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What is nuclear hybrid digital model?

Or “La Maquette Numérique Hybride”

Thomas Arduino (EDF DIPDE) | Aymen HASSOUN (AVEVA)

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Engineering Support and
Environmental Services
Division

Thomas ADUINO & Aymen HASSOUN
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Division de l'Ingénierie du Parc et De l'Environnement

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1. Presentation of speakers



Division de l'Ingénierie du Parc
et De l'Environnement

I'm Thomas Arduino. I have a degree in mechanical engineering from Ecole des Mines of Saint Etienne. I started working for EDF 9 years ago as a nuclear process nuclear trainer at the Tricastin power plant. At the end of 2019, I joined DIPDE at Marseille to manage IT projects involving 3D data and point clouds. I worked with Aymen in EDF during 3 Years



I am Aymen Hassoun, I have a Master's in construction, engineering from the University of Cergy-Pontoise, and today I am a Senior CAD Applications Engineer at AVEVA France, I am based in Paris, with extensive experience in 3D transformation projects and technical support for AVEVA tools. He has worked with notable companies like EDF and ALLIA, before joining AVEVA.

2. A bit little of history



One of France's distinctive features is the standardization of its nuclear power plants: all 56 PWR reactors use the same technology and are technically similar. They are located at 18 nuclear power plant sites, with each plant comprising between 2 and 6 reactors (or “tranche”).

Reactors are classified according to their model - known as a “tier” - and the electrical power they deliver: 900 megawatts electrical (MWe), 1300 MWe and 1450 MWe.

There are 32 900 MWe reactors: 4 **CP0 reactors** (4 at Bugey), and 28 **CPY reactors** (4 at Tricastin, 6 at Gravelines, 4 at Dampierre, 4 at Blayais, 4 at Chinon, 4 at Cruas and 2 at Saint-Laurent).

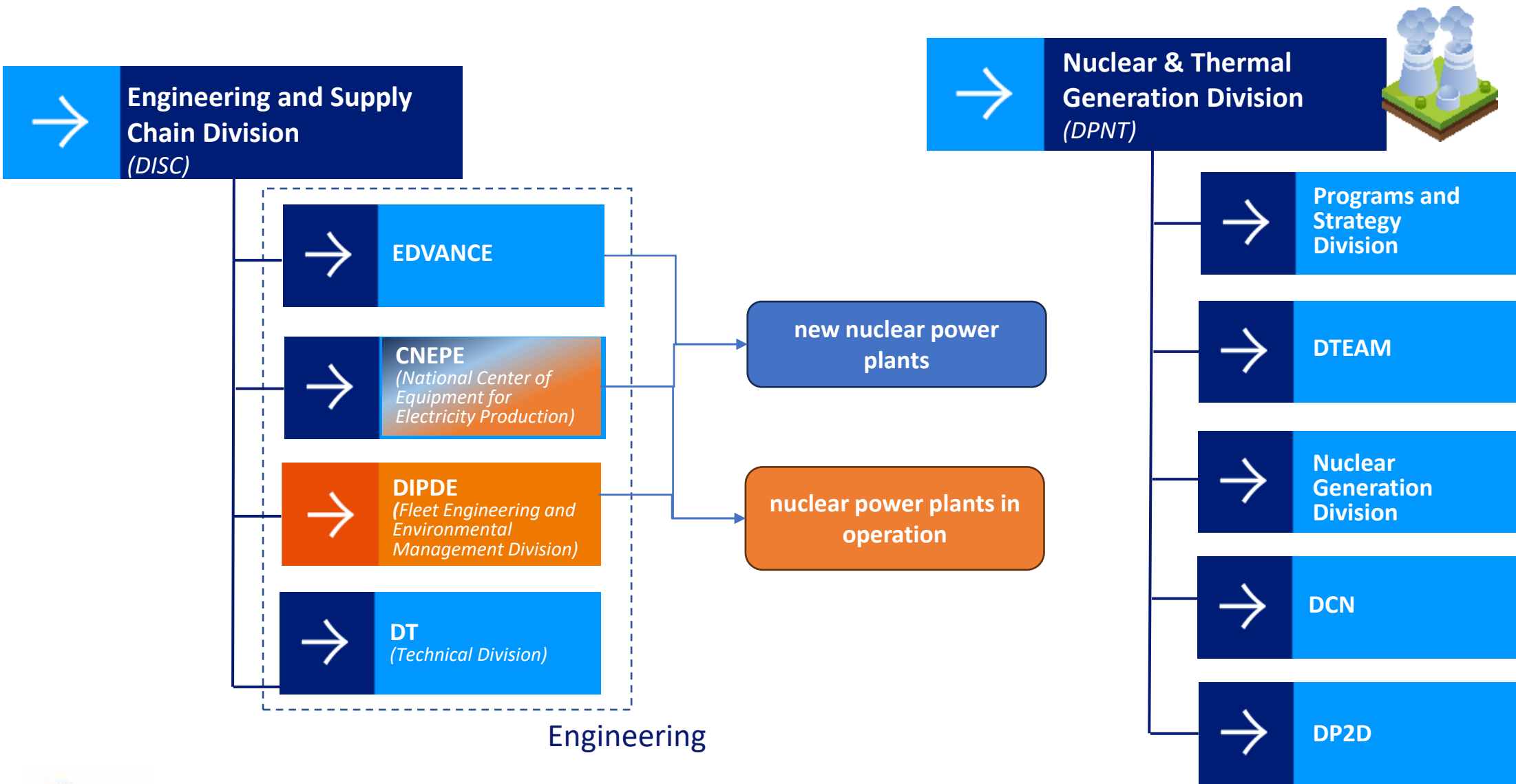
The 20 1,300 MWe reactors are divided into two levels: the **P4** level with 8 reactors (4 at Paluel, 2 at Saint-Alban and 2 at Flamanville) and the **P'4** level with 12 reactors (2 at Belleville sur Loire, 4 at Cattenom, 2 at Golfech, 2 at Nogent sur Seine and 2 at Penly).

There are 4 1,450 MWe reactors in the **N4 range** (2 at Chooz and 2 at Civaux).

Map of nuclear plants



3. DISC and DPNT Organisation



4. The role of DIPDE



5. High-Impact Worksites for DIPDE

Starting in 2012, the DIPDE will be working hard in the wake of the post-Fukushima accident and in preparation for the ten-yearly inspections (extending the life of power plants over 10 years).



SBO diesel generator (DUS in French)



VD4 900 – 4th ten-yearly 900 MW outages



Steam Generators Replacements

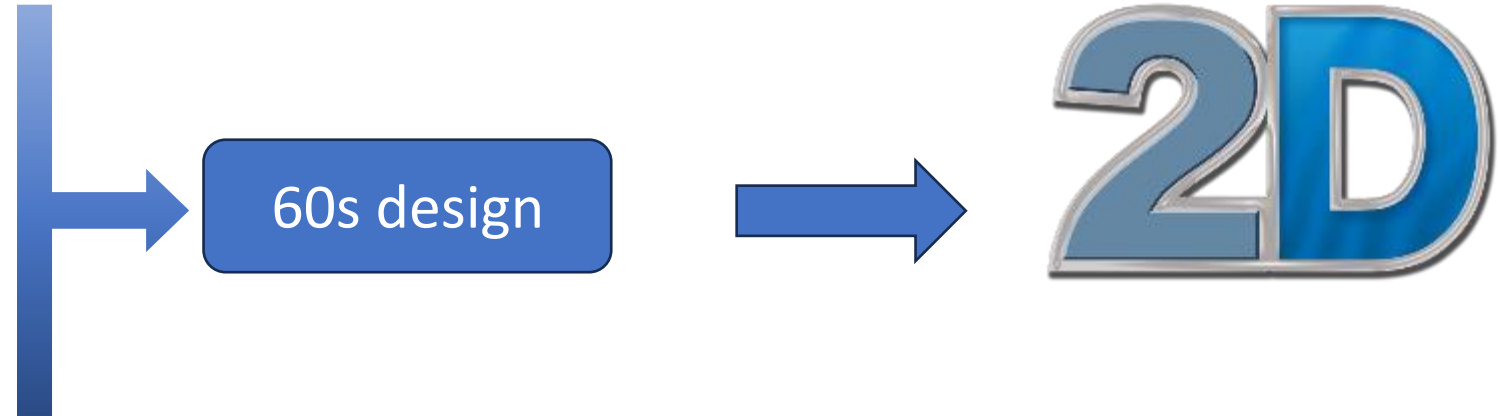
How to optimize future studies?

6. How we manage modifications of nuclear power plants

Or a little history « again »

The U.S. Army's nuclear power program operated pressurized water reactors (REP) from 1954 to 1974.

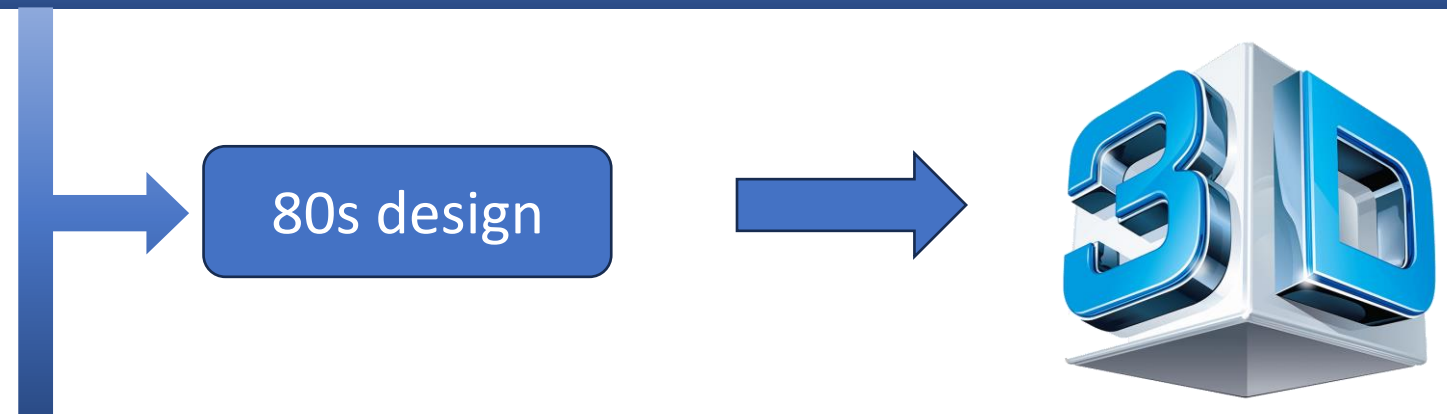
The **CPO, CPY, P4 and P'4 reactors** are REP technology and **were designed in the 1960s** (American Westinghouse license)



3D, or not 3D, that is the question

The **N4 stage**, for "new 4 loops"1, is the third and final stage in France's second-generation nuclear reactor fleet.

The project **was born in 1979 and initiated in 1982**. The N4 level marks the francization of the company's reactors



EDF leverages AVEVA E3D Design and PCM to revolutionize the design processes for France's nuclear plants.

Challenges

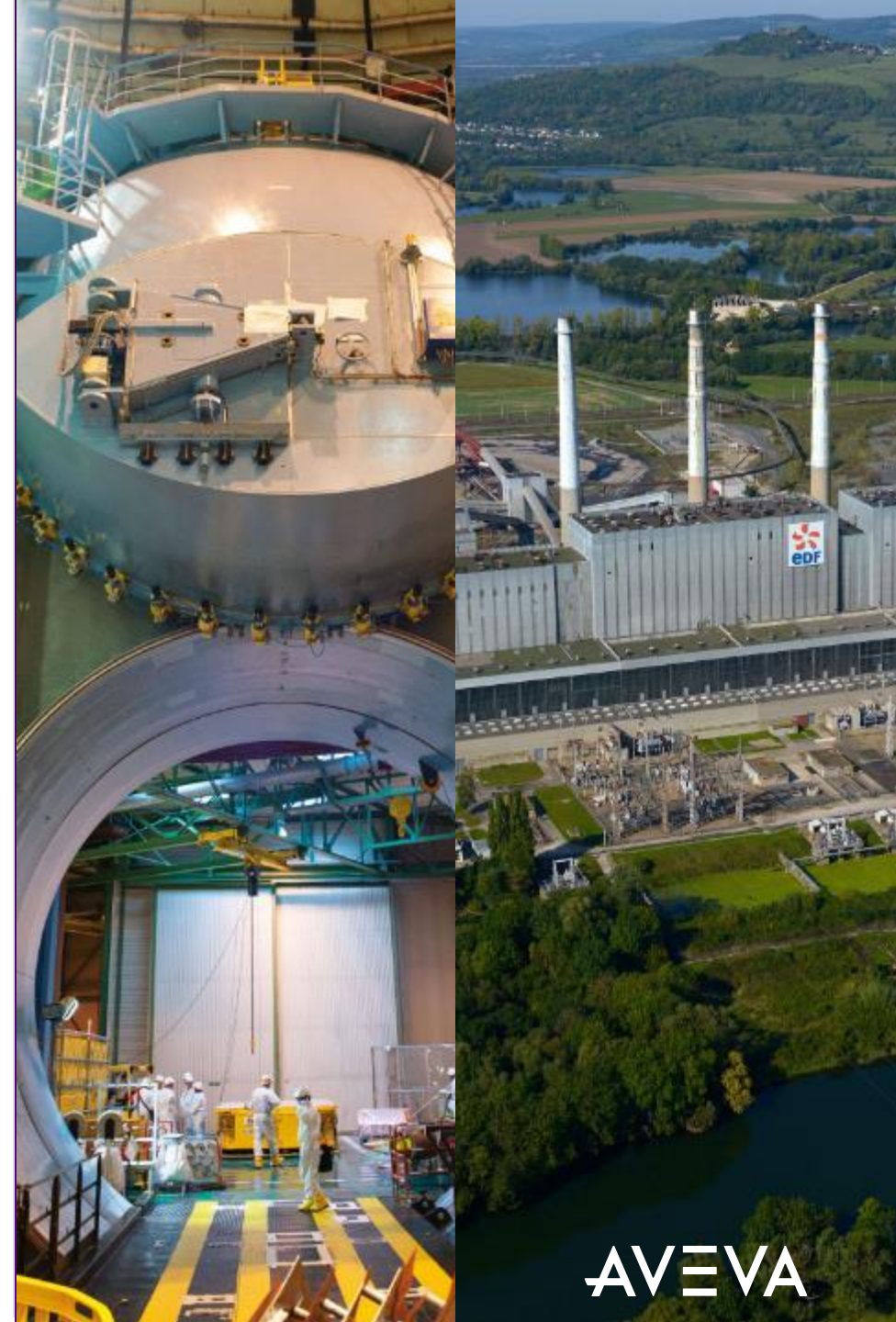
- Suffered from complex and Time-Consuming Design updates
- Design Offices struggled to consolidate and manage data
- Limited Collaboration and hazardous remote access

Solution

- Deployed AVEVA E3D Design and PCM to be the go-to CAD tool on every operating nuclear plant in France

Results

- **Increased Efficiency and Reduced Downtime**
- **Higher Data Accuracy and Consistency**
- **Enhanced Team Collaboration and Project Management**
- **Sustainability and Safety Advancements**



7. Build the future of work

Starting in 2014, **DIPDE** plans to **remodel in 3D** its **historic nuclear power plants**.

2 scenarios:

1. Remodel its entire nuclear power plants
2. Remodel only future modifications to nuclear power plants

Unlike **EDVANCE**, **DIPDE does not build new nuclear power plants**, but **only modifies existing ones**.



Need to go on site



Entering controlled areas



Some equipment is difficult to access



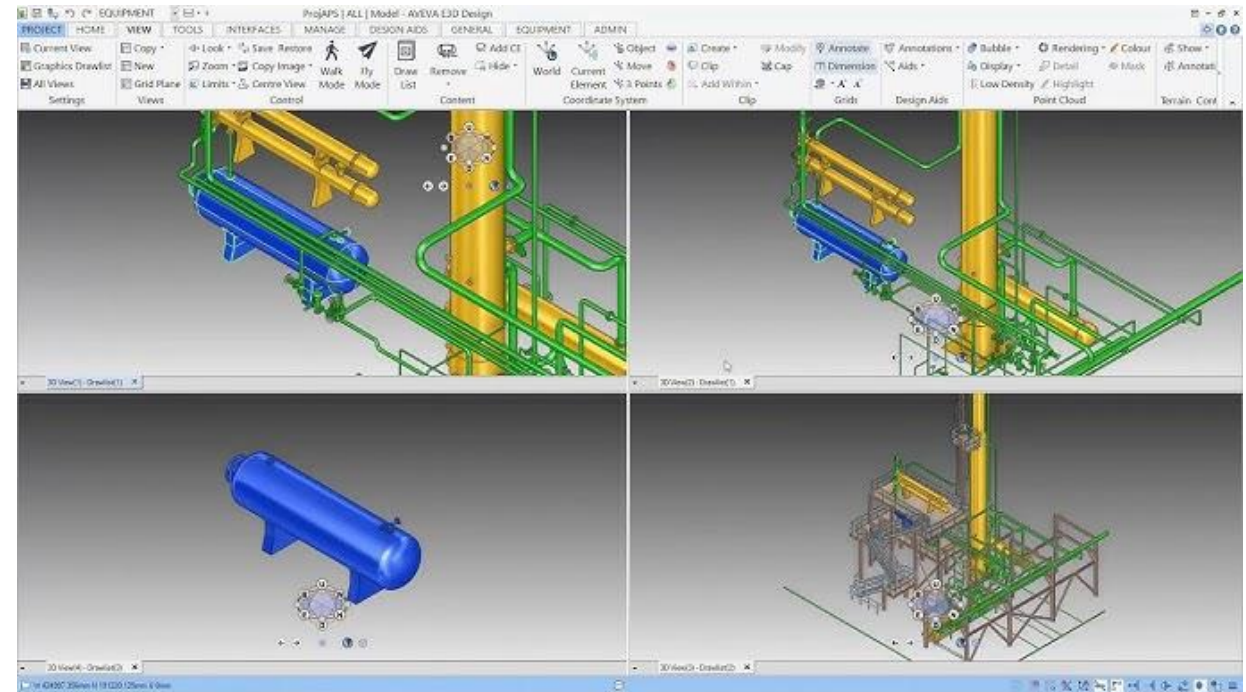
Access to the premises is not always possible

7. Build the future of work

1. Scenario with AVEVA E3D Design Alone

While AVEVA E3D Design is powerful on its own, it has certain limitations without Point Cloud Manager:

- **Reliance on Legacy Data and Assumptions**
- **Manual Clash Detection**
- **Increased Site Visits and Downtime**
- **Limited Visualization and Stakeholder Engagement**



7. Build the future of work

2. Scenario with AVEVA Point Cloud Manager (PCM) + AVEVA E3D Design

Using both tools in tandem significantly enhances the design process:

- **Accurate As-Built Documentation**
- **Seamless Integration for Clash Detection**
- **Faster Decision-Making and Reduced Downtime**
- **Enhanced Maintenance and Safety Planning**
- **Improved Visualization and Stakeholder Communication**



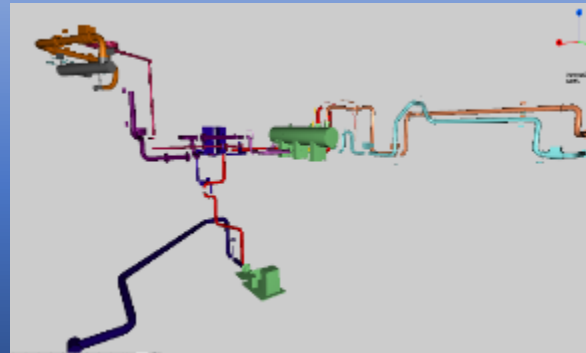
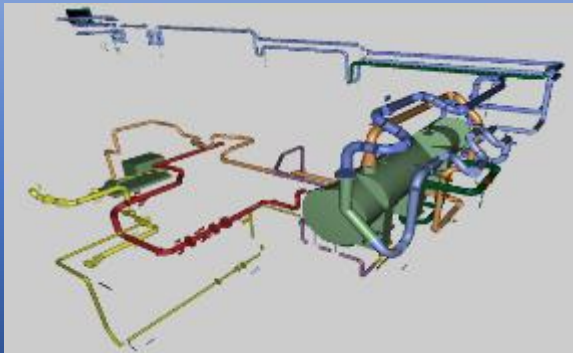
7. Build the future of work

Scenario 2 is possible with the arrival of **E3D Design and PCM on the market**.

We chose to model only the modifications to our existing nuclear power plants. **Scenario 1** is far **too expensive for EDF**.

Thanks to AVEVA, we can now use point clouds for industrial applications.

The hybrid digital model was born (MNH ->Maquette Numérique Hybride)



7. Build the future of work



« Maquette Numérique Hybride »



Acquisitions + post traitement

360° picture

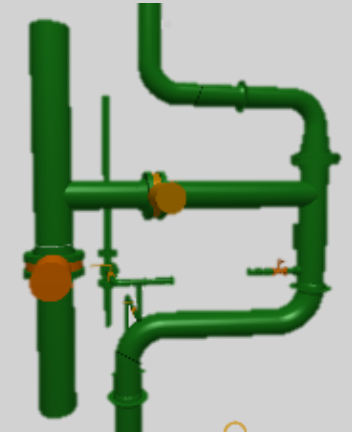


Point cloud



3D modelling

CAD

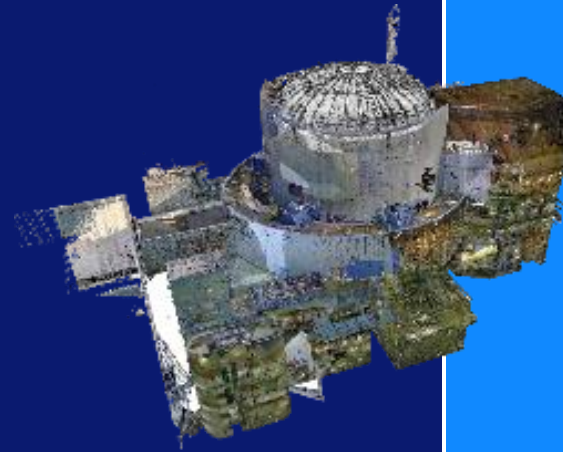
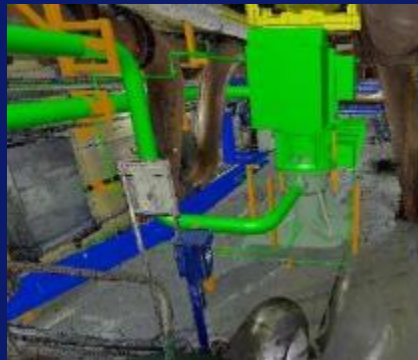
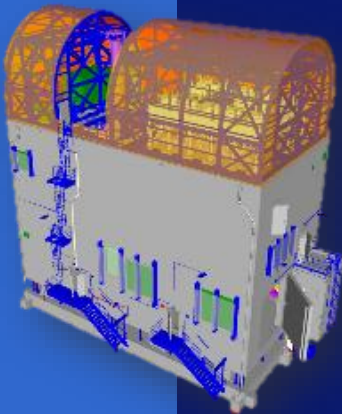


8. To summarise



➤ Today's results for the DIPDE

- Restore confidence in our historical designs, as laser scans represent the as-built state
- Reduce the need for design teams to travel to power plants
- Prepare maintenance work for major refurbishment and post-fukushima projects
- Decrease the exposure to radiation of people working on nuclear power plants



9. Our Future with AVEVA Unified Engineering and CONNECT



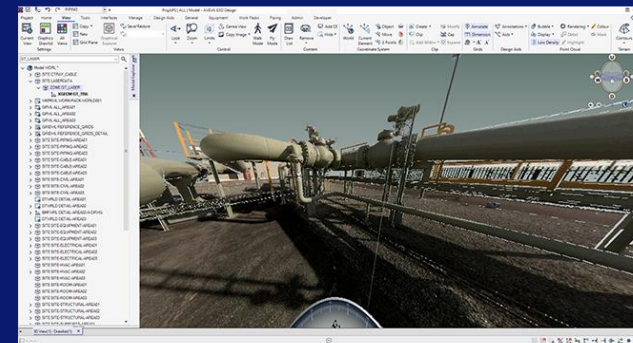
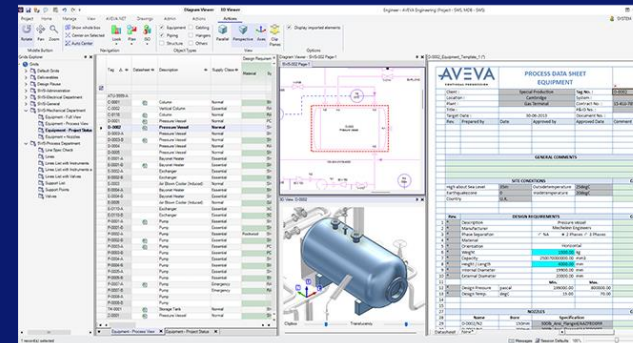
. Here's how a comprehensive use of the AVEVA Unified Engineering portfolio contributes to these areas:

1. Enhanced Data Management and Integration

- **Unified Data Platform**
- **Real-Time Updates and Version Control**
- **Data Traceability and Auditing**

2. Reduced Costs in Design Centers

- **Integrated Workflow Automation**
- **Optimized Resource Allocation**
- **Improved Design Reusability**



9. Our Future with AVEVA Unified Engineering and CONNECT

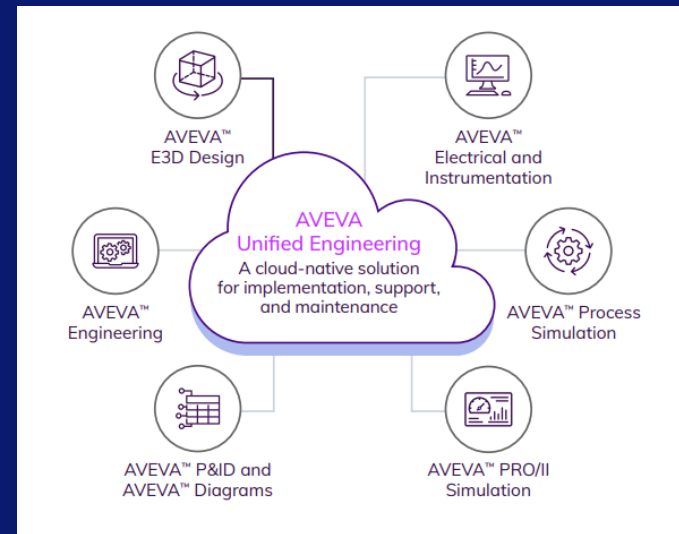


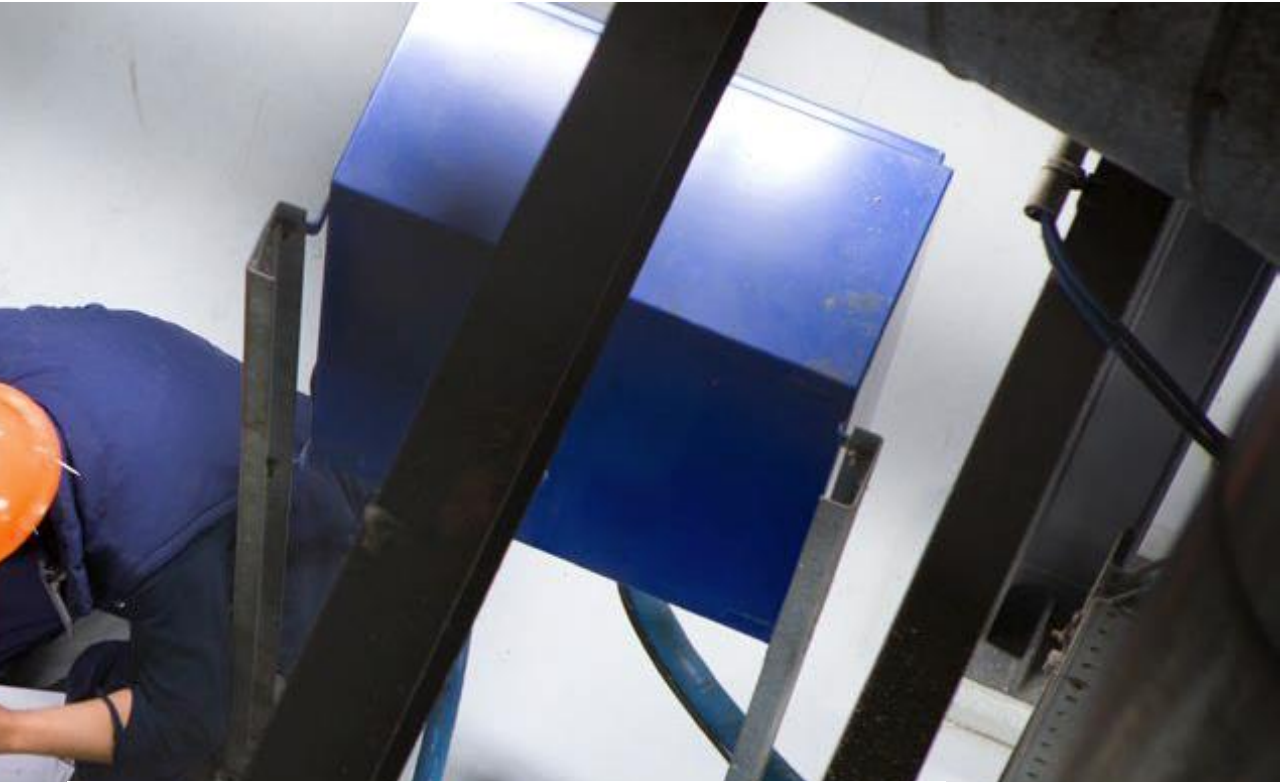
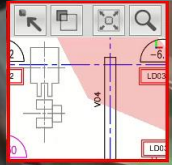
3. Better Reliability and Quality

- **Advanced Simulation and Analytics**
- **Comprehensive Change Management**
- **Digital Twin Capabilities**

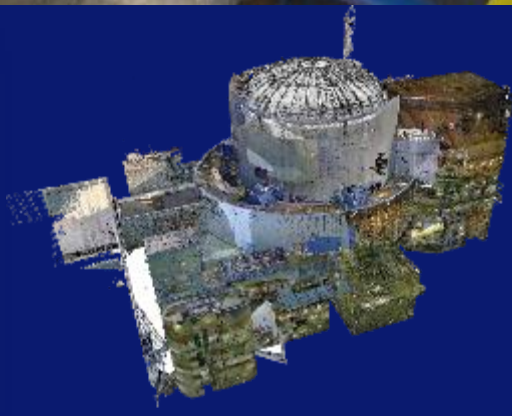
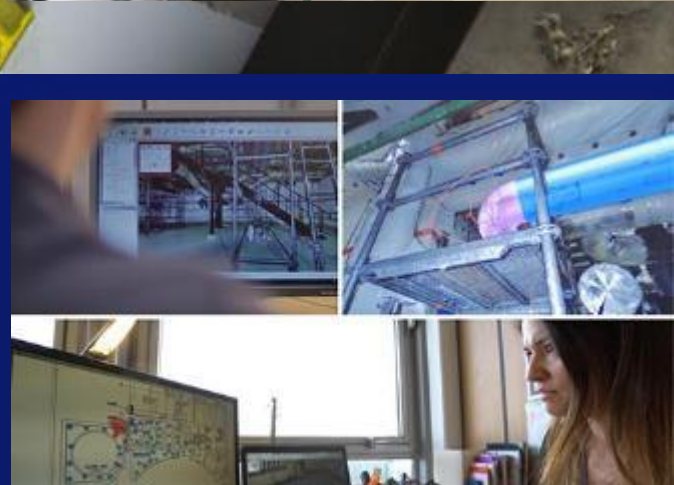
4. Easier Access to Information

- **Centralized Cloud-Based Access**
- **Improved Search and Retrieval**
- **Mobile Access and Visualization Tools:**





Thank you for
your attention!



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