DEXPI Data Exchange in the Process Industry

DEXPI+ – extension of the P&ID specification including BFD and PFD

the journey of creating a BFD/PFD model specification based on and connected to international standards

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DEXPI Data Exchange in the Process Industry

DEXPI+

- The blind spot related to “process”
- Project definition
- DEXPI+ Content

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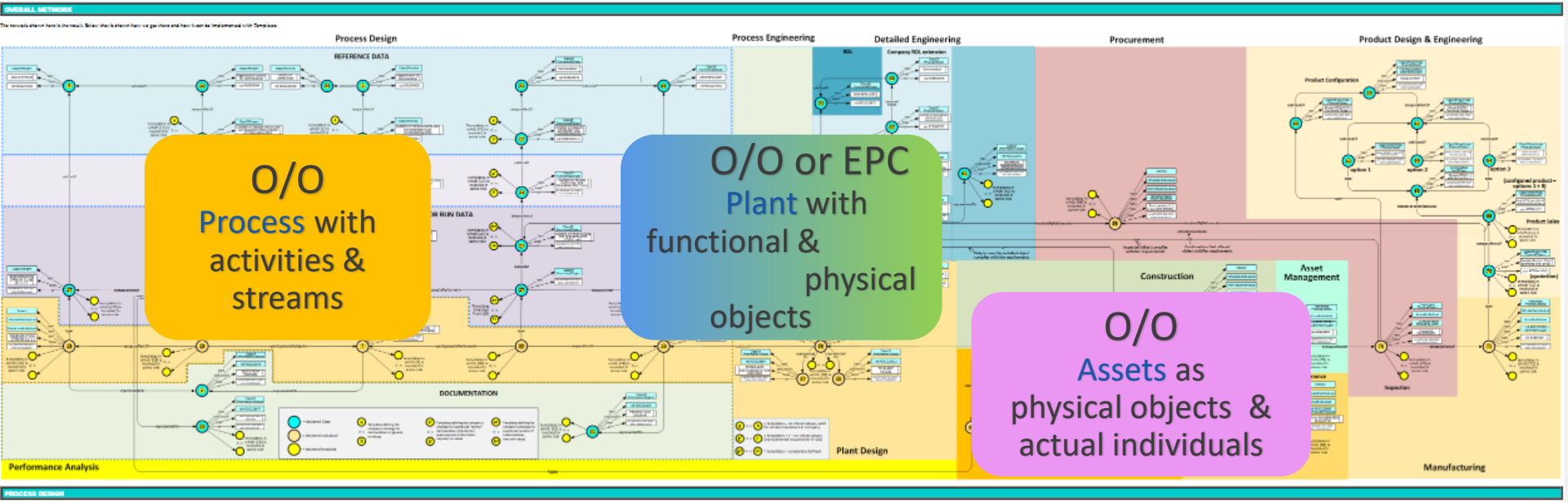
Plant lifecycle view – the blind spot regarding “process”

ISO 15926 Lifecycle stages network model with pump example



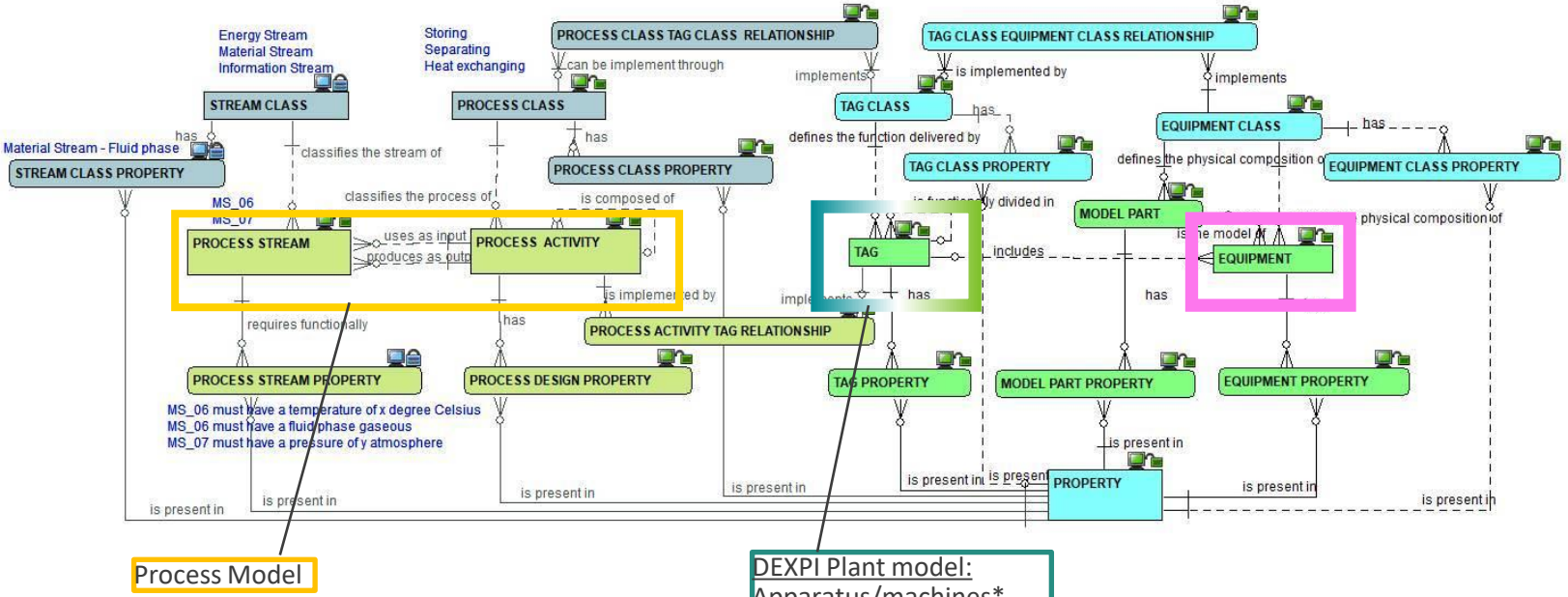
PUMPING
as a process step

PUMP and CENTRIFUGAL PUMP
as a plant object

A CENTRIFUGAL PUMP
as an installed object

https://15926.org/topics/LSN/index.htm

Lifecycle in CFIHOS data model 1.5



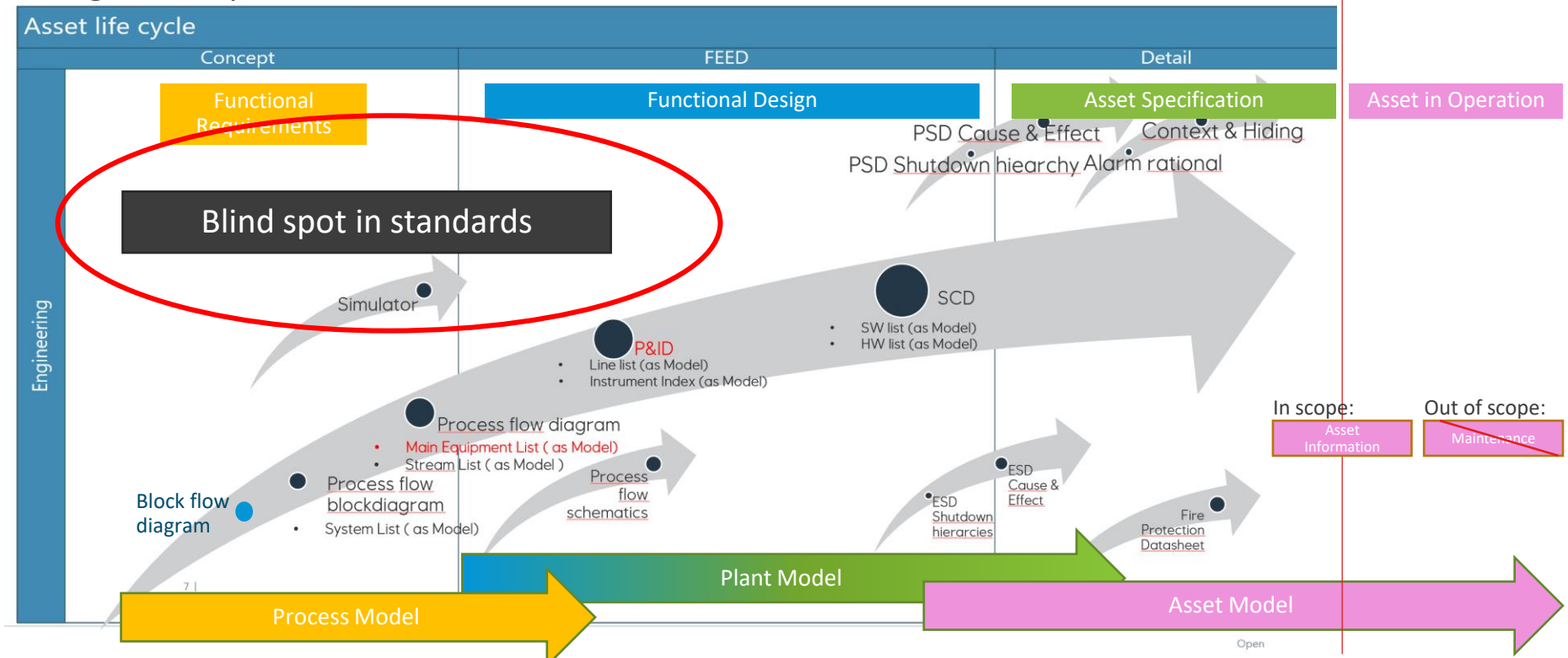
Process Model

DEXPI Plant model:
Apparatus/machines*
Piping
Automation

*'equipment' in DEXPI

Asset Lifecycle

Design development



DEXPI+ relates to early to engineering activities

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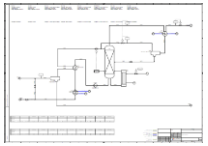
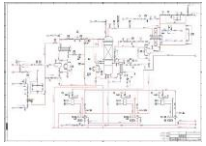
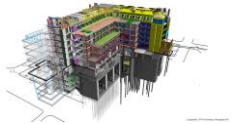
Work in progress

Asset Life Cycle







Block flow diagramm

Process flow sheet

PFD & P&ID; 3D drawing

DEXPI+

DEXPI+

DEXPI / CFIHOS 2D

JIP33

1. Block / stream model

CE

2. Process structure (activity/ stream) model

BE

3. Plant structure 2D-model

DE

Operations-model I4/5

Opera-tions

Model Issue 6.x

OPAS

MTP

FDI

NOA/ PADIM

3. Plant structure3D-model

USPI-3D

Building Model

BIM

Model / Structure / Data Set

Engineering activity/phase

Standard

The „blind spot“ regarding process

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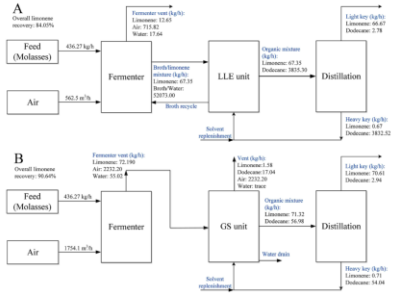
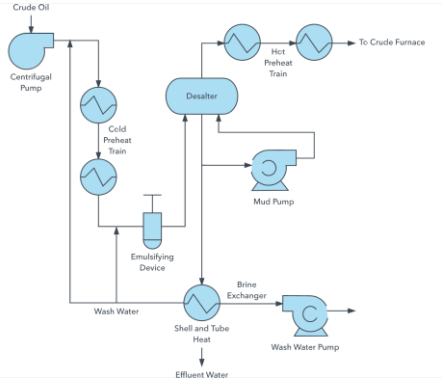
- Existing related standards (just some examples)
  - How to draw diagrams: ISO 10628 / ISA 95
  - Process simulation interoperability: CAPE-OPEN
  - Decomposition of technical objects: IEC/ISO 81346
  - …

- There is no sufficiently comprehensive, standardized data model and exchange format covering the “process“ part of the plant lifecycle
  - Plant part, P&ID -> DEXPI P&ID specification
  - Process part, BFD, PFD -> DEXPI+

BFD Block Flow Diagram



PFD Process Flow Diagram



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Project definition – DEXPI+ as one new DEXPI project

4 Main Topics defined in strategy process

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New Data format

- Technology defined after survey
- Showcase with import and export from at least two different tools
- New DEXPI Version with the new data format published
- Test and certification procedures adopted to new data format

Transport of SW configurations

- Requirements and Use-Cases defined
- Technology defined after survey
- Showcase with import and export from at least two different tools
- New DEXPI Version with the new data format published
- Test and certification procedures adopted to new data format

Best practices

- Have the first version of the „DEXPI best practices“ book for project end-users published

Transport of BFDs and PFDs (information)

- Content defined (Data Model)
- Exchange format extension defined
- Showcase with import and export from at least two different tools including a reference PFD

Sponsors:
Gregor Tolksdorf
Wilhelm Otten

DEXPI+ Project Definition

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Starting situation / environment

- DEXPI P&ID specification defines an information model for Piping and Instrumentation diagrams (PID), covering 'product aspects' in basic planning
- There is no standard information model applicable for Process Flow Diagrams (PFD) and Block Flow Diagrams (BFD), covering the process and functional aspects of the design
- For integrated engineering, an asset lifecycle data model is necessary

Project scope / goal / outcome

- Information model (UML) defined for BFD/PFD (process design and conceptual engineering) compatible with the DEXPI information model for PID
- 'reference' PFD drawing related to a DEXPI PID reference example
- Standard exchange format representation of the reference PFD similar to a DEXPI PID
- Scope: Transport layer out of scope

Project team/roles

- Sponsor: Gregor Tolksdorf, Wilhelm Otten
- Project Team: David Cameron (Convenor), Andreas Schüller (NAMUR), Anselm Klose (TU Dresden), Behnam Ghahraman (Aucotec), Eric Carnet (Aveva), Iskandar Halim (ISCEE), Leon Hanke (Aucotec), Maged Selim (Aveva), Manfred Theißen (PNB), Martin te Lintelo (USPI), +?
- cc: Idar Pe Ingebrigtsen, Michael Wiedau

Project effort/costs

- Preparation/team meeting
- Development of UML-Model

Challenges / open questions

- Engineering process not harmonized
- Information content of BFD/PFD not standardized
- Funding for data modelling

Activities / Milestones (updated)

Kick-off team 2022-03
- Objective, Project schedule/tasks
- Use case – Engineering process, definitions/requirements

Workshop 1: 2022-04
- Input – relevant standards, existing information models
- Information content for BFD/PFD based on references

Workshop 2:
- Verbal description of BFD/PFD information model 2022-05
- Activity and stream classes

Workshop 3:
- Instrumentation
- Draft of DEXPI Information Model (UML)

Workshop 4:
- Activity and stream properties

Workshop 5:
- Implementation, show case

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DEXPI+ Content – Information regarding BFD and PFD

Model Level 1, Functional Model (BFD-Model)

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Block flow diagrams provide the basic and most important information of the entire PROCESS

- Function blocks
  - All basic functions (unit operations) are indicated by **blocks** to illustrate the overall process
  - Function blocks have **ports**
  - **Names/Type** of the function blocks to explain their function such as reaction, separation,..
  - Some basic design values like temperature and pressure, additional characteristic information
- Streams
  - All material streams entering and leaving the overall process and between the blocks are represented by lines with arrows indicating the flow direction. They **connect the ports** of the function blocks.
  - Designation of all material, energy and information entering or leaving the process.
  - Design total mass flows for all material streams entering and leaving the plant and mass flow of the relevant streams
  - Streams must be identified
  - Streams can be **labeled** by the role, e.g. ‘WasteWater’, ‘concentrate’

DEXPI+ Reference BFD

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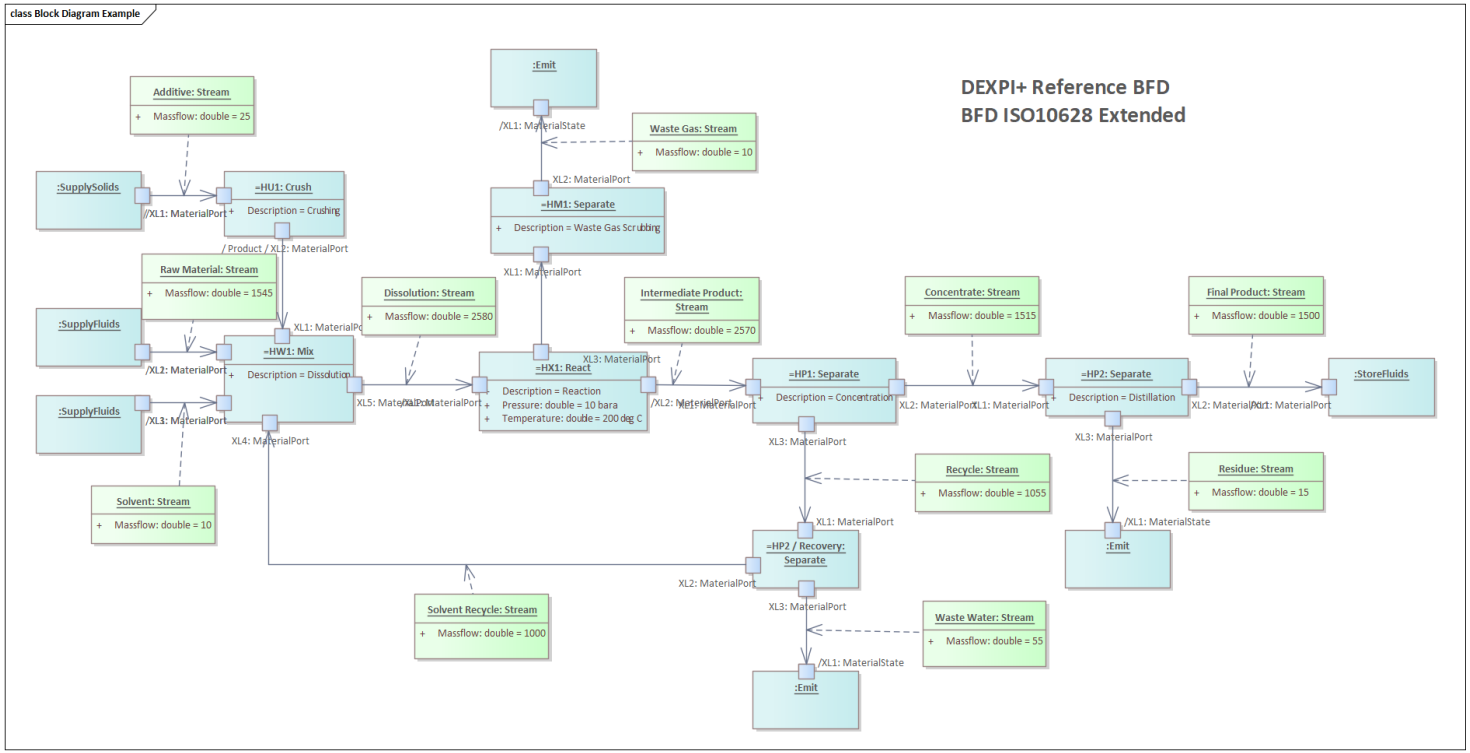
BFD Iso 10628 extended



DEXPI+ Information Model

Model Level 2, Process Model (PFD-Model)

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The process flow model provides information about the process topology, unit operations, streams

- Activities (process units, process steps, unit operations)
  - All itemized activities (process units) required to run the process
  - Name of the activities to explain their function e.g. ‘distillation 1’
  - Each activity has an identifier
  - Characteristic design values of process activities in the form of a data list or data bar. The numerical values shown in the list must be clearly assignable to the associated equipment items.
    - For example the convected heat flow (balance value) on process equipment such as heat exchangers, furnaces, etc. in W, kW, or MW.
    - The numbers of stages on tray columns that are important from a process engineering viewpoint, as well as first tray, last tray, and the numbers of those trays from which or to which lines / instrument leads are going.
    - The utilities of the units are shown and described
- Streams.
- All required basic process controls.

DEXPI+ function and activity classes

Definitions in accordance with ISO 15926 (final references to be added)

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E1: Block Flow Model (BFD)	E2: Process Model (PFD)	E2: Process Model (PFD)	Reference ISO15926-4ed3(2023)	S1: Process Simulation	E3: Plant Model (PID)
Process steps/top level activiti	Unit operations/activities lev1	Unit operations/activities lev2		Unit operations	Tag (CFIHOS/DEXPI) only expamples
Chemical Reacting	Chemical Reacting	Chemical Reacting		Reactors	Process Reactor
Separation	Fluid separation	Destillation		Column/Destillation (e.g	Destillation-Column
		Absorbing			Absorption-Column
		Desorbing			Desorption-Column
		Extracting		Column (Extract)	Extraction-Column
		Adsorption/Desorption		Adsorption	Adsorption/Desorption
		Flashing		Separator/Flash	Flash-Drum
		Decanter		Separater/Decanter	Knock-Out-Drum
	Solid separation	Crystallization		Cristallizer	Cristallizer
		Filtering (fabric filter, magnetic,..)		Fabric filter	Fabric filter
		Sieving			
		Separation by centrifugal forces		Centrifuge filter	Centrifuge filter
		Separation by contract (Scrubbing)		Scrubber	
		Drying			
Mixing	Mixing	Mixing		Mixer	Stream Mixer
		Humidifikation			
		Agitating			
Splitting	Splitting	stream splitting		Splitter	Stream Splitter

Process Model

Plant Model

DEXPI+ Information Model

Identification of process items

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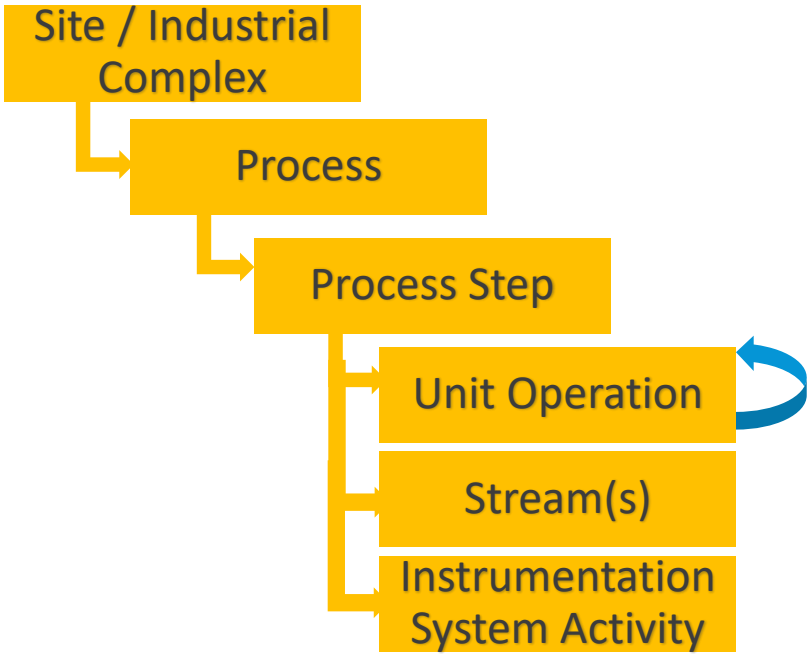

Hierarchy up to 3 levels

Key breakdown questions for PROCESS:
„What shall happen?
Which process activities do we have?“

Uniqueness level:
Unit Operations,
Streams and
Instrumentation System Activity(s)
are unique in the scope of a **Process**

DEXPI+ Reference PFD (simple)

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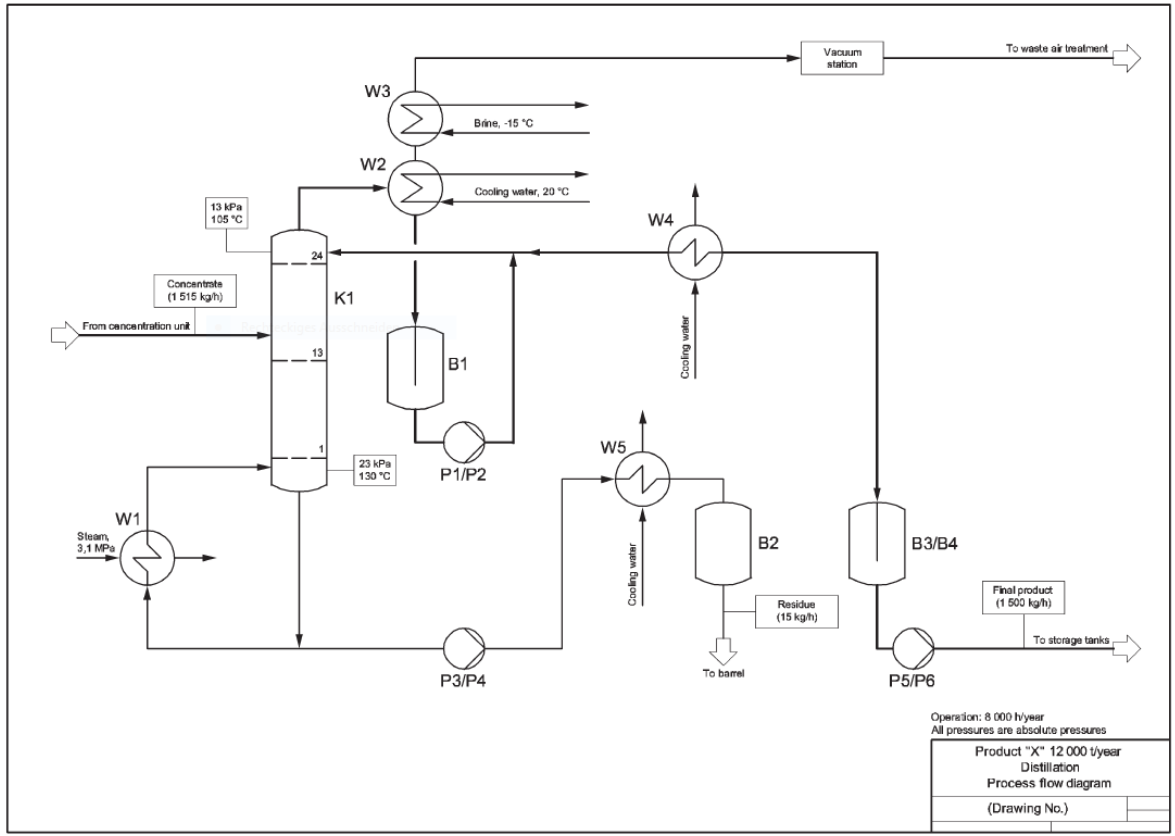
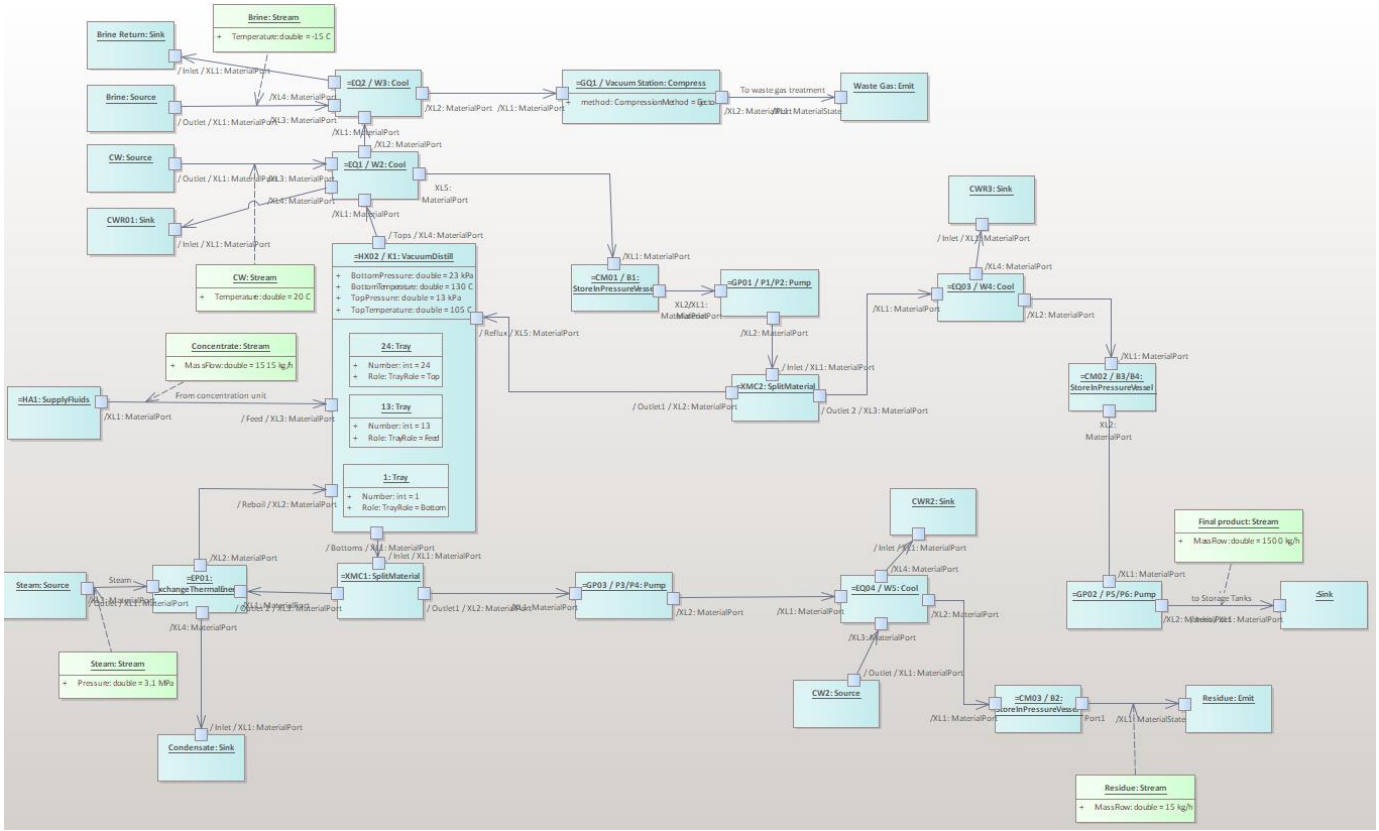
PFD Iso 10628



DEXPI+ Reference PFD (simple)

DEXPI Data Exchange in the Process Industry

PFD Iso 10628



DEXPI+ Information Model

DEXPI+ Reference PFD (detailed) – PFD Iso 10628 extended - used as basis for the information model

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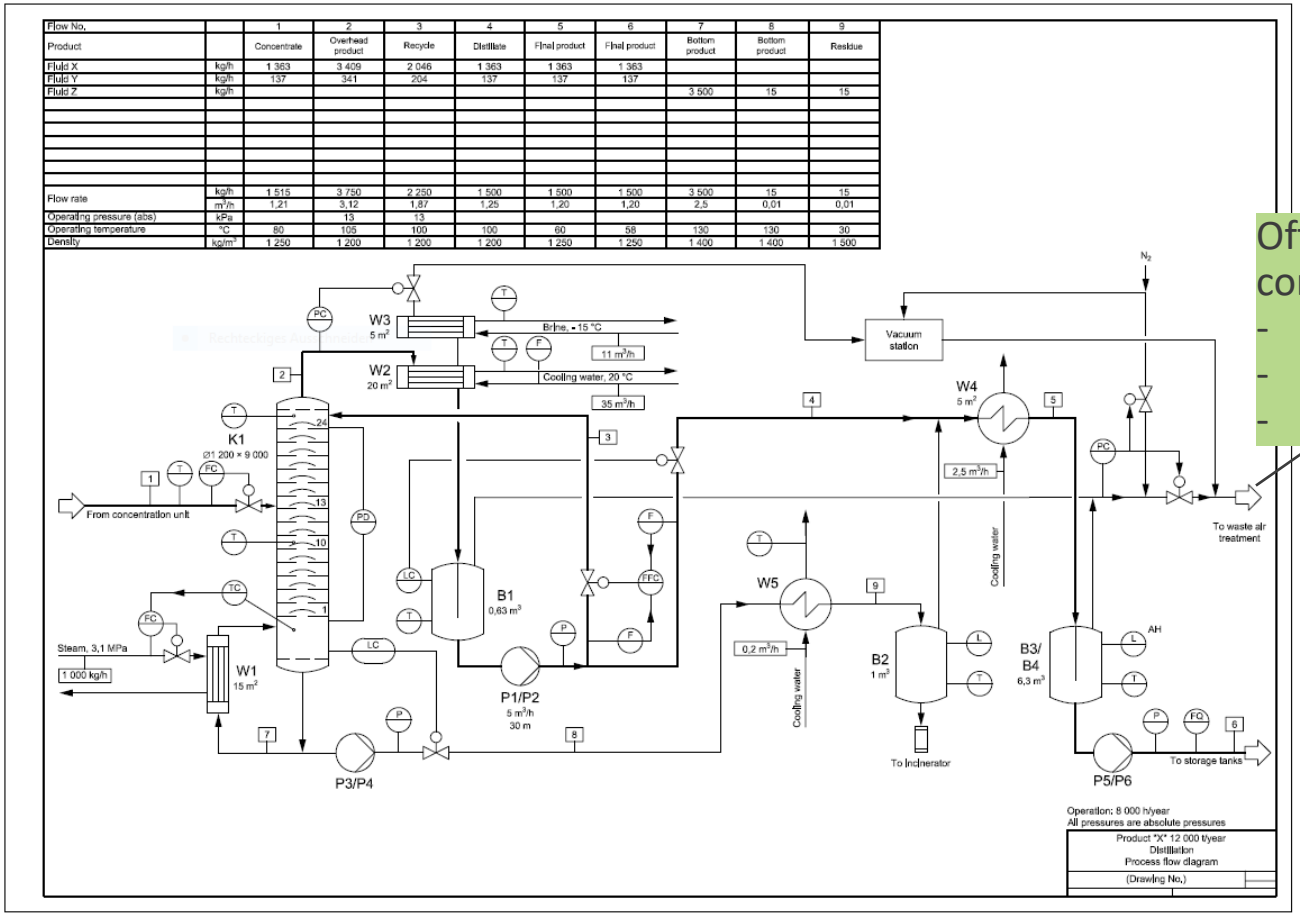
PFD Iso 10628 extended

Process control engineering activities according to IEC 62424

process safety instrumentation can be modelled

Safety functions:
Have a separate attribute for safety automation functions Iso 10418

Use standard symbols

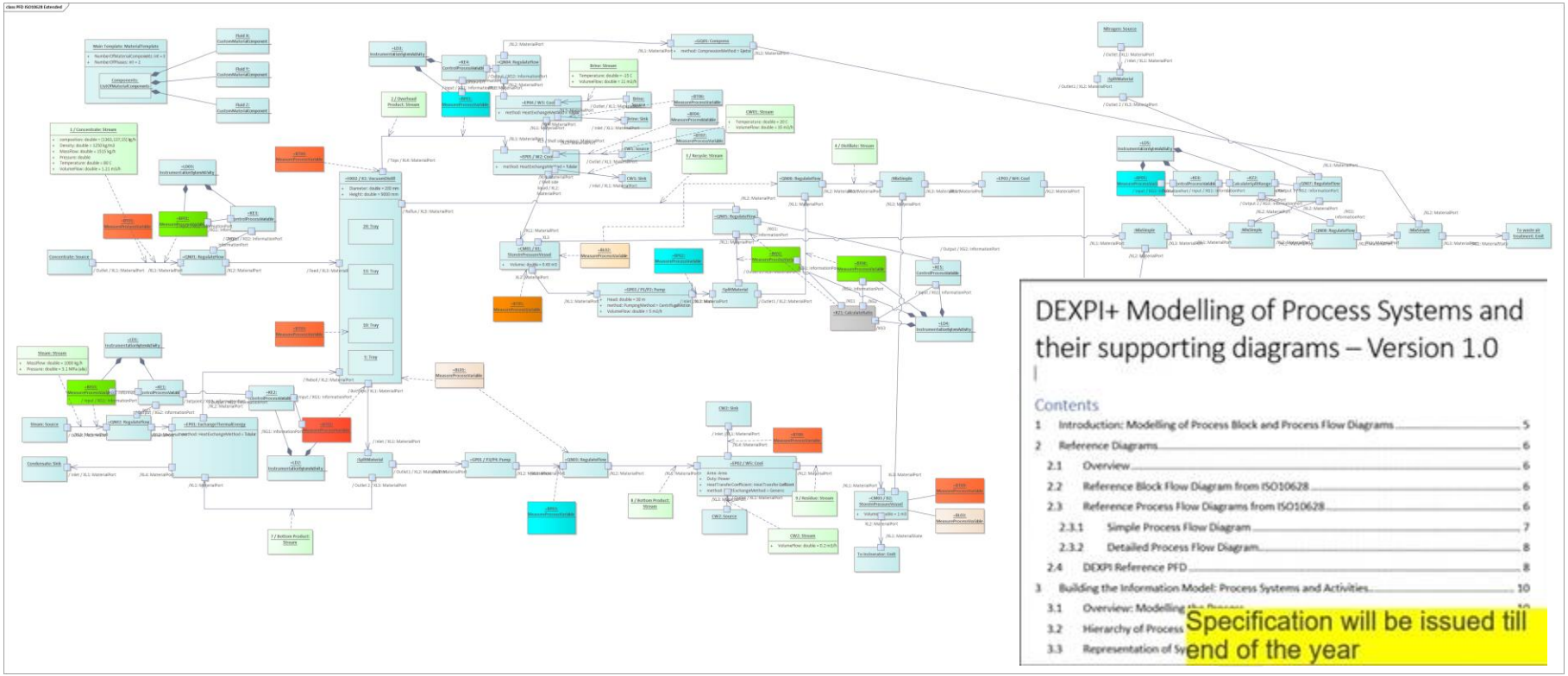


Off page connectors:
- Logical block
- Source-sink
- Cut stream

DEXPI+ Reference PFD (detailed) - used as basis for the information model

DEXPI Data Exchange in the Process Industry

PFD Iso 10628 extended



DEXPI+ Modelling of Process Systems and their supporting diagrams – Version 1.0

Contents

Specification will be issued till end of the year

DEXPI+ Summary

DEXPI Data Exchange in the Process Industry

- Shedding light on the blind spot „process model and exchange standard“
- Extending DEXPI (so far focus on P&ID) to BFD and PFD
  - Focus on standardization of information content
  - Topology comes for free from the already existing DEXPI Specification for P&IDs
- Embedded in the overarching lifecycle view