VISIPLAN 3D ALARA PLANNING AND COMMUNICATION TOOL

Background

Human operations are required in nuclear installation, during maintenance, outage, repair and decommissioning. This leads to the exposure of the worker to radiation. It is clear that these operations must be performed according to the ALARA principle (to reduce the dose As Low As Reasonably Achievable). The person responsible for planning the job needs to evaluate different scenarios based on the exposure of the worker. This involves the manipulation of a lot of information specific to the work place such as the geometry, materials, radiological and technical boundary conditions to assess the dose. A lot of communication between the ALARA stakeholders is needed during this pre-job study. A communication that can be cumbersome and tedious when based on written documents and paper plans. The use of 3D calculation and simulation tools provide a solution to this problem. They provide an excellent means to make the above mentioned process more efficient and effective by calculating and visualising the environment and the associated radiological risk.

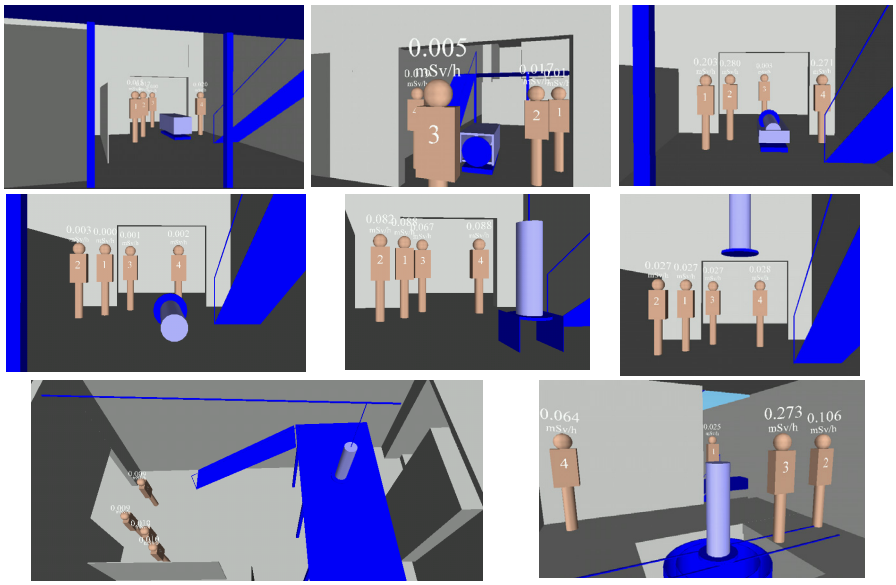
Objectives

- To enhance the communication capabilities of the VISIPLAN 3D ALARA planning tool enabling the transfer of the results from dose calculation and 3D data using internet technology.
- To make the results of the dose evaluations exploitable by the ALARA stakeholders without the implementation of the VISIPLAN base software on the stakeholder's stations.

Principal results

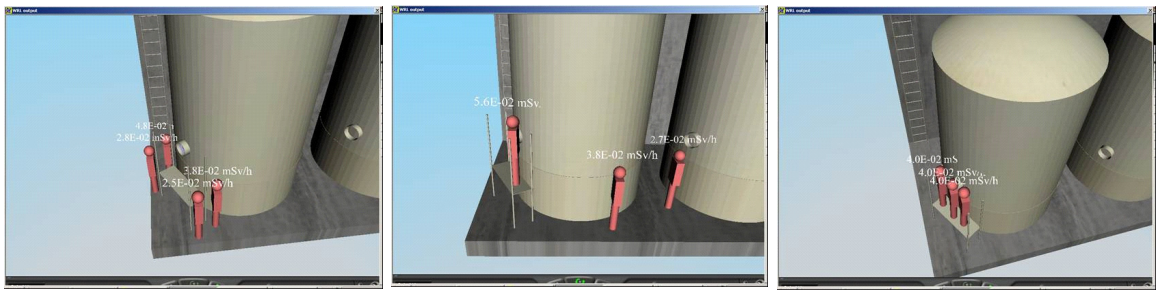
The VISIPLAN 3D ALARA planning tool is developed and designed by SCK•CEN as a dose assessment tool enabling the user to calculate the dose in a 3D environment for work scenarios. This software is very successful in the ALARA field. At present 22 companies in Europe use the VISIPLAN software in the field of dose assessment in maintenance and decommissioning.
The method used for the dose assessment is based on a point-kernel calculation with an infinite media build-up correction. The tool calculates the dose account for different work scenarios defined by the ALARA analyst, taking into account worker position, work duration and subsequent geometry and source distribution changes in a 3D computer simulation of the work place.
The results can be examined using the software and can be exported to text documents. The export to text documents restricted the possibilities of the ALARA stakeholders to examine the results in more detail.Therefore we developed the ARGUS web site generator as a communication tool between the ALARA stakeholders. The web generator enables the user to generate a full web site based on the information calculated using VISIPLAN. The information contains a full overview of different scenarios including information on the dose uptake on trajectories and work positions. Detailed information is made available on the contribution of the different sources to the worker dose at a work position. Each trajectory is represented in a fully examinable and interactive 3D environment. The work environment can be viewed from different positions, including the worker perspective.
The information is stored in a compact form enabling the easy transfer over the internet or intranet. Special features are available to add comments to the 3D representation in VRML. A mail back system allows reviewing the comments of the different stakeholders on the proposed scenarios.
The availability of a 3D representation of the workplace, the trajectories and the dose assessment also helps in the group decision process in the ALARA concept. The different stakeholders are confronted with the same data presented in a user friendly format allowing more efficient discussions and the introduction of possible new alternative work plans.

The VISIPLAN tools have been applied to many dose optimization problems at SCK•CEN and other nuclear installations. Recently we performed a simulation of the procedure to load a spent fuel bundle in the zero power critical facility VENUS of SCK•CEN. In this procedure we were confronted with a lifting operation that restricted the mass of the spent fuel shielding. With the simulation (see figure) we were able to show that the amount of shielding that was allowed was sufficient to keep the dose reasonable taken into account the total duration of the operation. The simulation of the dose rate field near the spent fuel container was used to inform the workers allowing them to position themselves in a lower dose rate field during the lifting operation.



Simulation of the spent fuel loading operation using VISIPLAN 3D ALARA planning tool.

Another example is the dismantling of the high level liquid waste tanks of the Belgian Reactor 3 (BR3). One of the preparatory operations is the cleaning of the tanks with a high pressure cleaner. The sequence of the operation is represented in the next figure. The figure is a direct result of the VISIPLAN simulation and is used to inform and prepare the workers.



Simulation of the cleaning of the high level waste tanks at BR3 (from left to right the placement of the scaffolding, the placement of the high pressure cleaner and the cleaning operation with a gradually reducing source strength).

Future work

The future work will be along two main axes. The first will be the further improvement of the calculational kernel of VISIPLAN. The second will be the further improvement of the 3D representation and the introduction of avatar with a restricted set of postures to simulate certain operations.

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Main reference

www.visiplan.be