***A**rbeits**K**reis **952.0.1**:*

Modelling Guideline and Sample Modelling using SCL

Version 1.0

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1 Introduction

This document describes the detailed specifications for the sample modelling of a reference substation in the form of a modelling guideline based on SCL (Substation Configuration description Language). This is based exclusively on edition 1 of IEC 61850. The only exception is that the elements “function” and “subfunction” are also assigned to voltage levels and bays. This is not permissible in edition 1 but was deemed necessary by working group 952.0.1 for the complete functional modelling of the substation. This expansion will also become normative in edition 2 of the IEC 61850.

The determinations in section 2 amend the modelling guidelines of DKE GAK 952.0.15 (part A to D, version 1.0 dated 10th February 2006) and update them by taking more recent knowledge into account. In this context, it has to be differentiated between general modelling rules (see section 2) and such rules defined specifically for the sample modelling performed by DKE AK 952.0.1 (see section 0).

Section 3 documents the sample substation modelled in SCL according to the rules described. This substation was basically adopted by GAK 952.0.15, and it does not claim to be complete or present secured substation functionality. It merely serves to illustrate the basic procedure for modelling information according to IEC 61850.

The process of engineering the substation documented in section 3 is carried out using a manufacturer-independent tool and comprises the following steps from 5 on:

I. Section 3:

   Project planning of the primary system including a planned process link for the secondary equipment with assignment of the template classes “InClass” which are not yet further specified. This step serves to determine the scope of the system and generate a first .ssd file.

II. Section 3.2:

   Typed definition of the LNs, DOs and DAs. During initial type definition this serves to create the type library, unless it already exists and an existing library is used.

III. Section 0:

   Assigning the typed information objects to the system and determining the entire scope of information. “InType” is assigned here. The prefix and the instance numbers are not used since they are reserved for the product-related view. The hierarchical information modelling is instead accomplished in a functional perspective (“functional naming”) using the elements “Equipment” and “Subequipment” for primary equipment and “Function” and “Subfunction” for the functions.

   The product-related structure of the control system is therefore still open in this phase of the engineering process so that this step results in an .ssd file including the information types (“data type templates”). It can be used for the solution-independent tendering phase.

   The product-independent system specification generated in engineering step III with the typed information scope of the sample substation can be

downloaded [1] as .ssd file. Although the project engineering of working group 952.0.1 was carried out using a manufacturer-independent engineering tool, all private data (e.g. graphic elements) have been deleted from this file and can be opened using an XML browser.

IV. Section 3.4:

Complete information modelling including the system structure Here, .icd files are generated based on the functional specifications, or manufacturer-specific .icd files are imported and their product-related view ("product naming") is adjusted or clearly assigned to the function-related view ("functional naming"). As a result of this step we obtain the .scd file. The .icd files tailored to the project for each device can be extracted from the .scd file's IED section. They represent the information modelling related to the project.

The result of engineering step IV at the example of a bay of the sample substation can also be downloaded[1] as .scd. file.

V. Datasets, communication structure and services have not yet been determined since they depend on the actual IED structures. Guidelines and recommendations in this context will be given when the work has further progressed.

In section 4 the modelling guidelines of DKE GAK 952.0.15 are appended and cross-references are given to the guidelines of working group 952.0.1 which are further developed in this document.

[1] Note for users of the Substation Configuration Tool (SCT):

The private elements have been removed from the SCL data published on the DKE server. Therefore, they can not be read using the SCT. The unabridged data can be downloaded at www.fh-dortmund.de/sct.

2 Modelling guidelines of DKE working group 952.0.1

2.1 General modelling rules according to IEC 61850

The following rules and recommendations are independent of the actual sample modelling of DKE working group 952.0.1. They concern the general application of the IEC 61850 standard.

2.1.1 Connecting the primary equipment

Basically, all LNs relating to the primary equipment (X..., T..., Y...) have to be modelled. They should at least be modelled to the secondary equipment connection (relation between SSD and SCD) even if their data is not used over a bus. For instance, XSWI is always used for the modelling of isolators regardless of whether the detection or control is conventional or unconventional. The model thus becomes independent of the location and type of processing.

Processing functions are always located in the corresponding control LNs. For instance, the suppression of the intermediate position is implemented in CSWI. The unprocessed switch position can then be accessed via XSWI.

The logical nodes for current (TCTR) and voltage transformers (TVTR) are modelled multiple times during IED structuring in logical devices.

2.1.2 Transformer modelling

Each conductor usually receives its own LN. In the system specification phase, the phase structuring is accomplished via the element “Subequipment“.

The alternative representation of the three phases by duplicating the data object Vol or Amp is excluded.

2.1.3 Assigning values to instances

For the structure and content of the modelling to remain valid independently of one another, the value assignments, e.g. command output time for CB, protection setting values, are made only during instancing and not during type definition. Different output times or parameters must not lead to different types. Such values are thus not found in the Data Type Template section of the SCL.

2.1.4 Duplicating data objects

The standard basically allows data objects to be duplicated (see 61850-7-4, A.1.1.2). Additional objects are then extended with numbers beginning from 1. When a new object is added, the object without extension is to be deleted.

An intelligent processing function, e.g. in the sense of group indications, is not incorporated into the duplication.

However, the object EEHealth or Health should not be duplicated because it makes a clear statement about the condition of the corresponding LN. (see also 0)

There is to be no descriptive use of the duplication numbers such as e.g. for the Buchholz messages in the GAK modelling (“SIML.GasFlwTr400“). Likewise the additional group information without extension is omitted.

The standard does not provide for a duplication of mandatory objects. Such an application in the GAK modelling where alarms are handled via CALH with two

alarms (“CALH.GrAlm1” and “CALH.GrAlm2“) is thus discarded and replaced by a two-stage warning with the optional object GrWrn (“CALH.GrWrn1” and “CALH.GrWrn2“).

2.1.5 Auxiliary circuit supervision

One auxiliary circuit each is monitored using ZAXN. Several auxiliary circuits in a bay are thus monitored by using this LN multiple times.

This does not affect the modelling of the equipment-related supervision (e.g. XCBR.EEHealth) which clearly relates to the corresponding piece of equipment and indicates its status as ok, warning or alarm (see also 2.1.3).

2.1.6 ctlModel for Mod

The ctlModel for mode has to be set to status only in all LNs except for LLN0. This had not been implemented consistently in the GAK 15 modelling.

2.1.7 Independence of the information modelling from the system structure and assignment of the logical devices

Instance numbers shall not be used for information modelling during this engineering phase in order to keep the information modelling independent of the later assignment and structuring of the logical device during the system specification phase. The instance numbers are thus assigned not before the assignment to the logical devices of the actual system structure (see also 2.2.3) and the associated transition to the product-related perspective.

Furthermore, the prefix shall not be used in the system specification phase to differentiate several instances of the same class. “Function” and “Subfunction” are used instead for the structuring. This structuring is therefore used in the scope of the “functional naming” for functions in the same way as the elements “Equipment” and “Subequipment” are used for the primary system.

2.1.8 Hierarchy assignment

Equipment-related LNs are allocated to these pieces of equipment according to a functional hierarchy (e.g. CSWI, XSWI, CILO) as well. Bay-related LNs (e.g. protection functions) are assigned to the bay via “function” and “subfunction”. This is not a structure specification for the IED assignment in the form of LDs.

2.2 Special rules for the modelling by DKE working group 952.0.1

2.2.1 Equipment designations

The designations of the GAK15 model substation according to DIN 40719 are replaced by the product-related reference labelling according to IEC 61346. This labelling is used for naming the element “Equipment“. Unlike the GAK15 modelling, the InPrefix is not used for this purpose.

2.2.2 Type management and designation

The modelling is done according to the SCL approach based on types for LNs, DOs and DAs. Types that use only the mandatory specifications of the standard are marked “m_”. Also those which the working group uses unambiguously and for options recommended for the entire modelling (e.g. standard attributes like TimeStamp). Types used throughout the entire substation that encompass both mandatory and optional objects are labelled “ak_“. Voltage level specific types are labelled according to IEC61346 (e.g. E_, C-); the high voltage is used with transformers (here types for several levels are possible e.g. EC_). Bay-specific types have the bay number added to the voltage level (e.g. E3_, C4_).

2.2.3 Substation Configuration Tool (SCT)

The sample substation is modelled using the Substation Configuration Tool and mapped in SCL. Initially, one project file per bay is created. Since the substation section and especially the substation topology is generated automatically from the substation graphic, the location of the connecting elements between the bays (busbar, transfer busbar) must be identical so that, when merged later, a complete circuit diagram for generating the .ssd file with correct substation topology is obtained.

2.2.4 Instantiation

The instance numbers are assigned only during the product-related assignment. Instance numbers must be unambiguous within a logical device for each instantiated class (e.g. LN CSWI1...n, LN XSWI1...n, etc.). The working group recommends incrementing the numbers for each class starting with 1.

2.2.5 Quality of the time stamp

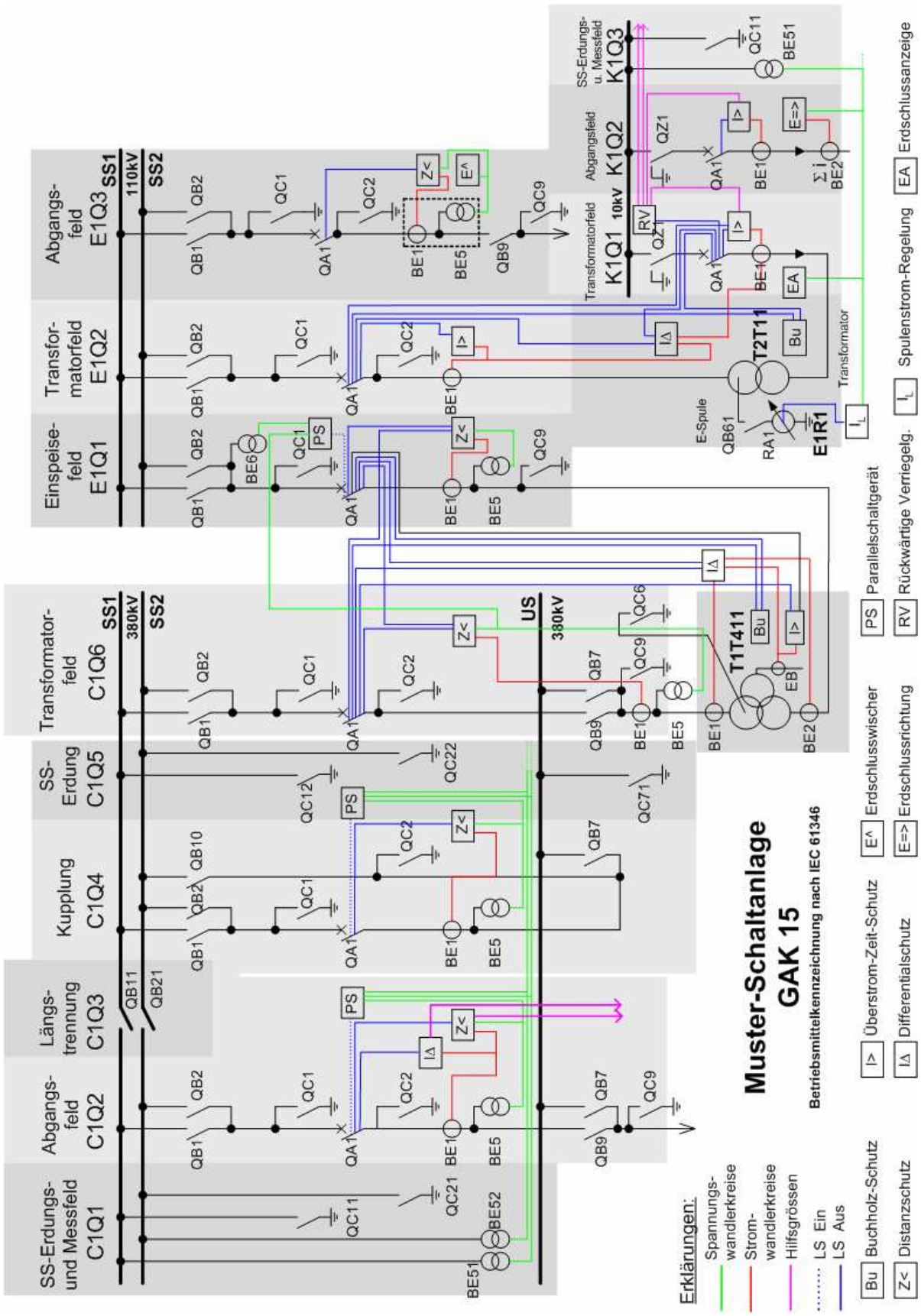
The option “ClockNotSynchronized” in the TimeQuality attribute of the time stamp is to be used generally.

2.2.6 Analog values

Analog values are formatted as FLOAT32.

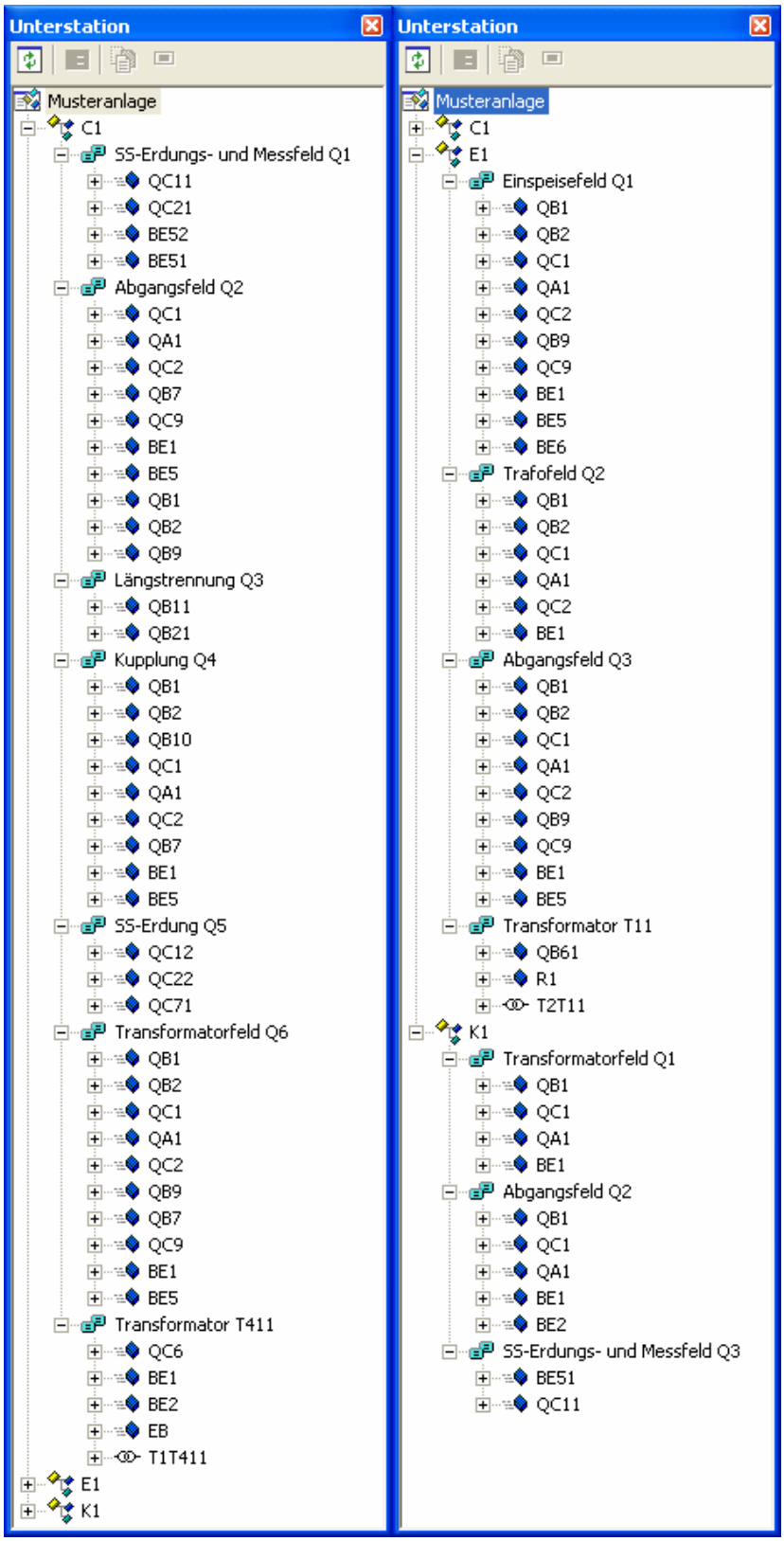
3 Documentation of the SCL-based sample modelling

3.1 Substation structure and topology mapping in SCL



Engineering step I:

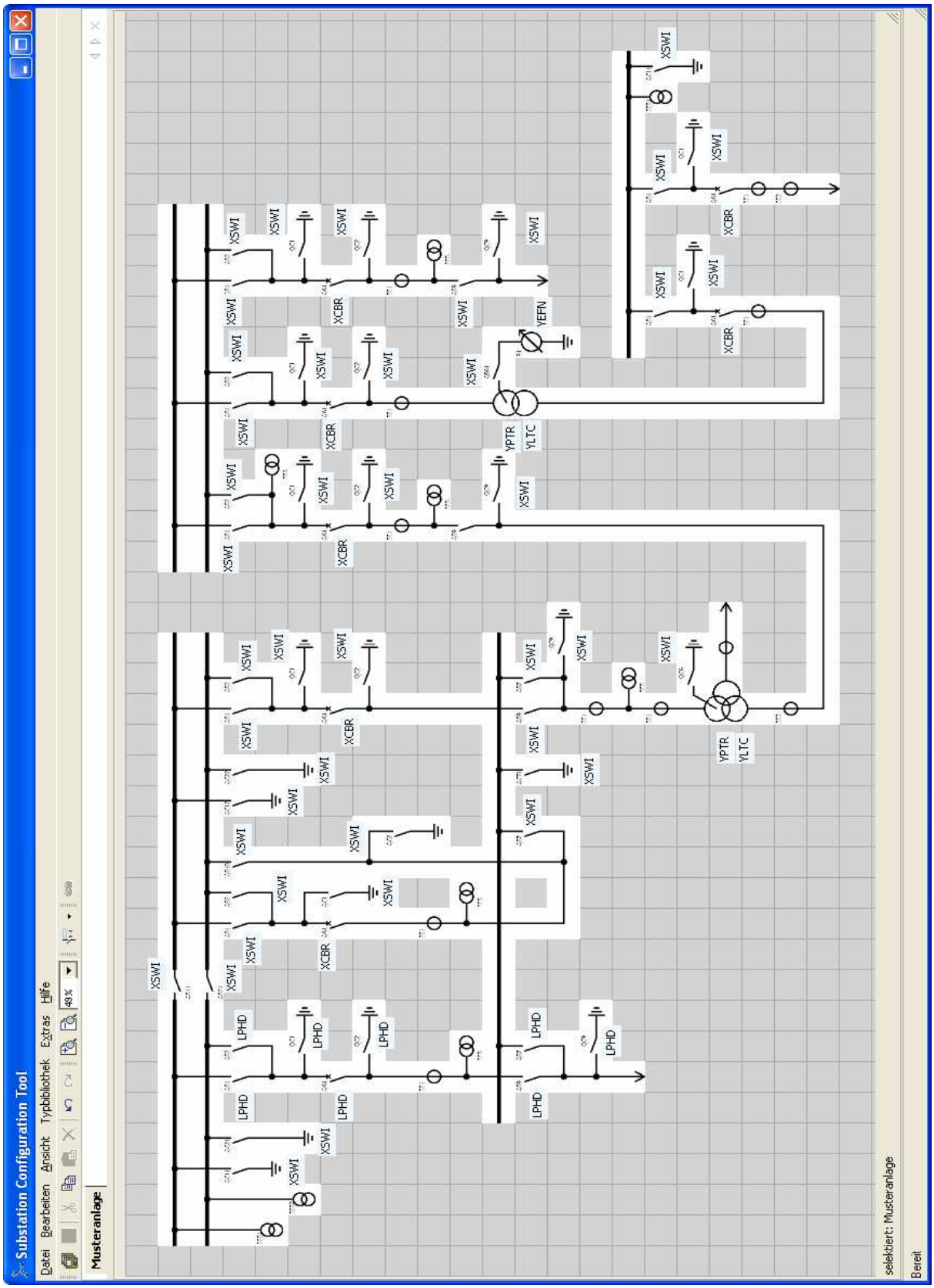
First, the topology of the primary system is configured including the process link for the secondary equipment with assignment of the template classes “InClass” which are not yet further specified. This step serves to determine the scope of the substation and generate a first .ssd file as the basis for the further configuration steps.



The SCL representation is hierarchical with substation, voltage and bay levels as shown in the left-hand picture. The pieces of equipment are clearly assigned to the bays.

The following overview shows the substation topology and the first level of the logical nodes directly assigned to the primary equipment (X___, Y___).

The intelligent primary equipment of bay C1Q2 is unconventional and can be recognized by the autonomous devices (IEDs) with LPHD.


Substation Configuration Tool
Datei Bearbeiten Ansicht Typbibliothek Extras Hilfe
Musteranlage
XSWI
XCBR
LPHD
YEFN
YPTR
YLTC
selektiert: Musteranlage
Bereit

3.2 Type library

Engineering step II:

The LNs, DOs and DAs are typed and a type library is created here. The types modelled for the sample substation are presented in the following.

To limit the data volume, the enumerations are not listed in their entirety. Only the enumerations specified in IEC 61850-7-4 were included in the data attributes. The data attribute “stVal“, for instance, was not assigned to the usage-dependent enumerations but left with type INT32 which is generally valid. This is the case, for instance, with the “Controllable Integer Status INC” used in various derived data objects (e.g. Mod, OpCntRe).

3.2.1 Logical node types

LNodeType

ak_ANCR : ANCR

Properties

id	lnClass	desc
ak_ANCR	ANCR	Neutral Current Regulator (Type: AK-specific)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Loc	Local operation	m_SPS
TapChg	Change Tap Position (stop, higher, lower)	ak_BSC
Auto	Automatic operation	ak_SPC

LNodeType

ak_ATCC : ATCC

Properties

id	lnClass	desc
ak_ATCC	ATCC	Automatic Tap Changer Controller (Type: AK-specific)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Loc	Local operation	m_SPS
ParOp	Parallel/Independent operation	ak_DPC
CtlV	Control Voltage	m_MV
TapChg	Change Tap Position (stop, higher, lower)	ak_BSC
Auto	Automatic/Manual operation	ak_SPC

LNodeType

C_CALH : CALH

Properties

id	lnClass	desc
C_CALH	CALH	Alarm Handling (Type: 380kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
GrAlm	Group alarm	m_SPS
GrWrn1	Group warning	m_SPS
GrWrn2	Group warning	m_SPS

LNodeType

E_CALH : CALH

Properties

id	lnClass	desc
E_CALH	CALH	Alarm Handling (Type: 110kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
GrAlm	Group alarm	m_SPS
GrWrn	Group warning	m_SPS

LNodeType

auto_CCGR : CCGR

Properties

id	lnClass	desc
auto_CCGR	CCGR	Cooling Group Control (Type: automatic)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
CECtl	Control of complete cooling group (pumps and fans)	ak_SPC
Auto	Automatic or manual	ak_SPC

LNodeType

C_CCGR : CCGR

Properties

id	lnClass	desc
C_CCGR	CCGR	Cooling Group Control (Type: 380kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
OilTmpIn	Oil temperature cooler in	m_MV
OilTmpOut1	Oil temperature cooler out	m_MV
OilTmpOut2	Oil temperature cooler out	m_MV
OilTmpOut3	Oil temperature cooler out	m_MV
FanFlw1	Air flow in fan	m_MV
FanFlw2	Air flow in fan	m_MV
FanFlw3	Air flow in fan	m_MV
FanFlw4	Air flow in fan	m_MV
CECtl	Control of complete cooling group (pumps and fans)	ak_SPC
PmpCtlGen	Control of all pumps	m_INC
FanCtlGen	Control of all fans	m_INC
Auto	Automatic or manual	ak_SPC
FanOvCur	Fan overcurrent trip	m_SPS
PmpOvCur	Pump overcurrent trip	m_SPS
PmpAlm	Loss of pump	m_SPS

LNodeType

E_CCGR : CCGR

Properties

id	lnClass	desc
E_CCGR	CCGR	Cooling Group Control (Type: 110kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
FanCtlGen	Control of all fans	m_INC
FanOvCur	Fan overcurrent trip	m_SPS

LNodeType

m_CILO : CILO

Properties

id	lnClass	desc
m_CILO	CILO	Interlocking (Type: mandatory)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
EnaOpn	Enable Open	m_SPS
EnaCls	Enable Close	m_SPS

LNodeType

C_CSWI : CSWI

Properties

id	lnClass	desc
C_CSWI	CSWI	Switch Controller (Type: 380kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Pos	Switch, general	ak_DPC
OpCntRs	Resetable operation counter	m_INC
PosA	Switch L1	ak_DPC
PosB	Switch L2	ak_DPC
PosC	Switch L3	ak_DPC

LNodeType

E_CSWI : CSWI

Properties

id	lnClass	desc
E_CSWI	CSWI	Switch Controller (Type: 110kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Pos	Switch, general	ak_DPC

LNodeType

E3_CSWI : CSWI

Properties

id	lnClass	desc
E3_CSWI	CSWI	Switch Controller (Type: 110kV E3)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Pos	Switch, general	ak_DPC
OpCntRs	Resetable operation counter	ak_INC

LNodeType

K_CSWI : CSWI

Properties

id	lnClass	desc
K_CSWI	CSWI	Switch Controller (Type: 10kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Pos	Switch, general	ak_DPC
OpCntRs	Resetable operation counter	ak_INC

LNodeType

ak_GGIO : GGIO

Properties

id	lnClass	desc
ak_GGIO	GGIO	Generic Process I/O (Type: AK-specific)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Alm	General single alarm	m_SPS

LNodeType

BC_LN0 : LLN0

Properties

id	lnClass	desc
BC_LN0	LLN0	Logical Node Zero (Type: BayController)

DOs

name	desc	type
Mod	Mode	ak_INC
NamPlt	Name plate	ak_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Loc	Local operation for complete logical device	m_SPS

LNodeType

m_LN0 : LLN0

Properties

id	lnClass	desc
m_LN0	LLN0	Logical Node Zero (Type: mandatory)

DOs

name	desc	type
Mod	Mode	ak_INC
NamPlt	Name plate	ak_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS

LNodeType

m_LPHD : LPHD

Properties

id	lnClass	desc
m_LPHD	LPHD	Physical Device Information (Type: mandatory)

DOs

name	desc	type
PhyName	Physical device name plate	ak_DPL
PhyHealth	Physical device health	m_INS
Proxy	Indicates if this LN is a proxy	m_SPS

LNodeType

C2_MDIF : MDIF

Properties

id	lnClass	desc
C2_MDIF	MDIF	Differential Measurements (Type: 380kV C2)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
OpARem	Operate Current (phasor) of the remote current measurement	ak_WYE

LNodeType

C_MMTR : MMTR

Properties

id	lnClass	desc
C_MMTR	MMTR	Metering (Type: 380kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
SupWh	Real energy supply (default supply direction: energy flow towards busbar)	m_BCR
SupVArh	Reactive energy supply (default supply direction: energy flow towards busbar)	m_BCR
DmdWh	Real energy demand (default demand direction: energy flow from busbar away)	m_BCR
DmdVArh	Reactive energy demand (default demand direction: energy flow from busbar away)	m_BCR

LNodeType

C_MMXU : MMXU

Properties

id	lnClass	desc
C_MMXU	MMXU	Measurement (Type: 380kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
TotW	Total Active Power (Total P)	m_MV
TotVAr	Total Reactive Power (Total Q)	m_MV
Hz	Frequency	range_MV
PPV	Phase to phase voltages (VL1VL2, …)	range_DEL
PhV	Phase to ground voltages (VL1ER, …)	range_WYE
A	Phase currents (IL1, IL2, IL3)	ak_WYE

LNodeType

C1_MMXU : MMXU

Properties

id	lnClass	desc
C1_MMXU	MMXU	Measurement (Type: 380kV C1)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Hz	Frequency	range_MV
PPV	Phase to phase voltages (VL1VL2, …)	ak_DEL
PhV	Phase to ground voltages (VL1ER, …)	range_WYE

LNodeType

C6_MMXU : MMXU

Properties

id	lnClass	desc
C6_MMXU	MMXU	Measurement (Type: 380kV C6)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
TotW	Total Active Power (Total P)	m_MV
TotVAr	Total Reactive Power (Total Q)	m_MV
PPV	Phase to phase voltages (VL1VL2, …)	range_DEL
PhV	Phase to ground voltages (VL1ER, …)	range_WYE
A	Phase currents (IL1, IL2, IL3)	ak_WYE

LNodeType

E1_MMXU : MMXU

Properties

id	lnClass	desc
E1_MMXU	MMXU	Measurement (Type: 110kV E1)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
TotW	Total Active Power (Total P)	m_MV
TotVAr	Total Reactive Power (Total Q)	m_MV
Hz	Frequency	m_MV
PPV	Phase to phase voltages (VL1VL2, …)	ak_DEL
PhV	Phase to ground voltages (VL1ER, …)	ak_WYE
A	Phase currents (IL1, IL2, IL3)	ak_WYE

LNodeType

E2_MMXU : MMXU

Properties

id	lnClass	desc
E2_MMXU	MMXU	Measurement (Type: 110kV E2)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
A	Phase currents (IL1, IL2, IL3)	ak_WYE

LNodeType

E3_MMXU : MMXU

Properties

id	lnClass	desc
E3_MMXU	MMXU	Measurement (Type: 110kV E3)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
TotW	Total Active Power (Total P)	m_MV
TotVAr	Total Reactive Power (Total Q)	m_MV
PPV	Phase to phase voltages (VL1VL2, …)	magCA_DEL
PhV	Phase to ground voltages (VL1ER, …)	ak_WYE
A	Phase currents (IL1, IL2, IL3)	ak_WYE

LNodeType

K1_MMXU : MMXU

Properties

id	lnClass	desc
K1_MMXU	MMXU	Measurement (Type: 10kV K1)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
A	Phase currents (IL1, IL2, IL3)	ak_WYE

LNodeType

K2_MMXU : MMXU

Properties

id	lnClass	desc
K2_MMXU	MMXU	Measurement (Type: 10kV K2)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
TotW	Total Active Power (Total P)	m_MV
TotVAr	Total Reactive Power (Total Q)	m_MV
PPV	Phase to phase voltages (VL1VL2, …)	magCA_DEL
PhV	Phase to ground voltages (VL1ER, …)	ak_WYE
A	Phase currents (IL1, IL2, IL3)	ak_WYE

LNodeType

K3_MMXU : MMXU

Properties

id	lnClass	desc
K3_MMXU	MMXU	Measurement (Type: 10kV K3)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Hz	Frequency	m_MV
PPV	Phase to phase voltages (VL1VL2, …)	magCA_DEL
PhV	Phase to ground voltages (VL1ER, …)	range_WYE

LNodeType

PSG_E1_MMXU : MMXU

Properties

id	lnClass	desc
PSG_E1_MMXU	MMXU	Measurement (Type: automatic synchronizer)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Hz	Frequency	m_MV
PPV	Phase to phase voltages (VL1VL2, …)	ak_DEL

LNodeType

sum_MMXU : MMXU

Properties

id	lnClass	desc
sum_MMXU	MMXU	Measurement (Type: summation currents)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
A	Phase currents (IL1, IL2, IL3)	sum_WYE

LNodeType

C_PDIF : PDIF

Properties

id	lnClass	desc
C_PDIF	PDIF	Differential Protection (Type: 380kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Op	Operate	ABC_ACT
Str	Start	ABC_ACD

LNodeType

E_PDIF : PDIF

Properties

id	lnClass	desc
E_PDIF	PDIF	Differential Protection (Type: 110kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Op	Operate	m_ACT
Str	Start	m_ACD

LNodeType

m_PDIR : PDIR

Properties

id	lnClass	desc
m_PDIR	PDIR	Direction Comparison (Type: mandatory)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Str	Start (appearance of the first related fault direction)	m_ACD
Op	Operate (decision from all sensors that the surrounded object is faulted)	m_ACT

LNodeType

C_PDIS : PDIS

Properties

id	lnClass	desc
C_PDIS	PDIS	Distance Protection (Type: 380kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Str	Start	dirABC_ACD
Op	Operate	ABC_ACT

LNodeType

E1_PDIS : PDIS

Properties

id	lnClass	desc
E1_PDIS	PDIS	Distance Protection (Type: 110kV E1)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Str	Start	m_ACD
Op	Operate	m_ACT

LNodeType

E3_PDIS : PDIS

Properties

id	lnClass	desc
E3_PDIS	PDIS	Distance Protection (Type: 110kV E3)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Str	Start	ak_ACD
Op	Operate	ak_ACT

LNodeType

C2_PSCH : PSCH

Properties

id	lnClass	desc
C2_PSCH	PSCH	Protection Scheme (Type: 380kV C2)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
ProTx	Teleprotection signal transmitted	m_SPS
ProRx	Teleprotection signal received	m_SPS
Str	Carrier Send	m_ACD
Op	Operate	m_ACT

LNodeType

E3_PSCH : PSCH

Properties

id	lnClass	desc
E3_PSCH	PSCH	Protection Scheme (Type: 110kV E3)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
ProTx	Teleprotection signal transmitted	m_SPS
ProRx	Teleprotection signal received	m_SPS
Str	Carrier Send	m_ACD
Op	Operate	m_ACT

LNodeType

m_PSDE : PSDE

Properties

id	lnClass	desc
m_PSDE	PSDE	Sensitive Directional Earthfault (Type: mandatory)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Str	Start	KdirABC_ACD

LNodeType

m_PTEF : PTEF

Properties

id	lnClass	desc
m_PTEF	PTEF	Transient Earth Fault (Type: mandatory)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Str	Start (Transient earth fault)	m_ACD

LNodeType

C_PTOC : PTOC

Properties

id	lnClass	desc
C_PTOC	PTOC	Time Overcurrent (Type: 380kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Str	Start	m_ACD
Op	Operate	m_ACT

LNodeType

E1_PTOC : PTOC

Properties

id	lnClass	desc
E1_PTOC	PTOC	Time Overcurrent (Type: 110kV E1)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Str	Start	m_ACD
Op	Operate	m_ACT

LNodeType

E2_PTOC : PTOC

Properties

id	lnClass	desc
E2_PTOC	PTOC	Time Overcurrent (Type: 110kV E2)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Str	Start	ak_ACD
Op	Operate	m_ACT

LNodeType

K_PTOC : PTOC

Properties

id	lnClass	desc
K_PTOC	PTOC	Time Overcurrent (Type: 10kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Str	Start	KdirABC_ACD
Op	Operate	m_ACT

LNodeType

C_PTOV : PTOV

Properties

id	lnClass	desc
C_PTOV	PTOV	Overvoltage (Type: 380kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Str	Start	m_ACD
Op	Operate	m_ACT

LNodeType

C_PTRC : PTRC

Properties

id	lnClass	desc
C_PTRC	PTRC	Protection Trip Conditioning (Type: 380kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Tr	Trip	ABC_ACT
Str	Sum of all starts of all connected Logical Nodes	dirABC_ACD

LNodeType

C2_PTRC : PTRC

Properties

id	lnClass	desc
C2_PTRC	PTRC	Protection Trip Conditioning (Type: 380kV E2)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Tr	Trip	ABC_ACT

LNodeType

E1_PTRC : PTRC

Properties

id	lnClass	desc
E1_PTRC	PTRC	Protection Trip Conditioning (Type: 110kV E1)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Tr	Trip	m_ACT
Str	Sum of all starts of all connected Logical Nodes	ak_ACD

LNodeType

E2_PTRC : PTRC

Properties

id	lnClass	desc
E2_PTRC	PTRC	Protection Trip Conditioning (Type: 110kV E2)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Tr	Trip	m_ACT

LNodeType

E3_PTRC : PTRC

Properties

id	lnClass	desc
E3_PTRC	PTRC	Protection Trip Conditioning (Type: 110kV E3)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Tr	Trip	m_ACT
Str	Sum of all starts of all connected Logical Nodes	m_ACD

LNodeType

K1_PTRC : PTRC

Properties

id	lnClass	desc
K1_PTRC	PTRC	Protection Trip Conditioning (Type: 10kV K1)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Tr	Trip	m_ACT

LNodeType

K2_PTRC : PTRC

Properties

id	lnClass	desc
K2_PTRC	PTRC	Protection Trip Conditioning (Type: 10kV K2)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Tr	Trip	m_ACT
Str	Sum of all starts of all connected Logical Nodes	m_ACD

LNodeType

C_RBRF : RBRF

Properties

id	lnClass	desc
C_RBRF	RBRF	Breaker Failure (Type: 380kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
OpEx	Breaker failure trip (“external trip”)	m_ACT

LNodeType

E1_RBRF : RBRF

Properties

id	lnClass	desc
E1_RBRF	RBRF	Breaker Failure (Type: 110kV E1)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
OpEx	Breaker failure trip (“external trip”)	m_ACT

LNodeType

E3_RBRF : RBRF

Properties

id	lnClass	desc
E3_RBRF	RBRF	Breaker Failure (Type: 110kV E3)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
OpEx	Breaker failure trip (“external trip”)	m_ACT
OpIn	Operate, retrip (“internal trip”)	m_ACT

LNodeType

E3_RDIR : RDIR

Properties

id	lnClass	desc
E3_RDIR	RDIR	Directional Element (Type: 110kV E3)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Dir	Direction	ak_ACD

LNodeType

m_RDIR : RDIR

Properties

id	lnClass	desc
m_RDIR	RDIR	Directional Element (Type: mandatory)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Dir	Direction	ak_ACD

LNodeType

m_RDRE : RDRE

Properties

id	lnClass	desc
m_RDRE	RDRE	Disturbance Recorder Function (Type: mandatory)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
RcdMade	Recording made	m_SPS
FltNum	Fault Number	m_INS

LNodeType

C_RFLO : RFLO

Properties

id	lnClass	desc
C_RFLO	RFLO	Fault Locator (Type: 380kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
FltZ	Fault Impedance	FltZang_CMV
FltDiskm	Fault Distance in km	m_MV

LNodeType

E_RFLO : RFLO

Properties

id	lnClass	desc
E_RFLO	RFLO	Fault Locator (Type: 110kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
FltZ	Fault Impedance	FltZang_CMV
FltDiskm	Fault Distance in km	m_MV

LNodeType

C_RREC : RREC

Properties

id	lnClass	desc
C_RREC	RREC	Autoreclosing (Type: 380kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Op	Operate (used here to provide close to XCBR)	ABC_ACT
AutoRecSt	Auto Reclosing Status	m_INS

LNodeType

E3_RREC : RREC

Properties

id	lnClass	desc
E3_RREC	RREC	Autoreclosing (Type: 110kV E3)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Op	Operate (used here to provide close to XCBR)	m_ACT
AutoRecSt	Auto Reclosing Status	m_INS

LNodeType

C_RSYN : RSYN

Properties

id	lnClass	desc
C_RSYN	RSYN	Synchronism Check (Type: 380kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Rel	Release	m_SPS
VInd	Voltage Difference Indicator	m_SPS
AngInd	Angle Difference Indicator	m_SPS
HzInd	Frequency Difference Indicator	m_SPS
DifAngClc	Calculated Difference of Phase Angle	m_MV

LNodeType

C4_RSYN : RSYN

Properties

id	lnClass	desc
C4_RSYN	RSYN	Synchronism Check (Type: 380kV C4)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Rel	Release	m_SPS
VInd	Voltage Difference Indicator	m_SPS
AngInd	Angle Difference Indicator	m_SPS
HzInd	Frequency Difference Indicator	m_SPS
DifHzClc	Calculated Difference in Frequency	m_MV
DifAngClc	Calculated Difference of Phase Angle	m_MV

LNodeType

E_RSYN : RSYN

Properties

id	lnClass	desc
E_RSYN	RSYN	Synchronism Check (Type: 110kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Rel	Release	m_SPS
DifAngClc	Calculated Difference of Phase Angle	m_MV

LNodeType

C_SIMG : SIMG

Properties

id	lnClass	desc
C_SIMG	SIMG	Insulation Medium Supervision Gas (Type: 380kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
InsAlm	Insulation gas critical (refill isolation medium)	m_SPS
InsBlk	Insulation gas not safe (block device operation)	m_SPS
DenAlm	Isolation gas density alarm	m_SPS

LNodeType

C_SIML : SIML

Properties

id	lnClass	desc
C_SIML	SIML	Insulation Medium Supervision Liquid (Type: 380kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
InsAlm	Insulation liquid critical (refill isolation medium)	m_SPS
EEHealth	External equipment health	m_INS
Tmp	Insulation liquid temperature	m_MV
Lev	Insulation liquid level	m_MV
Pres	Insulation liquid pressure	m_MV
H2O	Relative saturation of moisture in insulating liquid (in %)	m_MV
H2	Measurement of Hydrogen (H2 in ppm)	m_MV
TmpAlm1	Insulation liquid temperature alarm	m_SPS
TmpAlm2	Insulation liquid temperature alarm	m_SPS
GasInsAlm1	Gas in insulation liquid alarm (may be used for Buchholz alarm)	m_SPS
GasInsAlm2	Gas in insulation liquid alarm (may be used for Buchholz alarm)	m_SPS
GasInsAlm3	Gas in insulation liquid alarm (may be used for Buchholz alarm)	m_SPS
GasInsAlm4	Gas in insulation liquid alarm (may be used for Buchholz alarm)	m_SPS
GasInsTr1	Gas in insulation liquid trip (may be used for Buchholz trip)	m_SPS
GasInsTr2	Gas in insulation liquid trip (may be used for Buchholz trip)	m_SPS
GasFlwTr1	Insulation liquid flow trip because of gas (may be used for Buchholz trip)	m_SPS
GasFlwTr2	Insulation liquid flow trip because of gas (may be used for Buchholz trip)	m_SPS
GasFlwTr3	Insulation liquid flow trip because of gas (may be used for Buchholz trip)	m_SPS

LNodeType

E_SIML : SIML

Properties

id	lnClass	desc
E_SIML	SIML	Insulation Medium Supervision Liquid (Type: 110kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
InsAlm	Insulation liquid critical (refill isolation medium)	m_SPS
EEHealth	External equipment health	m_INS
TmpAlm1	Insulation liquid temperature alarm	m_SPS
TmpAlm2	Insulation liquid temperature alarm	m_SPS
GasInsAlm	Gas in insulation liquid alarm (may be used for Buchholz alarm)	m_SPS
GasInsTr	Gas in insulation liquid trip (may be used for Buchholz trip)	m_SPS
GasFlwTr	Insulation liquid flow trip because of gas (may be used for Buchholz trip)	m_SPS

LNodeType

TE1_SIML : SIML

Properties

id	lnClass	desc
TE1_SIML	SIML	Insulation Medium Supervision Liquid (Type: E-coil)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
InsAlm	Insulation liquid critical (refill isolation medium)	m_SPS
EEHealth	External equipment health	m_INS
TmpAlm	Insulation liquid temperature alarm	m_SPS
GasInsAlm	Gas in insulation liquid alarm (may be used for Buchholz alarm)	m_SPS
GasFlwTr	Insulation liquid flow trip because of gas (may be used for Buchholz trip)	m_SPS

LNodeType

m_TCTR : TCTR

Properties

id	lnClass	desc
m_TCTR	TCTR	Current Transformer (Type: mandatory)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Amp	Current (Sampled value)	m_SAV

LNodeType

EC_TVTR : TVTR

Properties

id	lnClass	desc
EC_TVTR	TVTR	Voltage Transformer (Type: 380/110kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Vol	Voltage (sampled value)	m_SAV
FuFail	TVTR fuse failure	m_SPS

LNodeType

K_TVTR : TVTR

Properties

id	lnClass	desc
K_TVTR	TVTR	Voltage Transformer (Type: 10kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Vol	Voltage (sampled value)	m_SAV
FuFail	TVTR fuse failure	m_SPS

LNodeType

C_XCBR : XCBR

Properties

id	lnClass	desc
C_XCBR	XCBR	Circuit Breaker (Type: 380kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Loc	Local operation (local means without substation automation communication, hardwired direct control)	m_SPS
OpCnt	Operation counter	m_INS
Pos	Switch position	ak_DPC
BlkOpn	Block opening	ak_SPC
BlkCls	Block closing	ak_SPC
CBOpCap	Circuit breaker operating capability	m_INS
EEHealth	External equipment health	m_INS
SumSwARs	Sum of Switched Amperes, resetable	m_BCR
POWCap	Point On Wave switching capability	m_INS

LNodeType

E_XCBR : XCBR

Properties

id	lnClass	desc
E_XCBR	XCBR	Circuit Breaker (Type: 110kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Loc	Local operation (local means without substation automation	m_SPS
OpCnt	Operation counter	m_INS
Pos	Switch position	ak_DPC
BlkOpn	Block opening	ak_SPC
BlkCls	Block closing	ak_SPC
CBOpCap	Circuit breaker operating capability	m_INS
EEHealth	External equipment health	m_INS

LNodeType

m_XCBR : XCBR

Properties

id	lnClass	desc
m_XCBR	XCBR	Circuit Breaker (Type: mandatory)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Loc	Local operation (local means without substation automation communication, hardwired direct control)	m_SPS
OpCnt	Operation counter	m_INS
Pos	Switch position	ak_DPC
BlkOpn	Block opening	ak_SPC
BlkCls	Block closing	ak_SPC
CBOpCap	Circuit breaker operating capability	m_INS

LNodeType

C_XSWI : XSWI

Properties

id	lnClass	desc
C_XSWI	XSWI	Circuit Switch (Type: 380kV)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Loc	Local operation	m_SPS
OpCnt	Operation counter	m_INS
Pos	Switch position	ak_DPC
BlkOpn	Block opening	ak_SPC
BlkCls	Block closing	ak_SPC
SwTyp	Switch type	m_INS
SwOpCap	Switch operating capability	m_INS
EEHealth	External equipment health	m_INS

LNodeType

m_XSWI : XSWI

Properties

id	lnClass	desc
m_XSWI	XSWI	Circuit Switch (Type: mandatory)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Loc	Local operation	m_SPS
OpCnt	Operation counter	m_INS
Pos	Switch position	ak_DPC
BlkOpn	Block opening	ak_SPC
BlkCls	Block closing	ak_SPC
SwTyp	Switch type	m_INS
SwOpCap	Switch operating capability	m_INS

LNodeType

m_YEFN : YEFN

Properties

id	lnClass	desc
m_YEFN	YEFN	Petersen Coil (Type: mandatory)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
Loc	Local operation	m_SPS
ECA	Earth coil current	m_MV
ColTapPos	Coil Tap Position	ak_ISC

LNodeType

ak_YLTC : YLTC

Properties

id	lnClass	desc
ak_YLTC	YLTC	Tap Changer (Type: AK-specific)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
EndPosR	End position raise reached	m_SPS
EndPosL	End position lower reached	m_SPS
TapChg	Change Tap Position (stop, higher, lower)	ak_BSC

LNodeType

ak_YPTR : YPTR

Properties

id	lnClass	desc
ak_YPTR	YPTR	Power Transformator (Type: AK-specific)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
OpOvA	Operation at overcurrent	m_SPS

LNodeType

ak_ZAXN : ZAXN

Properties

id	lnClass	desc
ak_ZAXN	ZAXN	Auxiliary Network (Type: AK-specific)

DOs

name	desc	type
Mod	Mode	m_INC
NamPlt	Name plate	m_LPL
Health	Health	m_INS
Beh	Behaviour	m_INS
EEHealth	External equipment health	m_INS

3.2.2 Data Object types

DOType

ABC_ACD : ACD

Properties

id	cdc	desc
ABC_ACD	ACD	

DAs

name	fc	desc	trg.opt.	bType	type
general	ST		dchg;	BOOLEAN	
dirGeneral	ST		dchg;	Enum	dir
q	ST		qchg;	Quality	
t	ST			Struct	m_TimeStamp
phsA	ST		dchg;	BOOLEAN	
phsB	ST		dchg;	BOOLEAN	
phsC	ST		dchg;	BOOLEAN	
neut	ST		dchg;	BOOLEAN	

DOType

ak_ACD : ACD

Properties

id	cdc	desc
ak_ACD	ACD	

DAs

name	fc	desc	trg.opt.	bType	type
general	ST		dchg;	BOOLEAN	
dirGeneral	ST		dchg;	Enum	dir
q	ST		qchg;	Quality	
t	ST			Struct	m_TimeStamp
phsA	ST		dchg;	BOOLEAN	
dirPhsA	ST		dchg;	Enum	dir
phsB	ST		dchg;	BOOLEAN	
dirPhsB	ST		dchg;	Enum	dir
phsC	ST		dchg;	BOOLEAN	
dirPhsC	ST		dchg;	Enum	dir
neut	ST		dchg;	BOOLEAN	
dirNeut	ST		dchg;	Enum	dir

DOType

dirABC_ACD : ACD

Properties

id	cdc	desc
dirABC_ACD	ACD	

DAs

name	fc	desc	trg.opt.	bType	type
general	ST		dchg;	BOOLEAN	
dirGeneral	ST		dchg;	Enum	dir
q	ST		qchg;	Quality	
t	ST			Struct	m_TimeStamp
phsA	ST		dchg;	BOOLEAN	
dirPhsA	ST		dchg;	Enum	
phsB	ST		dchg;	BOOLEAN	
dirPhsB	ST		dchg;	Enum	
phsC	ST		dchg;	BOOLEAN	
dirPhsC	ST		dchg;	Enum	
neut	ST		dchg;	BOOLEAN	
dirNeut	ST		dchg;	Enum	

DOType

KdirABC_ACD : ACD

Properties

id	cdc	desc
KdirABC_ACD	ACD	

DAs

name	fc	desc	trg.opt.	bType	type
general	ST		dchg;	BOOLEAN	
dirGeneral	ST		dchg;	Enum	dir
q	ST		qchg;	Quality	
t	ST			Struct	m_TimeStamp
phsA	ST		dchg;	BOOLEAN	
dirPhsA	ST		dchg;	Enum	
phsB	ST		dchg;	BOOLEAN	
dirPhsB	ST		dchg;	Enum	
phsC	ST		dchg;	BOOLEAN	
dirPhsC	ST		dchg;	Enum	

DOType

m_ACD : ACD

Properties

id	cdc	desc
m_ACD	ACD	

DAs

name	fc	desc	trg.opt.	bType	type
general	ST		dchg;	BOOLEAN	
dirGeneral	ST		dchg;	Enum	dir
q	ST		qchg;	Quality	
t	ST			Struct	m_TimeStamp

DOType

ABC_ACT : ACT

Properties

id	cdc	desc
ABC_ACT	ACT	

DAs

name	fc	desc	trg.opt.	bType	type
general	ST		dchg;	BOOLEAN	
q	ST		qchg;	Quality	
t	ST			Struct	m_TimeStamp
phsA	ST		dchg;	BOOLEAN	
phsB	ST		dchg;	BOOLEAN	
phsC	ST		dchg;	BOOLEAN	

DOType

ak_ACT : ACT

Properties

id	cdc	desc
ak_ACT	ACT	

DAs

name	fc	desc	trg.opt.	bType	type
general	ST		dchg;	BOOLEAN	
q	ST		qchg;	Quality	
t	ST			Struct	m_TimeStamp
phsA	ST		dchg;	BOOLEAN	
phsB	ST		dchg;	BOOLEAN	
phsC	ST		dchg;	BOOLEAN	

DOType

m_ACT : ACT

Properties

id	cdc	desc
m_ACT	ACT	

DAs

name	fc	desc	trg.opt.	bType	type
general	ST		dchg;	BOOLEAN	
q	ST		qchg;	Quality	
t	ST			Struct	m_TimeStamp

DOType

m_BCR : BCR

Properties

id	cdc	desc
m_BCR	BCR	

DAs

name	fc	desc	trg.opt.	bType	type
actVal	ST		dchg;	INT128	
q	ST		qchg;	Quality	
t	ST			Struct	m_TimeStamp
pulsQty	CF			FLOAT32	

DOType

ak_BSC : BSC

Properties

id	cdc	desc
ak_BSC	BSC	

DAs

name	fc	desc	trg.opt.	bType	type
persistent	CF			BOOLEAN	
ctlModel	CF			Enum	ctlModel
ctlVal	CO			CODEDENUM	
valWTr	ST		dchg;	Struct	ak_ValWithTrans
q	ST		qchg;	Quality	
t	ST			Struct	m_TimeStamp

DOType

ang_CMV : CMV

Properties

id	cdc	desc
ang_CMV	CMV	

DAs

name	fc	desc	trg.opt.	bType	type
cVal	MX		dchg;	Struct	ang_Vector
q	MX		qchg;	Quality	
t	MX			Struct	m_TimeStamp

DOType

ang_range_CMV : CMV

Properties

id	cdc	desc
ang_range_CMV	CMV	

DAs

name	fc	desc	trg.opt.	bType	type
cVal	MX		dchg;	Struct	ang_Vector
q	MX		qchg;	Quality	
t	MX			Struct	m_TimeStamp
range	MX		dchg;	Enum	range

DOType

FltZang_CMV : CMV

Properties

id	cdc	desc
FltZang_CMV	CMV	

DAs

name	fc	desc	trg.opt.	bType	type
cVal	MX		dchg;	Struct	ang_Vector
q	MX		qchg;	Quality	
t	MX			Struct	m_TimeStamp

DOType

FltZm_CMV : CMV

Properties

id	cdc	desc
FltZm_CMV	CMV	

DAs

name	fc	desc	trg.opt.	bType	type
cVal	MX		dchg;	Struct	m_Vector
q	MX		qchg;	Quality	
t	MX			Struct	m_Quality

DOType

m_CMV : CMV

Properties

id	cdc	desc
m_CMV	CMV	

DAs

name	fc	desc	trg.opt.	bType	type
cVal	MX		dchg;	Struct	m_Vector
q	MX		qchg;	Quality	
t	MX			Struct	m_TimeStamp

DOType

range_CMV : CMV

Properties

id	cdc	desc
range_CMV	CMV	

DAs

name	fc	desc	trg.opt.	bType	type
cVal	MX		dchg;	Struct	float_AnalogueValue
q	MX		qchg;	Quality	
t	MX			Struct	m_TimeStamp
range	MX		dchg;	Enum	range

DOType

ak_DEL : DEL

Properties

id	cdc	desc
ak_DEL	DEL	

SDOs

name	desc	type
phsAB		ang_CMV
phsCA		ang_CMV

DOType

magCA_DEL : DEL

Properties

id	cdc	desc
magCA_DEL	DEL	

SDOs

name	desc	type
phsCA		m_CMV

DOType

range_DEL : DEL

Properties

id	cdc	desc
range_DEL	DEL	

SDOs

name	desc	type
phsAB		ang_range_CMV
phsCA		ang_range_CMV

DOType

ak_DPC : DPC

Properties

id	cdc	desc
ak_DPC	DPC	

DAs

name	fc	desc	trg.opt.	bType	type
stVal	ST		dchg;	Enum	Dbpos
q	ST		qchg;	Quality	
t	ST			Struct	m_TimeStamp
ctlModel	CF			Enum	ctlModel
ctlVal	CO			BOOLEAN	
origin	CO			Struct	m_Originator
ctlNum	CO			INT8U	

DOType

ak_DPL : DPL

Properties

id	cdc	desc
ak_DPL	DPL	

DAs

name	fc	desc	trg.opt.	bType	type
vendor	DC			VISIBLESTRING255	
hwRev	DC			VISIBLESTRING255	
swRev	DC			VISIBLESTRING255	
serNum	DC			VISIBLESTRING255	

DOType

ak_INC : INC

Properties

id	cdc	desc
ak_INC	INC	

DAs

name	fc	desc	trg.opt.	bType	type
stVal	ST		dchg;	INT32	
q	ST		qchg;	Quality	
t	ST			Struct	m_TimeStamp
ctlModel	CF			Enum	ctlModel
ctlVal	CO			INT32	

DOType

m_INC : INC

Properties

id	cdc	desc
m_INC	INC	

DAs

name	fc	desc	trg.opt.	bType	type
stVal	ST		dchg;	INT32	
q	ST		qchg;	Quality	
t	ST			Struct	m_TimeStamp
ctlModel	CF			Enum	ctlModel

DOType

m_INS : INS

Properties

id	cdc	desc
m_INS	INS	

DAs

name	fc	desc	trg.opt.	bType	type
stVal	ST		dchg;	INT32	
q	ST		qchg;	Quality	
t	ST			Struct	m_TimeStamp

DOType

ak_ISC : ISC

Properties

id	cdc	desc
ak_ISC	ISC	

DAs

name	fc	desc	trg.opt.	bType	type
ctlModel	CF			Enum	ctlModel
ctlVal	CO			INT8	
valWTr	ST		dchg;	Struct	ak_ValWithTrans
q	ST		qchg;	Quality	
t	ST			Struct	m_TimeStamp

DOType

ak_LPL : LPL

Properties

id	cdc	desc
ak_LPL	LPL	

DAs

name	fc	desc	trg.opt.	bType	type
vendor	DC			VISIBLESTRING255	
swRev	DC			VISIBLESTRING255	
d	DC			VISIBLESTRING255	
configRev	DC			VISIBLESTRING255	

DOType

m_LPL : LPL

Properties

id	cdc	desc
m_LPL	LPL	

DAs

name	fc	desc	trg.opt.	bType	type
vendor	DC			VISIBLESTRING255	
swRev	DC			VISIBLESTRING255	
d	DC			VISIBLESTRING255	

DOType

m_MV : MV

Properties

id	cdc	desc
m_MV	MV	

DAs

name	fc	desc	trg.opt.	bType	type
mag	MX		dchg;	Struct	float_AnalogueValue
q	MX		qchg;	Quality	
t	MX			Struct	m_TimeStamp

DOType

range_MV : MV

Properties

id	cdc	desc
range_MV	MV	

DAs

name	fc	desc	trg.opt.	bType	type
mag	MX		dchg;	Struct	float_AnalogueValue
q	MX		qchg;	Quality	
t	MX			Struct	m_TimeStamp
range	MX		dchg;	Enum	range

DOType

m_SAV : SAV

Properties

id	cdc	desc
m_SAV	SAV	

DAs

name	fc	desc	trg.opt.	bType	type
instMag	MX			Struct	float_AnalogueValue
q	MX		qchg;	Quality	

DOType

ak_SPC : SPC

Properties

id	cdc	desc
ak_SPC	SPC	

DAs

name	fc	desc	trg.opt.	bType	type
ctlModel	CF			Enum	ctlModel
ctlVal	CO			BOOLEAN	
stVal	ST		dchg;	BOOLEAN	
q	ST		qchg;	Quality	
t	ST			Struct	m_TimeStamp

DOType

m_SPS : SPS

Properties

id	cdc	desc
m_SPS	SPS	

DAs

name	fc	desc	trg.opt.	bType	type
stVal	ST		dchg;	BOOLEAN	
q	ST		qchg;	Quality	
t	ST			Struct	m_TimeStamp

DOType

ak_WYE : WYE

Properties

id	cdc	desc
ak_WYE	WYE	

SDOs

name	desc	type
phsA		m_CMV
phsB		m_CMV
phsC		m_CMV

DOType

range_WYE : WYE

Properties

id	cdc	desc
range_WYE	WYE	

SDOs

name	desc	type
phsA		range_CMV
phsB		range_CMV
phsC		range_CMV

DOType

sum_WYE : WYE

Properties

id	cdc	desc
sum_WYE	WYE	

SDOs

name	desc	type
res		m_CMV

3.2.3 Data Attribute types

DAType

ak_ValWithTrans

Properties

id	desc
ak_ValWithTrans	

DAs

name	desc	bType	type
posVal		INT8	
transInd		BOOLEAN	

DAType

ang_Vector

Properties

id	desc
ang_Vector	

DAs

name	desc	bType	type
mag		Struct	float_AnalogueValue
ang		Struct	float_AnalogueValue

DAType

float_AnalogueValue

Properties

id	desc
float_AnalogueValue	

DAs

name	desc	bType	type
f		FLOAT32	

DAType

int_AnalogueValue

Properties

id	desc
int_AnalogueValue	

DAs

name	desc	bType	type
i		INT32	

DAType

m_Originator

Properties

id	desc
m_Originator	

DAs

name	desc	bType	type
orCat		Enum	orCategory
orIdent		Octet64	

DAType

m_TimeQuality

Properties

id	desc

m_TimeQuality

DAs

name	desc	bType	type
leapSecondsKnown		BOOLEAN	
clockFailure		BOOLEAN	
timeAccuracy		CODED ENUM	
clockNotSynchronized		BOOLEAN	

DAType

m_TimeStamp

Properties

id	desc
m_TimeStamp	

DAs

name	desc	bType	type
secondSinceEpoch		INT32	
fractionOfSecond		INT24U	
timeQuality		Struct	m_TimeQuality

DAType

m_Vector

Properties

id	desc
m_Vector	

DAs

name	desc	bType	type
mag		Struct	float_AnalogueValue

DAType

Unit

Properties

id	desc
Unit	

DAs

name	desc	bType	type
SIUnit		Enum	SIUnit

3.2.4 Enumeration types

Only the enumerations specified in IEC 61850-7-4 were used for modelling and no further ones were defined. Therefore, they are not documented separately in the current version.

3.3 Product-independent system specification

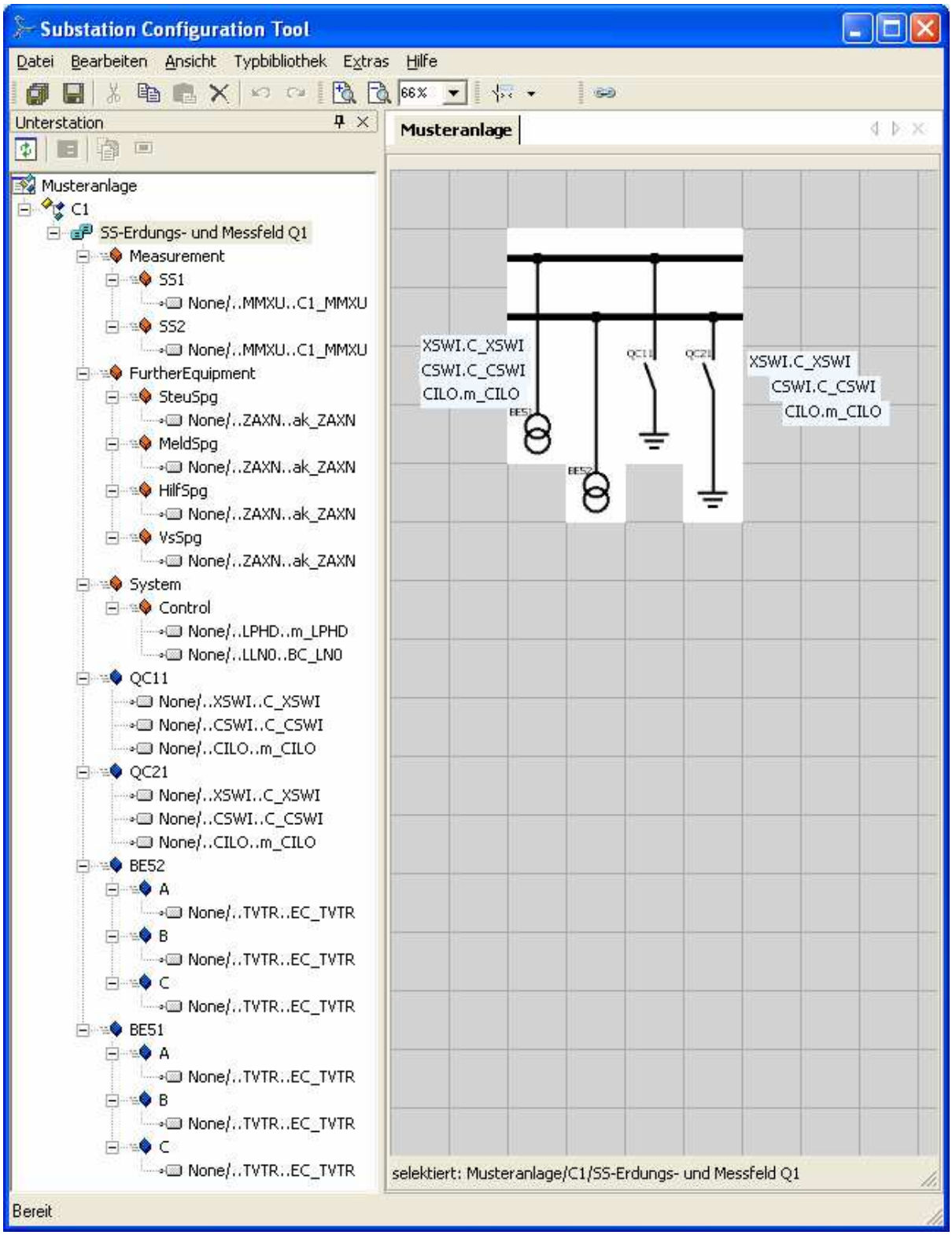
Engineering step III:

The product-independent system specification consists of the assignment of the typed information objects to the substation and the associated determination of the entire scope of information. The hierarchical information modelling is accomplished in a functional perspective (“functional naming”) using the elements “Equipment” and “Subequipment” for primary equipment and “Function” and “Subfunction” for functions. In the extension of edition 1 of IEC 61850, functions are also located under the elements “voltage level” and “bay” because otherwise an unambiguous and complete modelling is not possible.

The individual bays are documented below. The bay topology and the equipment-related functions and the remaining bay functions are shown hierarchically. Elements that may be hidden in the tree views for lack of space correspond to the elements of the same type in the same picture. For instance, the LNs assigned to an isolator are usually always identical in a bay. In large bays, the topology and equipment functions are shown in the first picture and the additional bay functions in the second picture.

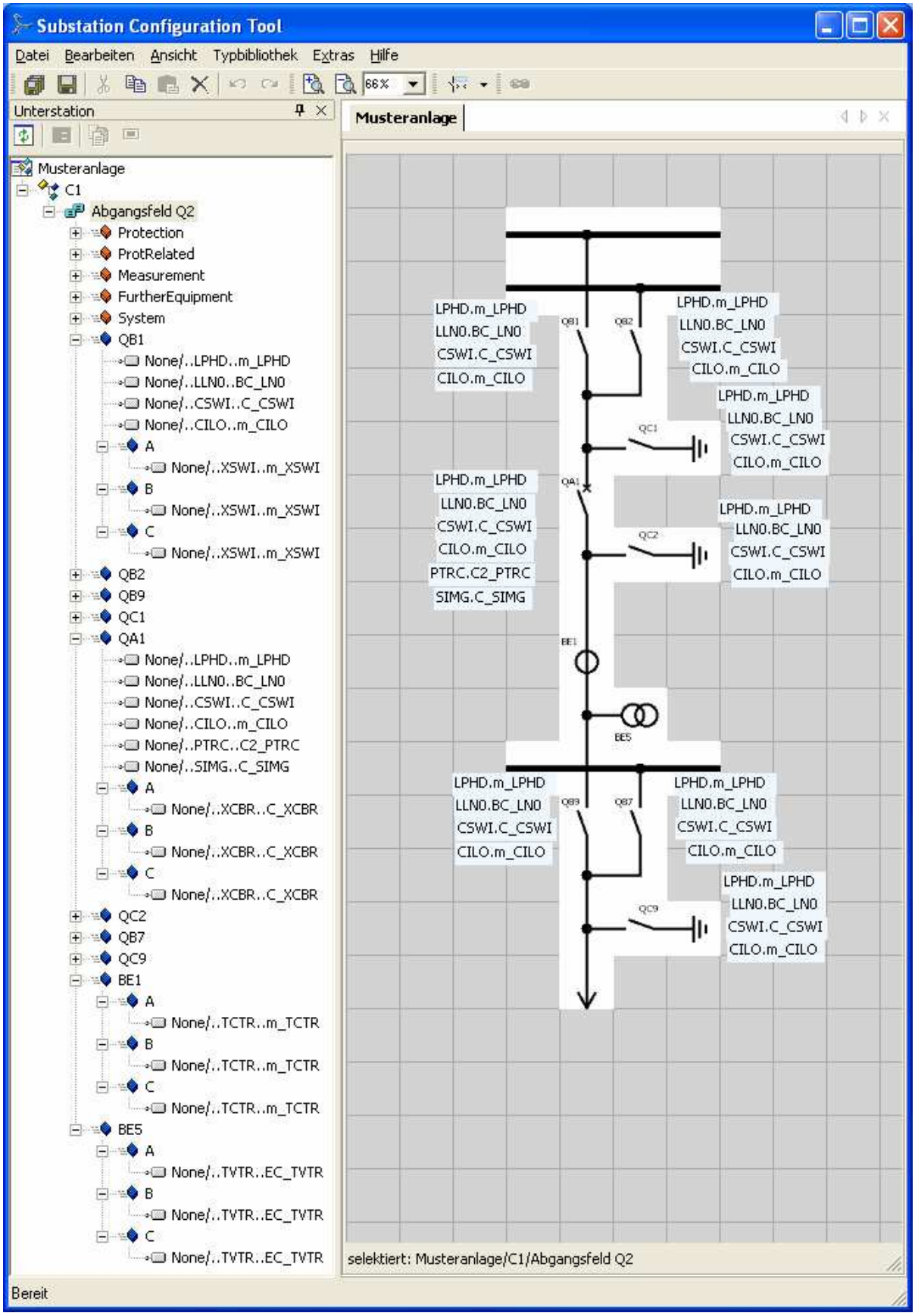
The identifiers of the logical nodes show the individual assignment of the LN types listed in section 0 carried out in this engineering step. The IED name “None” indicates that the product structure of the information model is still open.

3.3.1 380-kV busbar earthing and measurement bay C1Q1

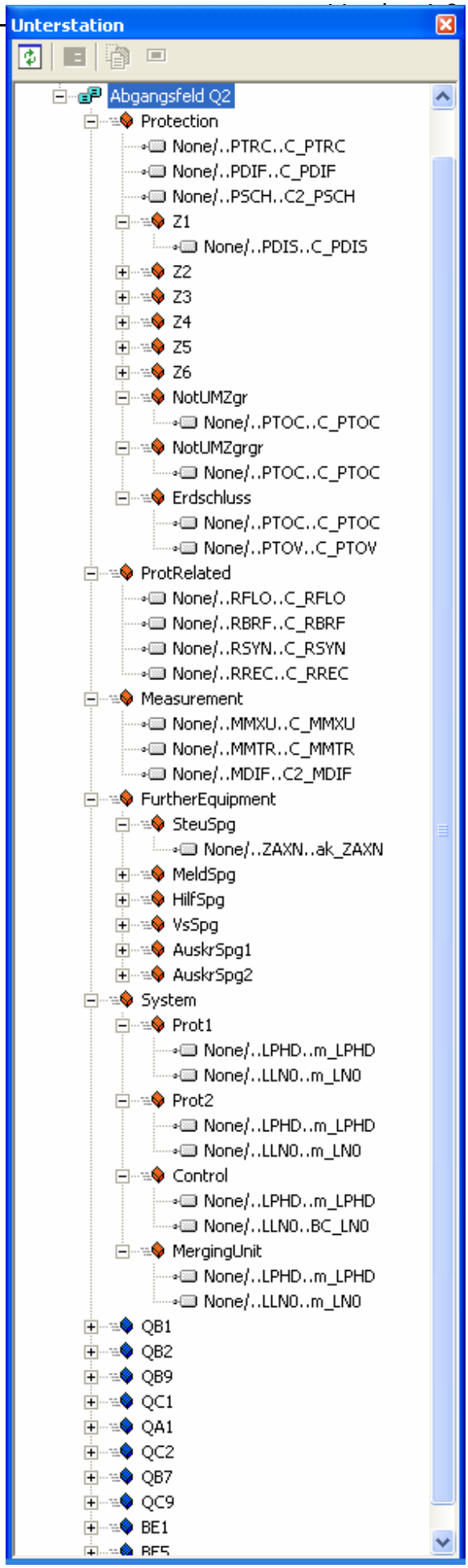


3.3.2 380-kV outgoing feeder bay C1Q2

Bay topology and equipment-related functions:



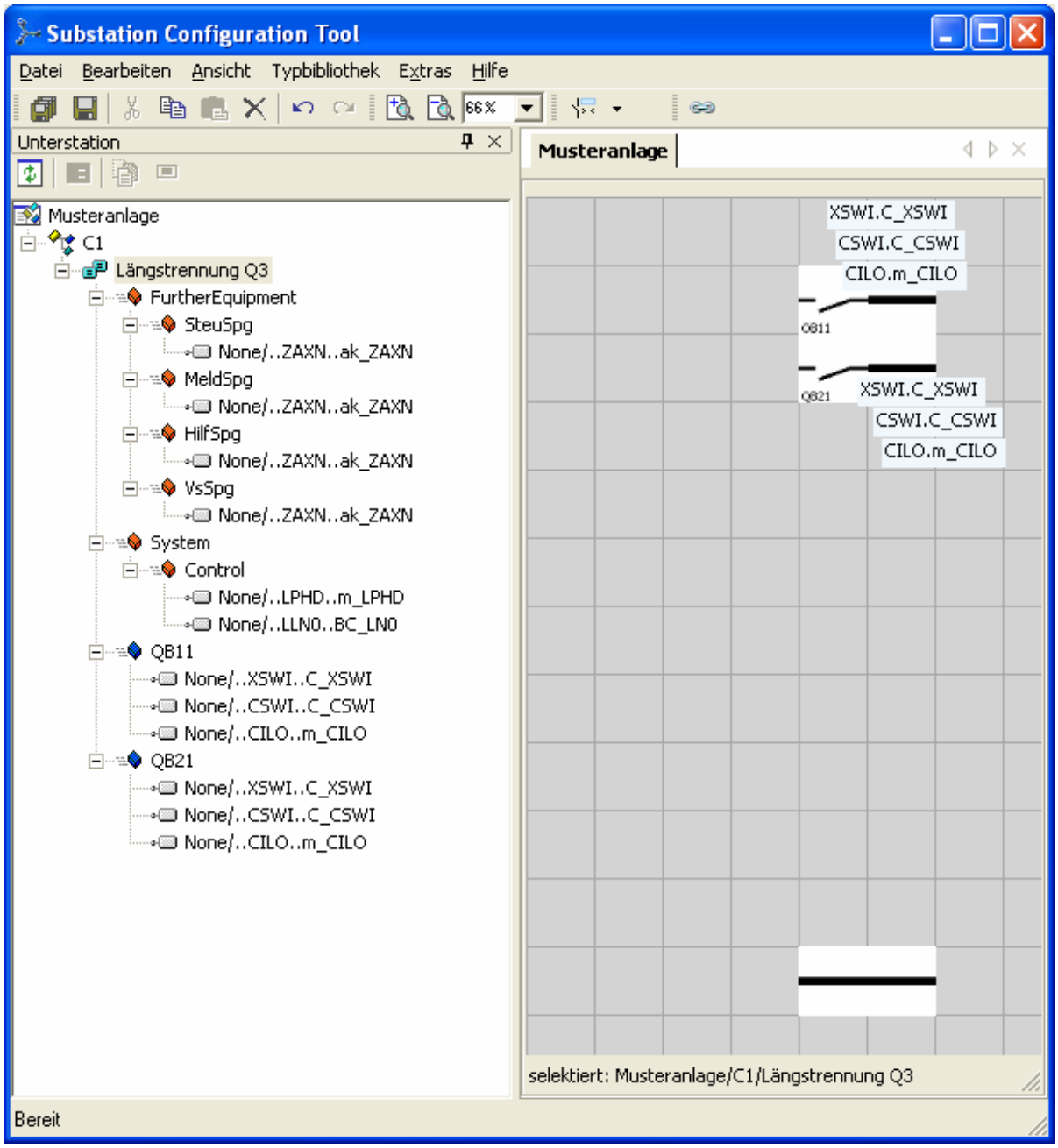
Bay functions:



Comments:

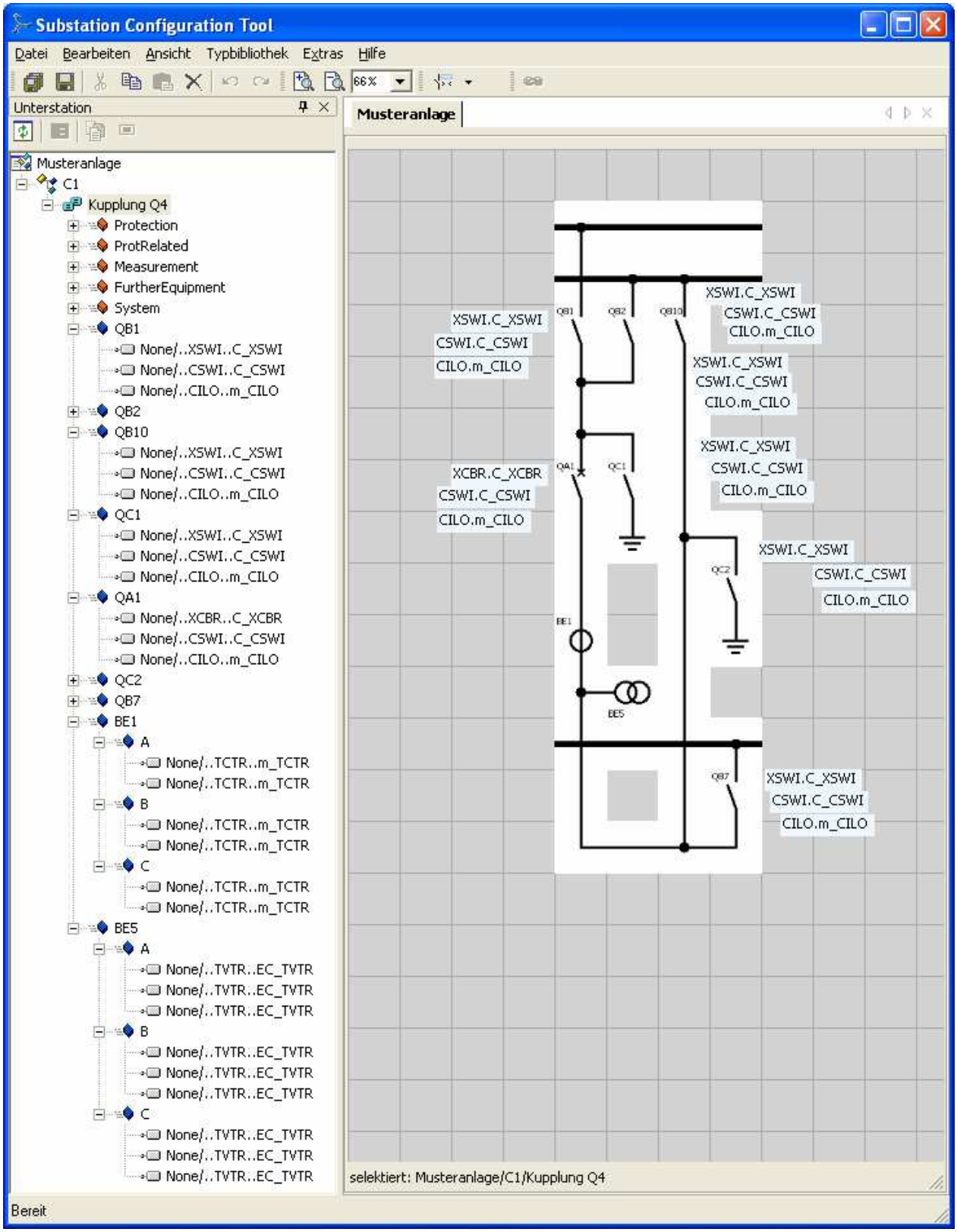
- Unconventional bay equipment with IEDs for each piece of equipment including single-pole control and measurement
- Double protection

3.3.3 380-kV sectionalizer C1Q3

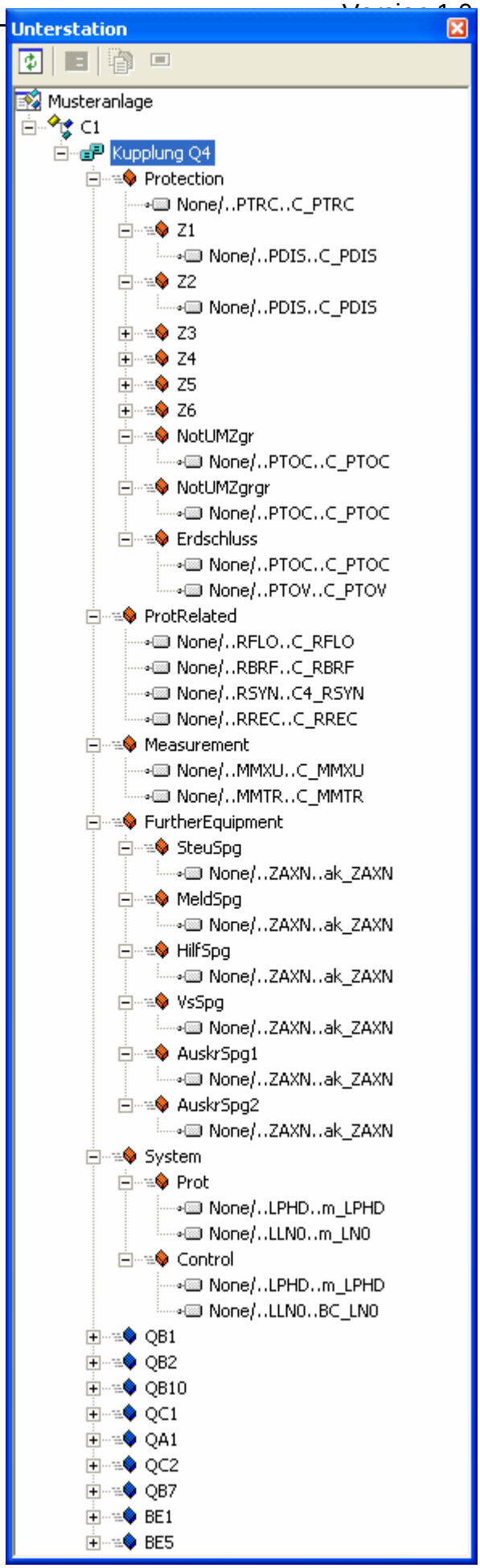


3.3.4 380-kV coupler C1Q4

Bay topology and equipment-related functions:



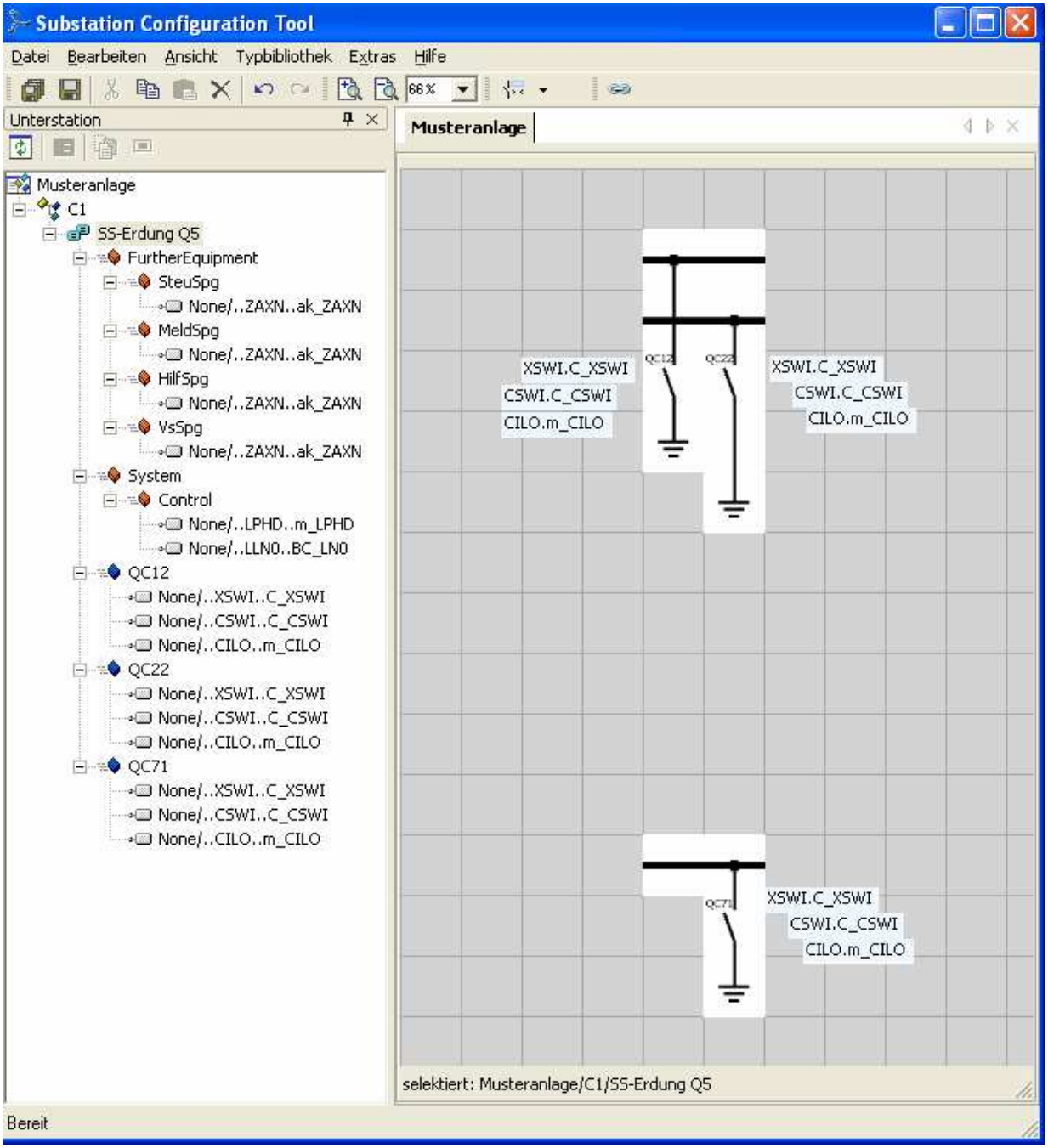
Bay functions:



Comments:

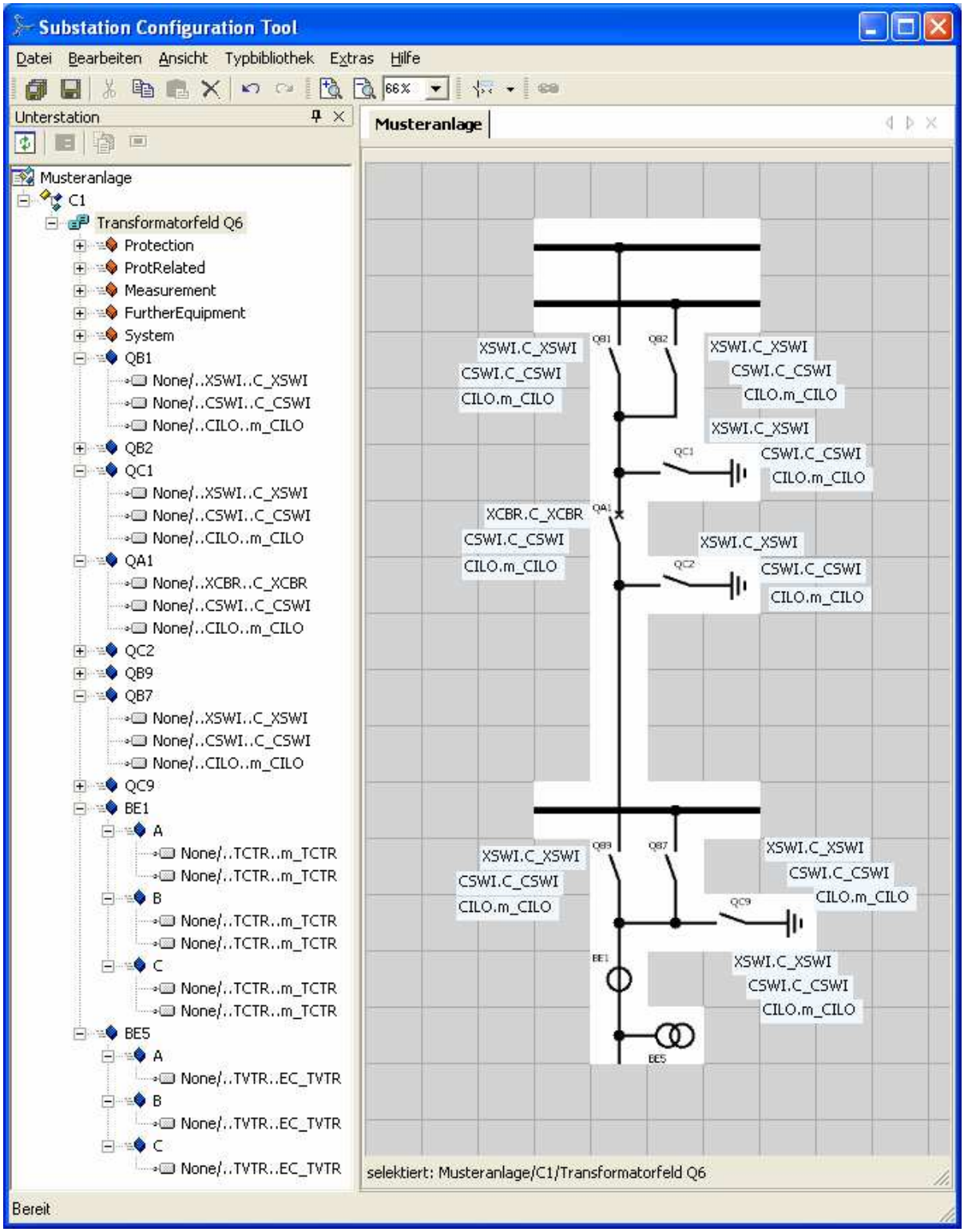
- Three separate voltage measurements (BI5) for protection, operational measurement and automatic synchronizer

3.3.5 380-kV busbar earthing C1Q5

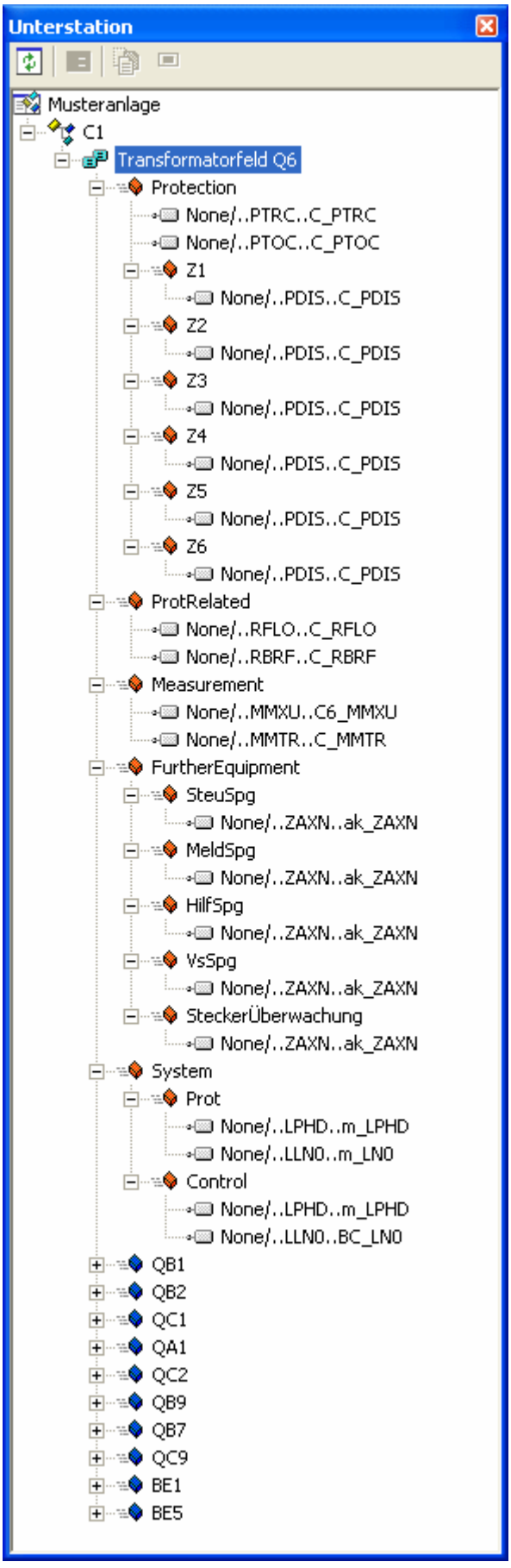


3.3.6 380-kV transformer bay C1Q6

Bay topology and equipment-related functions:



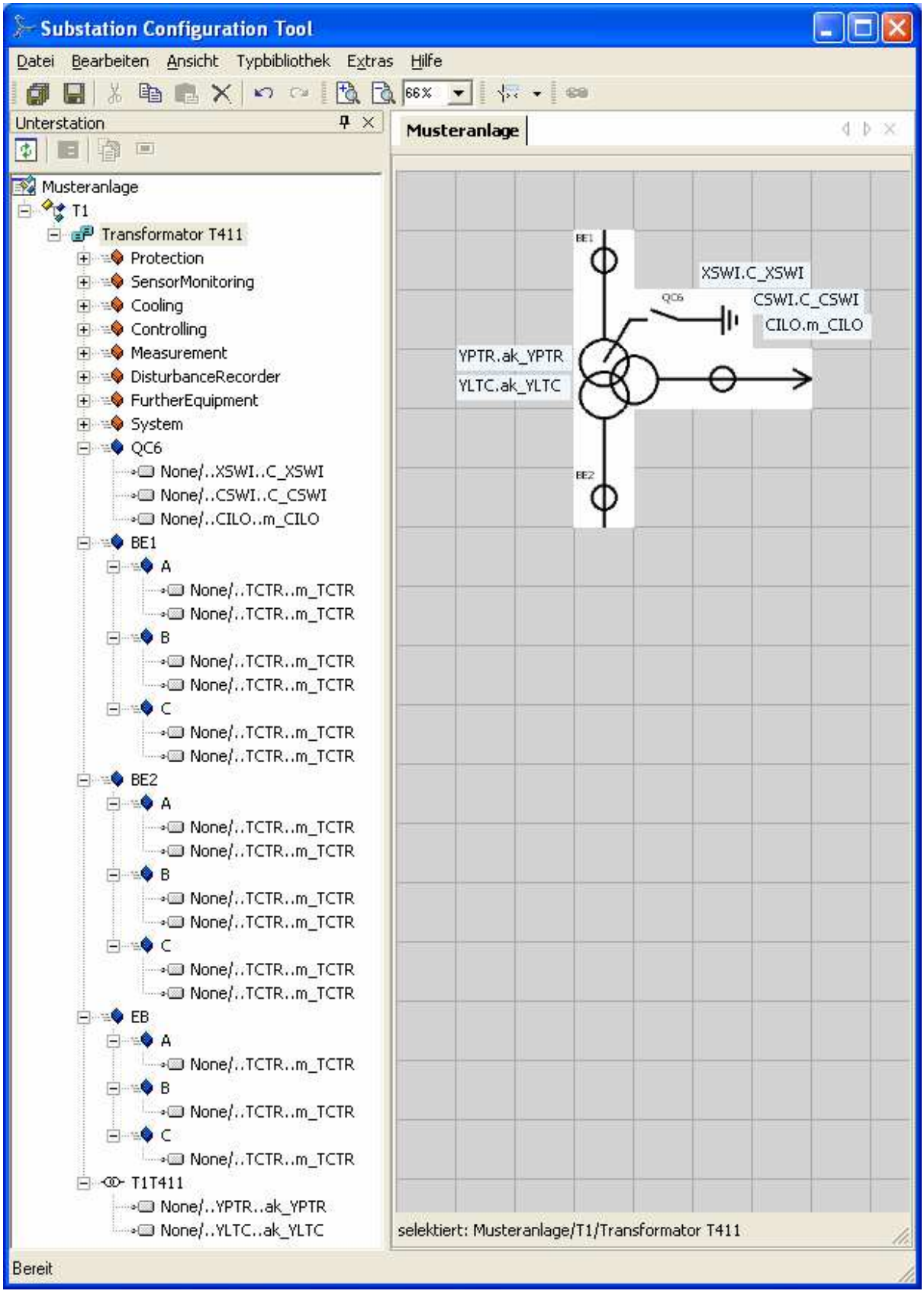
Bay functions:



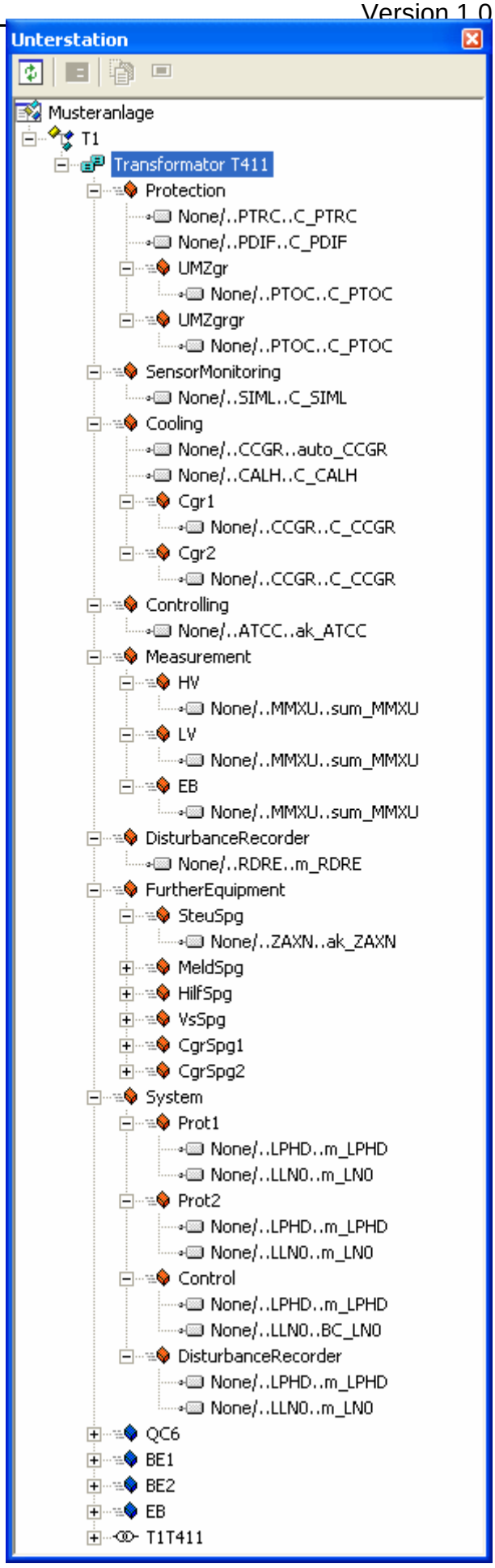
Comments:

3.3.7 380/110-kV transformation T1T411

Bay topology and equipment-related functions:



Bay functions:

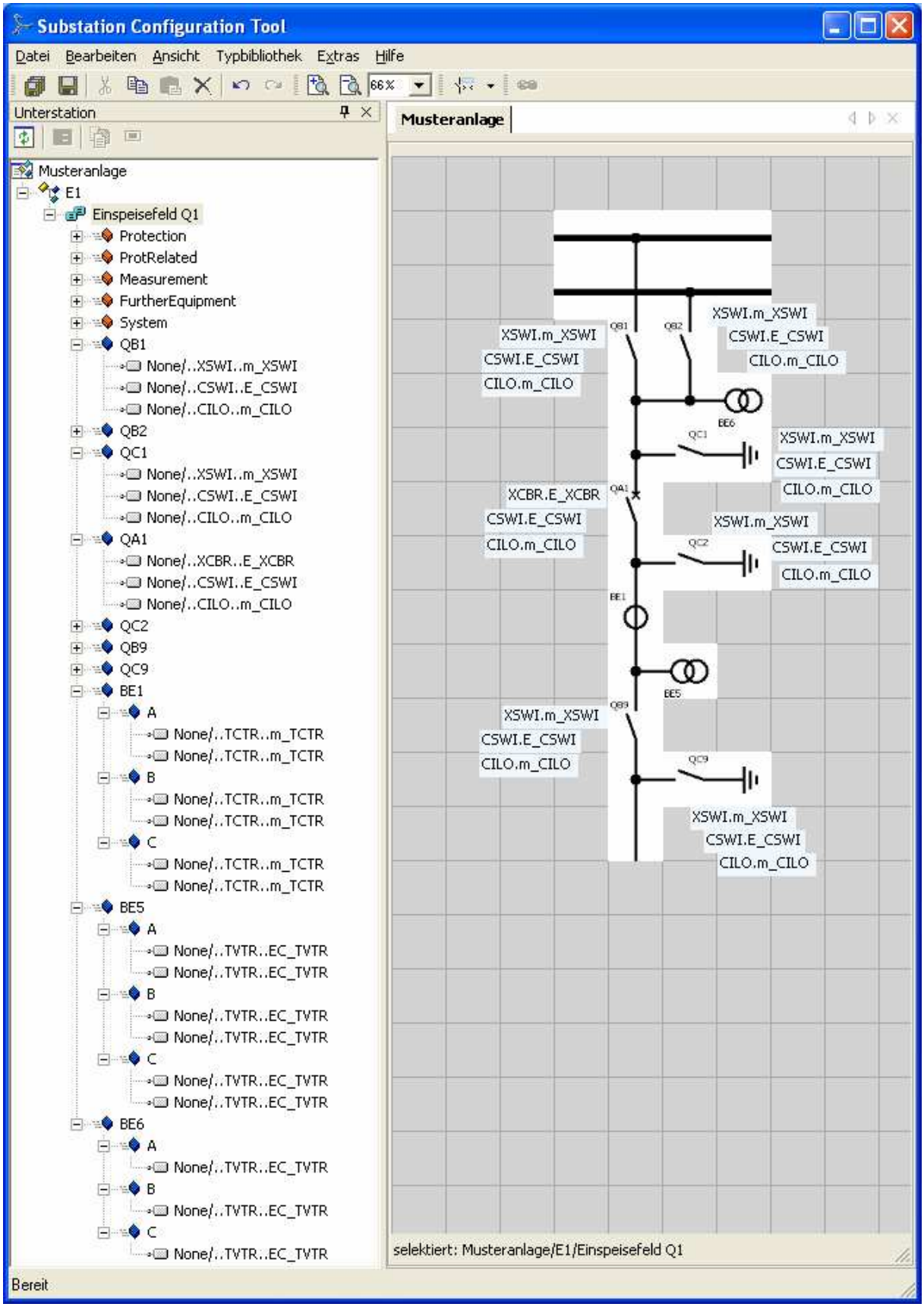


Comments:

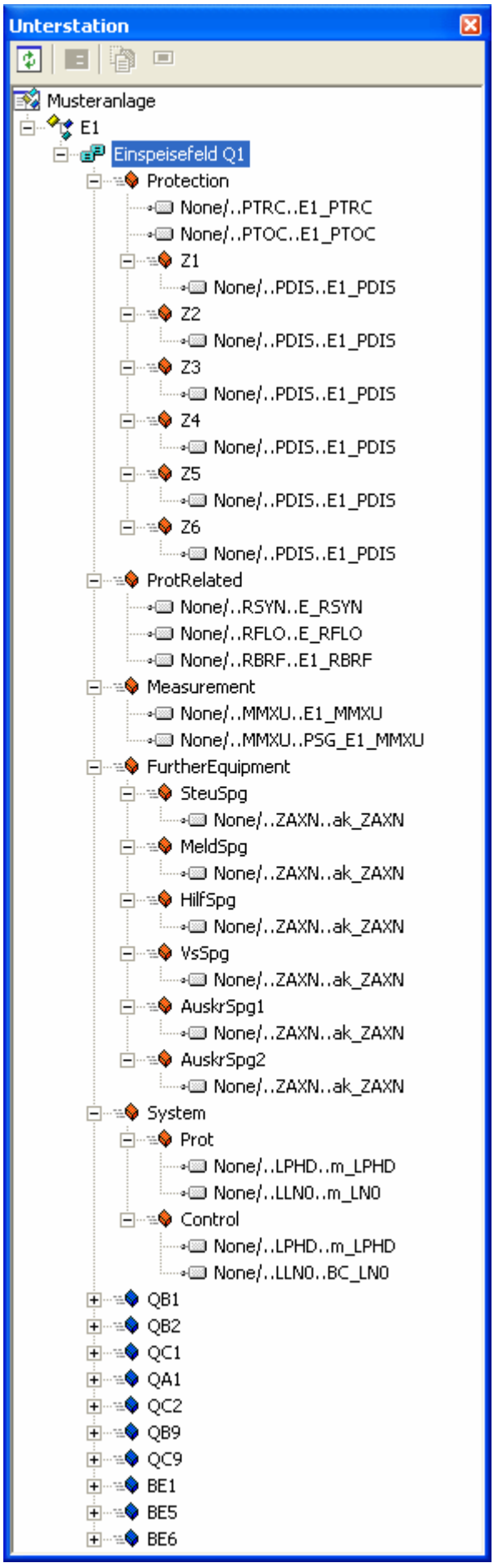
- Independent fault recorder

3.3.8 110-kV incoming feeder bay E1Q1

Bay topology and equipment-related functions:



Bay functions:

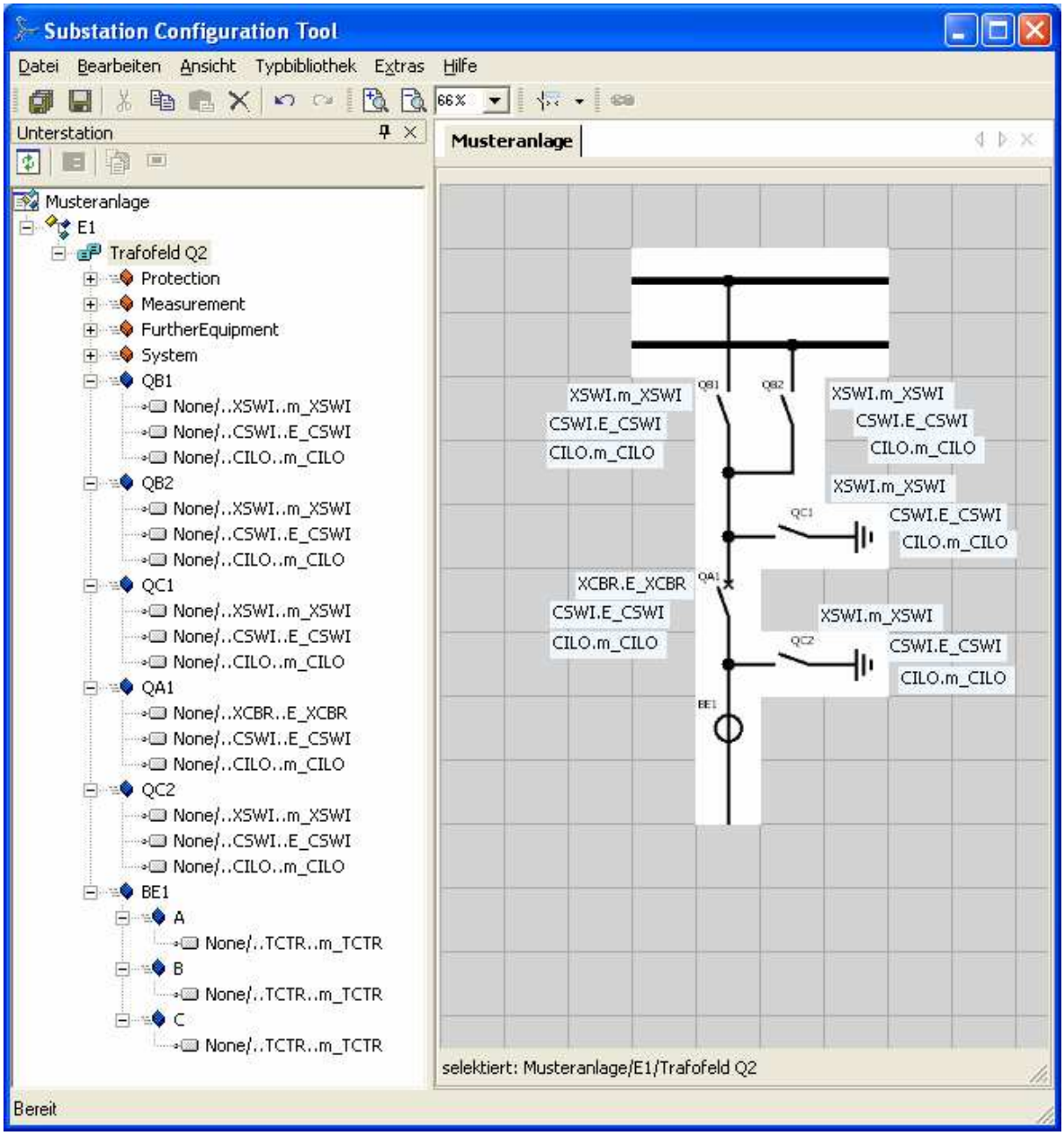


Comments:

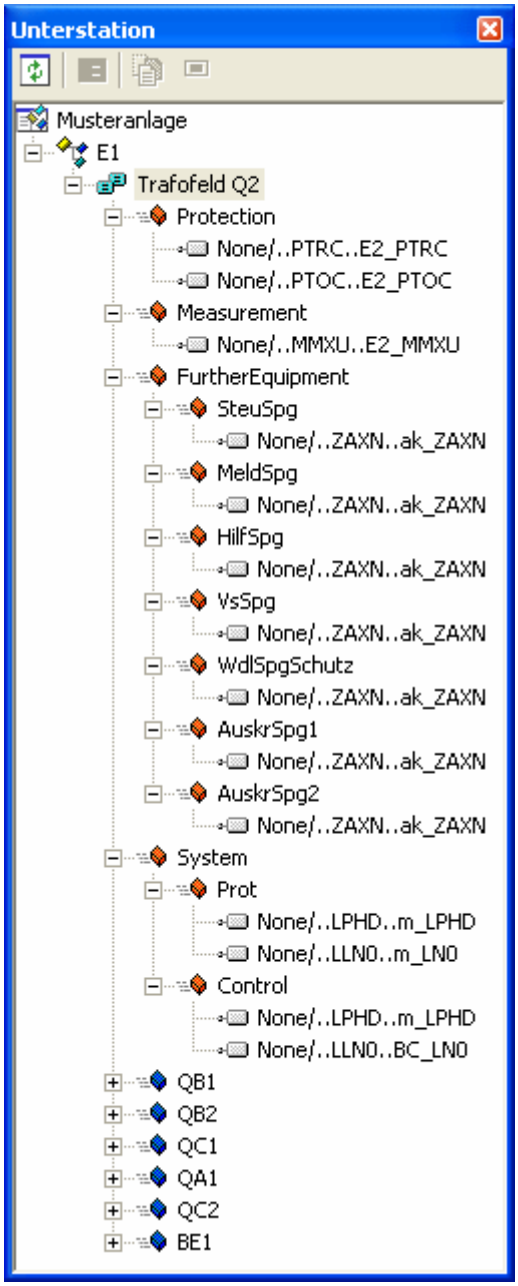
- Separate protection and operational measurement for current (BI1) and voltage (BI5)
- Voltage measurement (BI6) for automatic synchronizer

3.3.9 110-kV transformer bay E1Q2

Bay topology and equipment-related functions:



Bay functions:

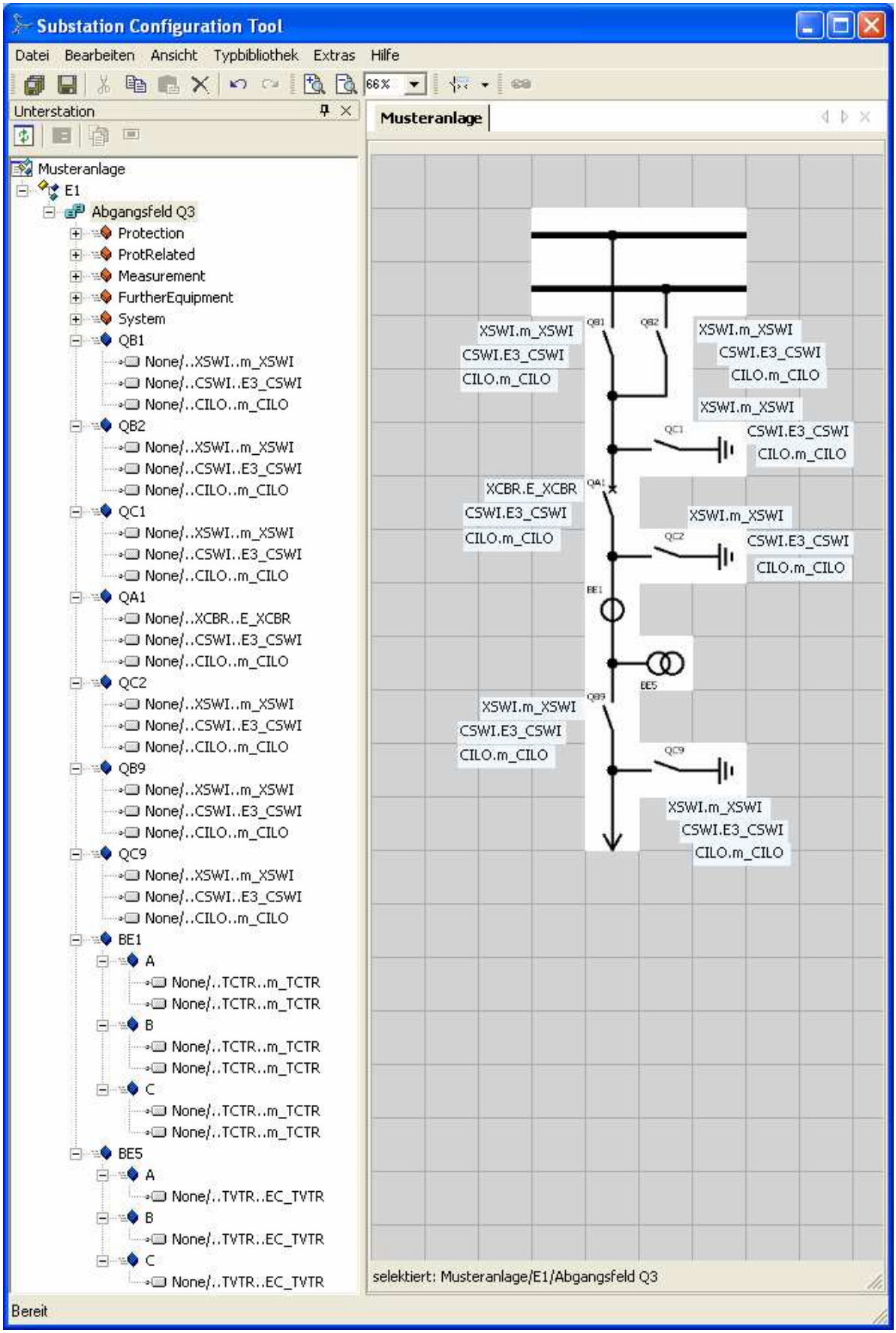


Comments:

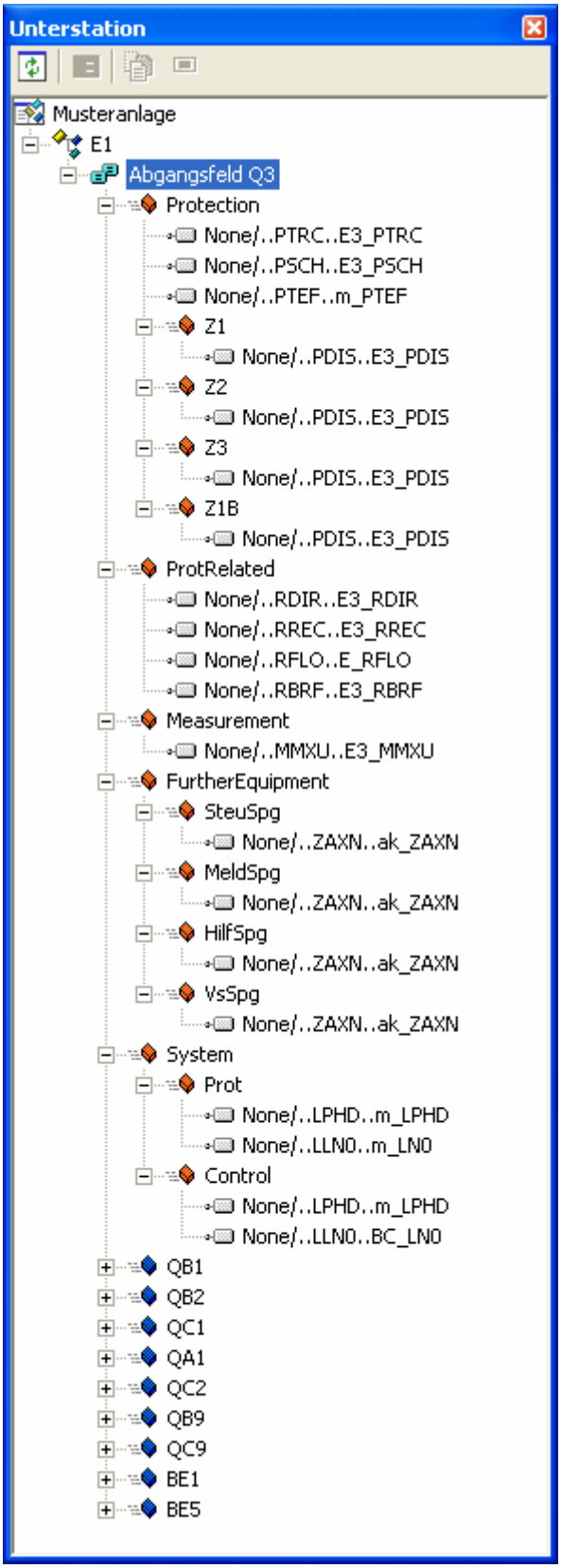
- Operating current measurement (BI1) via protection measurement core

3.3.10 110-kV outgoing feeder bay E1Q3

Bay topology and equipment-related functions:



Bay functions:

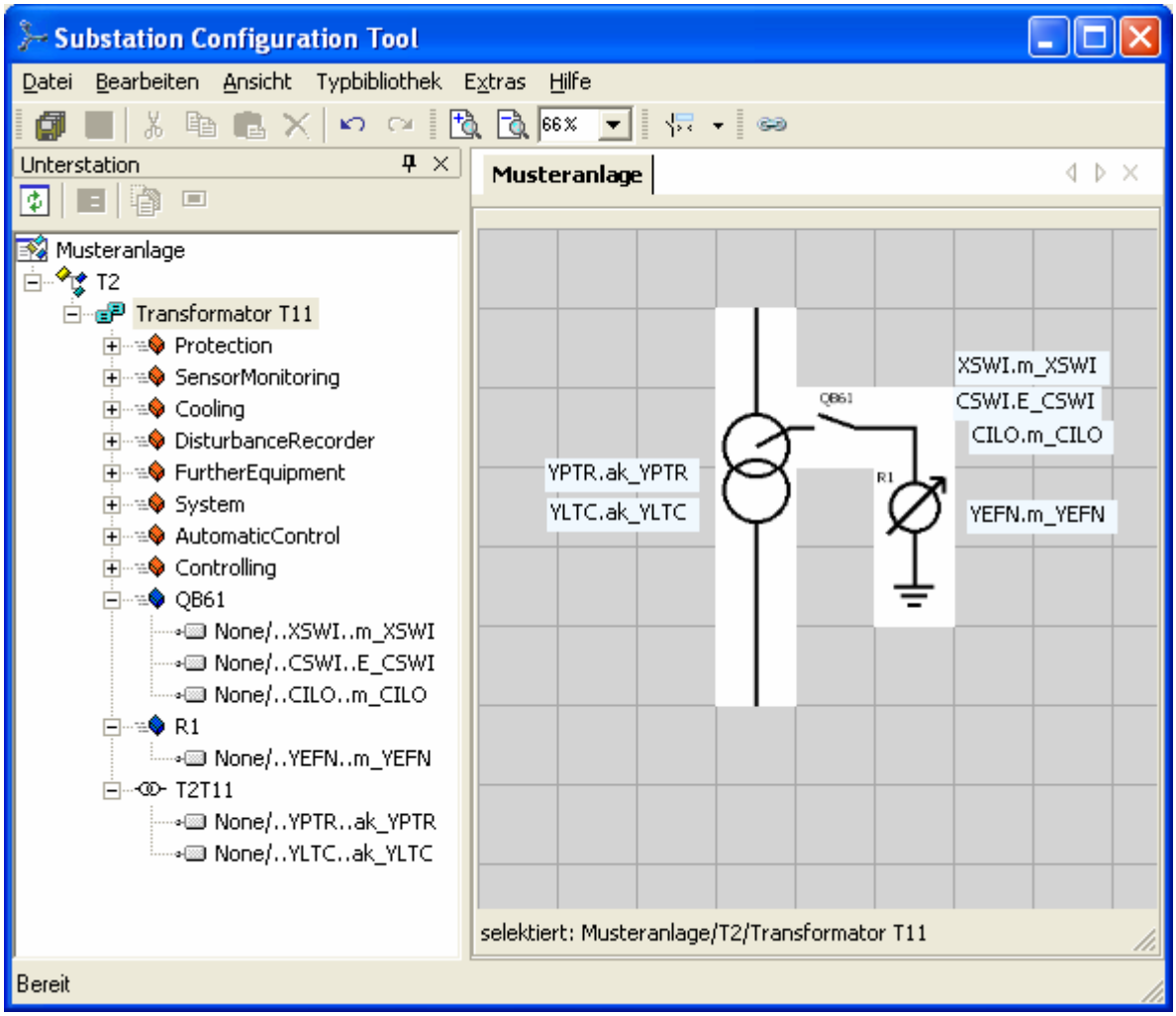


Comments:

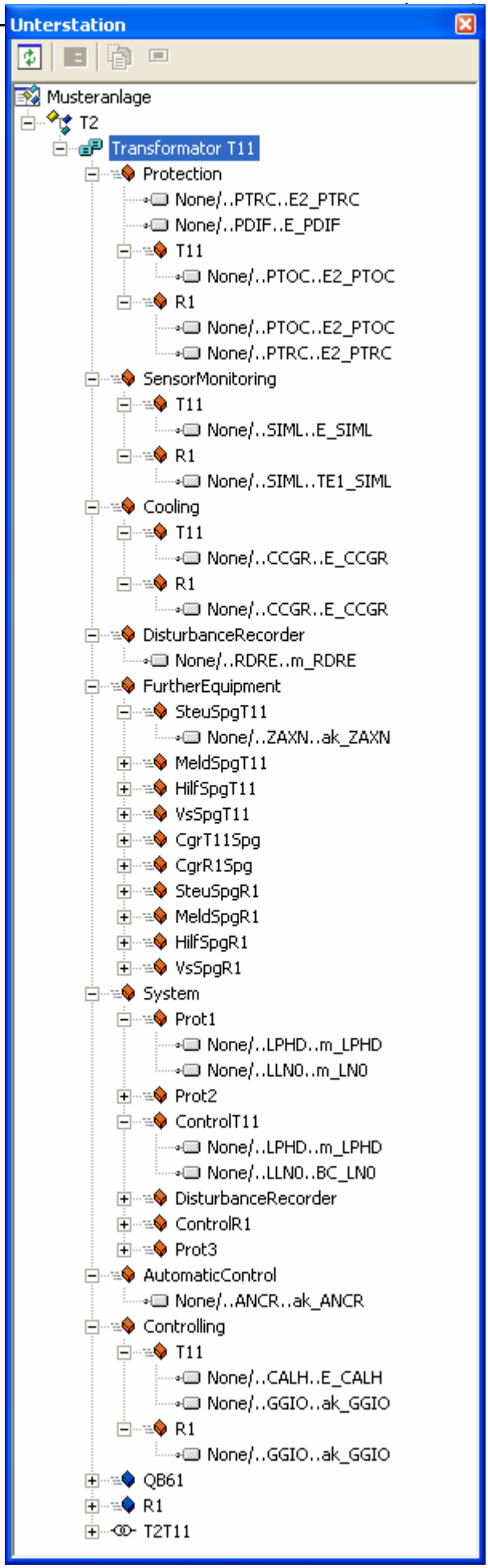
- Current measurement (BI1) with separate protection and operation measurement core

3.3.11 110/10-kV transformation T2T11 and E-coil E1R1

Bay topology and equipment-related functions:



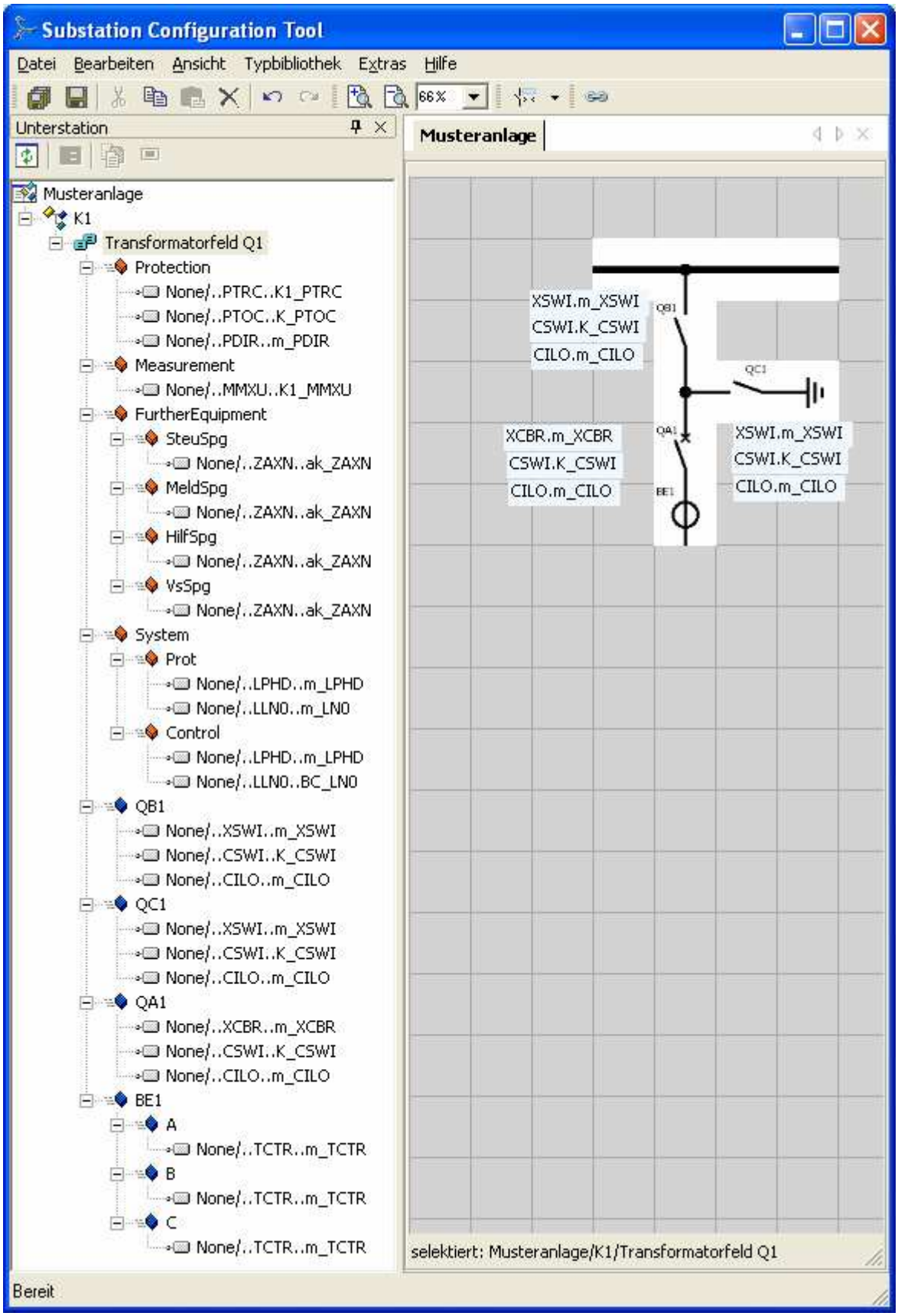
Bay functions:



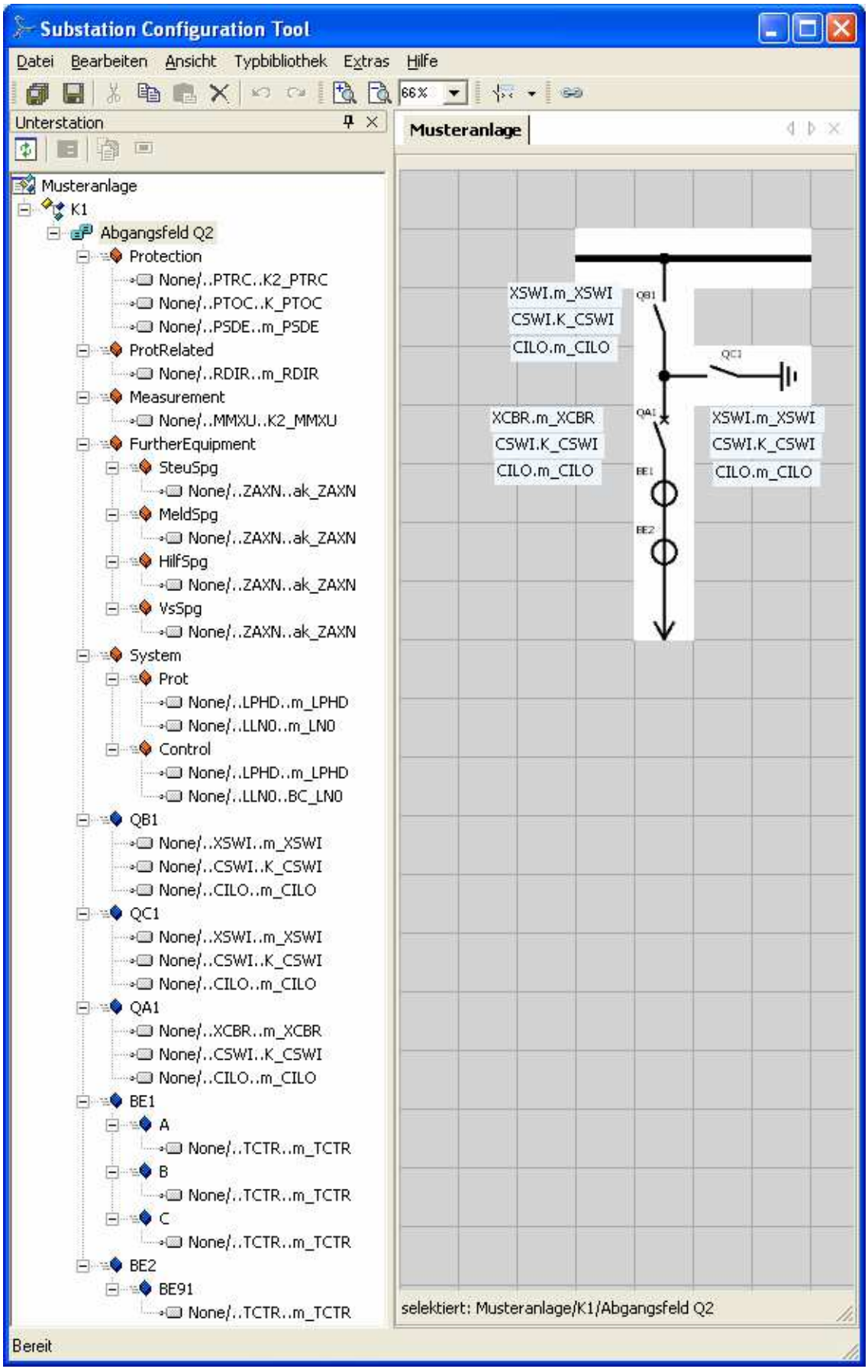
Comments:

- Some functions can also be assigned to the equipment (e.g. T11 or R1) if only one LN is required (e.g. SIML, CCGR).

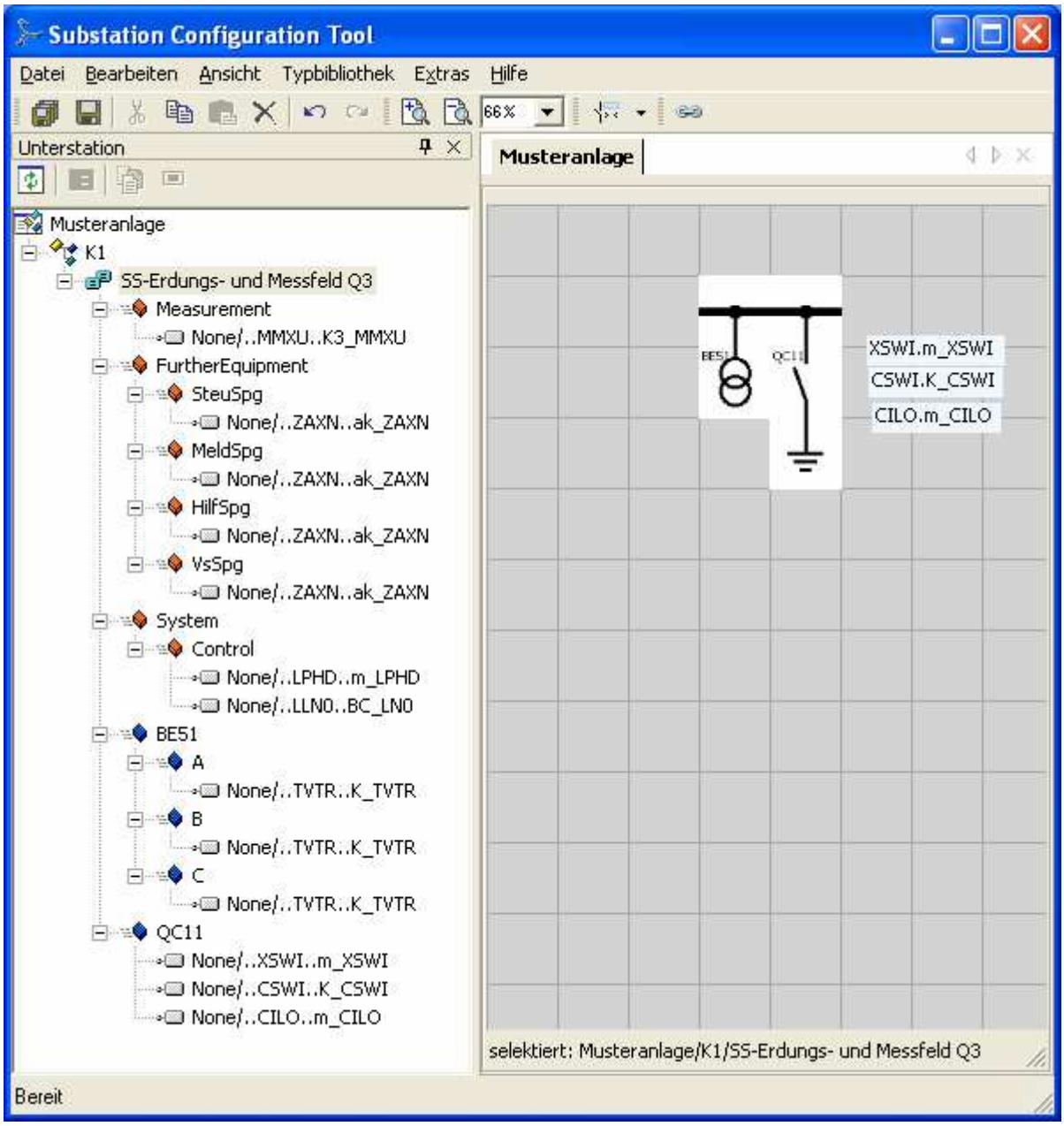
3.3.12 10-kV transformer bay K1Q1



3.3.13 10-kV outgoing feeder bay K1Q2



3.3.14 10-kV busbar earthing and measurement bay K1Q3



3.4 Product mapping to actual IED structures

Engineering step IV:

In this step, the product is mapped to a concrete system structure including the associated transition to the product-related perspective. This includes the assignment to the IED names and the logical devices of the IED structure and the allocation of the instance numbers.

The transition to the product structure is subsequently demonstrated in two ways at the example of the 110-kV outgoing feeder bay E1Q3:

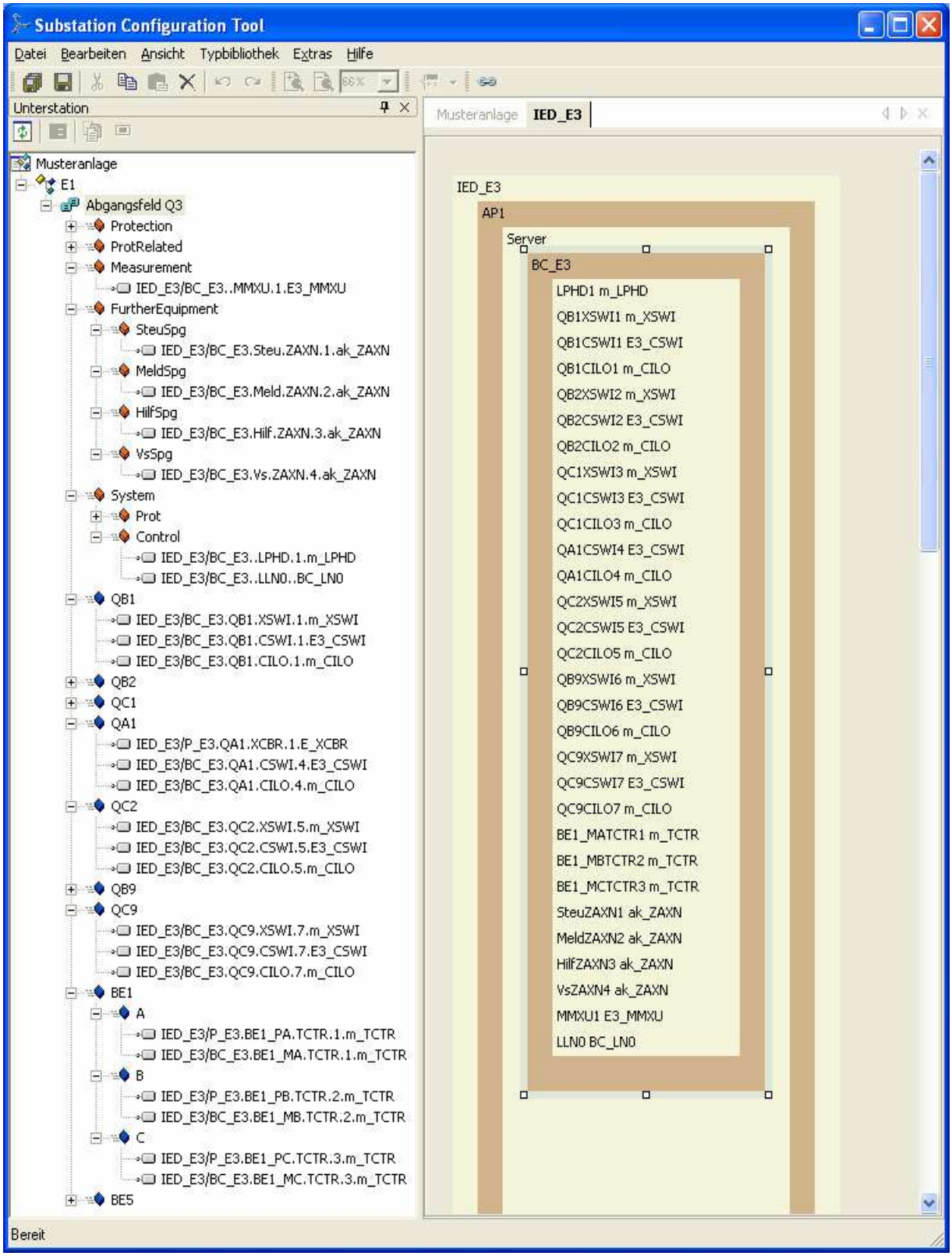
In section 0 the function-related typing is taken over into the IED. Thus, both the substation section and the IED section of the SCL data refer to the same data type.

Section 3.4.2 shows the import of a product-related typing (.icd file) which is then assigned to the function-related typing. Here, both the data type in the substation section and in the IED section is retained.

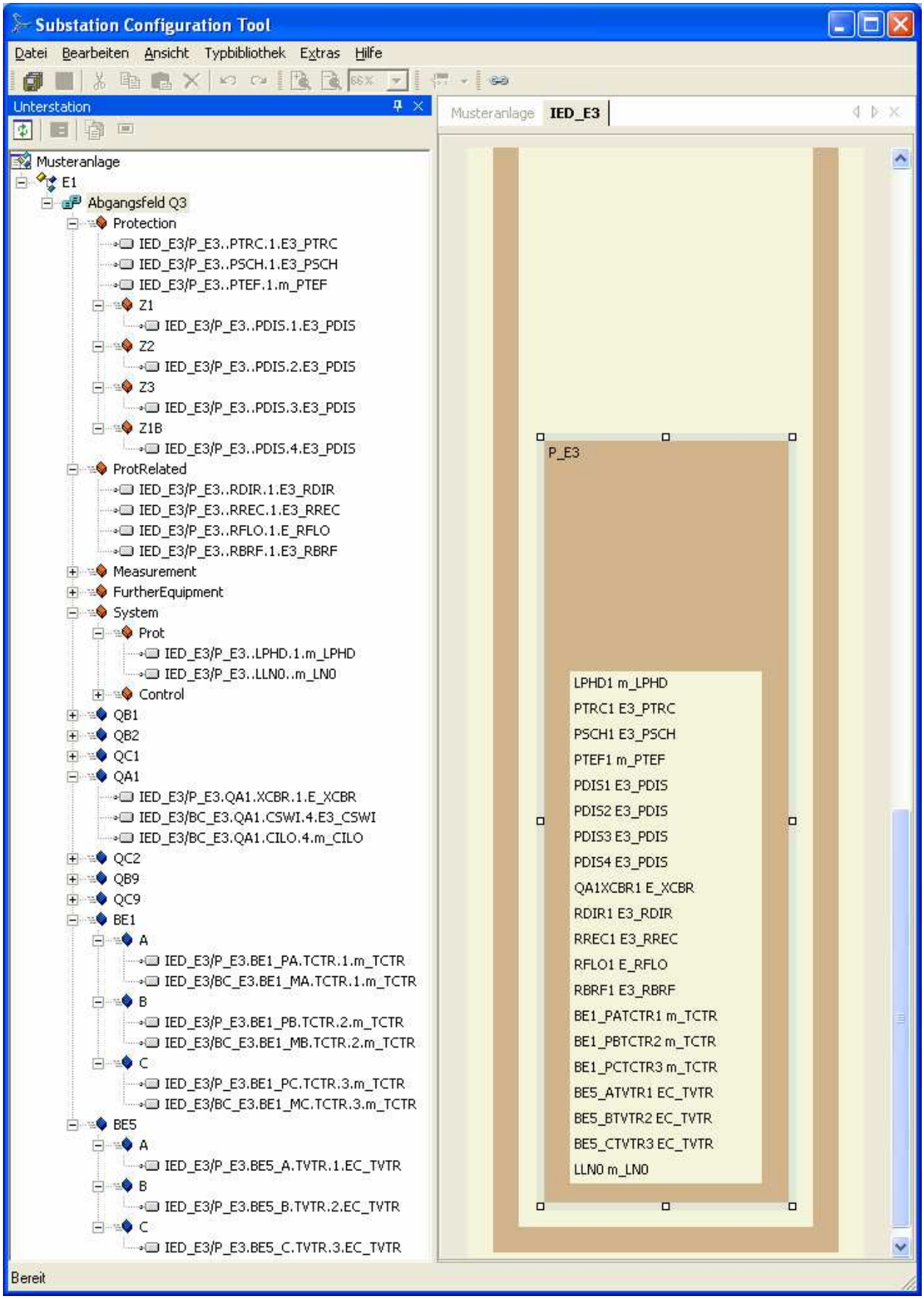
3.4.1 110-kV outgoing feeder bay E1Q3, taking over the function-related typing

Here, the functional perspective is taken over into the product structure. All data types from the substation section are taken over into the IED section with both sections referring to the same type. Ideally, the prefixes and instance numbers can also be assigned freely.

IED structure (logical device BC):



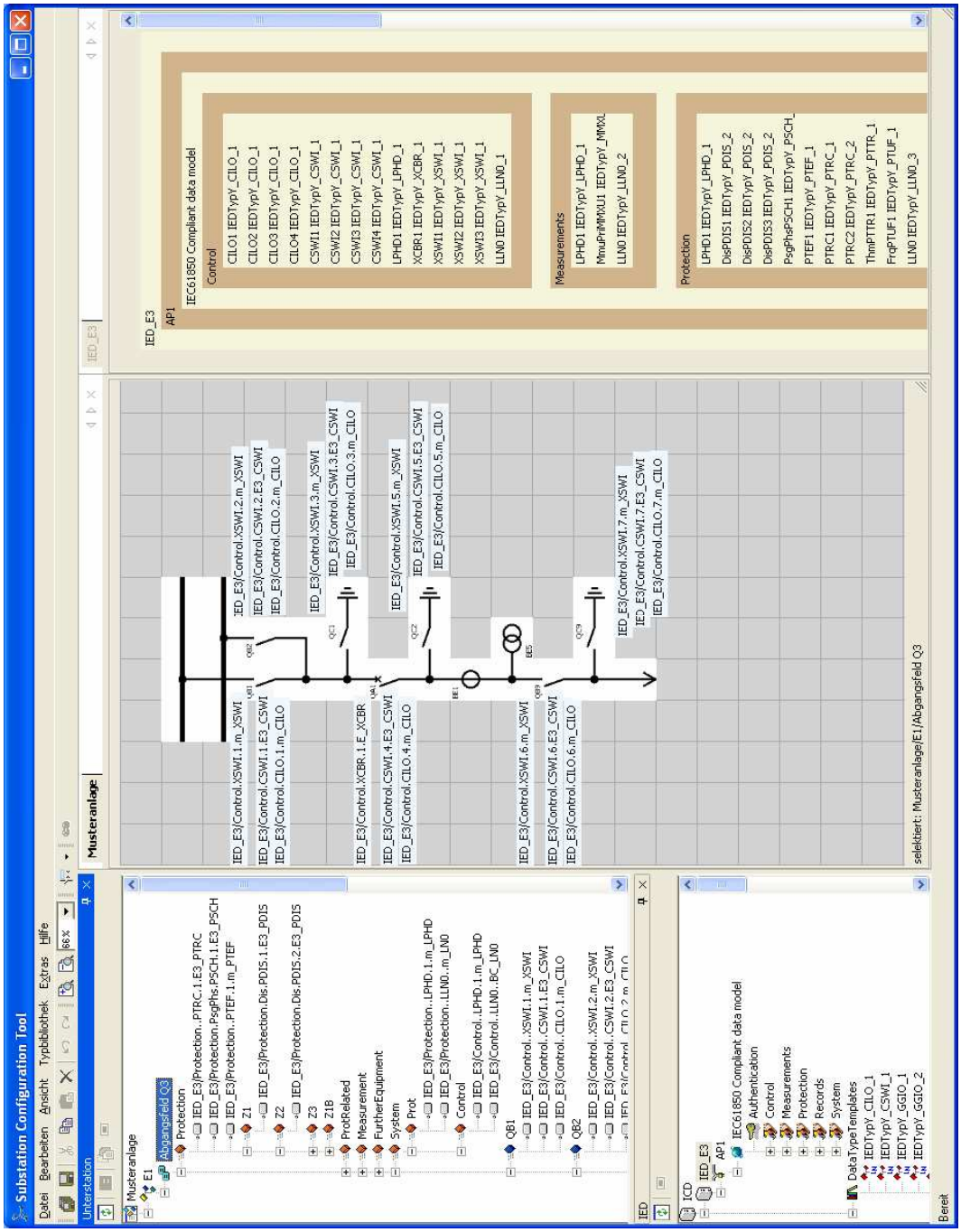
IED structure (logical device P):



3.4.2 110-kV outgoing feeder bay E1Q3, importing a product structure

Importing a given product structure requires a comparison with the function-related typing to be carried out.

The import is shown here at a subset of the information model only because a complete comparison would require a manual, device-specific adaptation in order to provide the required information objects (LN, DO, DA) exactly or as superset. Also no prefix was assigned to label the primary devices since it can not yet be known at the time the IED is configured. A prefix already determined by the product structure is, however, retained (e.g. for the protection zones in the illustrated example). The different types to which the substation section and IED section refer are clearly visible.



4 Appendix
Modelling guidelines of DKE GAK 952.0.15

4.1 Introduction

Parallel to the specification of the sample substation, the GAK 952.0.15 had already defined guidelines for its modelling. The result of this modelling was textual tables regarding the information scope of the substation.

The text of the guidelines of GAK 952.0.15 (version 1.0 dated 10th February 2006) is used here to document the consistent continuation of the GAK work conducted by the working group 952.0.1. Cross-reference and comments concerning the current modelling are given to point out modifications or new findings of the SCL-based modelling. These cross-references are underlined.

The numbered items in section 4.2 refer to the bulleted list in section 2 “General Notes” and the items in section 4.2.6 refer to the bulleted list in section 3 „Rules for Modelling Data“ in part D of the GAK15 document. The irrelevant items were also listed to facilitate the orientation, but their text was not included.

4.2 General Notes

4.2.1 not relevant

4.2.2 not relevant

4.2.3 Settled or revised (see 2.1)
Process modelling (switch, merging unit/transducer) only for bay C2

4.2.4 not relevant

4.2.5 The units (BC, P,...) listed in the substation definition (configurator) have to be modelled as logical devices each. The compilation in physical devices is not in the focus of the working group.

4.2.6 not relevant

4.3 Rules for modelling data

4.3.1 Revised: "-" is not permitted as part of the name. Replaced by underscore.
Naming for logical devices (LD): The name is composed of the designation of the LD in the configurator and the substation partial name. Examples: P-E1, P1-C2, BC-K2, etc.

4.3.2 Settled, see 0..
If a LN is required for modelling, an instance has to be created. A prefix is used for process LNs which integrates the designation of the process device, e.g. LN XCBR – name of process device Q0 – instance Q0XCBR.

4.3.3 Irrelevant since modelled with SCL.
Revised according to 2.1.
All LNs that only exists in a functional perspective and are thus not transferred to a communication bus outside of a device are written in italics and only indicated in the tables of the LDs. A further detailed description in the subordinate LN tables is not provided, e.g. data which is transmitted between LNs in one device only.

4.3.4 Irrelevant since modelled with SCL.
Column Value & Report Text: Message texts in the column "Values and Report Text" are written without equals sign and in upper case. Example: OK / WARNUNG/ STOER. Values of attributes are highlighted by a preceding equals sign and are always written in lower case. Example: „= false" or „= status-only".

4.3.5 Settled, see 2.1: All process connections are modelled.
All switching functions (XCBR, XSWI) in the 380-kV level for which the process bus is used/modelled must have the poles modelled individually (Q0XCBR1 ...3, XSWI1 …3). This concerns only substation part C2. 380-kV switching devices wired in parallel are modelled in the bay device by an XCBR/XSWI instance.

4.3.6 Settled, is modelled with "subequipment".
For all switch controls (CSWI) in the 380-kV level the positions of the individual poles must be indicated. CSWI: Pos, PosA, PosB, PosC

4.3.7 Modelling the datum position of CSWI and XCBR: Generally, switching is always with "Enhanced Security".
In case of a bay-oriented process bus, the "direct-with-enhanced-security" control model is sufficient for the XCBR. Reason: There is only one control point that can access the XCBR, therefore an SBO (Select Before Operate) is not necessary.
When communicating via the substation bus (substation controller - bay controller), the "sbo-with-enhanced-security" control model is required for CSWI. Reason: Risk that several control points want to access CSWI simultaneously.
If the circuit breaker XCBR is wired in parallel, the "direct-with-enhanced-security" control model is required for the XCBR.

4.3.8 Settled since entirely modelled with SCL.
Representation of nested data (e.g. for CDC WYE and DEL)
Only the first datum is entered in the "Data" column. All other (nested) data are shown together with the attribute in the column "(Data.)Attribute". Example PPV.phsCA.cVal.mag
representation under column "Data": PPV
representation under column „(Data.)Attribute": phsCA.cVal.mag

4.3.9 Settled, see 0.
Data Mode: The attribute "ctlval" shall only be used in LLNO; the attribute "ctlval" shall not be used for all other logical nodes but only the attribute "stVal".
The following attributes shall be used:
ctlVAL (LLNO only), stVal, q, t, ctlModel
Reason: Limiting the data volume, e.g. it does not make sense to switch off the fifth zone of the distance protection, security aspect "overriding certain functions should only be possible locally"
Information: The information block is set via a parameter of the report.

4.3.10 The following attributes shall be used for controlling a switching device (e.g. Data Pos, CDC DPC):
ctlVal, stVal, origin, ctlNum, q, t, ctlModel

4.3.11 OpCntRs should only be controllable locally, i.e. no ctlVal. Reason: corresponds to present-day practice.

4.3.12 The following attributes shall be used for the datum NamPlt:
vendor, swRev, d
The configRev attribute may only be used in LLN0.

4.3.13 The data TotW and TotVAr must be modelled according to the information list in bay C2 in MMXU.

4.3.14 Settled, see 2.1.3.The LN GGIO (or GAPC) can be used for messages or the like for which no LNs or DATA are available. Any number of instances can be created for the DATA within this LN. A serial number is suffixed to form an instance. Example: BinIn → BinIn1, BinIn2

4.3.15 Not used.
New LNs or DATA shall be created according to the rules of IEC 61850-7-4 Annex A for data that can not be modelled by existing LNs or DATA. These newly defined objects shall be commented correspondingly, i.e. why and for which purpose the new object was created. When naming the objects use the proposed abbreviations (see IEC 61850-7-4 chap. 4). If these abbreviations are not sufficent, a new abbreviation can be created. This new abbreviation must be commented, too.

4.3.16 Use LN LPHD for physical device messages.

4.3.17 Settled or revised, see 0.
LNs of the type ZAXN (auxiliary network) are used to monitor the auxiliary voltages. One LN ZAXN is used for each bay with the DATA of

all monitored voltages. The following DATA are supplemented in ZAXN for this purpose: EEHealth1 ... EEHealth2 etc.

4.3.18 System monitoring via DATA "Health": FE STOER (bay unit fault) and FE WARNG (bay unit warning) are defined in LPHD of the corresponding LD (each via Health). The messages report physical disturbance; functional (logical) disturbances are documented by the Healt elements of the corresponding LNs. The user functions of the device in use must ensure that all LPHD nodes within the device have the same Health status.

4.3.19 Settled or revised, see 0, 2.1.3.

Monitoring of the control voltage enters both ZAXN and equipment EEHealth.

Monitoring of control voltage of switching device: Is it desired that the supervision of the control voltage of a switching device is fed into the "Health" function of the associated LN QxCSWI? Health = green means that the device can be switched. Decision: Health only for function-related conditions, do not use to incorporate external information to this function. Monitoring of the control voltage of a switching device must be implemented via ZAXN.

4.3.20 Synchro check/ parallel switching: The reference system for the voltages to be synchronized must be identical. It is not clear whether this can be used as a base for the measured value acquisition in the two devices involved when the time is set via the bus (high accuracy requirement: simultaneous detection in both locations). Pragmatic solution: Wiring the required measured values to the RSYN devices. Alternative solution: Clocking of the transformers e.g. via external clock-pulse generation (clock input in the merging unit or at the intelligent transformer).

4.3.21 RSYN (synchro check/ parallel switching): The angle difference must be modelled. The difference of voltage and frequency is not necessary because the two values have to be provided from the bay value and comparison value and have to be displayed according to the information list.

4.3.22 The busbar protection based on the pickup comparison is modelled via PDIR (reverse interlocking).

4.3.23 Settled, see 0.

Setpoints (ASP): Remove all setpoints/settings from the modelling, since they are often manufacturer-specific.

4.3.24 NOT-UMZ (backup O/C protection) (for distance protection and voltage failure) is modelled as blocked or On in the DATA mode of LN PTOC.

4.3.25 Using the attributes available in the standard for monitoring to the extent available.

4.3.26 Settled, see Application Description

Information blocks (e.g. data transmission stop) are implemented by setting the ReportControls which are defined separately to 'disabled' via the service SetDataValue. Please note in this context that the possibility

to define ReportControls may be limited by the available device technology.

4.3.27 Settled, see Application Description
Local control to be modelled, using the datum Loc only in LN LLNO.

4.3.28 Settled, see Application Description
Only the corresponding (of each level) local/remote switchover is taken into account, i.e. one message "local" or "remote" is issued for each switchover. But how is a command block implemented from the HMI (i.e. remote/local switchover from HMI for one bay)? No modelling required or the datum Loc must be present in the bay.

4.3.29 NAHSTEU = control on substation level
ORTSTEU = control on bay level
FERNSTEU = control on network control level
Only the corresponding (of each level) local/remote switchover is taken into account, i.e. one message "local" or "remote" is issued for each switchover.

4.3.30 How is a command block implemented from the HMI (i.e. remote/local switchover from HMI for one bay)? No modelling required or the datum Loc must be present in the bay.

4.3.31 Remote deactivation of an interlock is not modelled.

4.3.32 "Name Space" only has to be used if LN, data, attribute or CDC are changed or added. "Name Space" must therefore not be used if these data are used unchanged.

4.3.33 Values have to be specified for some attributes, e.g. for ctlModle, etc.

4.3.34 A fault recording must be modelled as a separate logical device.

4.3.35 Settled, see 0.
If the auxiliary voltage is affected, the monitoring by ZAXN comes additionally.
For trip circuit supervision, the datum EEHealth of the corresponding LNs (XCBR, XSWI) must be used. Message "trip circuit failure".

4.3.36 The messages measured value supervision of current and voltage and phase sequence supervision are not modelled initially because no corresponding objects are available in IEC 61850.Possible solution: Create a new LN "SMMX" (supervision measurands for plausibility check of the sampled values, e.g. warning too few samples).

4.3.37 The message WDL SPG FEHL (no transformer voltage available) is modelled as FUFAIL in TVTR.

4.3.38 The message FE KOMM STOER (bay unit fault coming) is not considered any further for the modelling purpose since no communication via the bus is derived from it. -> In this context, see connection management in IEC 61850-7-2.

4.3.39 MIT PSG NICHT MÖGLICH (not possible with automatic synchronizer): This message is generated if the comparison bay is without voltage and the bay to be connected belongs to a certain bay type (e.g. machine bay, certain coupling bays). The bypassing logic used for normal bays (if the reference bay is dead, connection is permitted without automatic synchronizer check) is not permitted for these bay types. Switching of the automatic synchronizer is therefore aborted in this case. This message is irrelevant for the GAK model substation and can be omitted.

4.3.40 PSG NICHT VORH (automatic synchronizer not available): This message is generated by the substation control unit if the command "with automatic synchronizer" is sent via remote control but no automatic synchronizer is present in the bay in question.

4.3.41 The messages/commands for switching the measured value cycles contained in the lists (e.g. in E1: "KURZ ZYKL EIN") are not modelled since the demands on the transmission of measured values basically refer to the transmission path between substation and network control center. The demands must be defined there.

4.3.42 Settled, see Application Description
FE-Test (bay unit test): This message is largely operator-specific and can be omitted.

4.4 Further modifications to the GAK15 modelling

4.4.1 An earth fault detection for the 380-kV substation section is not planned because of the earthed starpoint.

5 Literature

[1] Harnischmacher, G.; Arph, J.; Hölscher, M.: Effiziente Datenmodellierung im Anlagenengineering nach IEC 61850. etz Elektrotechnik + Automation, 128. Jahrg., Heft 4/2007, S. 40-51(ISSN 0948-7387).