Water Treatment Plant Data Model (Conceptual)
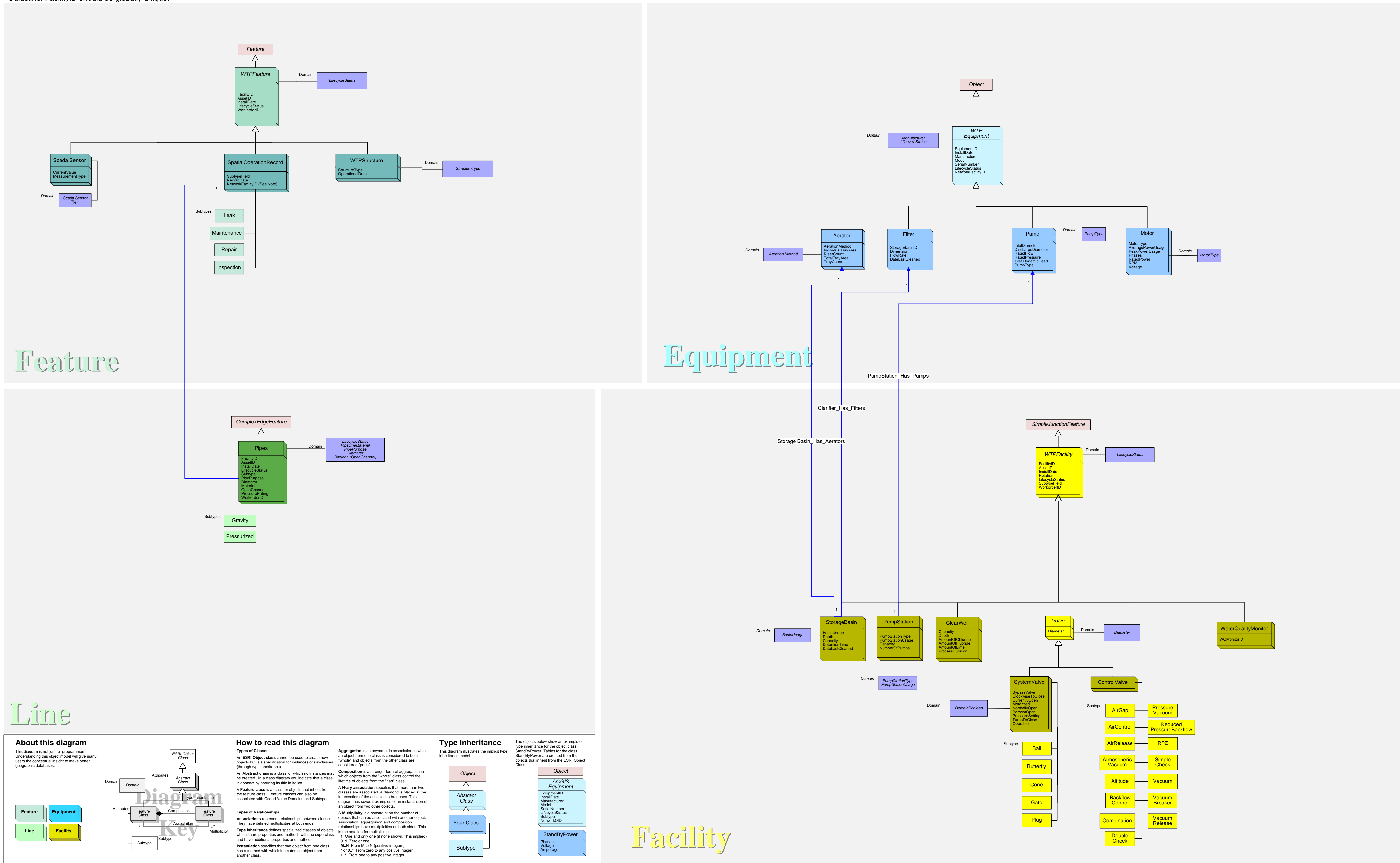
Version 1.0

Guideline: FacilityID should be globally unique.

Feature

Feature

WTPFeature
- FacilityID
- AssetID
- InstallDate
- LifecycleStatus
- WorkorderID

Domain — LifecycleStatus

Scada Sensor
- CurrentValue
- MeasurementType

Domain — Scada Sensor Type

SpatialOperationRecord
- SubtypeField
- RecordDate
- NetworkFacilityID (See Note)

WTPStructure
- StructureType
- OperationalDate

Domain — StructureType

Subtypes:
- Leak
- Maintenance
- Repair
- Inspection

Equipment

Object

WTP Equipment
- EquipmentID
- InstallDate
- Manufacturer
- Model
- SerialNumber
- LifecycleStatus
- NetworkFacilityID

Domain — Manufacturer, LifecycleStatus

Aerator
- AerationMethod
- IndividualTrayArea
- RiserCount
- TotalTrayArea
- TrayCount

Domain — Aeration Method

Filter
- StorageBasinID
- Dimension
- FlowRate
- DateLastCleaned

Pump
- InletDiameter
- DischargeDiameter
- RatedFlow
- RatedPressure
- TotalDynamicHead
- PumpType

Domain — PumpType

Motor
- MotorType
- AveragePowerUsage
- PeakPowerUsage
- Phases
- RatedPower
- RPM
- Voltage

Domain — MotorType

PumpStation_Has_Pumps

Line

ComplexEdgeFeature

Pipes
- FacilityID
- AssetID
- InstallDate
- LifecycleStatus
- Subtype
- SubtypeField
- Diameter
- Material
- OpenChannel
- PressureRating
- WorkorderID

Domain — LifecycleStatus, PipeLineMaterial, PipePurpose, Diameter, Boolean (OpenChannel)

Subtypes:
- Gravity
- Pressurized

Clarifier_Has_Filters

Storage Basin_Has_Aerators

Facility

SimpleJunctionFeature

WTPFacility
- FacilityID
- AssetID
- InstallDate
- LifecycleStatus
- Rotation
- SubtypeField
- WorkorderID

Domain — LifecycleStatus

StorageBasin
- BasinUsage
- Depth
- Capacity
- Detention Time
- DateLastCleaned

Domain — BasinUsage

PumpStation
- PumpStationType
- PumpStationUsage
- Capacity
- NumberOfPumps

Domain — PumpStationType, PumpStationUsage

ClearWell
- Capacity
- Depth
- AmountOfChlorine
- AmountOfFluoride
- AmountOfLime
- ProcessDuration

Valve
- Diameter

Domain — Diameter

WaterQualityMonitor
- WQMonitorID

SystemValve
- BypassValve
- ClockwiseToClose
- CurrentlyOpen
- Motorized
- NormallyOpen
- PercentOpen
- PressureSetting
- TurnsToClose
- Operable

Domain — DomainBoolean

Subtype:
- Ball
- Butterfly
- Cone
- Gate
- Plug

ControlValve

Subtype:
- AirGap
- AirControl
- AirRelease
- Atmospheric Vacuum
- Altitude
- Backflow Control
- Combination
- Double Check
- Pressure Vacuum
- Reduced Pressure Backflow
- RPZ
- Simple Check
- Vacuum
- Vacuum Breaker
- Vacuum Release

Domains

Manufacturer
DomainWTPManufacturer
FieldType : <unspecified> = esriFieldTypeString
MergePolicy : <unspecified> = esriMPTDefaultValue
SplitPolicy : <unspecified> = esriSPTDuplicate
John Smith : esriFieldTypeString = JS
McManus : esriFieldTypeString = M
John Foundry : esriFieldTypeString = JF
Unknown : esriFieldTypeString = Unk
Other : esriFieldTypeString = Oth

Boolean
DomainWTPBoolean
FieldType : <unspecified> = esriFieldTypeSmallInteger
MergePolicy : <unspecified> = esriMPTDefaultValue
SplitPolicy : <unspecified> = esriSPTDuplicate
False : esriFieldTypeSmallInteger = 0
True : esriFieldTypeSmallInteger = 1

LifecycleStatus
DomainWTPLifecycleStatus
FieldType : <unspecified> = esriFieldTypeString
MergePolicy : <unspecified> = esriMPTDefaultValue
SplitPolicy : <unspecified> = esriSPTDuplicate
Proposed : esriFieldTypeString = Proposed
Active : esriFieldTypeString = Active
Abandoned : esriFieldTypeString = Abandoned
Removed : esriFieldTypeString = Removed

PipeMaterial
DomainWTPPipeMaterial
FieldType : <unspecified> = esriFieldTypeString
MergePolicy : <unspecified> = esriMPTDefaultValue
SplitPolicy : <unspecified> = esriSPTDuplicate
Ductile Iron : esriFieldTypeString = DI
Cast Iron : esriFieldTypeString = CI
Poly Vinyl Chloride : esriFieldTypeString = PVC
Asbestos Concrete : esriFieldTypeString = AC
Clay : esriFieldTypeString = CL
Wood : esriFieldTypeString = Wo
Unknown : esriFieldTypeString = Unk
Other : esriFieldTypeString = Oth

PipePurpose
DomainWTPPipePurpose
FieldType : <unspecified> = esriFieldTypeString
MergePolicy : <unspecified> = esriMPTDefaultValue
SplitPolicy : <unspecified> = esriSPTDuplicate
RawWater : esriFieldTypeString = Raw Water
ChemicalInjection : esriFieldTypeString = Chemical Injection
InTreatment : esriFieldTypeString = In Treatment
TreatedWater : esriFieldTypeString = Treated Water
Air : esriFieldTypeString = Air
Effluent : esriFieldTypeString = Effluent

AerationMethod
DomainWTPAerationType
FieldType : <unspecified> = esriFieldTypeString
MergePolicy : <unspecified> = esriMPTDefaultValue
SplitPolicy : <unspecified> = esriSPTDuplicate
Diffused : esriFieldTypeString = Diffused Aeration
Spray : esriFieldTypeString = Spray Aeration
Multiple-tray : esriFieldTypeString = Multiple-tray Aeration
Cascade : esriFieldTypeString = Cascade Aeration
Airstripping : esriFieldTypeString = Air strippint Aeration

ScadaSensor
DomainWTPScadaSensorType
FieldType : <unspecified> = esriFieldTypeString
MergePolicy : <unspecified> = esriMPTDefaultValue
SplitPolicy : <unspecified> = esriSPTDuplicate
Amperage : esriFieldTypeString = Amp
Chlorine Residual : esriFieldTypeString = CR
Chlorine Tank Weight : esriFieldTypeString = CTW
Depth : esriFieldTypeString = Depth
Discharge Pressure : esriFieldTypeString = DP
Elevation : esriFieldTypeString = Elev
Flow : esriFieldTypeString = Flow
Pressure : esriFieldTypeString = Press
Suction Pressure : esriFieldTypeString = SP
Tank Level : esriFieldTypeString = TL
Temperature : esriFieldTypeString = Temp
Turbidity : esriFieldTypeString = Turbidity
Velocity : esriFieldTypeString = Velocity
Voltage : esriFieldTypeString = Volt
Well Level : esriFieldTypeString = WL

PumpType
DomainWTPPumpType
FieldType : <unspecified> = esriFieldTypeString
MergePolicy : <unspecified> = esriMPTDefaultValue
SplitPolicy : <unspecified> = esriSPTDuplicate
Axial : esriFieldTypeString = Axial Flow
Centrifugal : esriFieldTypeString = Centrifugal
Jet : esriFieldTypeString = Jet
Rotary : esriFieldTypeString = Rotary
Screw : esriFieldTypeString = Screw
Turbine : esriFieldTypeString = Turbine
Reciprocating : esriFieldTypeString = Reciprocating

SystemValveRegulationType
DomainWTPSystemValveRegulationType
FieldType : <unspecified> = esriFieldTypeString
MergePolicy : <unspecified> = esriMPTDefaultValue
SplitPolicy : <unspecified> = esriSPTDuplicate
Flow : esriFieldTypeString = Flow
Pressure : esriFieldTypeString = Pressure

PumpStationUsage
DomainWTPPumpStationUsage
FieldType : <unspecified> = esriFieldTypeString
MergePolicy : <unspecified> = esriMPTDefaultValue
SplitPolicy : <unspecified> = esriSPTDuplicate
Water : esriFieldTypeString = Water
Chemical : esriFieldTypeString = Chemical Meter
Effluent : esriFieldTypeString = Effluent/Sludge

PumpStationType
DomainWTPPumpStationType
FieldType : <unspecified> = esriFieldTypeString
MergePolicy : <unspecified> = esriMPTDefaultValue
SplitPolicy : <unspecified> = esriSPTDuplicate
Wet-pit : esriFieldTypeString = Wet-pit
Dry-pit : esriFieldTypeString = Dry-pit

MotorType
DomainWTPMotorType
FieldType : <unspecified> = esriFieldTypeString
MergePolicy : <unspecified> = esriMPTDefaultValue
SplitPolicy : <unspecified> = esriSPTDuplicate
Induction : esriFieldTypeString = Induction
Synchronous : esriFieldTypeString = Synchronous
VariableSpeed : esriFieldTypeString = Variable Speed

BasinUsage
DomainWTPBasinUsage
FieldType : <unspecified> = esriFieldTypeString
MergePolicy : <unspecified> = esriMPTDefaultValue
SplitPolicy : <unspecified> = esriSPTDuplicate
Raw : esriFieldTypeString = Raw Water Storage
Precipitation : esriFieldTypeString = Precipitation Basin
Coagulation : esriFieldTypeString = Coagulation Basin
Flocculation : esriFieldTypeString = Flocculation Basin
Clarifier : esriFieldTypeString = Clarifier
Sedimentation : esriFieldTypeString = Sedimentation Basin
Filtration : esriFieldTypeString = Filtration Basin
Effluent : esriFieldTypeString = Effluent Basin
Reservoir : esriFieldTypeString = Reservoir/Tank

Diameter
DomainWTPDiameter
FieldType : <unspecified> = esriFieldTypeDouble
MergePolicy : <unspecified> = esriMPTDefaultValue
SplitPolicy : <unspecified> = esriSPTDuplicate
Min : esriFieldTypeDouble = 1
Max : esriFieldTypeDouble = 48

StructureType
DomainWTPStructureType
FieldType : <unspecified> = esriFieldTypeString
MergePolicy : <unspecified> = esriMPTDefaultValue
SplitPolicy : <unspecified> = esriSPTDuplicate
Intake : esriFieldTypeString = Intake Structure
Raw : esriFieldTypeString = Raw Water Storage
PumpStation : esriFieldTypeString = Pump Station
Precipitation : esriFieldTypeString = Precipitation Basin
Coagulation : esriFieldTypeString = Coagulation Basin
Flocculation : esriFieldTypeString = Flocculation Basin
Clarifier : esriFieldTypeString = Clarifier
ClearWell : esriFieldTypeString = Clear Well
Sedimentation : esriFieldTypeString = Sedimentation Well
Filtration : esriFieldTypeString = Filtration Basin
Effluent : esriFieldTypeString = Effluent Basin
Reservoir : esriFieldTypeString = Reservoir Tank
TreatmentPlant : esriFieldTypeString = Treatment Plant
Laboratory : esriFieldTypeString = Laboratory
ChemicalBuilding : esriFieldTypeString = ChemicalBuilding
Administration : esriFieldTypeString = Administration Building
Maintenance : esriFieldTypeString = Maintenance Building
Other : esriFieldTypeString = Other

About this diagram

This diagram is not just for programmers. Understanding this object model will give many users the conceptual insight to make better geographic databases.

Diagram Key

- Feature
- Equipment
- Line
- Facility
- Domain
- Abstract Class
- Feature Class
- ESRI Object Class
- Attributes
- Type Inheritance
- Composition
- Association
- Subtype
- Multiplicity

How to read this diagram

Types of Classes

An **ESRI Object class** cannot be used to create new objects but is a specification for instances of subclasses of a "whole" and objects from the other class are considered "parts".

An **Abstract class** is a class for which no instances may be created. In a class diagram you indicate that a class is abstract by showing its title in italics.

A **Feature class** is a class for objects that inherit from the feature class. Feature classes can also be associated with Coded Value Domains and Subtypes.

Types of Relationships

Associations represent relationships between classes. They have defined multiplicities at both ends.

Type inheritance defines specialized classes of objects which share properties and methods with the superclass and have additional properties and methods.

Instantiation specifies that one object from one class has a method with which it creates an object from another class.

Composition is a stronger form of aggregation in which objects from the "whole" class control the lifetime of objects from the "part" class.

A **N-ary association** specifies that more than two classes are associated. A diamond is placed at the intersection of the association branches. This diagram has several examples of an instantiation of an object from two other objects.

A **Multiplicity** is a constraint on the number of objects that can be associated with another object. Association, aggregation and composition relationships have multiplicities on both sides. This is the notation for multiplicities:
- 1 One and only one (if none shown, '1' is implied)
- 0..1 Zero or one
- M..N From M to N (positive integers)
- * or 0..* From zero to any positive integer
- 1..* From one to any positive integer

Aggregation is an asymmetric association in which an object from one class is considered to be a "whole" and objects from the other class are considered "parts".

Type Inheritance

This diagram illustrates the implicit type inheritance model.

- Object
- Abstract Class
- Your Class
- Subtype

The objects below show an example of type inheritance for the object class StandByPower. Tables for the class StandByPower are created from the objects that inherit from the ESRI Object Class.

Object

ArcGIS Equipment
- EquipmentID
- InstallDate
- Manufacturer
- Model
- SerialNumber
- LifecycleStatus
- Subtype
- NetworkOID

StandByPower
- Phases
- Voltage
- Amperage