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THE 10th ANNIVERSARY INTERNATIONAL FORUM ATOMEXPO 2018

Education 4.0: how to prepare engineers of the future

Tools and technologies for Education 4.0 – are they already in use today?

Miko Olkkonen, Fortum Power and Heat Oy

Russian Federation, Sochi, May 14-16, 2018

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Miko Olkkonen

Head of Sales, Nuclear Services, Fortum

- 20 years of experience in industry
- Large, international, distributed, plant design and construction projects around the world
- Seven years as managing director of an IT company focusing on IT tools for project management, engineering and operating plants
- Several years of business development responsibilities
 - Hydro and Nuclear service units
 - Detail engineering services provided remotely
 - Engineering centers for detail plant engineering
- Several years of R&D program management with the topic:
 - ***“What is digitalization and how can it improve operations in Hydro and Nuclear power plants”***



Fortum is a mid-sized European power generation company with Nuclear Production and Expert Services for Nuclear companies

40 years of Nuclear,
3 GW capacity,
8 operating units, both
PWR and **BWR**,
2 under
decommissioning,
2 new build projects

62% of our
electricity
generation
is CO₂-free

Our core
Nuclear and Hydro,
Combined heat and
power production
Circular economy
**Energy-related
products and expert
services**

9,000
professionals
800 in Nuclear

2/3 of our
power
production is
**nuclear and
hydro**

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Fortum nuclear assets in Finland and Sweden



Loviisa

Two PWR units
502 + 502 MW = 1004 MW

Fortum's ownership 100%



Olkiluoto

Two BWR units, third EPR under construction

880 + 880 MW = 1,760 MW
Under construction 1,600 MW

Fortum's share: 27% (468 MW)



Oskarshamn

One operating BWR unit
1,400 MW

Fortum's share: 43% (602 MW)

In addition, Unit 2 of 630 MW was permanently shut down in 2015 and Unit 1 of 473 MW in 2017



Forsmark

Three BWR units
984 + 1,120 + 1,167 = 3,271 MW

Fortum's share: 22% (720 MW)

2 new builds :- one in licensing, another close to commissioning
2 units under decommissioning
Final spent fuel repository under construction (licensed)

For years Fortum has invested in finding ways to generate new value by taking newest digital technologies into daily use at our NPP



**Question the old ways and
create new for the future**

**We will help,
bring us your question**

The question:

Tools and technologies for Education 4.0
- are they already in use today?

The question:

... yes they are,
some even in daily use by
nuclear plant personnel themselves,

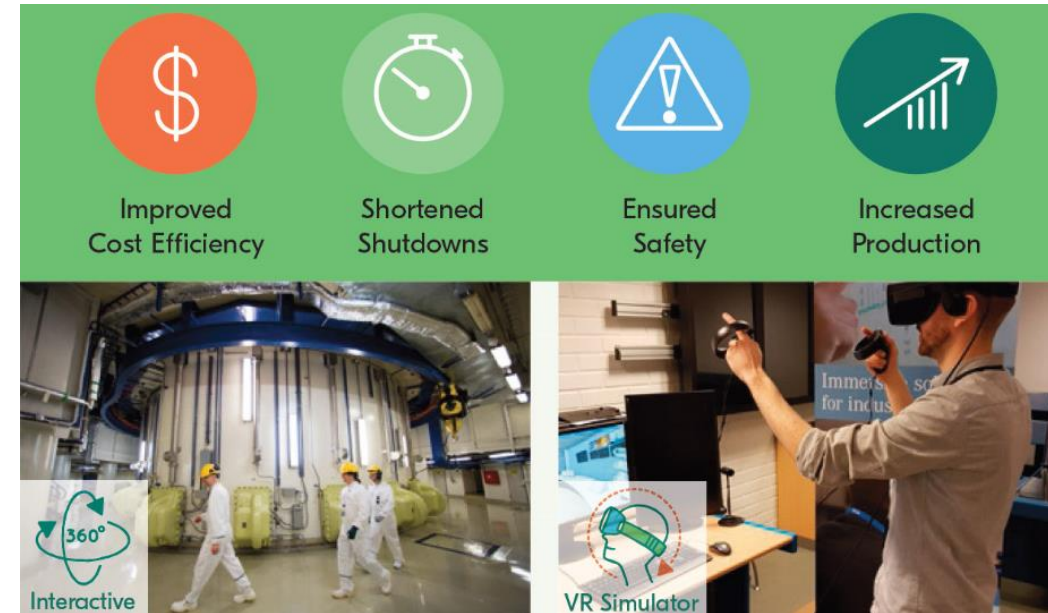
The question:

... and

they deliver high value
already today!

Systematic R&D resulted in new improved ways to conduct training at NPP

- A systematic, lean and iterative R&D program since year 2015
- Closely involving plant personnel to development
- Development through Proof of Concepts
 - 36 Proof of Concepts in one year
 - Verified feedback from end users at the plant
 - Resulted in 3 main development streams that were taken into concrete use at the Plant



- Interactive 360 degree video** → Fast and easy way to give the experience of visiting the plant
- VR – simulators** → Fast, cheap and more flexible control room and field simulator training
- Field worker AR – helmet** → New ways of transferring knowledge from experts to new staff

Some examples where latest digital technologies support maintenance and outage training at Loviisa NPP

- Training/induction with interactive 360° videos
 - Radiation protection training in steam generator room
 - EHSQ induction for contractors and staff before starting outage work
 - ALARA training to understand the affect of work methods to the dose received
- Training with VR – simulators
 - Full scope, fully functional control room training simulator in VR environment
 - Scenarios that are not possible at physical simulators (e.g. fire in main control room)
 - Interaction between control room and field workers



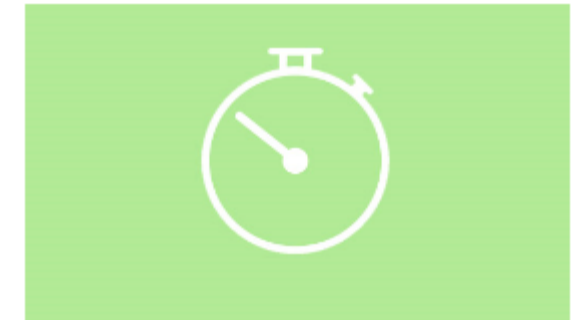
Improved Safety



Increased production



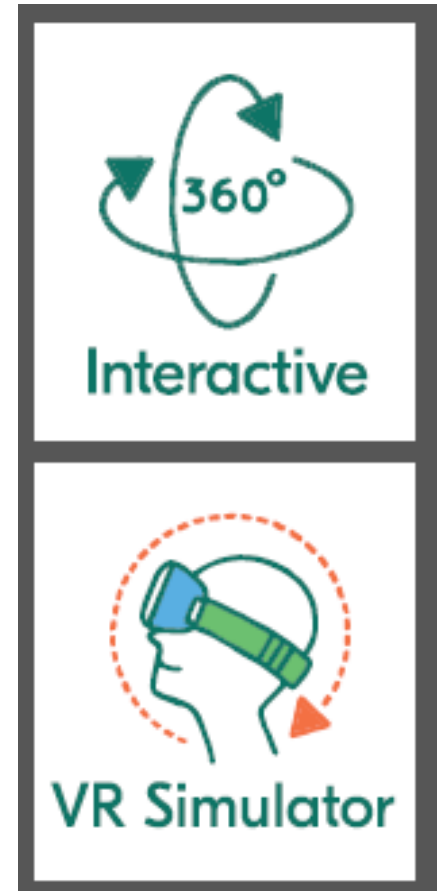
Lower maintenance costs



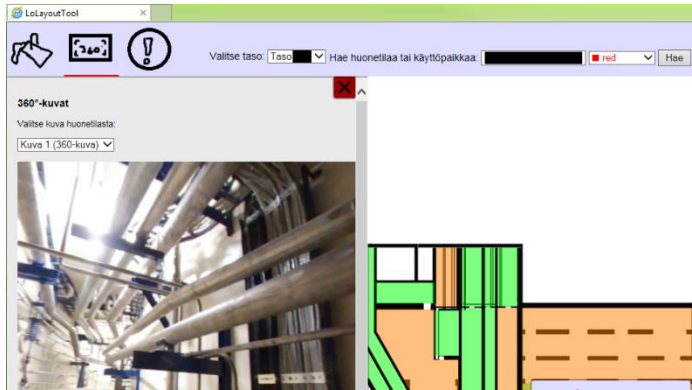
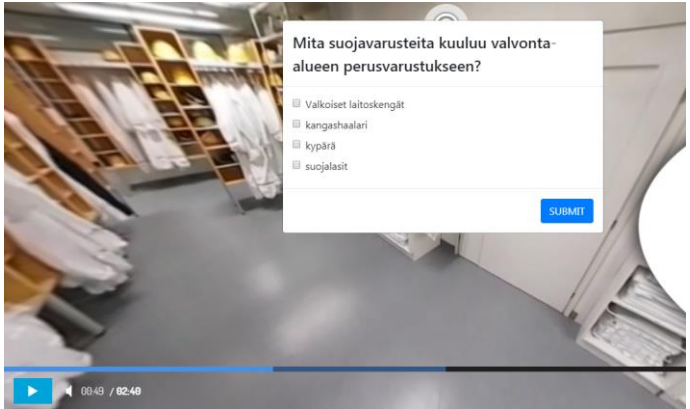
Shorter outages

Proven solutions for new ways of learning: interactive 360 degree video & VR simulators

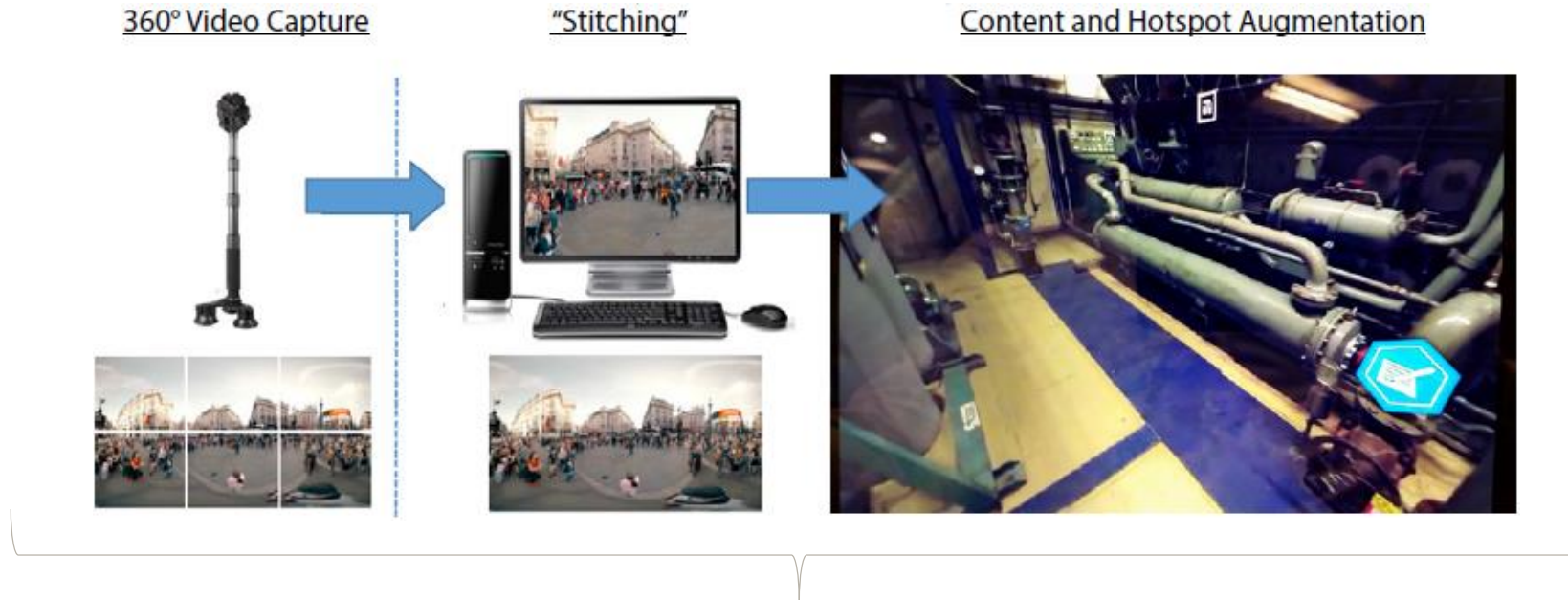
- Fortum provides solutions how to use newest VR, AR and interactive 360 video to let people “**experience**” the existing plant and let them “**interact**” there:
 - Increase their understanding on how things really look and operate at the site
 - Enable people to communicate, interact, collaborate, co-generate at the plant – without the need to access the plant
 - “Augment” relevant, up-to date, information “on top” of equipment and items at the site to support relevant and efficient learning and communication
- Through this process we are able to involve and energize plant’s own organization
↔ HR and Training organizations can focus on their core competences
- The outcome is training that is seamlessly integrated to the nuclear power plants critical work processes like:
 - Maintenance, radiation protection, outage planning, modification projects, purchasing, contractor management, safety walks, pre & post work review, radiation characterization, etc.



Some examples of AR, VR and interactive 360 at Fortum NPP

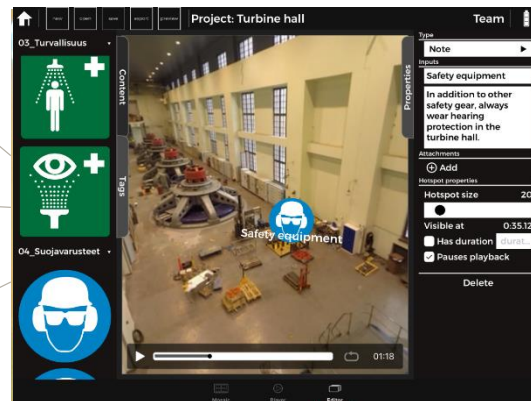


Interactive 360 degree video



Collaboration in the 360 video

- Maintenance planning
- Project meetings
- Radiation protection training



- Engineering
- Safety walks
- Contractor briefing

2016 Fortum used for the first time a virtual control room simulator to train and validate operator performance

- A full immersive experience of operating in the control room
- A complete shift can operate at the same time
- All the screens and panels are fully operational (Apros simulator in the backend)
- Emergency scenarios that were earlier impossible to practice are now easy to train
- Lots of additional features:
 - Operator Instructions
 - Field actions
 - Evacuation to reserve control room
 - Field control panels
 - Field maintenance tasks



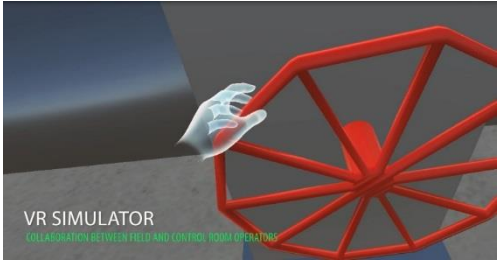
- Fast and inexpensive to build
- Flexible
- Interactive
- Supports all phases of the project

Schedule an exclusive demonstration or meet us at:

- 3rd International Conference on Human Resource Development for Nuclear Power Programmes: 28-31 May 2018, Korea

VR validation November 2017

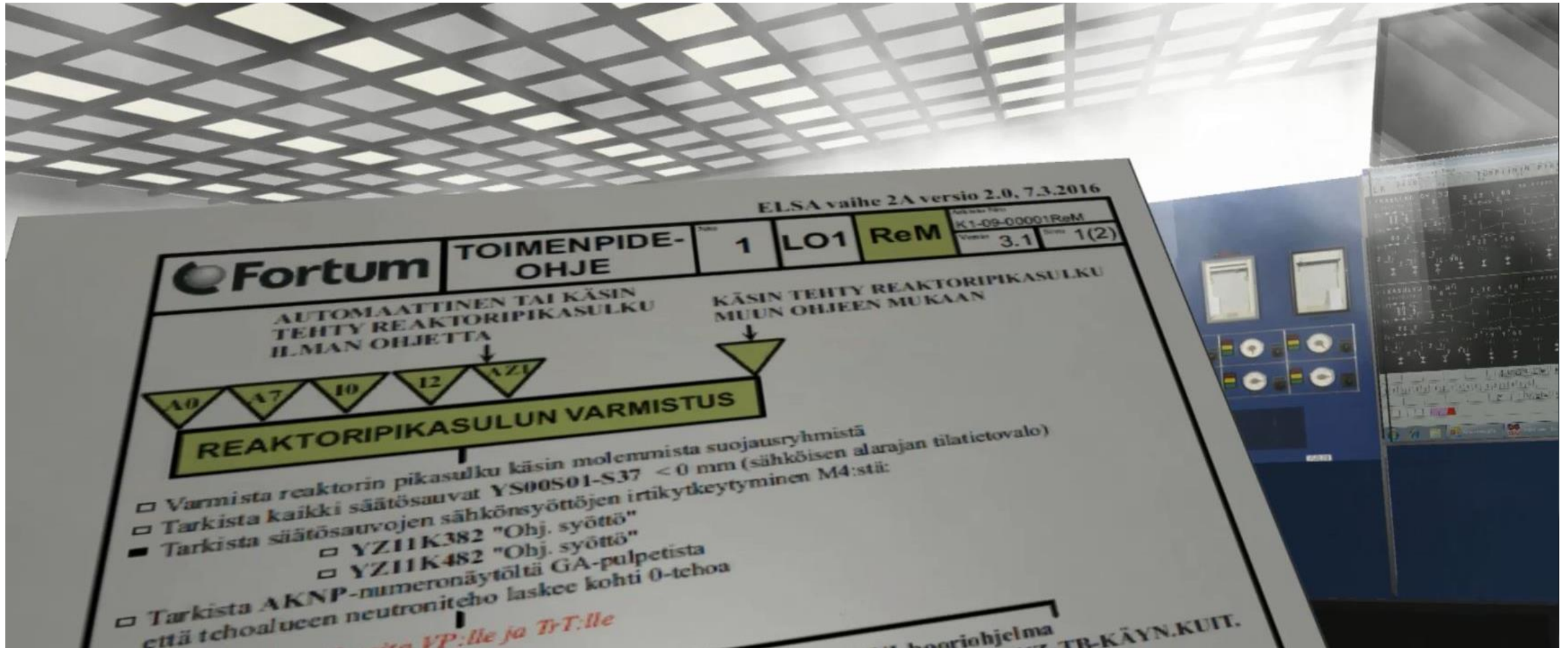
- Demonstration of VR simulator will be given during the break



A very immersive and collaborative experience where the full shift staff can work together in the VR control room



Emergency procedures and instruction folders like in real life



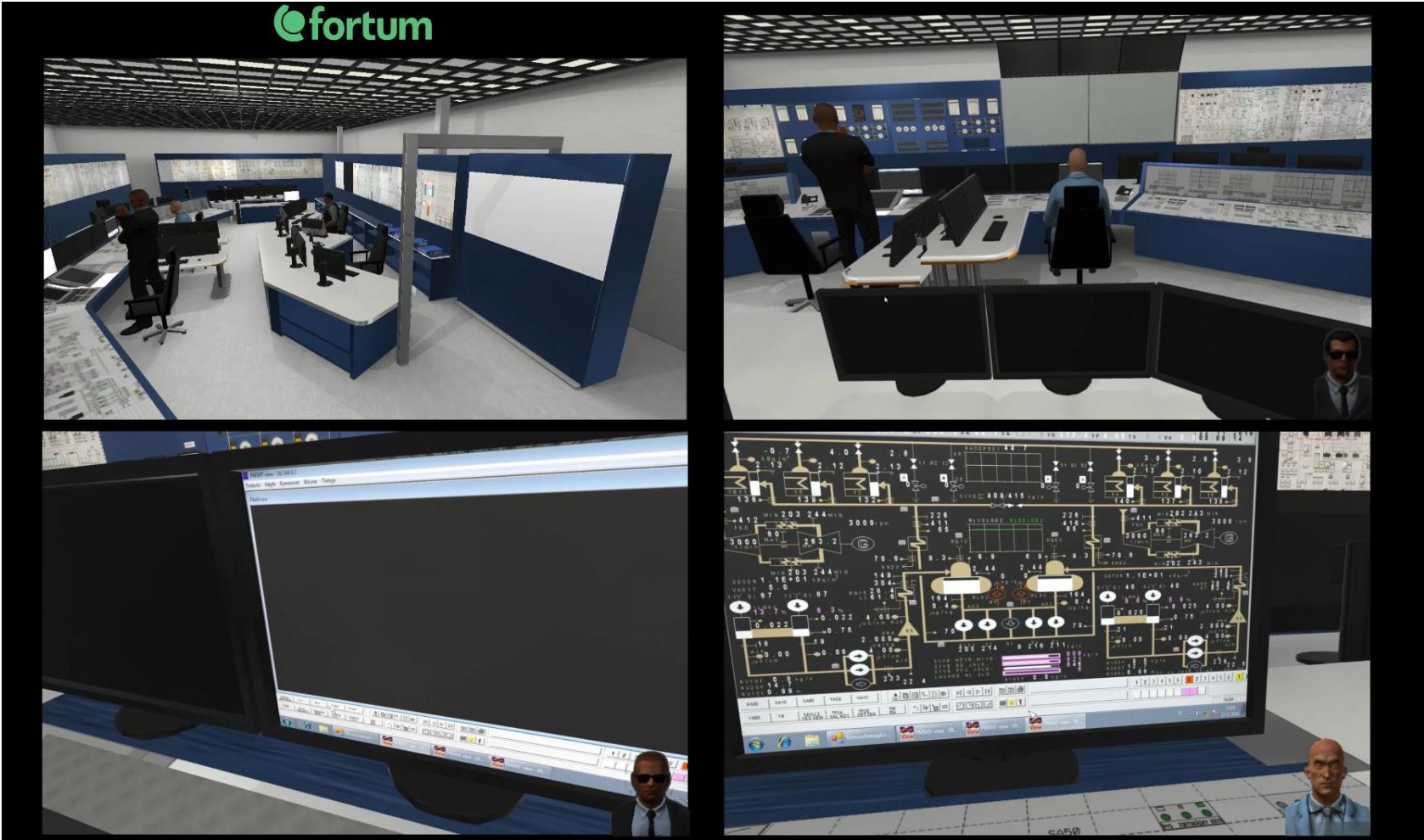
All screens and hardware panels are connected to the plant simulator and are alive and interactive.



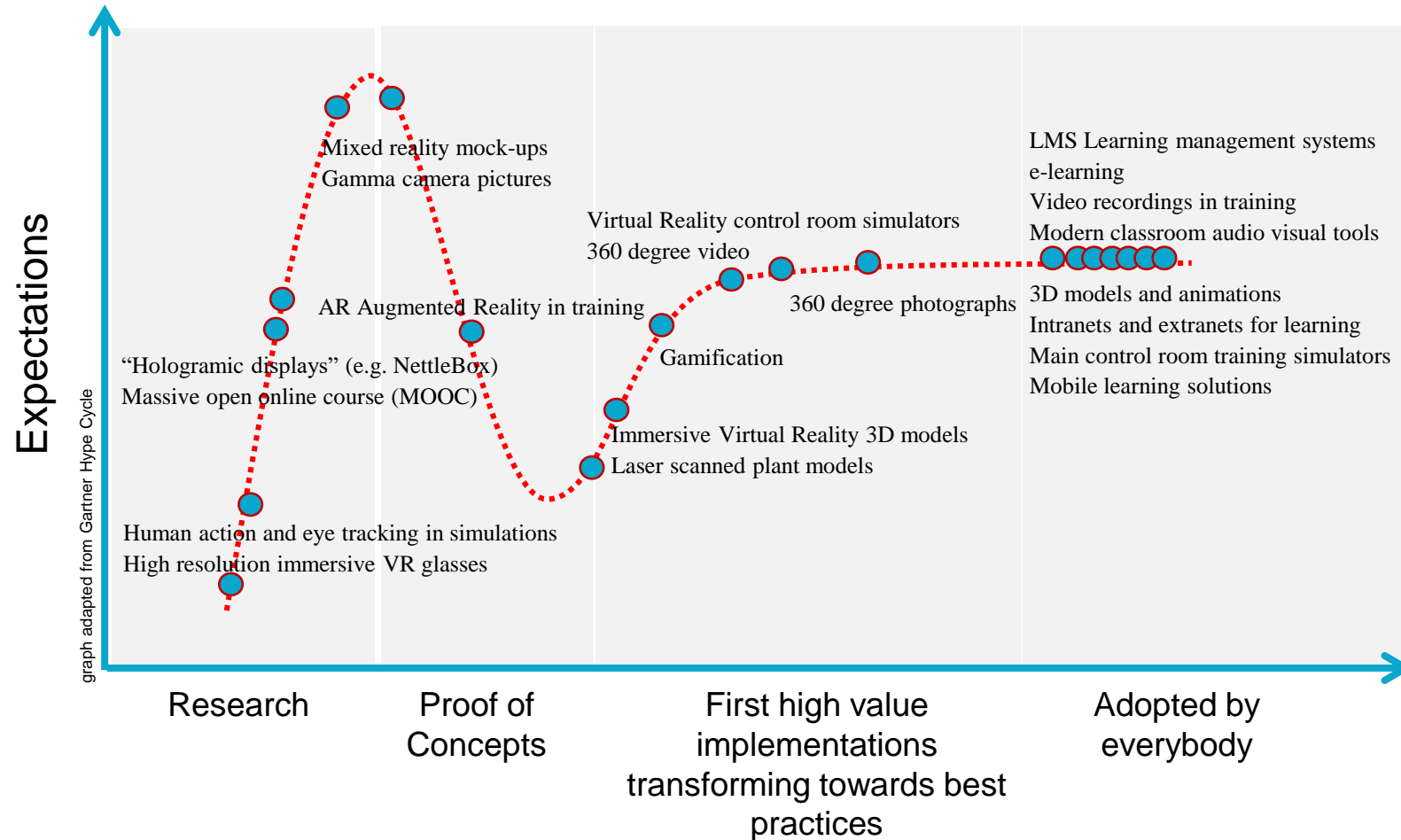
We can simulate and train scenarios that are otherwise difficult to train: fire, smoke, gases, earthquake, etc.



Trainers can monitor what all trainees are doing and how they are performing.



What is “hype” in training technologies in nuclear today?



Where is the biggest value for the new ways of learning?

- **Immersive and experiential training**
- Unleash untapped potential (new type of training, to new trainee groups)
- **Free from time and location constraints**
- Cost efficiency (lower cost of producing effective training material)
- **New ways to use existing control room simulators** → increase the return on investment
- Higher motivation to learn when there is collaboration and social interaction during training



- **Strengthening classroom training with cost effective realistic virtual visits**
- Collecting of data during training to provide feedback to trainees
- **More effective and site specific radiation protection training**
- Opportunities around: just in time learning, on the job learning, self study
- **Training and motivating the new generation employees**
- **Better learning results from the use of existing mock-ups**

Conclusion

Many of the tools and technologies that will enable Education 4.0 are already in use today and bring efficiency and improve safety!

Latest digital tools like VR, AR and interactive 360 degree videos have matured enough to take into use at NPP. It is now up to forerunner NPP and training organizations to start applying them into daily use.

Some lessons learned:

- Use lean, fast and iterative training development
- Don't think that VR, AR and 360 is a solution for all training → BUT try to find the place where it is superior compared to others
- Don't over complicate things even though the technologies are new – refer and learn from how other NPP are using the technologies
- Start small and involve plant personnel to training development → this way verify the need and value
- Use experienced companies to handle the technology and focus your own efforts to:
 - training content planning
 - change management and
 - Identifying new use cases that have a high payback.

For support at your NPP, contact us through the internet

- www.fortum.com/nuclearservices
- [Fortum 360° Video Starter Pack](http://www.fortum.com/360)
- <https://www.fortum.com/vrtraining>



Immersive Training Solutions

Take your training experience to the next level with our Virtual Reality (VR) Simulator solutions.



Interactive 360° Videos

Fortum has been the pioneer in use of 360° videos for Nuclear Power Plants. These immersive, spherical videos have been utilized to enhance understanding, collaboration and efficiency among NPP personnel.



Virtual Panels for Simulator Control Rooms

Give your plant personnel a fast, flexible and easy-to-use simulator interface at low costs - Fortum Virtual Panels for nuclear power plants.



APROS - Advanced Process Simulation Software

APROS helps you in ensuring safety and operational performance of your nuclear power plant.

For more information, visit our web pages or contact us:

- Immersive training solutions, a new way for efficiency – www.fortum.com/vrtraining
- Digitalisation, from in house R&D to improving Client performance – <https://www.fortum.com/en/energy-production/nuclear-power/nuclear-news/Pages/Digitalisation-boosts-power-plant-operations.aspx>
- Fortum nuclear services – www.fortum.com/nuclearservices

More info on our 360 services:

[Fortum 360° Video Starter Pack](#)

Interactive 360° Videos with VR/AR IN NUCLEAR POWER PLANTS

Fortum has been the pioneer in use of 360° videos for Nuclear Power Plants. These immersive, spherical videos have been utilized to enhance understanding, collaboration and efficiency among NPP personnel.

Our video library leads in using 360° video and immersive simulation technology for nuclear power plants. Our 360° video services offer a range of services from 360° video production to VR/AR training and simulation.

OUR VIDEO CAPABILITIES:

- 360° Video Capture
- Augmented Content & Integration
- Customized and delivery oriented
- 360° editing
- Immersive content creation, building and design
- Immersively enabled graphics / motion graphics
- Web-friendly apps for easy access and use
- 360° editing, rendering and delivery
- AR / VR-based applications

KEY BENEFITS:

- Comprehensive coverage of 360° camera - better than any other technology available
- One-off cost and non-recurring - suitable for long-term use
- Customized content creation, building and design
- Immersively enabled graphics / motion graphics
- 360° editing, rendering and delivery
- AR / VR-based applications
- 360° editing, rendering and delivery
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More info in our VR training:

<https://www.fortum.com/vrtraining>

VR - Control Room Simulators

NUCLEAR POWER PLANTS

Do you need to improve your control room or training simulator? Are your training simulators congested? Do you have the need for more wide and diverse training?

Due to Fortum's unique background as a nuclear operator, nuclear license holder and nuclear reactor provider, we have extensive knowledge and experience in control room simulation and VR/AR training. Let us help you improve your efficiency and safety.

- Real, realistic and cost efficient implementation and training
- Flexibility and scalability increasing
- Training scenarios that are possible for all real situations
- Earlier Validation and Verification of construction design
- Improved Human Factors Engineering (HFE)

SUCCESSFUL CONTROL ROOM DESIGN SINCE 1970

Since the 1970s we have been active in developing and providing the best of our knowledge and experience for the Control Room Design and Human Factors Engineering (HFE) projects ranging from small scale projects to complete new Control Room implementations.

OUR SERVICES WILL GIVE THE HIGHEST VALUE FOR:

- Risk operators looking for ways to improve their control room efficiency
- Complete planning or building new nuclear plants
- HFE planning or remedy existing 360° control room
- License holder construction supporting safe operations during abnormal situations
- Risk owner construction improving their operations with efficiency, safety and cost reduction
- Nuclear equipment suppliers & OEMs the best high fidelity equipment for their Control Room Design projects

WE OFFER:

- Highest cost efficient VR architecture
- Comprehensive development and maintenance
- Pre-engineering and control room simulation
- Function and task analysis
- HFE program planning and implementation
- Performance of exercises and operations
- Conceptual and layout design
- Human Factors Interface design (HFD)
- Virtual control room design and delivery
- Engineering and building simulation
- Validation and verification activities (VAV)
- Immersively enabled HFE design (A-prox)
- Independent evaluation

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Fortum is available to help other Nuclear companies get into good speed in the practical use of latest digital technologies at operating NPP: interactive 360-video, AR ja VR. **Let's keep in touch!**

Miko Olkkonen:

Project management

Engineering

Training



Improved Safety



Increased production



Lower maintenance costs



Shorter outages

