The use of computer simulations in specific job training, risk communication and safety.

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Content

- From general to specific job training in RP.
- Planning and training support using simulation
- Development of different tools
- The VISIPLAN 3D ALARA planning tool
- Communication and training using 3D simulation
- On-line or off-line simulations
- Conclusion

From general to specific job training in RP

- General training in RP → basic training
  - Good practices and attitudes towards radiological risk.
  - Broad training
- Site Specific Training
  - Informs the operator of specific risk and the peculiarities of the work environment.
  - Needs a lot of information on geometry, sources, radiation fields, protective measures in operation or to be put in operation.
  - Strong coupling with ALARA

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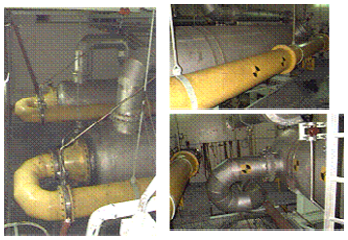
ALARA evaluation and training

• Application of ALARA and SST in nuclear installations is complex.
• We need to evaluate and communicate the dose for the different activities and environments.



Dose is influenced by:

- Geometry of the installation
- Source distribution and strength
- Shielding configuration, fixed or mobile
- Work organization

• ALARA and SST in changing installations is even more complex

- Changing geometry's
- Changing source distributions and strengths
- Changing shield distributions
- Changing work groups

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What do we need for a good ALARA study ?

• Predict the dose for a given job description.

• Evaluate methods or actions that can lead to a dose reduction or dose optimization for a given job description.

• **Compare different scenario's involving the following information:**

- Type of work or techniques used
- Work duration
- Number of workers
- Work force distribution
- Shielding requirements and shielding method applied
- Evaluate activities with a direct impact on sources (chemical cleaning).

Lets make a simulation of the described job.

Develop work simulation tool allowing the dose assessment of a work scenario in a 3D environment

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Developments in simulation in the RP field

- VR-Domain Rolls Royce Associates
- Virtual radiation field Un. Florida
- VR-dose Halden VR-centre
- HesPi UPM
- ErgoDose NNC
- IBERINCO & UPV
- VISIPLAN

3D ALARA planning tool (SCK•CEN)

Simulation tools are besides being a predictive or optimizing tool also a good support to the communication during site specific training

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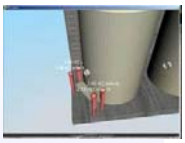
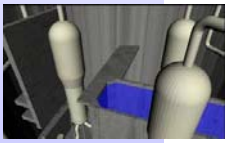
VISIPLAN 3D
ALARA planning tool





Purpose:

• VISIPLAN is a dose assessment program developed to assist the ALARA analyst in ALARA pre-job studies.

• The VISIPLAN tools assist both in the calculation and the communication in ALARA evaluations.

Current user group

Framatome (France)	NRG (The Netherlands)
ANSALDO (Italy)	SOGIN (Italy)
HSK (Switserland)	EDF(France)
CEA (France)	IPSN(France)
Tractebel(Belgium)	Belgoprocess(Belgium)
VUJE(Slovakia)	Ignalina(Lithuania)
RWE Nukem(UK)	RPC(Lithuania)
Steag (Germany)	IRE(Belgium)
APAT(Italy)	COVRA(The Netherlands)
SCK•CEN (Belgium)	DECOM(Slovakia)
TECHINT(Italy)	BN(Belgium)

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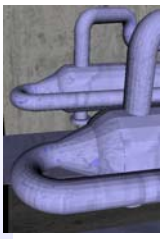
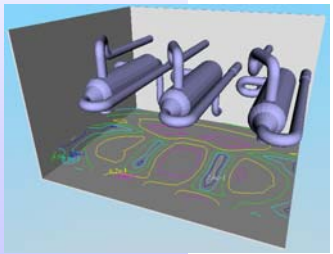
3D dose modeling and planning tool





Based on:

• 3D model including material, geometry and sources

• Point-kernel dose calculation, with build-up correction

Allows:

• Dose assessment for tasks, trajectories and scenarios

• Individual and collective dose assessment

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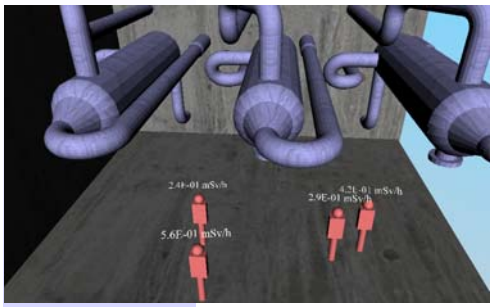
Dose analysis



Analysis of individual trajectories

Analysis of scenarios

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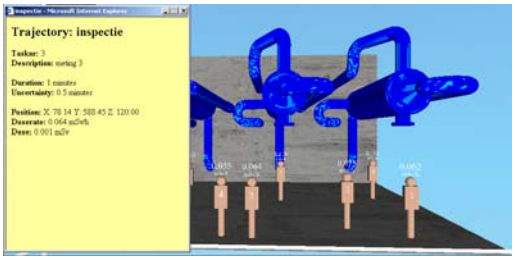
Communication tools
Convertor 1.1

Converts models and trajectories

in an interactive VRML file



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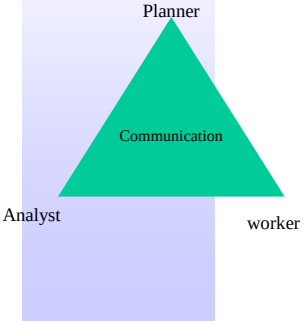
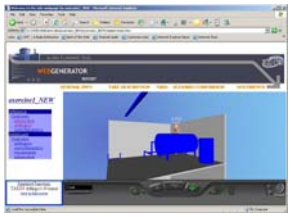
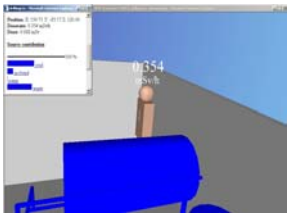
Communication tools
WebGen Argus 1.1

Creates a web site with the information on the dose optimization project you are working on.



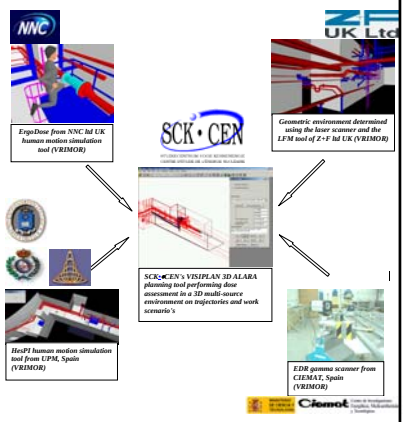




Research and development
Internationale projects
VRIMOR FP5

Virtual Reality in Maintenance Outage and Repair

To show the viability of an integrated approach to minimise occupational exposure through the combination of different technologies including gamma scanning, geometrical scanning, human motion simulation tools and a radio-geometrical modelling tool.



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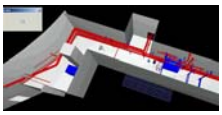
Trajectory Simulation

HeSPI (UPM)

ERGODose (NNC)

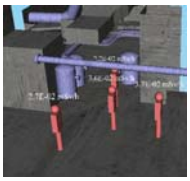
Trajectory calculation

VISIPLAN (SCK•CEN)



Detailed continuous movement controlled by voice command

Detailed continuous movement controlled by a SpaceMouse



Stepwise simulation with dummies fixed at work or action positions

Comparison on-line off-line simulation

- On-line (including movement simulation)
  - Advantage
    - ♣Fluent realistic movement.
    - ♣Detailed manipulations.
    - ♣Direct feedback of dose account
  - Disadvantage
    - ♣Time consuming in preparation

Comparison on-line off-line simulation

- Off-line
  - Advantage
    - ♣Planning capability
    - ♣Less time consuming in scenario building
    - ♣Less time consuming in calculations
  - Disadvantage
    - ♣Not continuous
    - ♣Dose feedback at the end

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Feedback from practice

- Dose account
  - The dose account of the on and off-line systems are comparable.
  - The dose account calculation is faster in the off-line system.
  - Detailed movement simulation is only required in specialized cases.
- Representation in 3D
  - The representation of every movement is not always required to make the communication on the task content and risk

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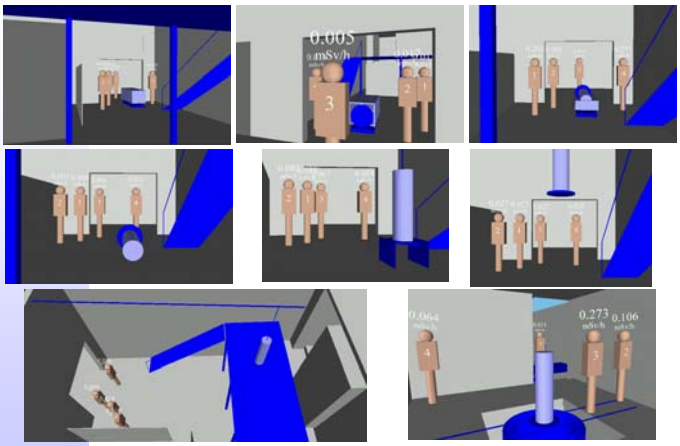
Example: Fuel loading REBUS



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Conclusion

- The use of simulation and 3D representation of the workplace and radiation risks enables
  - A better communication during the pre-job ALARA studies between the stakeholders.
  - An implicit training of the ALARA analyst (more scenarios can be tested)
  - A better final preparation of the worker.
  - A better awareness of the residual risk and the radiation protection measures put into practice.

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