ENERGINET
Eltransmission

Alle spændingsniveauer

Digitalisering af transmissionsnettet – Krav til åbne standarder

EDS-0156

English version is included

Dokumenttitel		EDS-0156 Rev 0 Digitalisering af transmissionsnettet – Krav til åbne standarder							
Dokumentnummer		13/90592-300							
Målgruppe		Energinet og eksterne leverandører							
Gyldig indtil		30. april 2020							
Revisi-on	**Dokument status**	**Forfatter**		**Medforfattere/ Designere**		**Reviewere**		**Godkender**	
		Navn	**Dato**	**Navn**	**Dato**	**Navn**	**Dato**	**Navn**	**Dato**
0	Godkendt	MTM	21.12.2017	JEJ, PIN, JBN, HSC, ASK, AIE, CAS	21.12.2017	ALJ, BBU, BEJ, BSK, CBA, EOM, EWP, FSD, HAB, LHI, JCK, KHK, MVF, PDI, RAO, SLM, TSL	19.03.2018	KSQ	17.04.2018

Indholdsfortegnelse

Design- og konfigurationsstand

1. Anvendelsesområde/indledning

1.1 Åbne standarder generelt

Standarder opstår sædvanligvis ved, at en gruppe aktører inden for et bestemt område erkender behovet for fælles retningslinjer eller færdselsregler. Kan aktørerne blive enige og opnå konsensus om en fælles 'måde at gøre tingene på', kan en standard defineres. En standard udtrykker således en 'overenskomst' mellem aktørerne.

En it-standard er en præcis beskrivelse af aftalte krav, der skal overholdes i en bestemt sammenhæng eller teknisk løsning. En it-standard sikrer dermed, at de byggesten, der bruges til at lave it-systemer, passer sammen.

It-systemer udvikles for at understøtte forretningsbehov ved at digitalisere forretningsprocesser. Der kan opnås store fordele, når der aftales fælles spilleregler for udvikling af nye systemer samt tekniske og indholdsmæssige datadefinitioner, der kan genbruges, og som ikke kun gælder mellem to parter, men mellem alle med et fælles forretningsbehov. Disse regler og tekniske definitioner kaldes standarder.

Det betyder, at jo flere der kan enes om en given standard, jo flere kan udnytte de muligheder, dette giver for at kommunikere. Det kan blive en selvforstærkende tendens og motivere leverandører til at udvikle produkter baseret på standarder.

Standarder, der kan aftales internationalt, er at foretrække, da disse vil sikre størst mulig udbredelse samt stabilitet omkring standardvalget. Men da it-udviklingen går meget hurtigt, og standardiseringsarbejdet kræver tid, debat og megen koordination, er det sjældent muligt at opnå globale standarder, der vinder tilslutning fra alle.

OIO-standarder vil i udgangspunktet ofte være baseret på internationale standarder. Det kan dog være nødvendigt med tilpasninger til særlige nationale forhold og behov. Det er imidlertid et generelt kendetegn ved den danske standardiseringsproces, at den altid søger et udgangspunkt i internationale standarder og derved sikrer, at de nationale standarder understøttes af it-industrien, og at nationale systemer kan hænge sammen med internationale.

1.2 Energinets krav om anvendelse af åbne standarder

Energinet stiller generelt krav om åbne standarder, hvilket betyder:

- Standarderne skal være åbne.
- Standarderne skal understøtte myndighedernes forretningsmæssige og forvaltningsmæssige behov og støtte op om centrale forvaltningsprocesser.
- Standarderne skal være understøttet på markedet.

1.3 Anvendelsesområde for denne standard

Denne standard skal anvendes til alle nye bygge- og anlægsprojekter, der vedrører opførelse af nye højspændingsstationer, som ifølge beslutning skal være digitale stationer.

Denne standard skal anvendes til alle nye bygge- og anlægsprojekter, der vedrører om- og nybygninger på eksisterende højspændingsstationer, som ifølge beslutning skal overgå til at være digitale stationer, dog senest gældende pr. 1. januar 2020.

1.4 Forkortelser og definitioner

ABAC	Attribute-based access control
BIM	Bygnings informations modellering
BPMN	Business Process Model and Notation
CGMES	Common grid model exchange specification
CIM	Common Information Model (CIM format)
EDS	Energinet design- og konfigurationsstandard
EGS	Energinet guideline
EMC	Elektromagnetisk kompatibilitet
ENISA	European Union Agency for Network and Information Security
ENTSO-E	European Network of Transmission System Operators for Electricity
FESD	Fællesoffentlig Elektronisk Sags- og Dokumenthåndtering
IEC	International Electrotechnical Commission
IFC	Industry Foundation Classes (IFC format)
IRIG	Inter-range instrumentation group
ISO	International Organization for Standardization
OCES	Offentlige Certifikater til Elektronisk Service
ODF	Open Document Format (ISO standard)
OIO	Offentlig information online
OIOUBL	Format til elektronisk faktura (e-faktura)
OIOXML	Standardiseret udvekslingformat for offentlige myndigheder i Danmark
OOXML	Office Open XML
PDF	Portable document format
PQ	Power quality
PTP	Precision time protocol
RBAC	Role-based access control
SCL	Substation configuration language
UML	Unified Modeling Language

2. Referencer og standarder

2.1 Generelle standarder

Følgende generelle standarder skal anvendes:

- Standarder for dokumentudveksling (ODF, OOXML og PDF)
- Standarder for udveksling med offentlige myndigheder:
    - Standarder for dataudveksling mellem offentlige myndigheder (OIOXML)
    - Standarder til elektronisk sags- og dokumenthåndtering (FESD)
    - Standarder til elektroniske indkøb i det offentlige (OIOUBL)
    - Standarder for offentlige netsteder, hjemmesider og tilgængelighed
- Standarder for it-sikkerhed (ISO 27000-serien, IEC 62443-serien, IEC 62351-serien)
- Standarder for digital signatur (OCES-certifikat) (eller alternativ digital signatur/identifikation)
- Standarder for IFC datamodellen (en model som danner grundlag for deling og udveksling af data). Datamodellen IFC er en neutral standard, som kan bruges uafhængigt af it-system og -platform (IFC format).

2.2 Lovgivning, Tekniske forskrifter og Energinet standarder

Følgende lovgivning er gældende:

- LOV nr. 502 af 23/05/2018 Lov om supplerende bestemmelser til forordning om beskyttelse af fysiske personer i forbindelse med behandling af personoplysninger og om fri udveksling af sådanne oplysninger (databeskyttelsesloven).

Følgende Teknisk Forskrift fra Energinet er gældende:

- TF 5.8.1 Måledata til systemdriftsformål: 2011

Den vil blive afløst af de 3 nedenstående Tekniske Forskrifter fra Energinet:

- TF 5.8.1 Dataudveksling produktion og forbrug (under udarbejdelse)
- TF 5.8.2 Dataudveksling stationer (under udarbejdelse)
- TF 5.8.5 Formater af data, kommunikationsprotokoller, sikkerhed (under udarbejdelse)

Følgende it-standard fra Energinet er gældende:

- It-standard nr. 9 ”Standard for adgangsstyring”

Følgende tekniske standarder fra Energinet er gældende:

- EDS-0064 Navngivning af højspændingsanlæg
- EGS-0047 Afprøvning – Testprocedure – Styring og overvågning

2.3 Overordnet overblik over åbne standarder

Herunder gives et samlet overblik over hovedgrupper af standarder, der skal anvendes:

Bygge-, anlægs- og driftsopgaver:

- IFC datamodel (Anvendes til Bygningsmodel og Asset Management)

Realtidsdata:

- IEC 61850 serien anvendes mod fysiske anlæg

Navngivning og strukturering af data:
Alle nedenstående standarder udgør tilsammen CIM-standarderne:

- IEC 61970 (CGMES) Beskrivelse af net og stationskomponenter
- IEC 61968 Beskrivelse af data til Asset Management, afregningsmåling, miljøformål mv.
- IEC 62325 Beskrivelse af data til elmarkedsudveksling

2.4 Internationale åbne standarder

Herunder gives en liste over de internationale åbne standarder, der skal anvendes. De nævnte standarder er oplistet i nummerorden.

Bygningsmodel til bygge- og anlægsprojekter samt drift og vedligehold (IFC):

- ISO 15686-4:2014 Building Construction -- Service Life Planning – Part 4: Service Life Planning using Building Information Modelling
- DS/EN ISO 16739:2016 IFC til datadeling inden for byggeri og facilitymanagement
- DS/ISO 16757-2:2016 Datastrukturer for elektroniske produktkataloger over byggeprodukter – Del 2: Geometri

ISO 27000-serien – Standarder for it-sikkerhed:

- DS/ISO/IEC 27000:2018 Informationsteknologi – Sikkerhedsteknikker – Ledelsessystemer for informationssikkerhed – Oversigt og ordliste
- DS/EN ISO/IEC 27001:2017 Informationsteknologi – Sikkerhedsteknikker – Ledelsessystemer for informationssikkerhed – Krav
- DS/EN ISO/IEC 27002:2017 Informationsteknologi – Sikkerhedsteknikker – Regelsæt for styring af informationssikkerhed
- DS/ISO/IEC 27003:2017 Informationsteknologi – Sikkerhedsteknikker – Ledelsessystemer for informationssikkerhed – Vejledning
- DS/ISO/IEC 27005:2018 Informationsteknologi – Sikkerhedsteknikker – Informationssikkerhed – Risikoledelse
- DS/ISO/IEC 27006:2015 Informationsteknologi – Sikkerhedsteknikker – Krav til organer, der foretager audit og certificering af ledelsessystemer for informationssikkerhed
- DS/ISO/IEC TS 27008:2019 Informationsteknologi – Sikkerhedsteknikker – Retningslinjer for vurdering af informationssikkerhedsstyring
- DS/ISO/IEC 27019:2017 Informationsteknologi – Sikkerhedsteknikker – Informationssikkerhedskontrol for energiforsyningsindustrien

Øvrige standarder for it-sikkerhed:

- IEC 60255-24:2013 Measuring relays and protection equipment – Part 24: Common format for transient data exchange (COMTRADE) for power systems
- IEEE 1159.3-2019 IEEE Approved Draft Recommended Practice for Power Quality Data Interchange Format (PQDIF)of Power Quality Data

IEC 61400-serien – Standarder for kommunikation med vindmøller:

- DS/EN 61400-25-1:2017 Elproducerende vindmøller – Del 25-1: Kommunikationssystemer til overvågning og styring af vindkraftanlæg – Overordnet beskrivelse af principper og modeller
- DS/EN 61400-25-2:2015 Elproducerende vindmøller – Del 25-2: Kommunikationssystemer til overvågning og styring af vindkraftanlæg – Informationsmodeller
- DS/EN 61400-25-3:2015 Elproducerende vindmøller – Del 25-3: Kommunikationssystemer til overvågning og styring af vindkraftanlæg – Modeller for informationsudveksling
- DS/EN 61400-25-4:2017 Vindenergisystemer – Del 25-4: Kommunikationssystemer til overvågning og styring af vindkraftanlæg – Kortlægning til kommunikationsprofil
- DS/EN 61400-25-5:2017 Vindkraftanlæg – Del 25-5: Kommunikationssystemer til overvågning og styring af vindkraftanlæg – Overensstemmelsesprøvning

- DS/EN 61400-25-6:2017 Vindenergisystemer – Del 25-6: Kommunikationssystemer til overvågning og styring af vindmølleanlæg – Klasser for logiske knudepunkter og dataklasser anvendt ved tilstandsovervågning

IEC 61850-serien – Standarder for kommunikation med fysiske anlæg:

- IEC TR 61850-1:2013 Communication networks and systems for power utility automation – Part 1: Introduction and overview
- IEC TS 61850-2:2003 Communication networks and systems in substations – Part 2: Glossary
- DS/EN 61850-3:2014 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 3: Generelle krav
- DS/EN 61850-4:2011 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 4: System- og projektledelse
- DS/EN 61850-5:2013 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 5: Kommunikationskrav til funktioner og udstyrsmodeller
- DS/EN 61850-6:2010 cd-rom Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 6: Sprog til beskrivelse af konfiguration til kommunikation i elektriske understationer med intelligent elektronisk udstyr (IED)
- DS/EN 61850-6:2010/A1:2018 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 6: Sprog til beskrivelse af konfiguration til kommunikation i elektriske understationer med intelligent elektronisk udstyr (IED)
- DS/EN 61850-7-1:2011 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 7-1: Grundlæggende kommunikationsstruktur – Principper og modeller
- DS/EN 61850-7-2:2010 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 7-2: Grundlæggende informations- og kommunikationsstruktur – Abstrakt kommunikationsserviceinterface (ACSI)
- DS/EN 61850-7-3:2011 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 7-3: Grundlæggende kommunikationsstruktur – Fælles dataklasser
- DS/EN 61850-7-4:2010 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 7-4: Grundlæggende kommunikationsstruktur – Kompatible logiske nodeklasser og dataobjektklasser
- DS/IEC TS 61850-7-7:2018 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 7-7: Maskinlæsbart format beregnet til IEC 61850-relaterede værktøjsdatamodeller
- DS/EN 61850-7-420:2009 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 7-420: Basiskommunikationsstruktur – Distribuerede energiressourcers logiske noder
- DS/IEC TR 61850-7-500:2017 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 7-500: Grundlæggende information og kommunikationsstruktur – Anvendelse af logiske noder til modellering af applikationsfunktioner samt relaterede begreber og retningslinjer for transformerstationer
- DS/EN 61850-8-1:2011 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 8-1: Specifik mapping af kommunikationssystem (SCSM) – Mapping til MMS (ISO 9506-1 og ISO 9506-2) og til ISO/IEC 8802-3
- DS/EN 61850-9-2:2012 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 9-2: Specifik mapping af kommunikationssystem (SCSM) – Samplede værdier via ISO/IEC 8802-3
  (Denne standard (DS/EN 61850-9-2) anvendes til kommunikation af hurtigt samplede værdier fra processen (måletransformere, koblingsudstyr, o.lign.) enten direkte eller via Merging Units, hvor man fx har gamle måletransformere, som ikke har deres egen IEC 61850 udgang. Netværket til procesinformation kaldes Procesbus.)

- DS/IEC/IEEE 61850-9-3:2016 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 9-3: Profil for Precision Time Protocol til elforsyningsautomation
- DS/EN 61850-10:2013 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 10: Overensstemmelsesprøvning
- IEC TS 61850-80-1:2016 Communication networks and systems for power utility automation – Part 80-1: Guideline to exchanging information from a CDC-based data model using IEC 60870-5-101 or IEC 60870-5-104
- DS/IEC TR 61850-80-3:2015 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 80-3: Mapping til webprotokoller – Krav og tekniske valg
- IEC TR 61850-90-1:2010 Communication networks and systems for power utility automation – Part 90-1: Use of IEC 61850 for the communication between substations
- DS/IEC/TR 61850-90-2:2016 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 90-2: Brug af IEC 61850 til kommunikation mellem understationer og kontrolcentre
- DS/IEC TR 61850-90-3:2016 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 90-3: Brug af IEC 61850 til diagnose-overvågning og analyse af driftforhold
- IEC TR 61850-90-4:2013 Communication networks and systems for power utility automation – Part 90-4: Network engineering guidelines
- IEC TR 61850-90-5:2012 Communication networks and systems for power utility automation – Part 90-5: Use of IEC 61850 to transmit synchrophasor information according to IEEE C37.118
- DS/IEC TR 61850-90-6:2018 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 90-6: IEC 61850 brugt i distributionsautomationssystemer
- IEC TR 61850-90-7:2013 Communication networks and systems for power utility automation – Part 90-7: Object models for power converters in distributed energy resources (DER) systems
- DS/IEC TR 61850-90-8:2016 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 90-8: Objektmodel for elkøretøjer
- DS/IEC TR 61850-90-10:2017 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 90-10: Skeduleringsmodeller
- DS/IEC TR 61850-90-12:2015 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 90-12:Vejledning i opbygning af Wide Area Network
- DS/IEC TR 61850-90-17:2017 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 90-17: Benyttelse af IEC 61850 til overførsel af data for elkvalitet

<u>Øvrige standarder for kommunikation med fysiske anlæg:</u>

- DS/EN 61869-6:2016 Måletransformere – Del 6: Yderligere generelle krav til laveffekt-måletransformere
- IEC 61869-9:2016 Instrument transformers – Part 9: Digital interface for instrument transformers

<u>IEC-61970-serien – Beskrivelse af net og stationskomponenter:</u>

- DS/EN 61970-1:2007 Grænseflade for systemprogrammel til energiledelse (EMS-API) – Del 1: Vejledning og generelle krav
- DS/CLC/TS 61970-2:2005 Grænseflade for systemprogrammel til energiledelse (EMS-API) – Del 2: Fagudtryk
- DS/EN 61970-301:2017 Grænseflade for applikationsprogrammer til energistyringssystemer (EMS-API) – Del 301: Fælles informationsmodel (CIM)

- DS/IEC/TS 61970-401:2005 Interface-applikationsprogram til energistyringssystem (EMS-API) – Del 401: Struktur for komponentgrænsefladespecifikation (CIS)
- DS/EN 61970-452:2017 Grænseflade for applikationsprogrammer til energistyringssystemer (EMS-API) – Del 452: CIM-profiler for statiske transmissionsmodeller
- DS/EN 61970-453:2014 Energistyringssystemets grænseflade til applikationsprogrammer (EMS-API) – Del 453: Profil for diagramlayout
- DS/EN 61970-453:2014/A1:2019 Energistyringssystemets grænseflade til applikationsprogrammer (EMS-API) – Del 453: Profil for diagramlayout
- DS/EN IEC 61970-456:2018 Grænseflade for applikationsprogrammer til energistyringssystemer (EMS-API) – Del 456: Profil for beregnet elsystemtilstand
- DS/EN 61970-501:2006 Energiledelsessystemers anvendelsesgrænseflade (EMS-API) – Del 501: Fælles informationsmodel som hjælpemiddel til beskrivelse af strukturskemaer (CIM RDF)
- DS/EN 61970-552:2016 Grænseflade for applikationsprogrammer til energistyringssystemer (EMS-API) – Del 552: CIM-XML-modeludvekslingsformat
- IEC TS 61970-555:2016 Energy management system application program interface (EMS-API) – Part 555: CIM based efficient model exchange format (CIM/E)
- DS/IEC TS 61970-556:2016 Energistyringssystemets grænseflade til applikationsprogrammer (EMS-API) – Del 556: CIM-baseret grafisk udvekslingsformat (CIM/G)
- DS/IEC TS 61970-600-1:2017 Grænseflade for applikationsprogrammer til energistyringssystemer (EMS-API) – Del 600-1: Fælles udviklingsspecifikationer for grid model (CGMES) – Strukturer og regler
- DS/IEC TS 61970-600-2:2017 Grænseflade for applikationsprogrammer til energistyringssystemer (EMS-API) – Del 600-2: Fælles udvekslingsspecifikationer for Grid Model (CGMES) – Specifikationer for udvekslingsprofiler

Øvrige standarder for beskrivelse af net og stationskomponenter:

- DS/EN 62271-3:2015 Højspændingskoblingsudstyr – Del 3: Digitale grænseflader baseret på IEC 61850
- DS/IEC TR 62357-200:2015 Elforsyningssystemadministration og tilhørende informationsudveksling – Del 200: Vejledning i migration fra internetprotokol version 4 (IPv4) til internetprotokol version 6 (IPv6)
- DS/IEC TR 62689-100:2016 Strøm- og spændingssensorer eller -detektorer, der skal anvendes til kortslutningsindikering – Del 100: Krav og forslag for datamodeludvidelser til IEC 61850 for at understøtte FPI-anvendelser

IEC 62351-serien – Implementering af cybersikkerhed:

IEC 62351-serien understøtter implementering af cybersikkerhed for serierne
IEC 60870, IEC 61850, IEC 61968, IEC 61970 og IEC 62325.

- DS/IEC/TS 62351-1:2007 Kraftanlægsstyring og tilhørende informationsudveksling – Data- og kommunikationssikkerhed – Del 1: Kommunikationsnetværk og systemsikkerhed – Introduktion til sikkerhedsspørgsmål
- IEC TS 62351-2:2008 Power systems management and associated information exchange – Data and communications security – Part 2: Glossary of terms
- DS/EN 62351-3:2015 Kraftanlægsstyring og tilhørende informationsudveksling – Data- og kommunikationssikkerhed – Del 3: Sikkerhed af kommunikationsnetværk og kommunikationssystemer – Profiler inklusive TCP/IP
- DS/EN 62351-3:2014/A1:2018 Kraftanlægsstyring og tilhørende informationsudveksling – Data- og kommunikationssikkerhed – Del 3: Sikkerhed af kommunikationsnetværk og kommunikationssystemer – Profiler inklusive TCP/IP

- DS/EN IEC 62351-4:2018 Kraftanlægsstyring og tilhørende informationsudveksling – Data- og kommunikationssikkerhed – Del 4: Profiler indeholdende MMS og dens afledninger
- DS/IEC/TS 62351-5:2013 Kraftanlægsstyring og tilhørende informationsudveksling – Data- og kommunikationssikkerhed – Del 5: Sikkerhed for IEC 60870-5 og afledte protokoller
- DS/IEC/TS 62351-6:2007 Kraftanlægsstyring og tilhørende informationsudveksling – Data- og kommunikationssikkerhed – Del 6: Sikkerhed i IEC 61850
- DS/EN 62351-7:2017 Kraftanlægsstyring og tilhørende informationsudveksling – Data- og kommunikationssikkerhed – Del 7: Dataobjektmodeller til netværks- og systemstyring (NMS)
- IEC TS 62351-8:2011 Power systems management and associated information exchange – Data and communications security – Part 8: Role-based access control
- DS/EN 62351-9:2017 Kraftanlægsstyring og tilhørende informationsudveksling – Data- og kommunikationssikkerhed – Del 9: Cybersikkerhedsrelateret nøglehåndtering relevant for materiel i kraftanlægsregi
- DS/IEC/TR 62351-10:2012 Kraftanlægsstyring og tilhørende informationsudveksling – Data- og kommunikationssikkerhed – Del 10: Vejledning for sikkerhedsarkitektur
- DS/EN 62351-11:2017 Kraftanlægsstyring og tilhørende informationsudveksling – Data- og kommunikationssikkerhed – Del 11: XML-dokumenters sikkerhed
- DS/IEC TR 62351-12:2016 Kraftanlægsstyring og tilhørende informationsudveksling – Data- og kommunikationssikkerhed – Del 12: Anbefalinger til robusthed og sikkerhed for cyberfysiske systemer i elsystemer med decentrale energiressourcer (DER)
- DS/IEC TR 62351-13:2016 Kraftanlægsstyring og tilhørende informationsudveksling – Data- og kommunikationssikkerhed – Del 13: Vejledning om datasikkerhedsrelaterede emner dækket af standarder og specifikationer
- DS/IEC TR 62351-90-1:2018 Kraftanlægsstyring og tilhørende informationsudveksling – Data- og kommunikationssikkerhed – Del 90-1: Retningslinjer for håndtering af rollebaseret adgangskontrol i elsystemer

IEC 62443-serien – It-sikkerhed:

- IEC TS 62443-1-1:2009 Industrial communication networks – Network and system security – Part 1-1: Terminology, concepts and models
- DS/IEC 62443-2-1:2011 Industrielle kommunikationsnetværk – Netværks- og systemsikkerhed – Del 2-1: Etablering af et sikkerhedsprogram til industrielle automations- og styringssystemer
- IEC TR 62443-2-3:2015 Security for industrial automation and control systems – Part 2-3: Patch management in the IACS environment
- IEC 62443-2-4:2015 Security for industrial automation and control systems – Part 2-4: Security program requirements for IACS service providers
- IEC 62443-2-4:2015/COR1:2015 Corrigendum 1 – Security for industrial automation and control systems – Part 2-4: Security program requirements for IACS service providers
- IEC TR 62443-3-1:2009 Industrial communication networks – Network and system security – Part 3-1: Security technologies for industrial automation and control systems
- DSF/prEN 62443-3-2:2018 (Forslag) Sikkerhed til industriel proces måling og kontrol – Del 3-2: Sikkerhedsrisikovurdering og systemdesign
- DSF/prEN IEC 62443-3-3:2018 (Forslag) Industrielle kommunikationsnetværk – Netværks- og systemsikkerhed – Del 3-3: Systemsikkerhedskrav og sikkerhedsniveauer

- IEC PAS 62443-3:2008 Security for industrial process measurement and control – Network and system security
- DS/IEC 62443-3-3:2013 Industrielle kommunikationsnetværk – Netværks- og systemsikkerhed – Del 3-3: Systemsikkerhedskrav og sikkerhedsniveauer
- DS/IEC 62443-3-3:2013/COR1:2014 Industrielle kommunikationsnetværk – Netværks- og systemsikkerhed – Del 3-3: Systemsikkerhedskrav og sikkerhedsniveauer
- DS/EN IEC 62443-4-1:2018 Sikre IACS-netværk – Del 4-1: Krav til sikker produktudviklingslivscyklus
- IEC 62443-4-2:2019 Security for industrial automation and control systems – Part 4-2: Technical security requirements for IACS components

IEC 81346-serien – Standarder for navngivning:

- DS/EN 81346-1:2009 Industrianlæg, installationer og udstyr samt industriprodukter – Principper for strukturer og referencebetegnelser – Del 1: Grundlæggende regler
- DS/EN 81346-2:2009 Industrianlæg, installationer og udstyr samt industriprodukter – Principper for strukturer og referencebetegnelser – Del 2: Klassifikation af objekter og koder for klasser

3. Afhængigheder og forudsætninger

3.1 It-systemer

Alle de standarder, der vælges, har afhængigheder til Energinets øvrige it-systemer. De væsentligste it-systemer antages i denne sammenhæng at være:

- SCADA
- PDC
- ERP system
- Fejlanalyse og PQ
- Tegningsdokumentation
- Afregningssystem
- Stations- og komponentdatabase
- Beskyttelses- og komponentkonfigurationsdatabase
- Netberegningsprogram
- Relæfelter
- Konfiguration og test af 61850-komponenter
- GIS
- Netværksinfrastruktur
- It-platforme

3.2 Forretningssystemer

Denne standard er også afhængig af Energinets governance strukturer generelt, hvor der tages stilling til en yderligere udvikling.

3.2.1 Beskrivelse af forretningsprocesser

For forretningsprocesser generelt gælder følgende:

- Forretnings- og it-arkitektur beskrives i Archimate
- Digitale forretningsprocesser beskrives i BPMN notationen
- Interne digitale it-systemprocesser, funktioner og kommunikation beskrives i UML 2.0 notationen

3.2.2 Digitale forretningsprocesser og systemer

Digitale forretningsprocesser og systemer beskrives med værktøjet Enterprise Architect.

3.2.3 Product Life Cycle Management for digitale løsninger

Der udvikles Product Life Cycle Management for digitale løsninger i Energinet.

3.2.4 Risikostyring for digitale løsninger

Risikostyring for digitale løsninger følger i udgangspunktet ISO 27000.

Der skal anvendes det risikostyringsværktøj, som Energinet til enhver tid benytter.

3.3 Øvrige afhængigheder

I forhold til fysisk sikkerhed på stationen henvises til Energinets tekniske standarder.

Telefoni behandles i andre standarder fra Energinet.

EMC krav og krav til afskærmning af antenne behandles ligeledes i andre standarder fra Energinet.

4. Funktionskrav

Overordnet set ønskes en fremtidig løsning, der giver mulighed for, at flere systemer kan hente de data, som de skal bruge fra den enkelte station.

Der skal etableres tjek til at validere data inden for bestemte grænser. Såfremt data falder uden for udfaldsrummet, skal de behandles manuelt.

5. Designkrav

5.1 Interoperabilitet

5.1.1 Interoperabilitet generelt

Interoperabilitet (samspil mellem forskellige typer) dækker over flere aspekter. Ultimativt stræber interoperabilitet mod plug and play-løsninger på tværs af komponenter og leverandører.

Digital interoperabilitet handler om standardisering af sammenspillet mellem komponenter og værktøjer for konfiguration, informationsmodeller og -beskrivelser, digitale funktioner, it-protokoller, tidssynkronisering og fysiske elementer, fx stik.

5.1.2 Internationalt standardiseret information

IEC 81346-serien, IEC 61970-serien og IEC 61850-7-serien anvendes til at navngive henholdsvis stationskomponenter, stationsstrukturer og signalinformation på stationen.

5.1.3 Internationalt standardiserede protokoller til informationsudveksling

IEC 61850-8-1 anvendes mellem feltenheder eller systemer - Feltbus (fx mellem relæer, mellem feltenhed og RTU/stations-Gateway eller mellem RTU/stations-Gateway og centrale systemer som SCADA/SAP/mv.)

IEC 61850-9-serien anvendes mellem måleenheder og fysiske stationskomponenter, hvor der er behov for hurtigt samplede målinger og indikeringer, som sendes løbende - Proces-bus (fx 200 x 50 Hz eller mere).

5.1.4 International standard for tidssynkronisering

Der anvendes IEC/IEEE 61850-9-3 Kommunikationsnetværk og -systemer til elforsyningsautomation – Del 9-3: Profil for Precision Time Protocol til elforsyningsautomation.

GPS eller Galileo bruges som tidsreference til PTP eller direkte via fx IRIG-B interface til komponenter, som måtte kræve dette.

5.1.5 Internationale standarder til udveksling af stationskonfiguration

- IEC 61850-6 mellem komponenter
- IEC 61970 til udveksling af stationslayout

5.1.6 International standard til beskrivelse af digitale funktioner

- OMG UML 2.0 (http://www.omg.org/spec/UML/2.0/)

5.2 Sikkerhed

5.2.1 Sikkerhed generelt

Sikkerhed skal tænkes ind fra starten af ethvert projekt. Princippet hedder "security by design". Sikkerhed er indbygget i designet og ikke noget, der er tilføjet.

Overordnet handler designkravene om security by design. Herunder hører:

- Roller og rettigheder til stationer tildeles efter principperne ABAC (Attribute-based access control) og RBAC (Role-based access control). Administrationssystemer, som understøtter disse, skal opfylde kravene i ISO 27002 kapitel 9
- Certifikat
- Loginprocedure skal suppleres med 2 former for identifikation.

I de nedenstående afsnit er disse krav uddybet.

Opbygning og håndtering af stationsanlæg skal følge principperne i sikkerhedsstandarderne i ISO 27000-serien, herunder med minimumskrav efter Energinet it-sikkerhed og ENTSO-E.

Se også ISO/IEC 27019 og ENISA Appropriate Security Measures for Smart Grid (https://www.enisa.europa.eu/publications/appropriate-security-measures-for-smart-grids).

ENISA-dokumentet behandler områderne:

1. Sikkerhedsorganisering og risikohåndtering
2. Håndtering af 3.part, herunder komponent- og underleverandører
3. Sikker livscyklus for komponenter/systemer og driftsprocedurer
4. Personalesikkerhed, bevidsthed og træning
5. Hændelsesrespons & informations- og erfaringsudveksling
6. Audit og ansvarlighed
7. Driftskontinuitet
8. Fysisk sikring
9. Informationssystemsikkerhed
10. Netværkssikkerhed

5.2.2 System- og datafortrolighed (Privacy)

Al information på en station skal være beskyttet mod uretmæssig adgang, enten med brugernavn/password og/eller med digitale signaturer som sikker identifikation.

Der skal være password og adgangsstyring på alt digitalt udstyr.

Der skal foretages en risikovurdering, om lagret information på en station skal krypteres eller på anden måde sikres yderligere mod uretmæssig adgang.

Der henvises generelt til Energinets It-sikkerhedsstandard "Standard for adgangsstyring".

5.2.3 System- og datatilgængelighed og integritet

Information som flyttes (kommunikeres) mellem stationer og centrale systemer skal sikres mod uretmæssig adgang, og det skal forhindres, at informationer fra alle stationer kan samles, hvis der skaffes uretmæssig adgang til én station. Derfor anvendes ikke kun fysisk sikrede, men også logisk sikrede kanaler på netværk mellem stationer og centrale systemer.

Hvor der ikke allerede er etablerede principper eller krav for redundans og leverandørspredning, skal en risikovurdering afgøre, i hvilket omfang dette skal sikres.

5.2.4 It-beredskab

Det skal sikres, at udstyr kan isoleres i tilfælde af uretmæssig kompromittering.

Alt udstyr skal kunne retableres med firmware og konfiguration.

5.3 Åbenhed

5.3.1 Internationalt standardiseret interface

Alle centrale systemer, som har behov for adgang til data på en station, skal kunne få adgang til data via et internationalt standardiseret interface direkte på stationen.

5.4 Fleksibilitet

5.4.1 Modularisering

Det skal sikres, at komponenter fra flere leverandører kan kommunikere med korrekt implementering af informations- og kommunikationsstandarderne.

5.4.2 Løst koblede systemer med kommunikation gennem standardiserede interfaces

Det skal være muligt at udskifte en digital komponent med en tilsvarende fra en anden leverandør uden at ændre konfigurationen på alle tilstødende komponenter.

5.4.3 Distribueret automation

Automation distribueres ud på stationer, så centrale systemer kun skal have den overordnede supervision, der ikke kan udføres på stationsniveau. Derved mindskes afhængigheden af centrale systemer til koordinering på tværs af stationer.

5.5 Skalerbarhed

5.5.1 Automatisering af engineering-processer (stationsdesign og -konfiguration)

Specifikation af interoperabilitet skal muliggøre lettere udvidelse af funktionerne på en station (både elektriske og digitale udvidelser af en station).

Konfiguration af digitale stationskomponenter med IEC 61850-serien skal beskrives iht. IEC 61850-6 (SCL-format), herunder

- Konfiguration af de enkelte komponenter
- Kommunikation mellem komponenter
- Stationens elektriske funktioner og grafiske brugergrænseflader (1-stregsdiagram)
- Kommunikation til og fra SCADA og andre centrale systemer.

Stationslayout importeres fra netberegningsprogrammer i CIM-formatet (IEC 61970-serien)

6. Tekniske krav

Tekniske krav er indeholdt i Energinets tekniske standarder.

7. Reservedele

Ikke relevant.

8. Dokumentation

Der skal udarbejdes en testrapport, som dokumenterer anlæggets anvendelsesmulighed og eventuelle begrænsninger, se standard EGS-0047 Afprøvning – Testprocedure - Styring og overvågning.

9. Bilag

Ingen.

All voltage levels
Digitalization of the transmission grid – Requirements for open standards
EDS-0156

Document title	EDS-0156 Rev 0 Digitalization of the transmission grid – Requirements for open standards								
Document no.	13/90592-300								
Target group	Electricity Transmission and external suppliers								
Valid until	30 April 2020								
Revisi-on	Document status	Author		Co-authors/ Designers		Reviewer		Approver	
		Name	Date	Name	Date	Name	Date	Name	Date
0	Approved	MTM	21.12.2017	JEJ, PIN, JBN, HSC, ASK, AIE, CAS	21.12.2017	ALJ, BBU, BEJ, BSK, CBA, EOM, EWP, FSD, HAB, HRH, JCK, KHK, MVF, PDI, RAO, SLM, TSL	19.03.2018	KSQ	17.04.2018

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1. Scope/introduction

1.1 Open standards in general

Standards usually come into existence when a group of interested parties within a certain field recognize the need for common guidelines or regulations. If the parties reach agreement and consensus on a common 'way of doing things', a standard may be defined. A standard is thus a 'collective agreement' between the parties.

An IT standard is a precise description of the agreed requirements, which must be complied with in a certain context or technical solution. Thus, an IT standard ensures that the building blocks used to make IT systems are compatible.

IT-systems are developed to support business needs by digitalizing business processes. Major benefits may be gained, when agreement is reached on common rules for the development of new systems as well as on technical and content-related data definitions, which can be reused, and which not only apply between two parties, but between all parties with a common business need. Such rules and technical definitions are referred to as standards.

This means that the more people who can agree on a given standard, the more people can utilize the opportunities this gives to communicate. This may result in a self-increasing trend and motivate suppliers to develop products based on standards.

Standards that can be agreed internationally, are preferable, as these will ensure the highest possible dissemination and stability in respect of standard selection. However, as IT development is very fast, and the standardisation work takes time, debate and much coordination, it is rarely possible to achieve global standards, winning the support of all.

As a starting point OIO-standards will often be based on international standards. Still adaptations to specific national conditions and requirements may be necessary. A general characteristic of the Danish standardisation process, however, is that it always seeks a starting point in international standards, thereby ensuring that the national standards are supported by the IT industry, and that national systems may correlate with international systems.

1.2 Energinet requirements for the use of open standards

Energinet generally requires open standards, which means:

- The standards must be open.
- The standards must support business and governance needs of the authorities as well as support key governance processes.
- The standards must be supported on the market.

1.3 Scope of this standard

This standard must be applied for all new building and civil engineering projects relating to the construction of new high-voltage substations, which according to decision must be digital substations.

This standard must be applied for all new building and civil engineering projects relating to renovations and new constructions on existing high-voltage substations, which according to decision must be changed into digital substations applicable as of and no later than 1. January 2020.

1.4 Abbreviations and definitions

ABAC	Attribute-based access control
BIM	Building information modelling
BPMN	Business Process Model and Notation
CGMES	Common grid model exchange specification
CIM	Common Information Model (CIM format)
EDS	Energinet design and configuration standard
EGS	Energinet guideline
EMC	Electromagnetic compatibility
ENISA	European Union Agency for Network and Information Security
ENTSO-E	European Network of Transmission System Operators for Electricity
FESD	Common ECDM (Electronic Case and Document Management) used by public authorities in Denmark.
IEC	International Electrotechnical Commission
IFC	Industry Foundation Classes (IFC format)
IRIG	Inter-range instrumentation group
ISO	International Organization for Standardization
OCES	Public certificates for electronic service
ODF	Open Document Format (ISO standard)
OIO	Public information online
OIOUBL	Format for electronic invoice (e-invoice)
OIOXML	Standardised communication format for public government agencies and institutions in Denmark
OOXML	Office Open XML
PDF	Portable document format
PQ	Power quality
PTP	Precision time protocol
RBAC	Role-based access control
SCL	Substation configuration language
UML	Unified Modeling Language

2. References and standards

2.1 General standards

The following general standards must be applied:

- Standards for document exchange (ODF, OOXML, and PDF)
- Standards for exchange with public government agencies and institutions:
    - Standards for exchange between public government agencies and institutions (OIOXML)
    - Standards for common electronic case and document management (FESD)
    - Standards for electronic procurement in the public sector (OIOUBL)
    - Standards for public websites, web pages, and accessibility
- Standards for IT security (ISO 27000 series, IEC 62443 series, IEC 62351 series)
- Standards for digital signature (OCES certificate) (or alternative digital signature/identification)
- Standards for the IFC data model (a model forming the basis for sharing and exchange of data). The IFC data model is a neutral standard that can be used independently of the IT system and IT platform (IFC format).

2.2 Legislation, Technical regulations, and Energinet standards

The following legislation applies:

- LOV nr. 502 af 23/05/2018 Lov om supplerende bestemmelser til forordning om beskyttelse af fysiske personer i forbindelse med behandling af personoplysninger og om fri udveksling af sådanne oplysninger (databeskyttelsesloven). *In Danish only (Act on the supplementary provisions to the regulation on the protection of individuals with regard to the processing of personal data and on the free movement of such data (Data Protection Act)*.

The following Technical regulation issued by Energinet applies:

- TR 5.8.1 Metering data for system operation purposes: 2011

It will be replaced by the three following technical regulations issued by Energinet:

- TR 5.8.1 Data exchange production and consumption (in preparation)
- TR 5.8.2 Data exchange substations (in preparation)
- TR 5.8.5 Data formats, communication protocols, security (in preparation)

The following IT standard from Energinet applies:

- IT standard no. 9 "Standard for access control"

The following technical standards from Energinet apply:

- EDS-0064 HV switchgear object identification
- EGS-0047 Testing – Test procedure – Control and monitoring

2.3 General overview of open standards

Below follows an overview of the main groups of standards that apply:

Building, civil engineering and operational tasks:

- IFC data model (used for building model and Asset Management)

Real-time data:

- IEC 61850 series is used for physical installations

Naming and structuring of data:
All of the following standards constitute the CIM-standards:

- IEC 61970 (CGMES) Description of the grid and substation components
- IEC 61968 Description of data for Asset Management, settlement metering, environmental purposes, etc.
- IEC 62325 Description of data for the electricity market communications

2.4 International open standards

Below follows a list of the international open standards to be applied. These standards are listed in numerical order.

Building model for building and civil engineering projects as well as operation and maintenance (IFC):

- ISO 15686-4:2014 Building Construction -- Service Life Planning – Part 4: Service Life Planning using Building Information Modelling
- DS/EN ISO 16739:2016 Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries (ISO 16739:2013)
- DS/ISO 16757-2:2016 Data structures for electronic product catalogues for building services – Part 2: Geometry

ISO 27000 series – Standards for IT security:

- DS/ISO/IEC 27000:2018 Information technology – Security techniques – Information security management systems – Overview and vocabulary
- DS/EN ISO/IEC 27001:2017 Information technology – Security techniques – Information security management systems – Requirements (ISO/IEC 27001:2013 including Cor 1:2014 and Cor 2:2015)
- DS/EN ISO/IEC 27002:2017 Information technology – Security techniques – Code of practice for information security controls (ISO/IEC 27002:2013 including Cor 1:2014 and Cor 2:2015)
- DS/ISO/IEC 27003:2017 Information technology – Security techniques – Information security management systems – Guidance
- DS/ISO/IEC 27005:2018 Information technology – Security techniques – Information security risk management
- DS/ISO/IEC 27006:2015 Information technology -- Security techniques -- Requirements for bodies providing audit and certification of information security management systems
- DS/ISO/IEC TR 27008:2019 Information technology – Security techniques – Guidelines for the assessment of information security controls
- DS/ISO/IEC 27019:2017 Information technology – Security techniques – Information security controls for the energy utility industry

Other standards for IT security:

- IEC 60255-24:2013 Measuring relays and protection equipment – Part 24: Common format for transient data exchange (COMTRADE) for power systems
- IEEE 1159.3-2019 - IEEE Approved Draft Recommended Practice for Power Quality Data Interchange Format (PQDIF)

IEC 61400 series – Standards for communication with wind turbines:

- DS/EN 61400-25-1:2017 Wind energy generation systems – Part 25-1: Communications for monitoring and control of wind power plants – Overall description of principles and models
- DS/EN 61400-25-2:2015 Wind turbines – Part 25-2: Communications for monitoring and control of wind power plants – Information models
- DS/EN 61400-25-3:2015 Wind turbines – Part 25-3: Communications for monitoring and control of wind power plants – Information exchange models
- DS/EN 61400-25-4:2017 Wind energy generation systems – Part 25-4: Communications for monitoring and control of wind power plants – Mapping to communication profile
- DS/EN 61400-25-5:2017 Wind energy generation systems – Part 25-5: Communications for monitoring and control of wind power plants – Compliance testing
- DS/EN 61400-25-6:2017 Wind energy generation systems – Part 25-6: Communications for monitoring and control of wind power plants – Logical node classes and data classes for condition monitoring

IEC 61850 series – Standards for communication with physical installations:

- IEC TR 61850-1:2013 Communication networks and systems for power utility automation – Part 1: Introduction and overview
- IEC TS 61850-2:2003 Communication networks and systems in substations – Part 2: Glossary
- DS/EN 61850-3:2014 Communication networks and systems for power utility automation – Part 3: General requirements
- DS/EN 61850-4:2011 Communication networks and systems for power utility automation – Part 4: System and project management
- DS/EN 61850-5:2013 Communication networks and systems for power utility automation – Part 5: Communication requirements for functions and device models
- DS/EN 61850-6:2010 cd-rom Communication networks and systems for power utility automation – Part 6: Configuration description language for communication in electrical substations related to IEDs
- DS/EN 61850-6:2010/A1:2018 Communication networks and systems for power utility automation – Part 6: Configuration description language for communication in electrical substations related to IEDs
- DS/EN 61850-7-1:2011 Communication networks and systems for power utility automation – Part 7-1: Basic communication structure – Principles and models
- DS/EN 61850-7-2:2010 Communication networks and systems for power utility automation – Part 7-2: Basic information and communication structure – Abstract communication service interface (ACSI)
- DS/EN 61850-7-3:2011 Communication networks and systems for power utility automation – Part 7-3: Basic communication structure – Common data classes
- DS/EN 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
- DS/IEC TS 61850-7-7:2018 Communication networks and systems for power utility automation – Part 7-7: Machine-processable format of IEC 61850-related data models for tools
- DS/EN 61850-7-420:2009 Communication networks and systems for power utility automation – Part 7-420: Basic communication structure – Distributed energy resources logical nodes
- DS/IEC TR 61850-7-500:2017 Communication networks and systems for power utility automation – Part 7-500: Basic information and communication structure – Use of logical nodes for modeling application functions and related concepts and guidelines for substations
- DS/EN 61850-8-1:2011 Communication networks and systems for power utility automation – Part 8-1: Specific communication service mapping (SCSM) – Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3
- DS/EN 61850-9-2:2012 Communication networks and systems for power utility automation – Part 9-2: Specific communication service mapping (SCSM) – Sampled values over ISO/IEC 8802-3
  (This standard (DS/EN 61850-9-2) is used for communication of fast sampled values from the process (instrument transformers, switchgear, etc.) either directly or through Merging Units that may be featuring old instrument transformers without own IEC 61850 output. The network to process information is called process bus.)
- DS/IEC/IEEE 61850-9-3:2016 Communication networks and systems for power utility automation – Part 9-3: Precision time protocol profile for power utility automation
- DS/EN 61850-10:2013 Communication networks and systems for power utility automation – Part 10: Conformance testing

- IEC TS 61850-80-1:2016 Communication networks and systems for power utility automation – Part 80-1: Guideline to exchanging information from a CDC-based data model using IEC 60870-5-101 or IEC 60870-5-104
- DS/IEC TR 61850-80-3:2015 Communication networks and systems for power utility automation – Part 80-3: Mapping to web protocols – Requirements and technical choices
- IEC TR 61850-90-1:2010 Communication networks and systems for power utility automation – Part 90-1: Use of IEC 61850 for the communication between substations
- DS/IEC/TR 61850-90-2:2016 Communication networks and systems for power utility automation – Part 90-2: Using IEC 61850 for communication between substations and control centres
- DS/IEC TR 61850-90-3:2016 Communication networks and systems for power utility automation – Part 90-3: Using IEC 61850 for condition monitoring diagnosis and analysis
- IEC TR 61850-90-4:2013 Communication networks and systems for power utility automation – Part 90-4: Network engineering guidelines
- IEC TR 61850-90-5:2012 Communication networks and systems for power utility automation – Part 90-5: Use of IEC 61850 to transmit synchrophasor information according to IEEE C37.118
- DS/IEC TR 61850-90-6:2018 Communication networks and systems for power utility automation – Part 90-6: Use of IEC 61850 for Distribution Automation Systems
- IEC TR 61850-90-7:2013 Communication networks and systems for power utility automation – Part 90-7: Object models for power converters in distributed energy resources (DER) systems
- DS/IEC TR 61850-90-8:2016 Communication networks and systems for power utility automation – Part 90-8: Object model for E-mobility
- DS/IEC TR 61850-90-10:2017 Communication networks and systems for power utility automation – Part 90-10: Models for scheduling
- DS/IEC TR 61850-90-12:2015 Communication networks and systems for power utility automation – Part 90-12: Wide area network engineering guidelines
- DS/IEC TR 61850-90-17:2017 Communication networks and systems for power utility automation – Part 90-17: Using IEC 61850 to transmit power quality data

Other standards for communication with physical installations:

- DS/EN 61869-6:2016 Instrument transformers – Part 6: Additional general requirements for low-power instrument transformers
- IEC 61869-9:2016 Instrument transformers – Part 9: Digital interface for instrument transformers

IEC 61970 series - Description of grid and substation components:

- DS/EN 61970-1:2007 Energy management system application program interface (EMS-API) – Part 1: Guidelines and general requirements
- DS/CLC/TS 61970-2:2005 Energy management system application program interface (EMS-API) – Part 2: Glossary
- DS/EN 61970-301:2017 Energy management system application program interface (EMS-API) – Part 301: Common information model (CIM) base
- DS/IEC/TS 61970-401:2005 Energy management system application program interface (EMS-API) – Part 401: Component interface specification (CIS) framework
- DS/EN 61970-452:2017 Energy management system application program interface (EMS-API) – Part 452: CIM static transmission network model profiles

- DS/EN 61970-453:2014 Energy management system application program interface (EMS-API) – Part 453: Diagram layout profile
- DS/EN 61970-453:2014/A1:2019 Energy management system application program interface (EMS-API) – Part 453: Diagram layout profile
- DS/EN 61970-456 Energy management system application program interface (EMS-API) – Part 456: Solved power system state profiles
- DS/EN 61970-456:2013 Energy management system application program interface (EMS-API) – Part 456: Solved power system state profiles
- DS/EN 61970-456:2013/A1:2016 Energy management system application program interface (EMS-API) – Part 456: Solved power system state profiles
- DS/EN 61970-501:2006 Energy management system application program interface (EMS-API) – Part 501: Common Information Model Resource Description Framework (CIM RDF) schema
- DS/EN 61970-552:2016 Energy management system application program interface (EMS-API) – Part 552: CIMXML Model exchange format
- IEC TS 61970-555:2016 Energy management system application program interface (EMS-API) – Part 555: CIM based efficient model exchange format (CIM/E)
- DS/IEC TS 61970-556:2016 Energy management system application program interface (EMS-API) – Part 556: CIM based graphic exchange format (CIM/G)
- DS/IEC TS 61970-600-1:2017 Energy management system application program interface (EMS-API) – Part 600-1: Common Grid Model Exchange Specification (CGMES) – Structure and rules
- DS/IEC TS 61970-600-2:2017 Energy management system application program interface (EMS-API) – Part 600-2: Common Grid Model Exchange Specification (CGMES) – Exchange profiles specification

Other standards for description of grid and substation components:

- DS/EN 62271-3:2015 High-voltage switchgear and controlgear – Part 3: Digital interfaces based on IEC 61850
- DS/IEC TR 62357-200:2015 Power systems management and associated information exchange – Part 200: Guidelines for migration from internet Protocol version 4 (IPv4) to Internet Protocol version 6 (IPv6)
- DS/IEC TR 62689-100:2016 Current and voltage sensors or detectors, to be used for fault passage indication purposes – Part 100: Requirements and proposals for the IEC 61850 series data model extensions to support fault passage indicators applications

IEC 62351 series – Implementation of cyber security:

The IEC 62351 series supports implementation of cyber security for the following series: IEC 60870, IEC 61850, IEC 61968, IEC 61970, and IEC 62325.

- DS/IEC/TS 62351-1:2007 Power systems management and associated information exchange – Data and communications security – Part 1: Communication network and system security – Introduction to security issues
- IEC TS 62351-2:2008 Power systems management and associated information exchange – Data and communications security – Part 2: Glossary of terms
- DS/EN 62351-3:2015 Power systems management and associated information exchange – Data and communications security – Part 3: Communication network and system security – Profiles including TCP/IP
- DS/EN 62351-3:2014/A1:2018 Power systems management and associated information exchange – Data and communications security – Part 3: Communication network and system security – Profiles including TCP/IP

- DS/EN IEC 62351-4:2018 Power systems management and associated information exchange – Data and communications security – Part 4: Profiles including MMS and derivatives
- DS/IEC/TS 62351-5:2013 Power systems management and associated information exchange – Data and communications security – Part 5: Security for IEC 60870-5 and derivatives
- DS/IEC/TS 62351-6:2007 Power systems management and associated information exchange – Data and communications security – Part 6: Security for IEC 61850
- DS/EN 62351-7:2017 Power systems management and associated information exchange – Data and communications security – Part 7: Network and System Management (NSM) data object models
- IEC TS 62351-8:2011 Power systems management and associated information exchange – Data and communications security – Part 8: Role-based access control
- DS/EN 62351-9:2017 Power systems management and associated information exchange – Data and communications security – Part 9: Cyber security key management for power system equipment
- DS/IEC/TR 62351-10:2012 Power systems management and associated information exchange – Data and communications security – Part 10: Security architecture guidelines
- DS/EN 62351-11:2017 Power systems management and associated information exchange – Data and communications security – Part 11: Security for XML documents
- DS/IEC TR 62351-12:2016 Power systems management and associated information exchange – Data and communications security – Part 12: Resilience and security recommendations for power systems with distributed energy resources (DER) cyber-physical systems
- DS/IEC TR 62351-13:2016 Power systems management and associated information exchange – Data and communications security – Part 13: Guidelines on security topics to be covered in standards and specifications
- DS/IEC TR 62351-90-1:2018 Power systems management and associated information exchange – Data and communications security – Part 90-1: Guidelines for handling role-based access control in power systems

IEC 62443 series – IT security:

- IEC TS 62443-1-1:2009 Industrial communication networks – Network and system security – Part 1-1: Terminology, concepts and models
- DS/IEC 62443-2-1:2011 Industrial communication networks – Network and system security – Part 2-1: Establishing an industrial automation and control system security program
- IEC TR 62443-2-3:2015 Security for industrial automation and control systems – Part 2-3: Patch management in the IACS environment
- IEC 62443-2-4:2015 Security for industrial automation and control systems – Part 2-4: Security program requirements for IACS service providers
- IEC 62443-2-4:2015/COR1:2015 Corrigendum 1 – Security for industrial automation and control systems – Part 2-4: Security program requirements for IACS service providers
- IEC TR 62443-3-1:2009 Industrial communication networks – Network and system security – Part 3-1: Security technologies for industrial automation and control systems
- DSF/prEN 62443-3-2:2018 (Proposal) Security for industrial automation and control systems – Part 3-2: Security risk assessment and system

- DSF/prEN IEC 62443-3-3:2018 (Proposal) Industrial communication networks – Network and system security – Part 3-3: System security requirements and security levels
- IEC TR 62443-3-1:2009 Industrial communication networks – Network and system security – Part 3-1: Security technologies for industrial automation and control systems
- DS/IEC 62443-3-3:2013 Industrial communication networks – Network and system security – Part 3-3: System security requirements and security levels
- DS/IEC 62443-3-3:2013/COR1:2014 Corrigendum 1 – Industrial communication networks – Network and system security – Part 3-3: System security requirements and security levels
- DS/EN IEC 62443-4-1:2018 Security for industrial automation and control systems – Part 4-1: Secure product development lifecycle requirements
- IEC 62443-4-2:2019 Security for industrial automation and control systems – Part 4-2: Technical security requirements for IACS components

IEC 81346 series – Standards for naming:

- DS/EN 81346-1:2009 Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations – Part 1: Basic rules
- DS/EN 81346-2:2009 Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations – Part 2: Classification of objects and codes for classes

3. Dependences and conditions

3.1 IT systems

All the standards selected have dependencies to Energinet's other IT systems. The most important IT systems in this context are assumed to be:

- SCADA
- PDC
- ERP system
- Error analysis and PQ
- Drawing documentation
- Settlement system
- Substation and component database
- Protection and component configuration database
- Power system simulation and analysis tool
- Relay panels
- Configuration and testing of 61850-components
- GIS
- Network infrastructure
- IT platforms

3.2 Business systems

This standard is also dependent on Energinet's governance structures in general, which take further development into account.

3.2.1 Description of business processes

For business processes in general, the following apply:

- Business architecture and IT architecture are described in Archimate
- Digital business processes are described in the BPMN notation
- Internal digital IT system processes, functions and communication are described in the UML 2.0 notation

3.2.2 Digital business processes and systems

Digital business processes and systems are described with the Enterprise Architect tool.

3.2.3 Product Life Cycle Management for digital solutions

Energinet develops Product Life Cycle Management for digital solutions.

3.2.4 Risk management for digital solutions

Risk management for digital solutions are based on ISO 27000.

The risk management tool used by Energinet at any time must be applied.

3.3 Other dependencies

In relation to physical security at the substation, reference is made to Energinet's technical standards.

Telephony is dealt with in other standards from Energinet.

EMC requirements and requirements for shielding of antenna are also dealt with in other standards from Energinet.

4. Performance requirements

Overall, the requested future solution must allow multiple systems to be able to collect the data, they need, from the individual substation.

Checks must be established to validate the data within certain limits. If the data fall outside the outcome space, they must be processed manually.

5. Design requirements

5.1 Interoperability

5.1.1 Interoperability in general

Interoperability (interaction between different types) covers several aspects. Ultimately, interoperability strives for plug and play solutions across components and suppliers.

Digital interoperability is about standardisation of the interaction between components and tools for configuration, information models and descriptions, digital functions, IT protocols, time synchronisation and physical elements, such as plugs.

5.1.2 Internationally standardised information

The IEC 81346 series, the IEC 61970 series, and the IEC 61850-7 series are used to name the substation components, substation structures, and signal information at the substation, respectively.

5.1.3 Internationally standardised protocols for information exchange

IEC 61850-8-1 is applied between bay units or systems - Fieldbus (e.g. between relays, between bay unit and RTU/substation gateway or between RTU/substation gateway and central systems such as SCADA/SAP/etc.)

The IEC 61850-9 series is applied between measurement units and physical substation components, where there is a need for fast sampled measurements and indications, which are sent continuously - Process bus (for example, 200 x 50 Hz or more).

5.1.4 International standard for time synchronisation

The following standard is applied: IEC/IEEE 61850-9-3 Communication networks and systems for power utility automation – Part 9-3: Precision time protocol profile for power utility automation

GPS or Galileo is used as a time reference to the PTP or directly via e.g. IRIG-B interface for components, which may require this.

5.1.5 International standards for the exchange of substation configuration

- IEC 61850-6 between components
- IEC 61970 for exchange of station layout

5.1.6 International standard for description of digital functions

- OMG UML 2.0 (http://www.omg.org/spec/UML/2.0/)

5.2 Security

5.2.1 Security in general

Security must be an integral part at the very beginning of any project. The principle is called "security by design". Security is integrated in the design, and not something that is added.

Overall, design requirements are about security by design. This includes:

- Roles and rights for the substations are assigned according to the principles of ABAC (Attribute-based access control) and RBAC (Role-based access control). Management systems supporting these must comply with the requirements of ISO 27002 Chapter 9
- Certificate
- Login procedure must to be completed with two types of identification.

These requirements are specified in greater detail in the sections below.

Structure and managing of substations must comply with the principles of security standards in the ISO 27000 series, including minimum requirements according to Energinet IT security and ENTSO-E.

See also ISO/IEC 27019 and ENISA Appropriate Security Measures for Smart Grid (https://www.enisa.europa.eu/publications/appropriate-security-measures-for-smart-grids).

The ENISA document deals with the following topics:

1. Security governance and risk management

2. Management of third parties, including component suppliers and subcontractors
3. Secure lifecycle of process for smart grid components/systems and operating procedures
4. Personnel security, awareness and training
5. Incident response & information knowledge sharing
6. Audit and accountability
7. Continuity of operations
8. Physical security
9. Information systems security
10. Network security

5.2.2 System and data confidentiality (Privacy)

All information at a substation must be protected against unauthorised access, either with username/password and/or with digital signatures as secure identification.

Password and access management must be in place on all digital devices.

A risk assessment must be carried out to determine whether stored information at a substation must be encrypted or otherwise secured against unauthorised access.

In general, reference is made to Energinet's IT security standard "Standard for access control".

5.2.3 System and data accessibility and integrity

Information which is transferred (communicated) between substations and central systems must be secured against unauthorised access, and it must be prevented that information from all substations can be gathered, if unauthorised access is obtained to a single station. Therefore, not only physically but also logically secured channels are used on networks between substations and central systems.

If principles or requirements for redundancy and supplier spread do not already exist, a risk assessment is to determine the extent to which this must be ensured.

5.2.4 IT emergency response plan

It must be ensured that equipment can be isolated in the event of unauthorized access and/or a compromising act.

Restoration of all equipment with firmware and configuration must be ensured.

5.3 Openness

5.3.1 Internationally standardised interface

All central systems that need access to data at a substation must be able to gain access to data via an internationally standardised interface directly at the substation.

5.4 Flexibility

5.4.1 Modularization

It must be ensured that components from multiple suppliers will be able to communicate with the proper implementation of information and communication standards.

5.4.2 Loosely coupled systems with communication through standardised interfaces

It must be possible to replace a digital component with a similar component from another supplier without changing the configuration of all adjacent components.

5.4.3 Distribution automation

Automation is distributed to substations, so that key systems only need to have the overall supervision, which cannot be carried out at substation level. This reduces dependence on key systems for coordination across the substations.

5.5 Scalability

5.5.1 Automation of engineering processes (substation design and configuration)

Specification of interoperability will enable and facilitate extension of the functions at a substation (both electrical and digital expansions of a substation).

Configuration of digital substation components with the IEC 61850 series must be described in accordance with IEC 61850-6 (SCL-format), including

- Configuration of the individual components
- Communication between components
- The station's electrical functions and graphical user interfaces (single-line diagram)
- Communication to and from the SCADA system and other central systems.

The substation layout is imported from power system simulation and analysis tools in CIM-format (IEC 61970 series).

6. Technical requirements

Technical requirements are included in Energinet's technical standards.

7. Spare parts

Not relevant.

8. Documentation

A test report documenting the installation use and any limitations must be prepared, see standard EGS-0047 Testing – Test procedure – control and monitoring.

9. Appendices

No appendices.