AVEVAWORLD

ACCELERATE INDUSTRIAL INTELLIGENCE

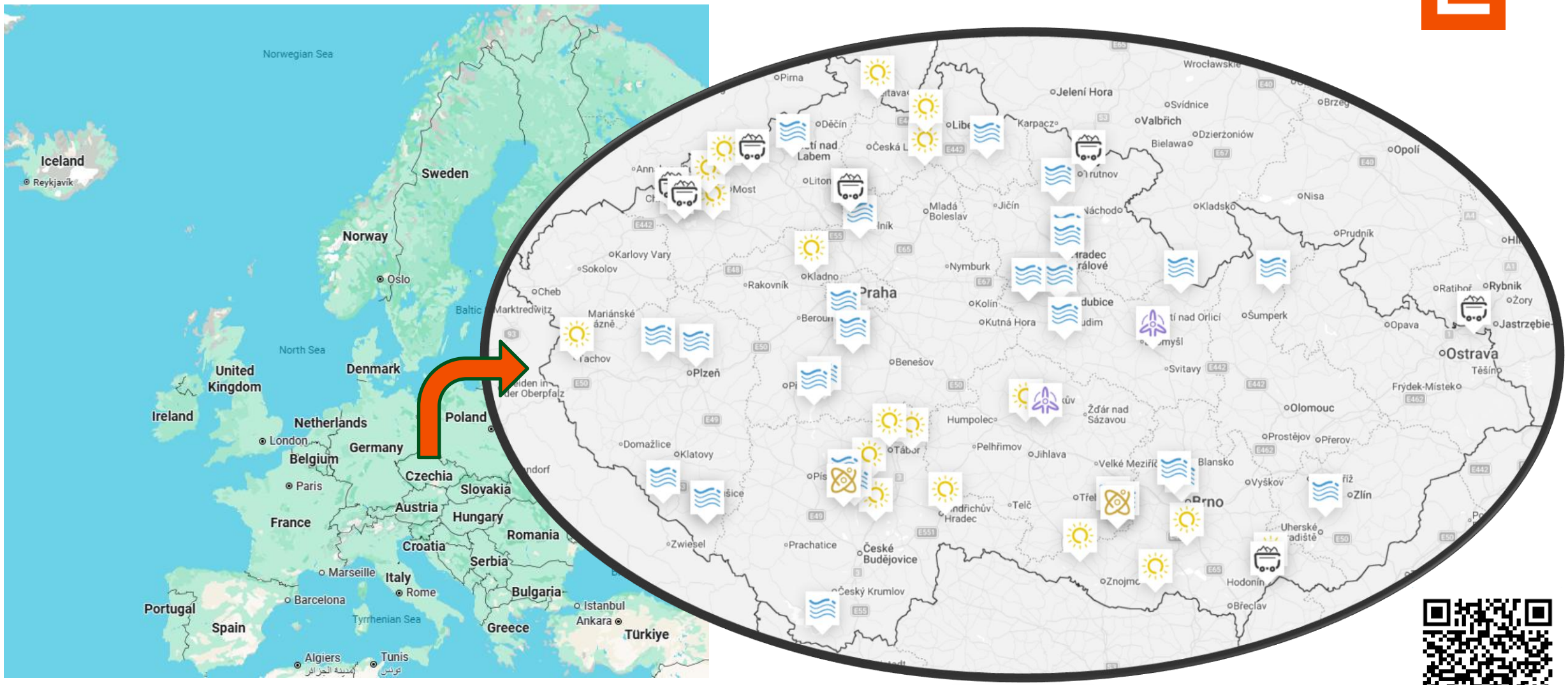
ČISTÁ ENERGIE ZÍTŘKA

Digitalization at ČEZ NPP‘s
From Document-Centric to Data-Centric solution with AVEVA

František Kružík, ČEZ a.s.

Documentation & Data management Dep.

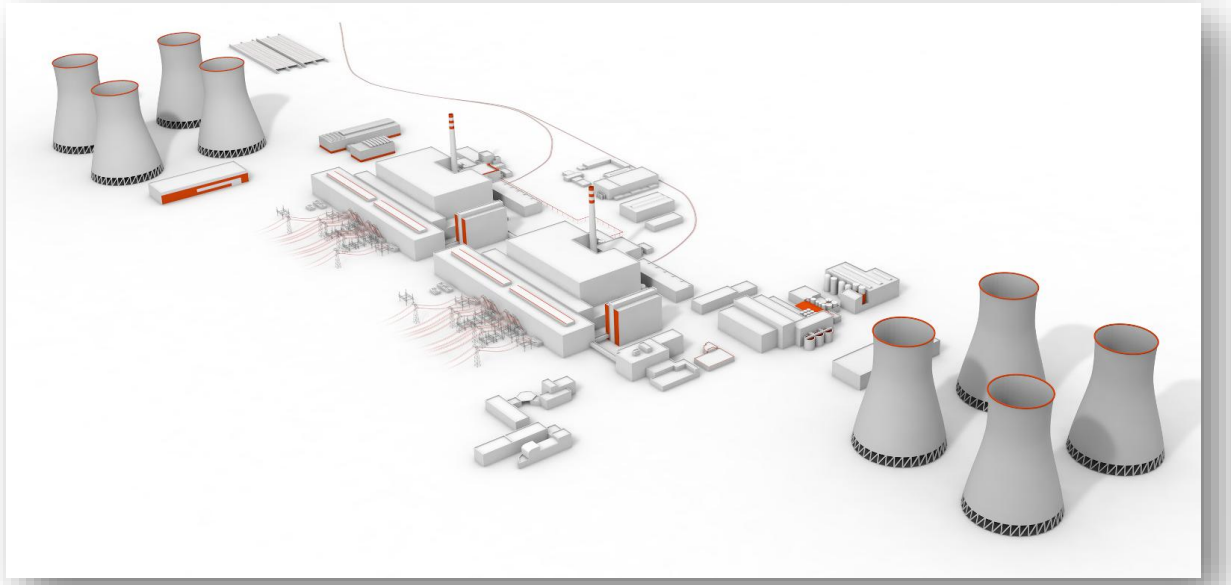
ČEZ Group - one of the largest European Power companies



[Production Resource Map | CEZ Goup]

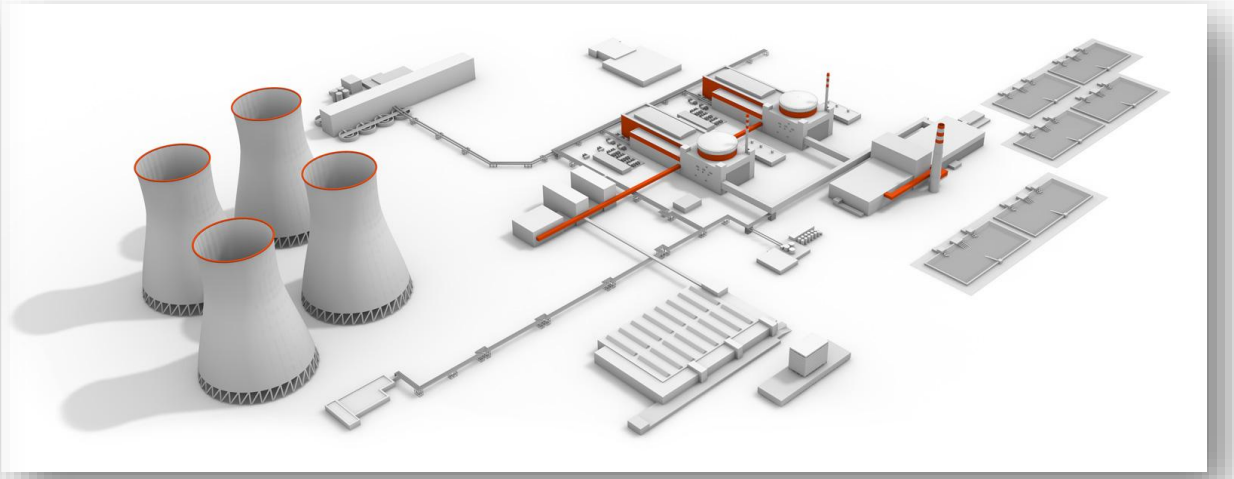
ČEZ Nuclear Division

NPP Dukovany 4 Units



Installed capacity: 4 x 510MWe
Type of reactor: VVER 440/213
In operation: since 1985

NPP Temelín 2 Units



Installed capacity: 2 x 1080 MWe
Type of reactor: VVER 1000/320
In operation: since 2000

Document Digitalization at ČEZ NPP‘s - Reasons

Reasons – status of the existing As-built-NPP:

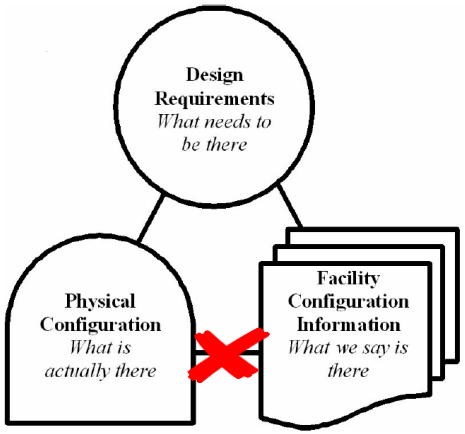
Detail Design from 80s - Only TIFF format of currently valid As-built available

- Content does not correspond to the on-site condition
- The detail does not allow the Engineering Change (EC) to be reflected in the documentation
- Therefore, mere redrawing/digitization in AutoCAD is not effective
- The use CAD tools for detail design were becoming the standard

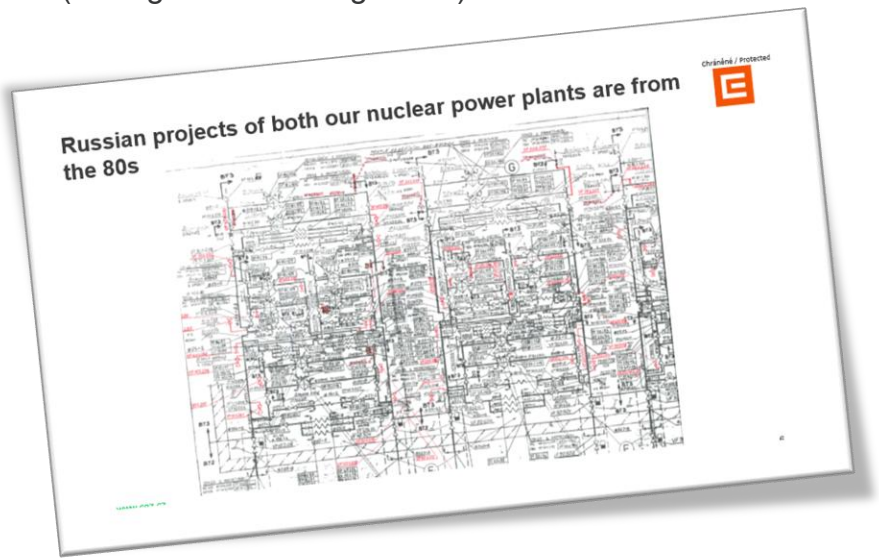
Automatic generation of a Document-Device link is not possible

- difficult identification of EC affected valid As-built documentation = gradual degradation of timeliness

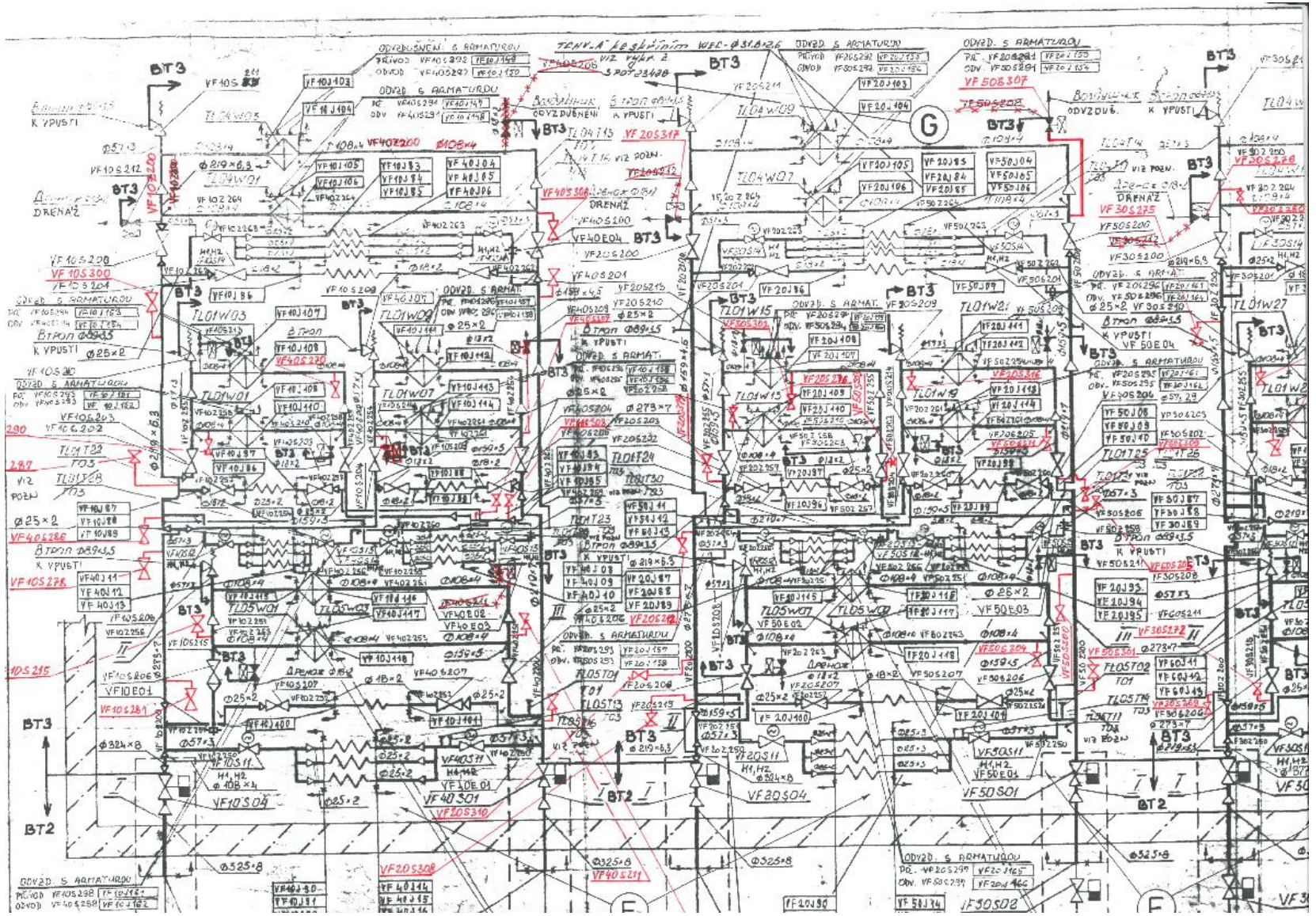
It is not possible to automatically update the contents of a drawing after EC realization



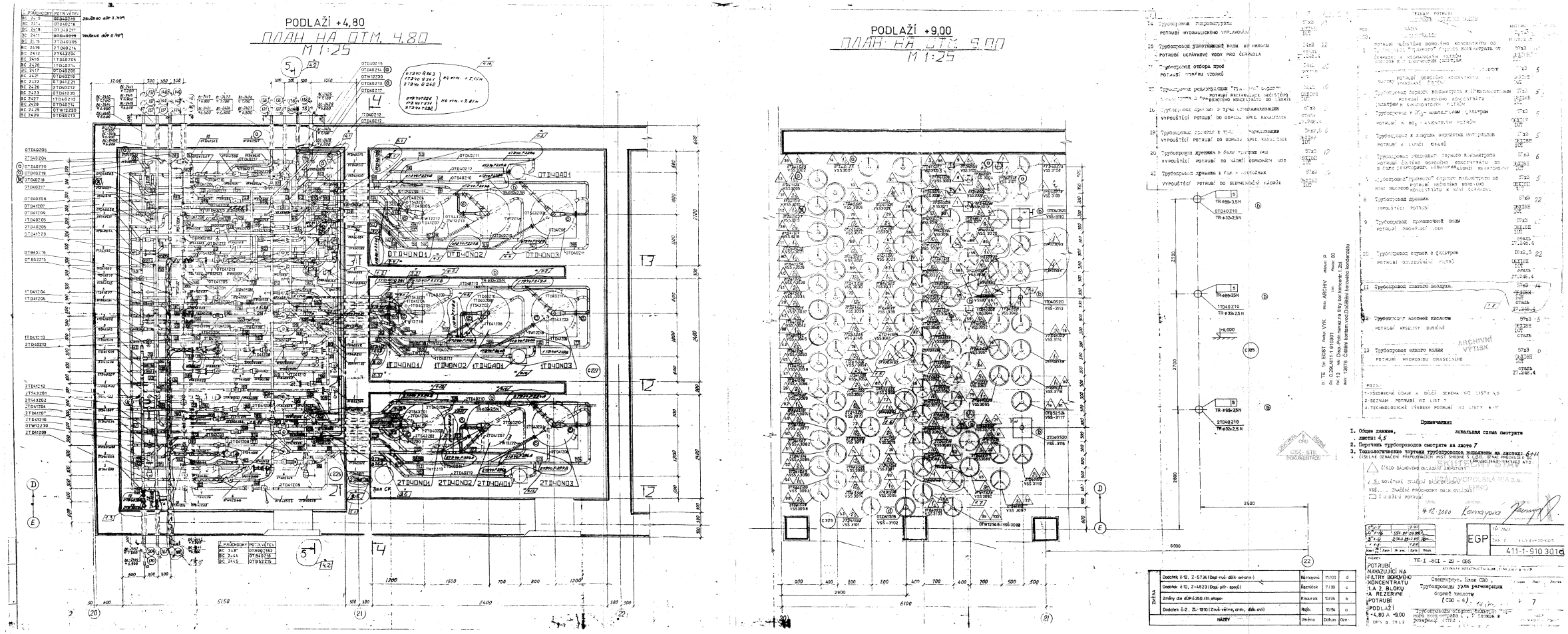
CM Objective = CM equilibrium
(Configuration Management)



Russian projects of both our nuclear power plants are from the 80s



Russian projects of both our nuclear power plants are from the 80s



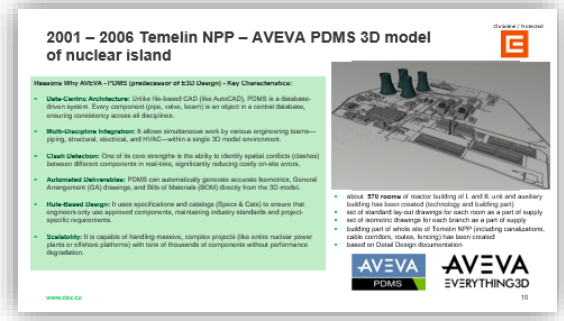
Document Digitalization at ČEZ NPP‘s with AVEVA – Main milestones

1998

- Photogrammetry

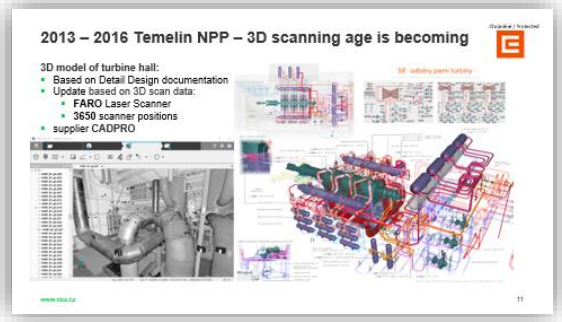
2001

- 3Dmodel



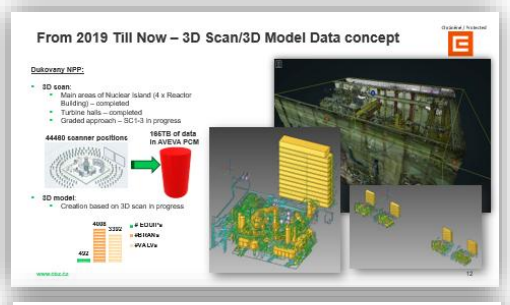
2013

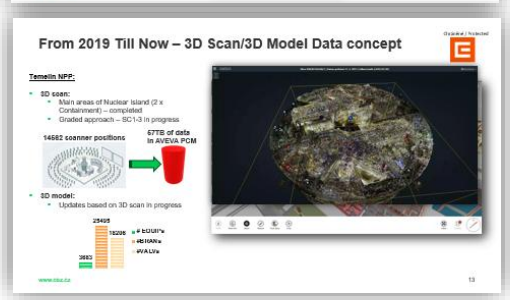
- First 3D scans



2019

- 3D scan/model concept





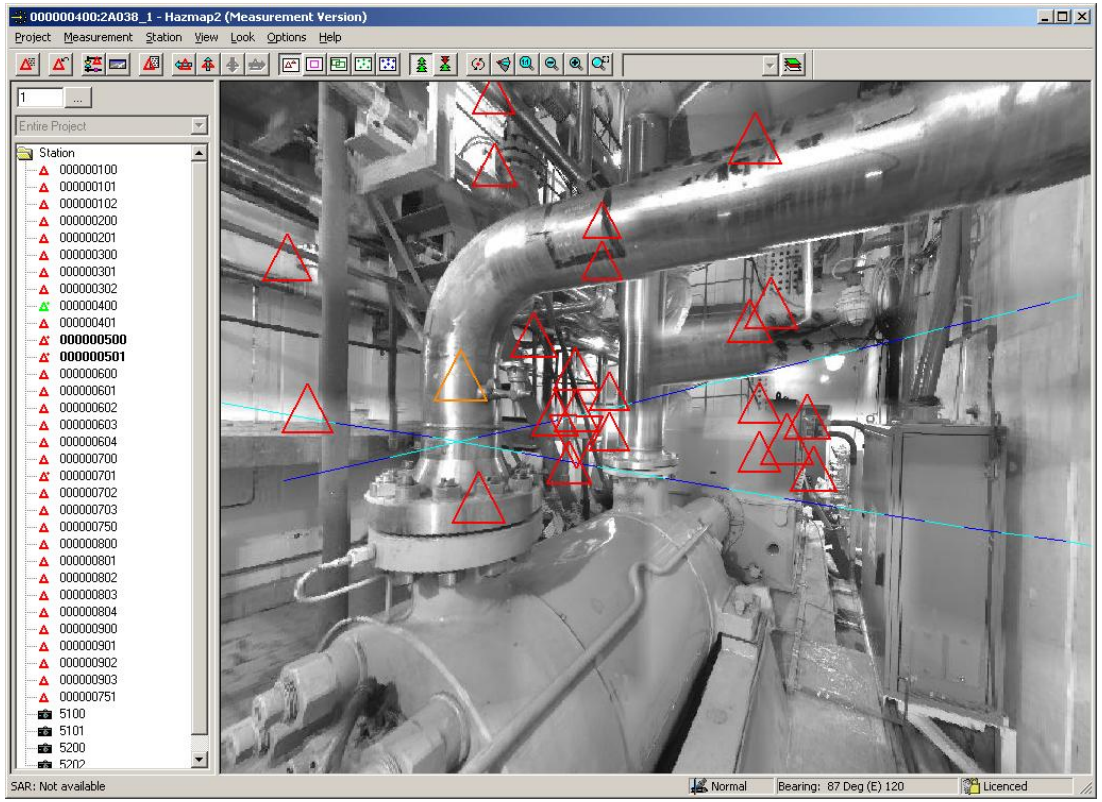
2027

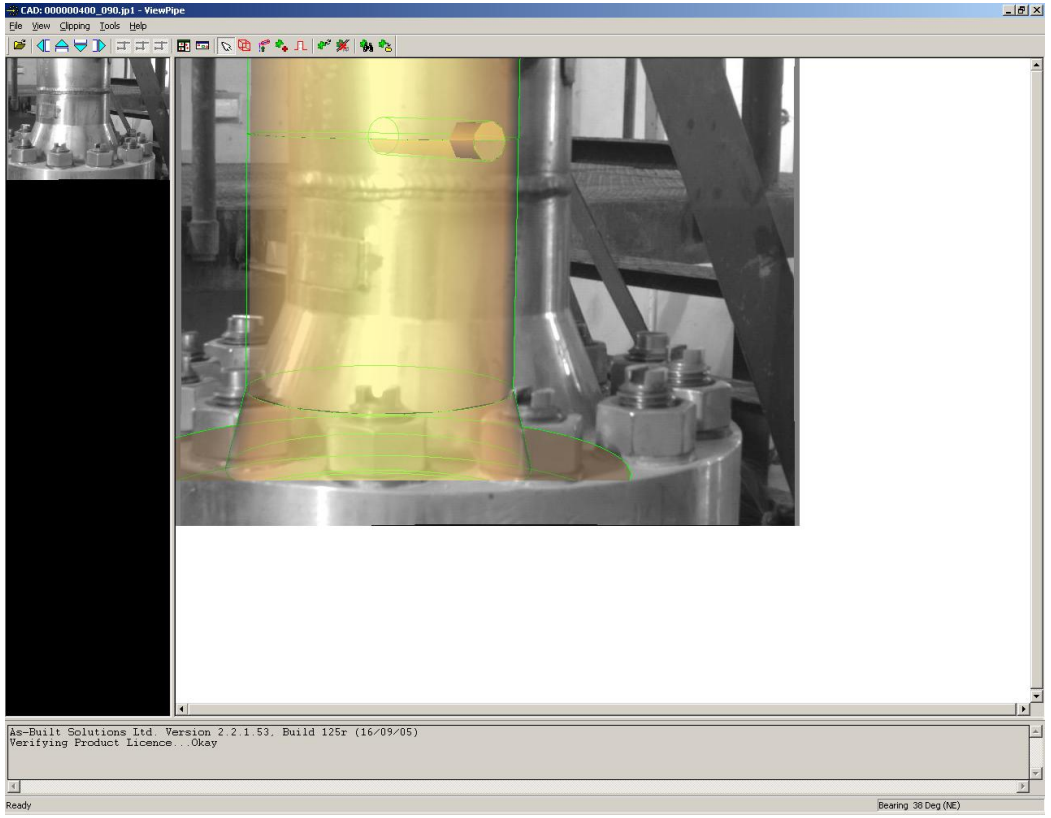
- AVEVA UE 4.0

1998 – 2001 Temelin NPP - photogrammetry

HAZMAP

- data capture system based on photogrammetry (videogrametry) technology with full 3D measurement capability and full 3D modelling capability (provides connectivity to **AVEVA PDMS**)
- data capturing – before pipe insulation (welds, …)

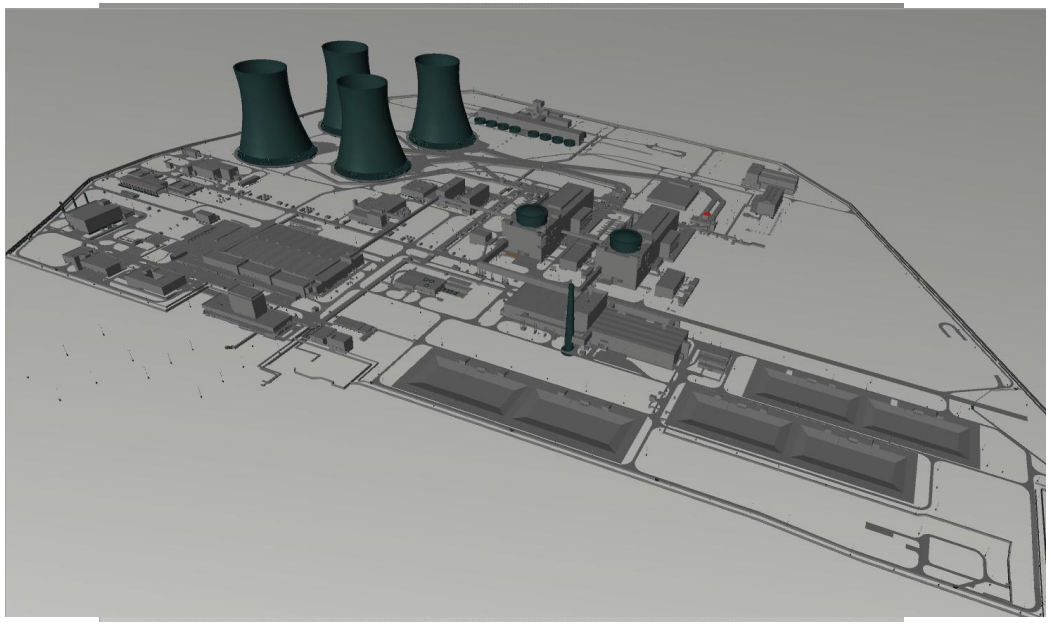




2001 – 2006 Temelin NPP – AVEVA PDMS 3D model of nuclear island

Reasons Why AVEVA - PDMS (predecessor of E3D Design) - Key Characteristics:

- **Data-Centric Architecture:** Unlike file-based CAD (like AutoCAD), PDMS is a database-driven system. Every component (pipe, valve, beam) is an object in a central database, ensuring consistency across all disciplines.
- **Multi-Discipline Integration:** It allows simultaneous work by various engineering teams—piping, structural, electrical, and HVAC—within a single 3D model environment.
- **Clash Detection:** One of its core strengths is the ability to identify spatial conflicts (clashes) between different components in real-time, significantly reducing costly on-site errors.
- **Automated Deliverables:** PDMS can automatically generate accurate Isometrics, General Arrangement (GA) drawings, and Bills of Materials (BOM) directly from the 3D model.
- **Rule-Based Design:** It uses specifications and catalogs (Specs & Cats) to ensure that engineers only use approved components, maintaining industry standards and project-specific requirements.
- **Scalability:** It is capable of handling massive, complex projects (like entire nuclear power plants or offshore platforms) with tens of thousands of components without performance degradation.



- about **570 rooms** of reactor building of I. and II. unit and auxiliary building has been created (technology and building part)
- set of standard lay-out drawings for each room as a part of supply
- set of isometric drawings for each branch as a part of supply
- building part of whole site of Temelin NPP (including canalizations, cable corridors, routes, fencing) has been created
- based on Detail Design documentation

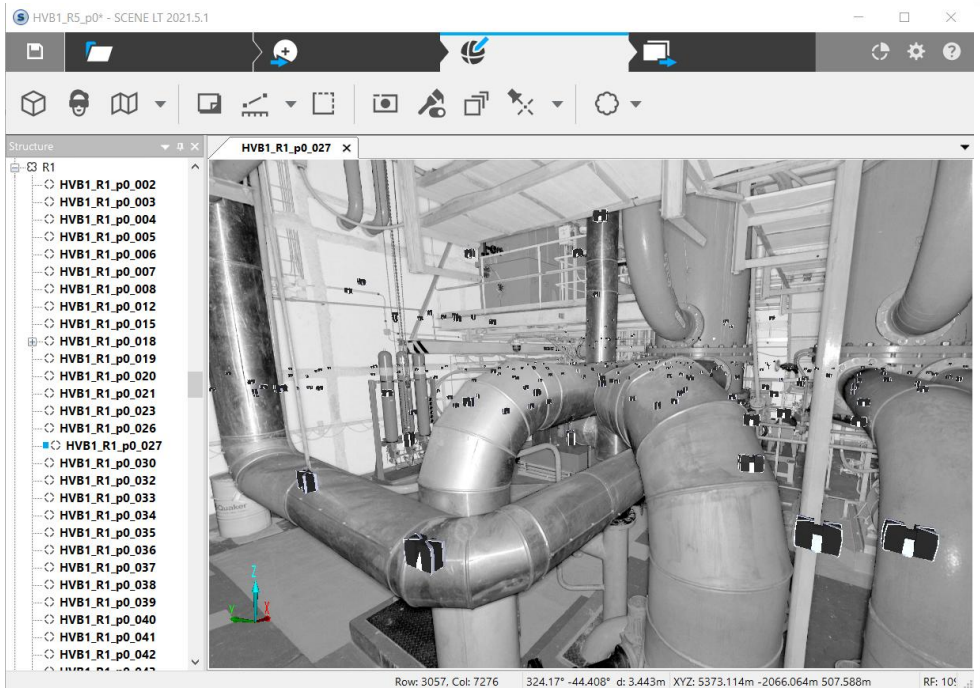
AVEVA PDMS

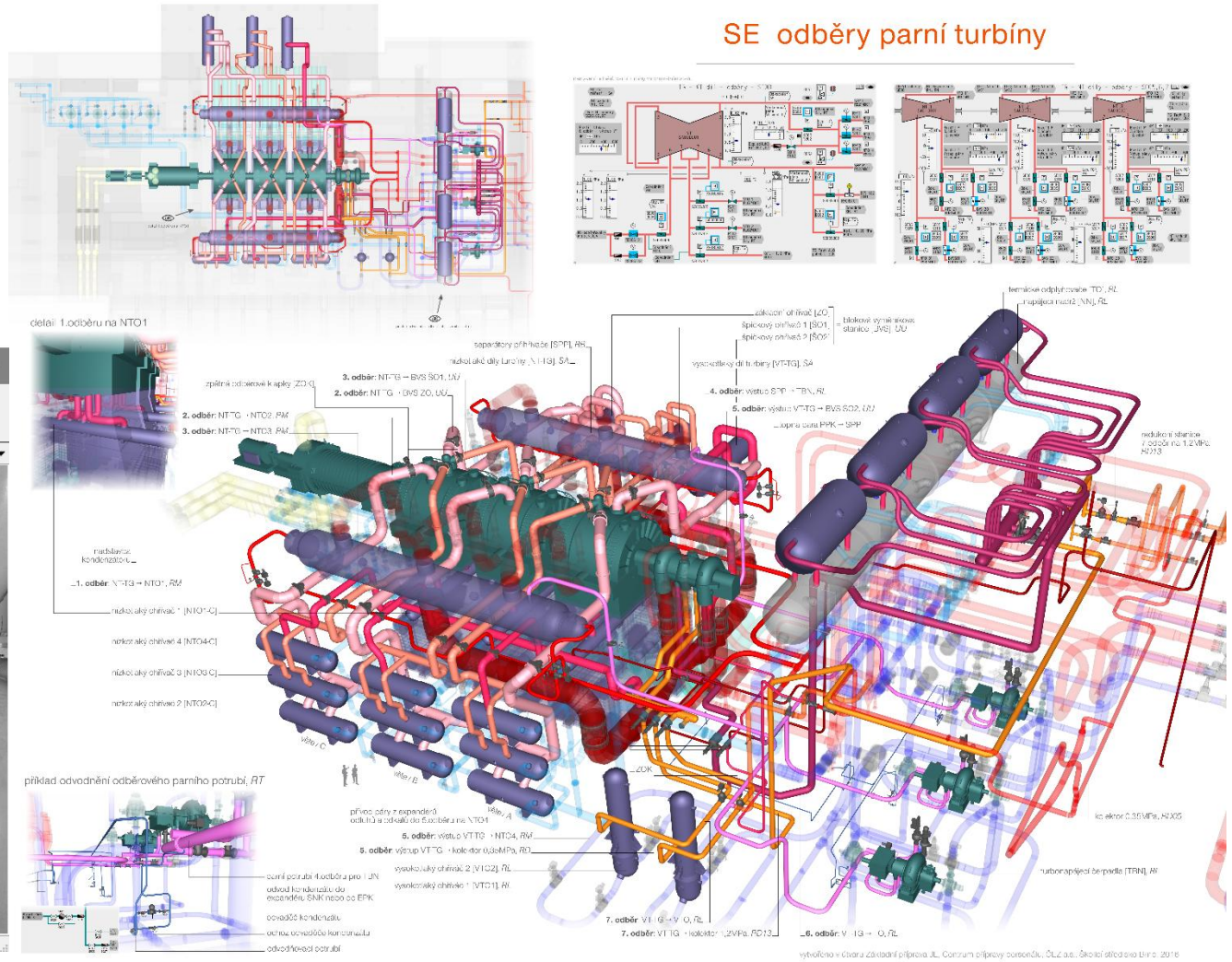
AVEVA EVERYTHING3D

2013 – 2016 Temelin NPP – 3D scanning age is becoming

3D model of turbine hall:

- Based on Detail Design documentation
- Update based on 3D scan data:
  - **FARO** Laser Scanner
  - **3650** scanner positions
- supplier **CADPRO**



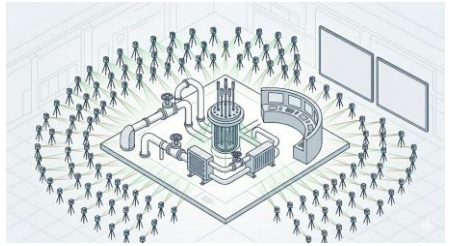


From 2019 Till Now – 3D Scan/3D Model Data concept

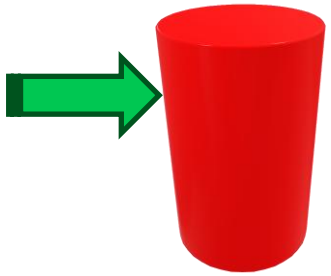
Dukovany NPP:

- **3D scan**:
  - Main areas of Nuclear Island (4 x Reactor Building) – completed
  - Turbine halls – completed
  - Graded approach – SC1-3 in progress

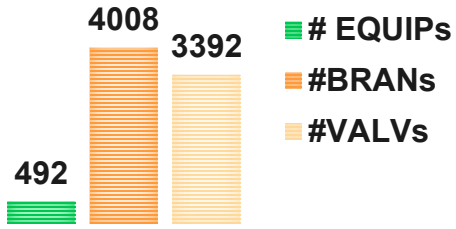
44460 scanner positions

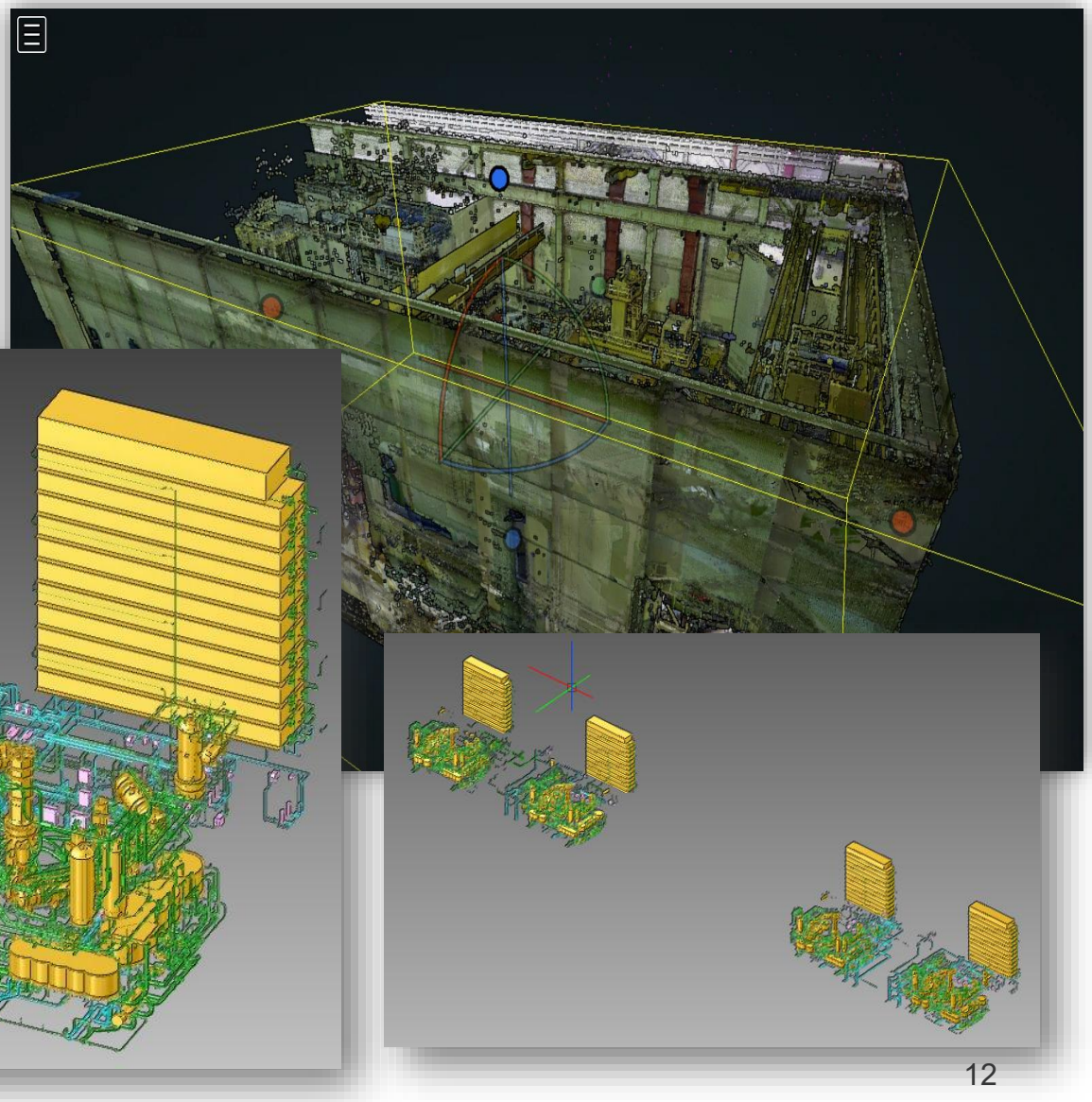


165TB of data in AVEVA PCM



- **3D model**:
  - Creation based on 3D scan in progress



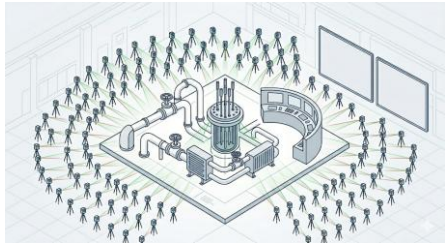


From 2019 Till Now – 3D Scan/3D Model Data concept

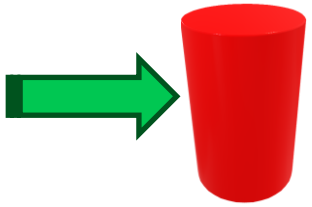
Temelin NPP:

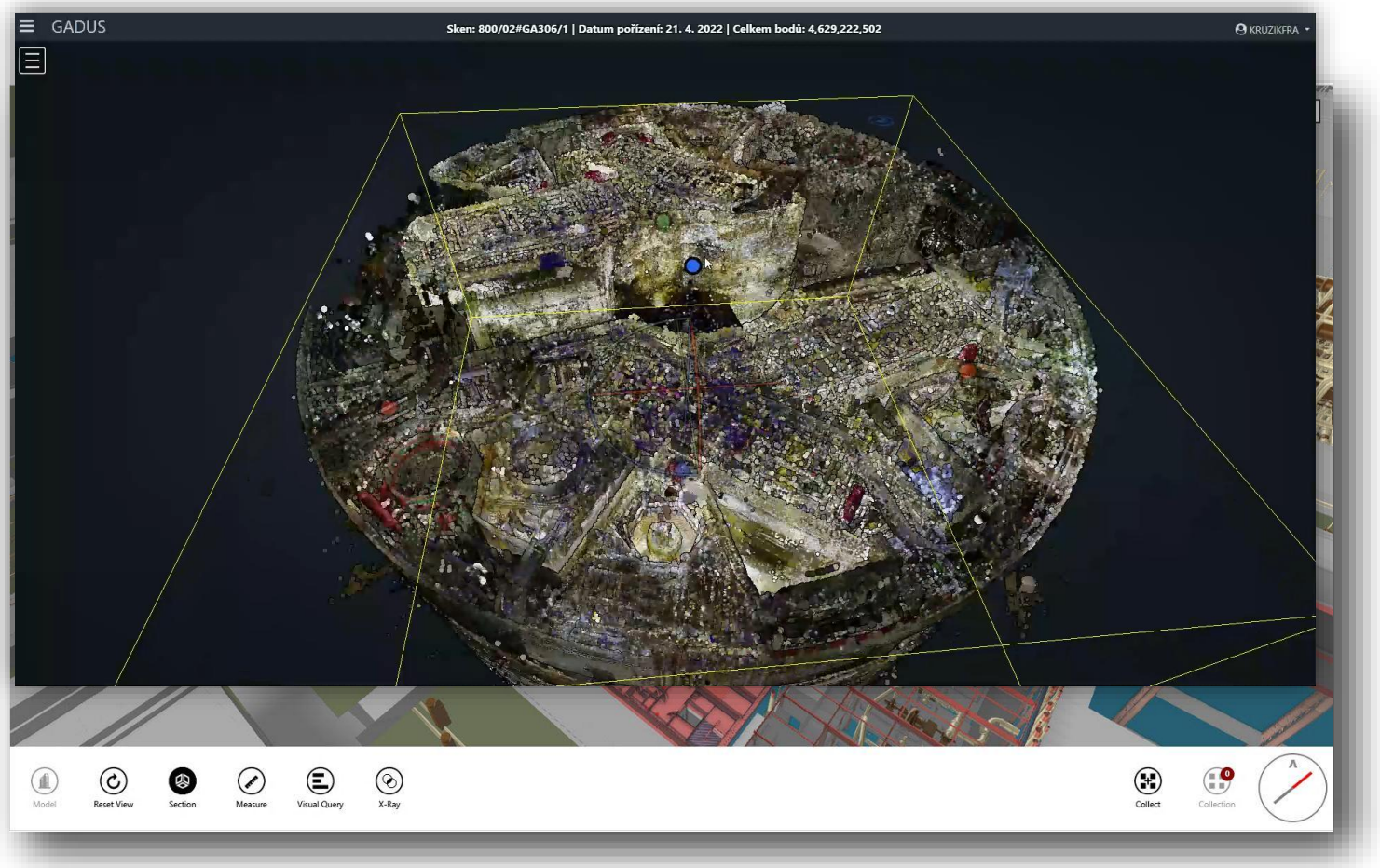
- **3D scan:**
  - Main areas of Nuclear Island (2 x Containment) – completed
  - Graded approach – SC1-3 in progress

14562 scanner positions

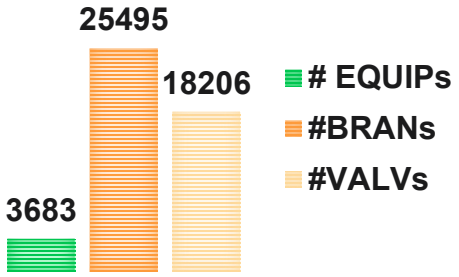


57TB of data in AVEVA PCM

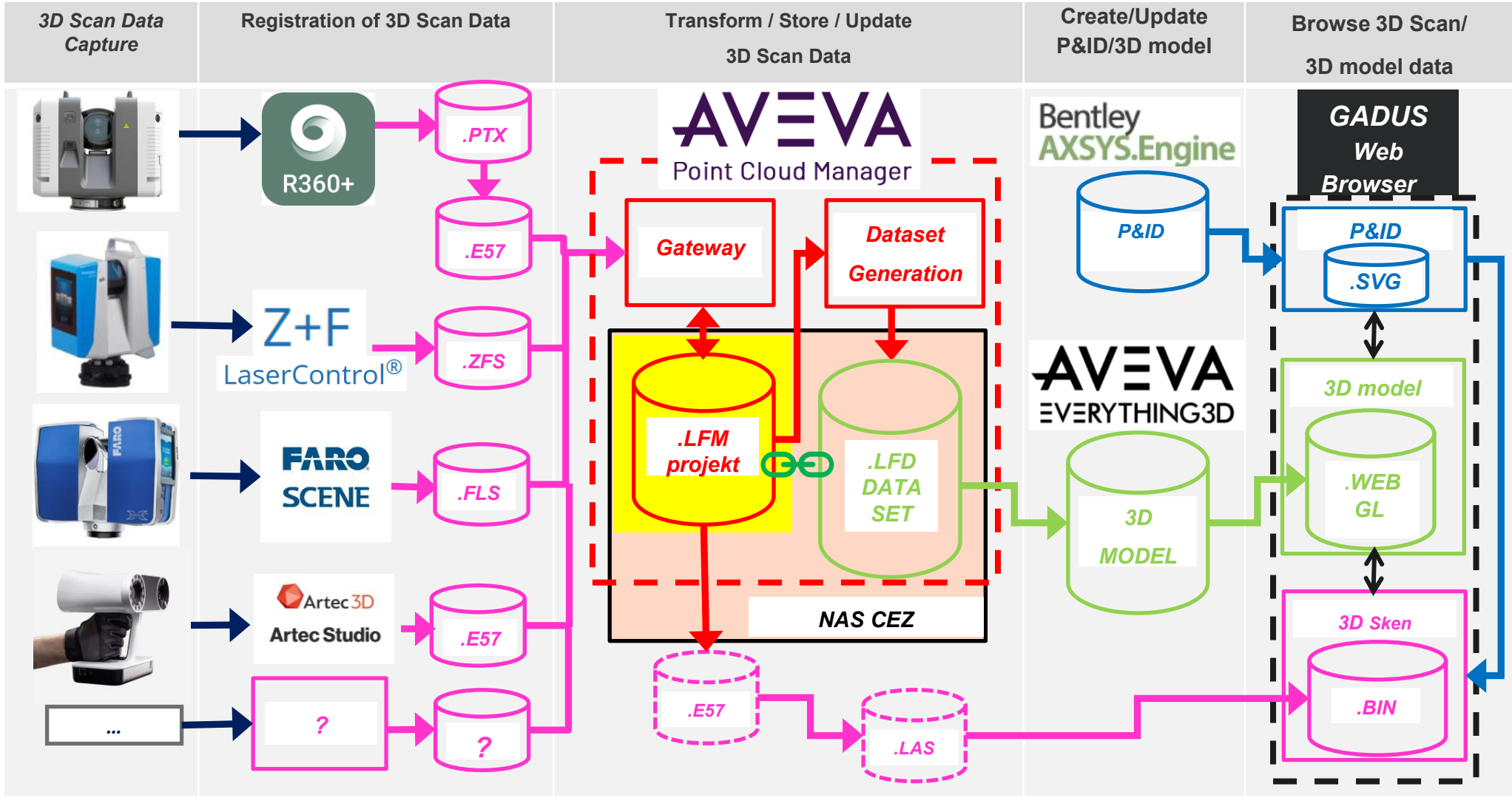




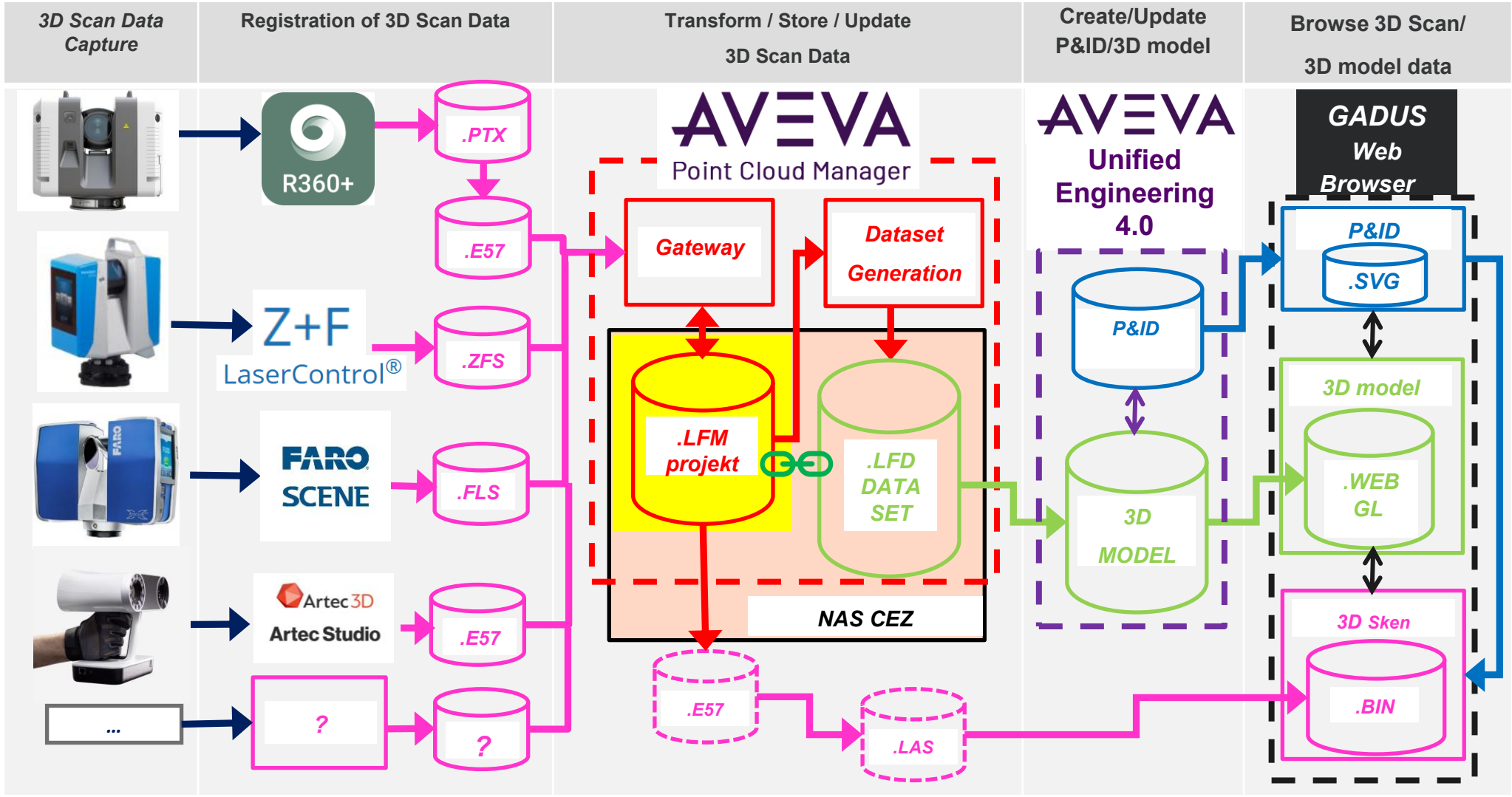
- **3D model:**
  - Updates based on 3D scan in progress



3D Scan/3D Model Data WF/Concept in particular phases with AVEVA

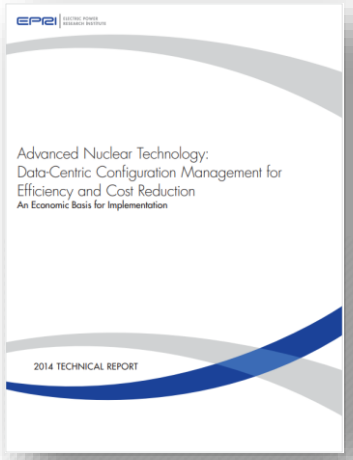


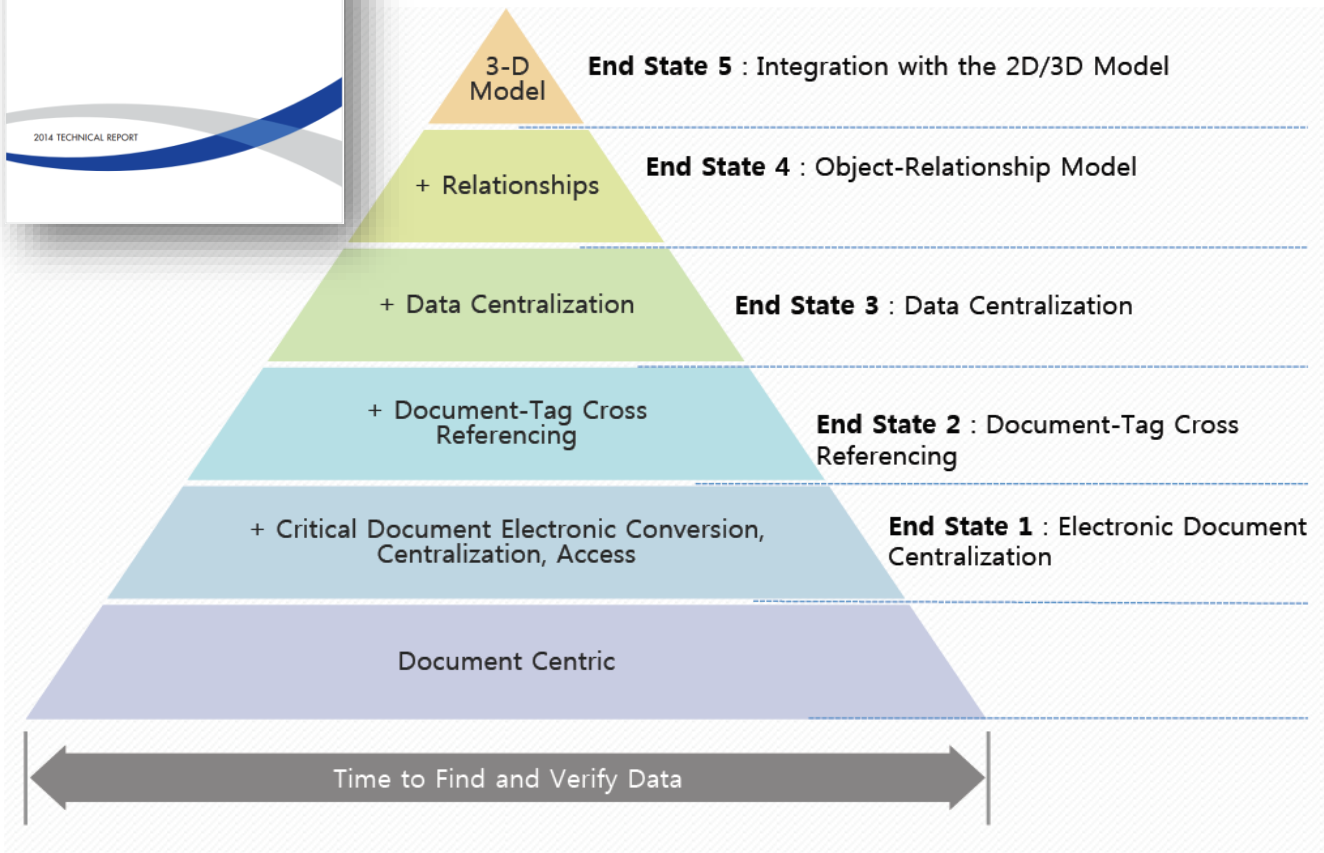
From 2019 Till Now - 3D Scan/3D Model Data WF/Concept in particular phases with AVEVA from 2027



Documentation digitalization

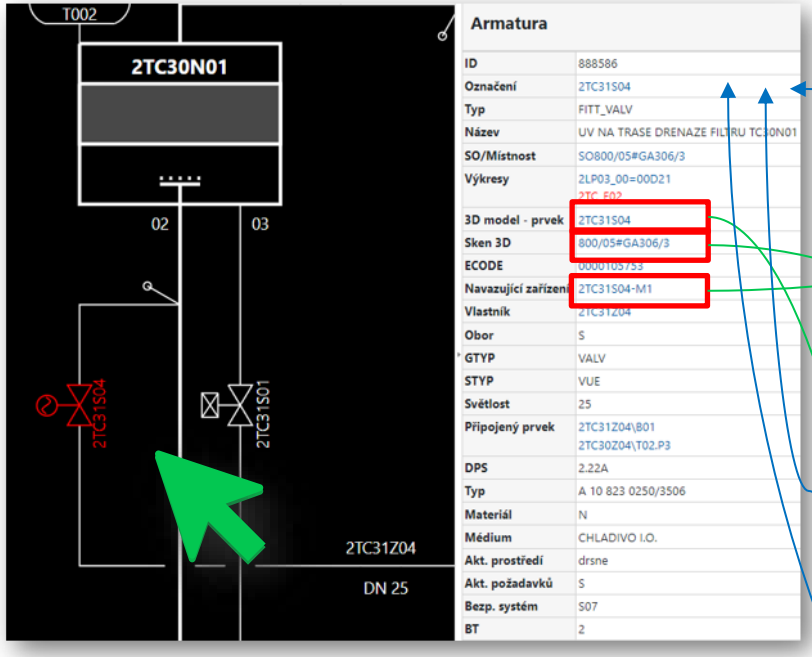
Steps according to EPRI & Graded approach in NPP CM Evolution Programme





ČEZ Nuclear Division - Documentation digitalization – L5

P&ID



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Sken 3D	800/05#GA306/3
ECODE	0000105753
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Vlastník	2TC31Z04
Obor	S
GTYP	VALV
STYP	VUE
Světlost	25
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DPS	2.22A
Typ	A 10 823 0250/3506
Materiál	N
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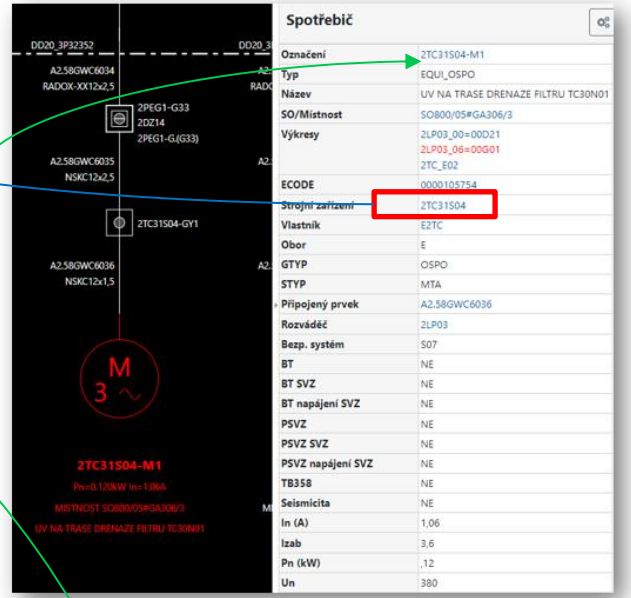
Akt. prostředí	drsne
Akt. požadavků	S
Bezp. systém	S07
BT	2

Single Line Diagram



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Vlastník	E2TC
Obor	E
GTYP	OSPO
STYP	MTA
Připojený prvek	A2.58GWC6036
Rozváděč	2LP03
Bezp. systém	S07
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BT SVZ	NE
BT napájení SVZ	NE
PSVZ	NE
PSVZ SVZ	NE
PSVZ napájení SVZ	NE
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Seismicita	NE
In (A)	1,06
Izab	3,6
Pn (kW)	,12
Un	380

3D Model

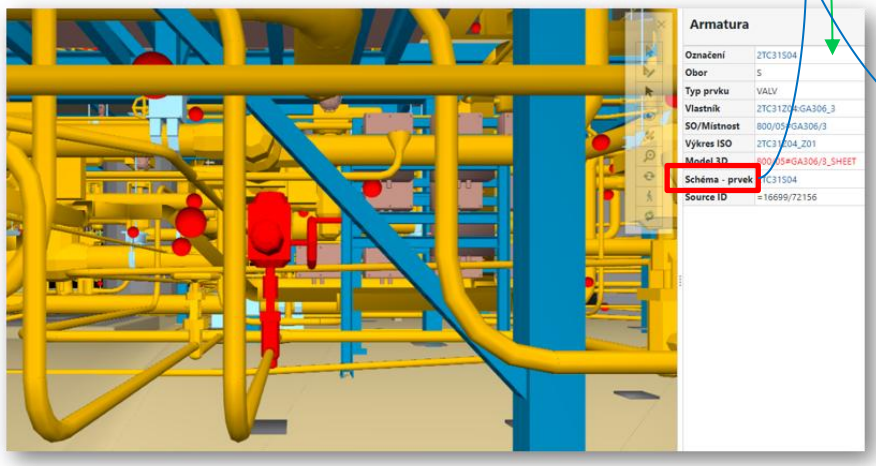

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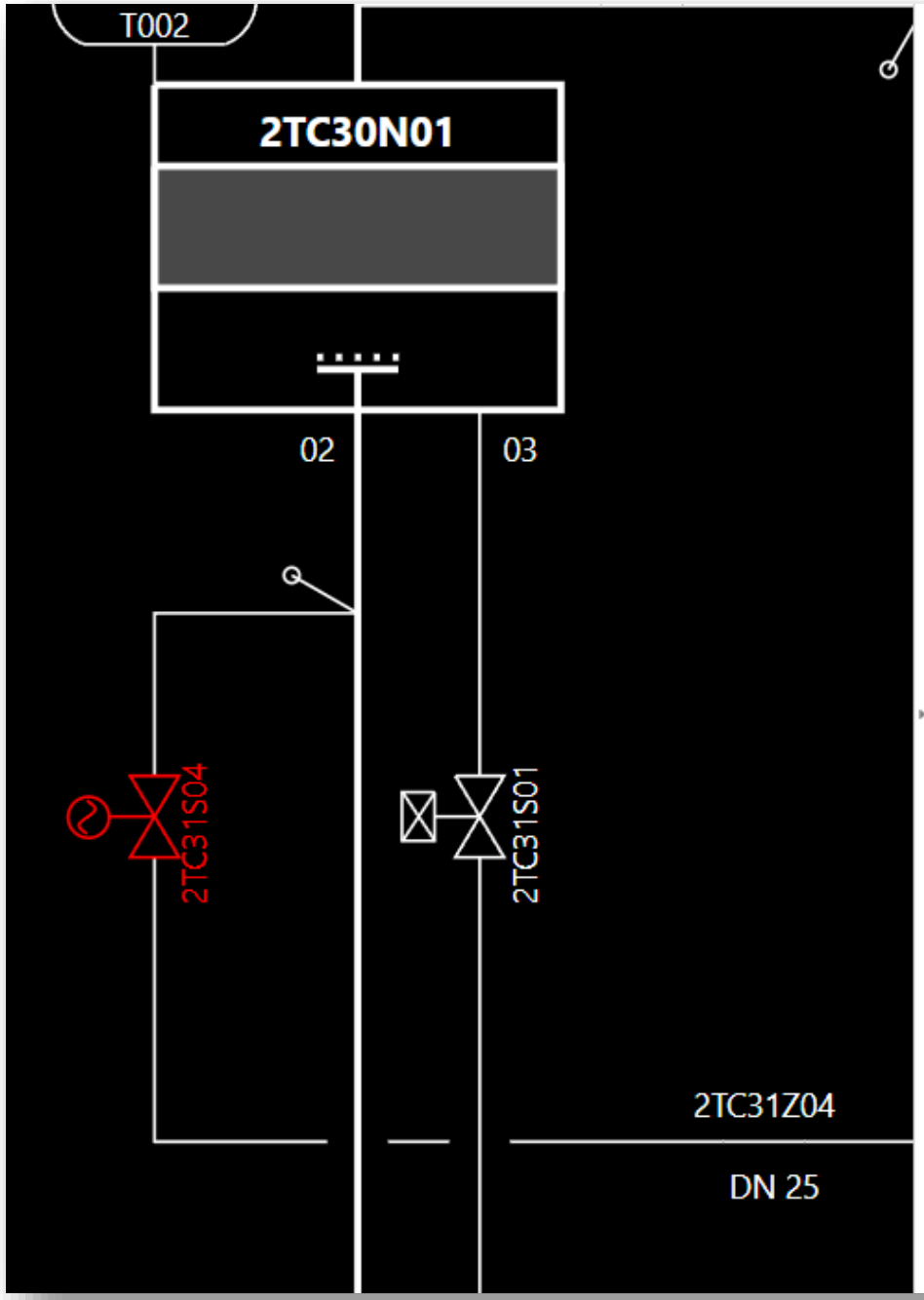
Schéma - prvek	2TC31S04
Source ID	=16699/72156

3D Scan

P&ID



Armatura

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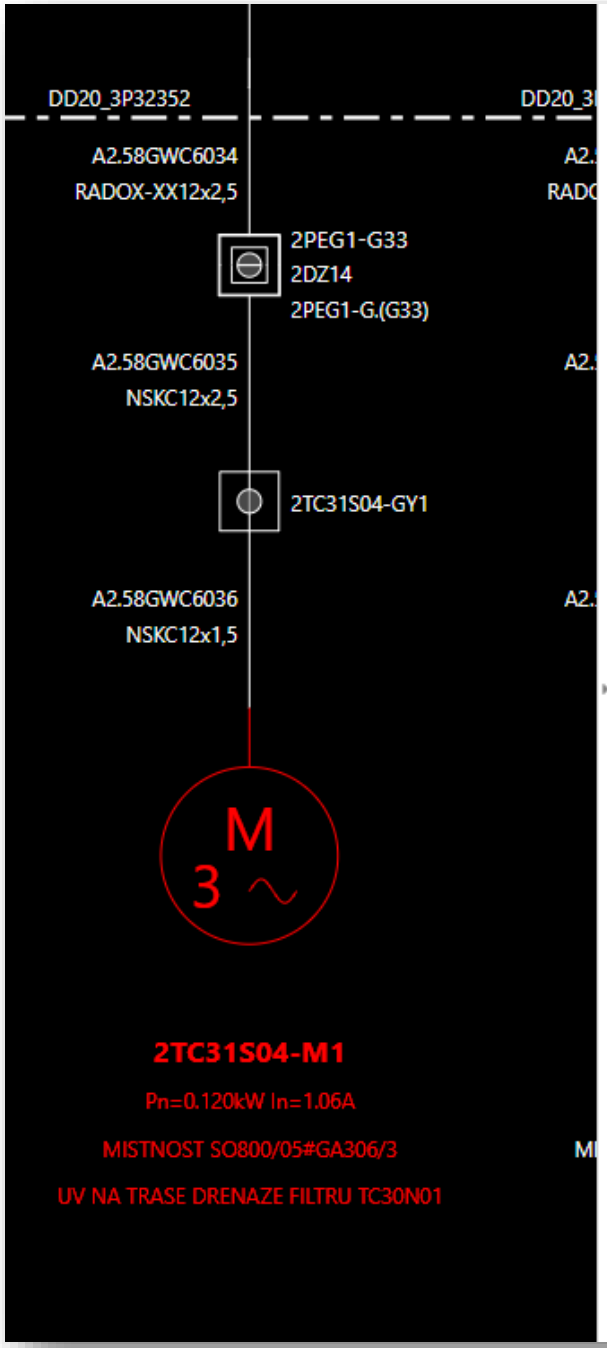
Výkresy	2LP03_00=00D21 2TC_E02
3D model - prvek	2TC31S04
Sken 3D	800/05#GA306/3
ECODE	0000105753
Navazující zařízení	2TC31S04-M1
Vlastník	2TC31Z04
Obor	S
GTYP	VALV
STYP	VUE
Světlost	25
Připojený prvek	2TC31Z04\B01 2TC30Z04\T02.P3
DPS	2.22A
Typ	A 10 823 0250/3506
Materiál	N
Médium	CHLADIVO I.O.
Akt. prostředí	drsne
Akt. požadavků	S
Bezp. systém	S07
BT	2

Single Line Diagram



Spotřebič

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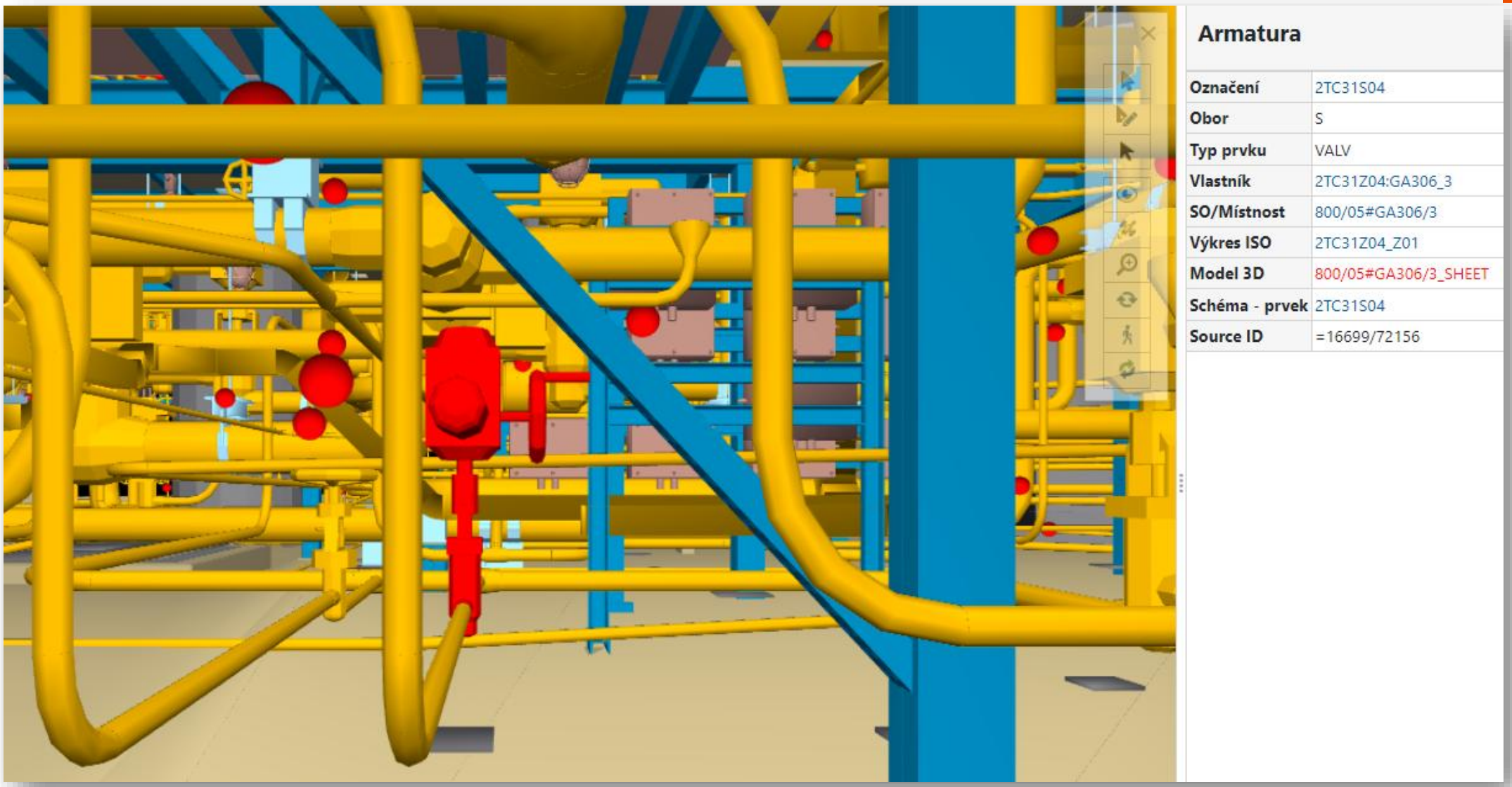
Strojní zařízení	2TC31S04
Vlastník	E2TC
Obor	E
GTYP	OSPO
STYP	MTA
Připojený prvek	A2.58GWC6036
Rozváděč	2LP03
Bezp. systém	S07
BT	NE
BT SVZ	NE
BT napájení SVZ	NE
PSVZ	NE
PSVZ SVZ	NE
PSVZ napájení SVZ	NE
TB358	NE
Seismicita	NE
In (A)	1,06
Izab	3,6
Pn (kW)	,12
Un	380

3D Scan


2TC31S04
Armatura
ID 259990
Označení 2TC31S04
Typ FITT_VALV
Obor S
Typ prvku VALV
Vlastník 2TC31Z04:GA306_3
SO/Místnost 800/05#GA306/3
Výkres ISO 2TC31Z04_Z01
Model 3D 800/05#GA306/3_SHEET
Schéma - prvek 2TC31S04
Source ID =16699/72156
2TC31S04 [1.07 m]

3D Model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Označení 2TC31S04
Obor S
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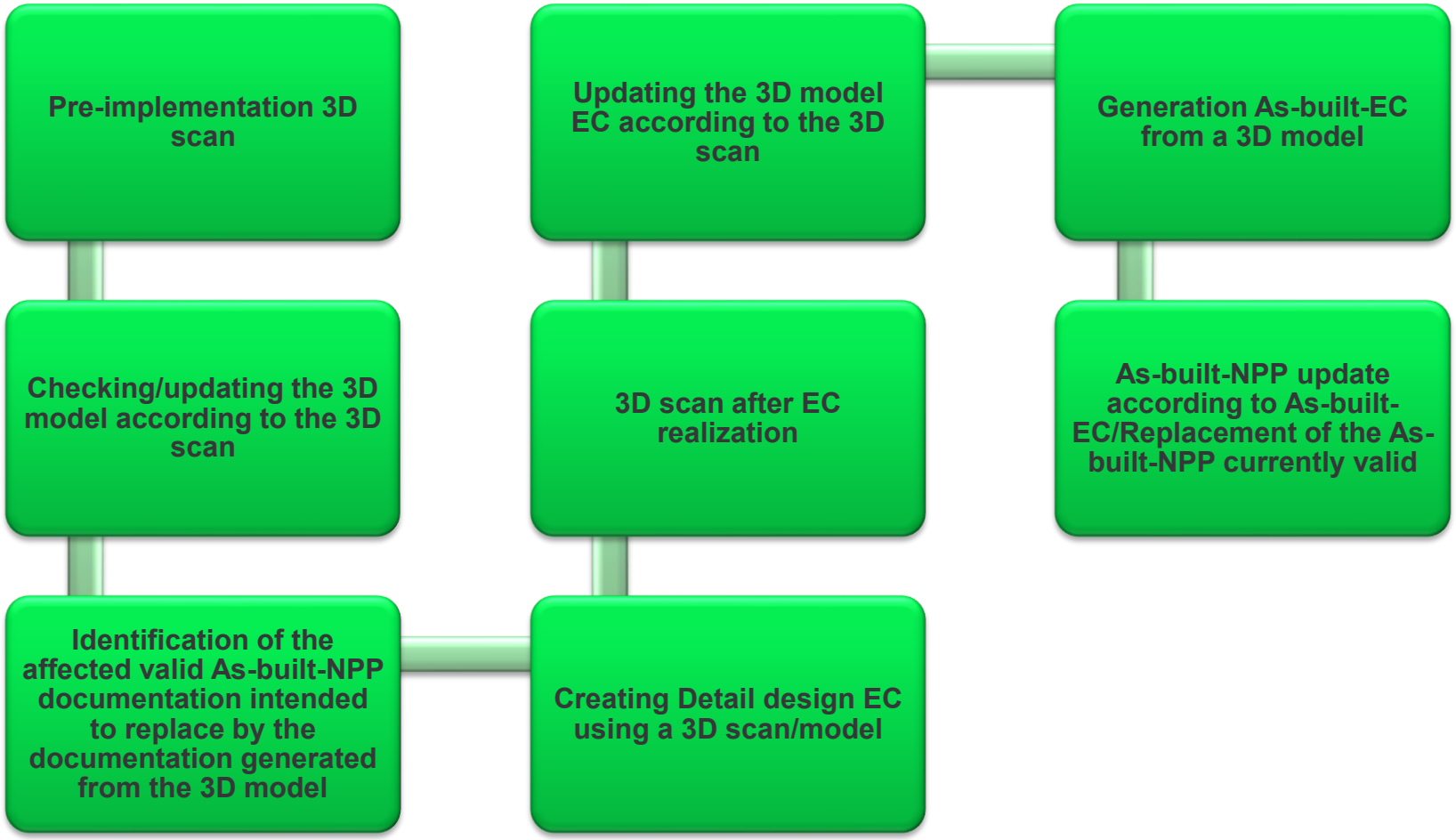
Vlastník 2TC31Z04:GA306_3
SO/Místnost 800/05#GA306/3
Výkres ISO 2TC31Z04_Z01
Model 3D 800/05#GA306/3_SHEET
Schéma - prvek 2TC31S04
Source ID =16699/72156

Work Flow of Engineering Change in 3D



WF of EC(Engineering Change) in 3D – Expected benefits

Benefits of 3D:

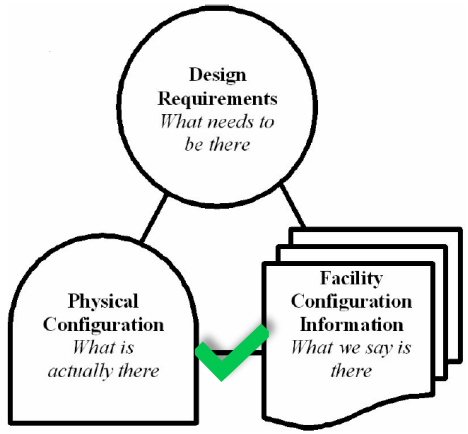
3D scan of As-built

- Possibility of a virtual tour of the condition on site – **complete** layout of all technology, measurement possibility, ...
- Possibility of update the 3D model according to the current 3D scan

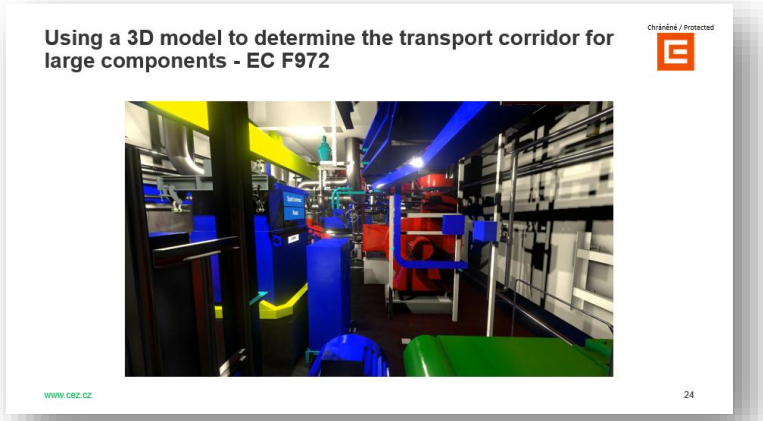
3D model of As-built

- Generation of digitized documentation(including hotspots) from a 3D model
- Automatic generation of the Document-Device link
- Automatic update of drawing content after EC from an updated 3D model
- Automatic generation of isometrics pipeline drawings
- Using a 3D model (updated according to the current 3D scan) to determine the transport corridor for large components
- The existence of a digital 3D model is currently enshrined in the Czech legislative requirements for the process of decommissioning of a nuclear facility

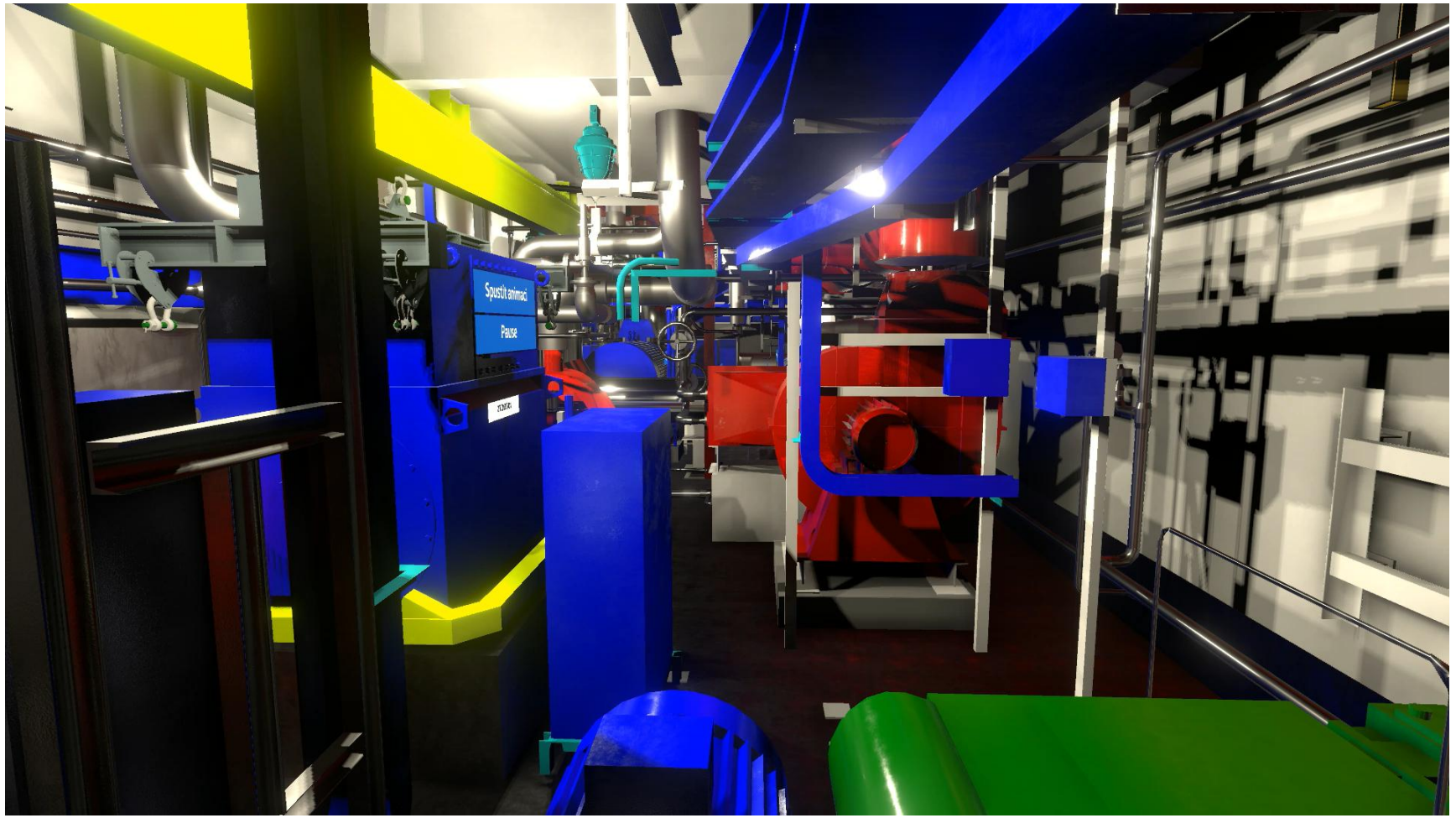
Trustful 3D data becomes part of the Digital Twin



CM Objective = CM equilibrium



Using a 3D model to determine the transport corridor for large components - EC F972



ČEZ Data-Centric solution for Efficiency and Cost Reduction in Engineering Change Design Process

Challenge

- Status of the existing As-built-NPP - Detail Design from 80s - Only TIFF format of currently valid As-built available
- Document-centric solution for As-built-NPP
- Content does not correspond to the on-site condition
- The detail does not allow the EC to be reflected in the documentation
- The use 3D CAD tools for detail design is standard nowadays

Solution

- Deployed **AVEVA E3D** and **AVEVA PCM** to create and maitain trustful 3D model (graded approach applied) as a part of Data-Centric solution for usage also in the EC design process

Results

- Automatic generation of digitized As-built-NPP documentation from the 3D model after the implementation of the Engeneering Change
- Trustful 3D model as a part of Data-Centric solution
- Cost reduction in EC Design Process, assuming consideration in the form of a valid 3D model and 3D scan data:

Estimated savings (time in %) by five major suppliers of EC Design					
EC phase / Supplier	**Energoservis**	**I&C Energo**	**KPSAG**	**ŠKODA JS**	**ÚJV Řež**
on-site errand	80	70	50	35	50
search for documents	60	30	60	50	50
EC Detail design	0	25	25	25	40
calculations	80	40	25	50	40
EC As-built	15	20	25	35	30