Research Project no. 2 on Intervention Planning

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on the behalf of
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Radiation protection modelling methods to assess radiation implications of interventions using different handling scenarios
What are the needs?
1. – Collective dose at CERN

414 pers·mSv·y\(^{-1}\) in 2010

144 pers·mSv·y\(^{-1}\) ↔ 1539 CERN’s staff

97 pers·mSv·y\(^{-1}\) ↔ 1046 contractors’ staff

173 pers·mSv·y\(^{-1}\) ↔ 4372 users

For the maintenance of a NPP → ca. 600 pers·mSv·y\(^{-1}\)

For the maintenance of the LHC → > 1000 pers·mSv·y\(^{-1}\)
2. – Hazard and Risks

DETERMINISTIC EFFECTS
- Effect = f(dose)
- Gravity = f(dose)
- Early effects
- ∃ thresholds
- Probability = 1

STOCHASTIC EFFECTS
- Effect ≠ f(dose)
- Gravity ≠ f(dose)
- Late effects
- “No threshold”
- Probability = f(dose)
3. – Trade-off

- Staff training
- Special tools
- Remote means
- ≠ solutions
- ≠ procedures
- ...

Dose vs. ALARA
The issue

- There are many systems owners
- There are many interventions
- It’s difficult to appraise which are those interventions that are dosing and that require special attention
- It’s difficult for systems owners themselves to have a global idea of the total dose of an intervention
- It’s difficult for the radiation protection group to track and estimate doses for all foreseen interventions.
The needs

• A system that would allow systems owners to evaluate raw dose estimates of foreseen interventions

• A system that informs radiation protection technicians of foreseen interventions and to trigger out of them those that might be rather dosing

• A system that would help systems owners and the radiation protection group to optimize interventions by proposing alternate solutions (different access routes, remote systems...)
Here: some kind of geo-localisation for finding easily paths and locations

Here: possible means to decrease the doses received by workers

<table>
<thead>
<tr>
<th>#</th>
<th>S/D</th>
<th>path/location</th>
<th>time/speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>D</td>
<td>US25 → RE28</td>
<td>3 km/h</td>
</tr>
<tr>
<td>2</td>
<td>S</td>
<td>RE28</td>
<td>20 min</td>
</tr>
<tr>
<td>3</td>
<td>D</td>
<td>RE28 → RE32</td>
<td>3 km/h</td>
</tr>
<tr>
<td>4</td>
<td>S</td>
<td>RE32</td>
<td>30 min</td>
</tr>
<tr>
<td>5</td>
<td>D</td>
<td>RE32 → US25</td>
<td>3 km/h</td>
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</tbody>
</table>
And the research approach...
Research approach

1. Conceive and develop a software tool for assembling radiation maps (from particle physics Monte Carlo simulation packages, and from in-situ measurements), in a central database

2. Conceive and develop a work intervention description tool that can easily be learned by all those who need to access this service
Research approach

3. Conceive and develop a software module for displaying dose rates to which personnel or sensitive equipment are exposed and individual and collective doses associated to the simulated intervention.

4. Conceive and develop a method of dealing with standard human interventions, but also of semi-remote and fully remote interventions.

5. Integrate these modules to propose an easy to use tool.
Research approach, in practice

2-01
learn FLUKA

2-02
create very simple FLUKA radiation maps

2-03
collect radiation maps from all over the LHC

2-04
assemble all these maps in a single DB

2-05
find some way to describe work interventions

2-06
learn PHP, SVG, Java, Flash, Flex...

2-07
design & develop an interface to do so

2-08
compute \( \tilde{d} \) and \( d \) for the intervention (static rad field)

1
e.g. a work intervention XML format

2-09
compute \( d \) and \( \tilde{d} \) for the intervention (dynamic rad field)

2-10
find some way to display results of computation

2-11
propose a library of improvement solutions

2-12
recompute \( d \) and \( \tilde{d} \) for the intervention with solutions