance active. Pour les unités non commandables, cette valeur correspond à la valeur fixe de production. La valeur doit être comprise entre les points haut et bas des limites de fonctionnement.
controlDeadband	ActivePower	Bande morte de réglage. Lorsqu'une modification en puissance active requise pour l'unité est inférieure à cette bande morte, aucune impulsion de commande ne sera alors transmise à l'unité.
controlPulseHigh	Seconds	Limite supérieure de l'impulsion correspondant à l'impulsion de commande la plus élevée à laquelle l'unité peut répondre.
controlPulseLow	Seconds	Limite inférieure de l'impulsion correspondant à l'impulsion de commande la plus basse à laquelle l'unité peut répondre.
controlResponseRate	ActivePowerChangeRate	Taux de réponse de l'unité spécifiant la modification de puissance active pour une impulsion de commande d'une seconde dans le niveau de charge le plus réactif de l'unité.
dispReserveFlag	Boolean	
efficiency	PU	Efficacité de l'unité à convertir l'énergie mécanique, depuis la machine motrice, en énergie électrique.
energyMinP	HeatRate	
fastStartFlag	Boolean	
fuelPriority	Integer	
genControlMode	GeneratorControlMode	Le mode de commande de l'unité.
genControlSource	GeneratorControlSource	La source de commandes pour une unité de production.
genOperatingMode	GeneratorOperatingMode	Mode de fonctionnement pour réglage secondaire.
governorMPL	PU	Limite de position du moteur du régulateur.
governorSCD	PerCent	Statisme du changeur de vitesse du régulateur.
highControlLimit	ActivePower	Limite supérieure du réglage secondaire (AGC, automatic generation control).
initialP	ActivePower	Valeur initiale par défaut de la puissance active, permettant d'enregistrer un résultat de flux d'énergie pour la valeur initiale de puissance active de cette unité, pour cette configuration réseau.
longPF	Float	Facteur de participation économique de l'unité de production.
lowControlLimit	ActivePower	Limite inférieure du réglage secondaire (AGC).
lowerRampRate	ActivePowerChangeRate	
maxEconomicP	ActivePower	Limite économique supérieure maximale de puissance active, il convient qu'elle ne dépasse pas la limite de puissance active maximum de fonctionnement.
maximumAllowableSpinningReserve	ActivePower	Réserve tournante maximale autorisée. La réserve tournante ne sera jamais supérieure à cette valeur sans tenir compte du point de fonctionnement en cours.
maxOperatingP	ActivePower	Limite maximale de puissance active de fonctionnement pouvant être entrée dans l'unité par le répartiteur.
minEconomicP	ActivePower	Limite économique inférieure de puissance active devant être supérieure ou égale à la limite minimale de puissance active de

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nom	type	note
		fonctionnement.
minimumOffTime	Seconds	Intervalle de temps minimal entre l'arrêt et le démarrage de l'unité.
minOperatingP	ActivePower	Limite minimale de puissance active de fonctionnement pouvant être entrée dans l'unité par le répartiteur.
modelDetail	Classification	Détails des données de modèle de la génératrice.
normalPF	Float	Facteur de participation économique de l'unité de production.
penaltyFactor	Float	Défini de la manière suivante: 1 / (1 - perte de transport différentielle); la perte de transport différentielle est exprimée en valeur plus/moins. Les facteurs de retenue (penalty factors) types sont compris entre (0,9 et 1,1).
raiseRampRate	ActivePowerChangeRate	
ratedGrossMaxP	ActivePower	Capacité maximale brute nominale de l'unité (Book Value, c'est-à-dire valeur comptable).
ratedGrossMinP	ActivePower	Niveau de production minimal brut nominal avec lequel l'unité peut fonctionner sans risques en fournissant de l'énergie à la grille de transport.
ratedNetMaxP	ActivePower	Capacité maximale nette nominale obtenue en soustrayant l'énergie auxiliaire utilisée pour faire fonctionner les machines internes de la centrale de la capacité maximale brute nominale.
shortPF	Float	Facteur de participation économique de l'unité de production.
spinReserveRamp	ActivePowerChangeRate	
startupCost	Money	Le coût de démarrage initial encouru pour chaque démarrage de l'unité de production GeneratingUnit.
startupTime	Seconds	Temps requis pour connecter l'unité, à partir du moment où l'énergie mécanique des machines motrices est appliquée.
stepChange	ActivePower	
tieLinePF	Float	Facteur de participation économique de l'unité de production.
variableCost	Money	La composante coût variable de production par unité de puissance active (ActivePower).
normallyInService	Boolean	hérité de: Equipment
mRID	String	hérité de: IdentifiedObject
name	String	hérité de: IdentifiedObject
localName	String	hérité de: IdentifiedObject
pathName	String	hérité de: IdentifiedObject
aliasName	String	hérité de: IdentifiedObject
description	String	hérité de: IdentifiedObject

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