# 3D based integrated support concept for improving safety and cost-efficiency of nuclear decommissioning projects

István SZŐKE*

*Institute for Energy Technology, OECD Halden Reactor Project*

*PO Box 173, NO-1751 Halden, Norway*

**corresponding author: istvan.szoke@hrp.no*

Keywords: decommissioning, characterization, plant information, 3D simulation.

New concepts enabled by emerging computing technologies based on 3D simulation, virtual (VR) and augmented reality (AR), advanced user interfaces (UI), mobile and wearable computing devices, and geographical information systems have great potential for improving nuclear decommissioning strategies. Such techniques offer very effective new opportunities for improving early characterisation and strategical decision making, knowledge management, on-site management of radiological waste, and regulatory compliance. In addition, such methods allow for an effective training of foreseen decommissioning workers to begin during operation and transition phase without disturbance to normal operation of the plant.

Early characterisation and strategical decision making:
Improved plant information systems enabled by 3D simulation, advanced user interface, and mobile computing technologies, offer better ways for acquiring and managing the radiological and other plant information that are required for informed decision making in the early planning phase of decommissioning activities. User friendly, realistic management and visualisation of available radiological information, and results of radiological data analyses, allows decision makers to have a better understanding of the radiological conditions expected when decontamination and dismantling work starts, without high need for physical presence in the environment. Such functionalities, combined with capabilities for easy evaluation of possible decommissioning (decontamination, dismantling) options allow decision makers to make informed decisions, and enable a seamless communication (common language) within a multidisciplinary decommissioning planning team.

Knowledge management:
Support systems, enabled by modern information technologies are expected to improve information and knowledge management in decommissioning projects, especially during transition from the operation phase. Traditionally, inefficient transfer of knowledge from the design and operation phase, results in suboptimal work strategies and extensive rework during the decommissioning phase. 3D technologies have the potential for minimising knowledge loss during the transition to decommissioning, and support efficient reconstruction of design and other knowledge supporting more optimised decommissioning strategies.

Management of radiological waste:
Application of advanced 3D visualisation technologies are applied for planning the manipulation of heavy large components in decommissioning projects. With the decreasing time and cost investment

required for application of 3D simulation and AR technology, an increasing number of experts are exploring the possibilities in using such methods for supporting on-site logistics (categorisation, transportation, and temporary storage) of contaminated and activated components during decommissioning.

Regulatory compliance:
3D radiological simulation and visualisation technology provides a new more efficient way for explaining complex radiological conditions, work plans, and compliance with regulatory requirements (Figure 1).

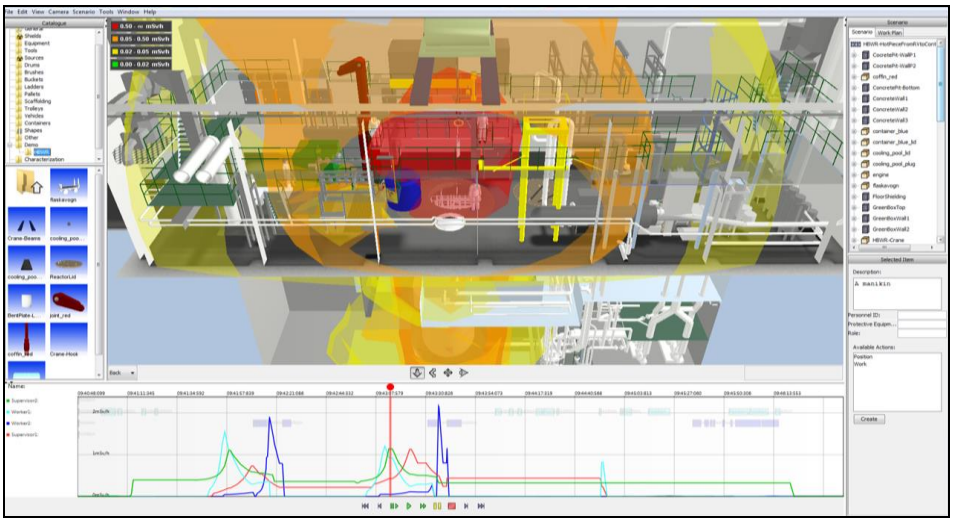

*Figure 1: User interface of the VRdose system, an interactive work simulation tool with real-time 3D radiological modelling and visualisation capabilities*

Good examples and lessons learned in preparation for decommissioning:
Advanced support systems based on 3D technologies have successfully been applied in the decommissioning of a number of nuclear installations (e.g. Fugen NPP, Chernobyl NPP, Leningrad NPP, Andreeva Bay branch of Northwest Center for Radioactive Waste Management in NW Russia) for increasing safety and optimising costs. For further details the reader is referred to the literature [1-5].

# References


[1] I. Szőke et al., "New software tools for dynamic radiological characterisation and monitoring in nuclear sites" *in: Proceedings of Workshop on Radiological Characterisation for Decommissioning*, Nyköping – Sweden, April 17-19; 2012 http://www.oecd-nea.org/rwm/wpdd/rcd-workshop/

[2] I. Szőke, T. Johnsen, "Human-centred radiological software techniques supporting improved nuclear safety" *Nuclear Safety and Simulation*, **4**(3), 219-25, 2013. http://www.ijnsweb.com/?type=subscriber&action=articleinfo&id=176

[3] I. Szőke et al. "Real-time 3D radiation risk assessment supporting simulation of work in nuclear environments" *Journal of Radiological Protection*; **34**(2), 389–416, 2014. http://iopscience.iop.org/0952-4746/34/2/389/

[4] I. Szőke et al. "Comprehensive support for nuclear decommissioning based on 3D simulation and advanced user interface technologies" *Journal of Nuclear Science and Technology*, **52**(3), 371-82, 2014. http://www.tandfonline.com/doi/full/10.1080/00223131.2014.951704

[5] K. Chizhov, M. Sneve, I. Szőke et al. "3D simulation as a tool for improving safety culture during the remediation work in the Andreeva Bay" *Journal of Radiological Protection*.; **34**(4), 755-73, 2014. http://iopscience.iop.org/0952-4746/34/4/755/ *(Bernard Wheatley Award for 2014)*