Dose Algorithm Changes Necessary to Satisfy Anticipated Revisions to the External Dosimetry DOELAP

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What Revisions?

- Adoption of ANSI N13.11
- Single standard has been long anticipated
- ANSI committees have tried to make a test standard acceptable to DOE
- In 2006 DOE announced changes to 10 CFR 835 including adoption of some or all of N13.11-2001
- When will it happen?
  - Attend THAM-B roundtable session for more
## Comparison of Test Conditions

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Photon fields</strong></td>
<td>6 fields 20-662 keV</td>
<td>• 70 fields, 20-1332 keV,</td>
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<td></td>
<td></td>
<td>• New $c_k$ factors,</td>
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<td>• Angles for keV &gt; 70</td>
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<td><strong>Beta fields</strong></td>
<td>3 fields ($^{204}$Tl, $^{90}$Sr/Y, DU)</td>
<td>3 fields ($^{85}$Kr, $^{204}$Tl,</td>
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<td></td>
<td></td>
<td>$^{90}$Sr/Y)</td>
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<td><strong>Neutron fields</strong></td>
<td>2 fields ($^{252}$Cf bare, $D_2O$ mod)</td>
<td>-- same --</td>
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<td><strong>Mixtures</strong></td>
<td>• $^{137}$Cs + any x-ray,</td>
<td>Same, with $^{60}$Co as well</td>
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<tr>
<td></td>
<td>• Any photon plus neutron,</td>
<td>as $^{137}$Cs available for</td>
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<td></td>
<td>• High E beta + any photon</td>
<td>gamma source</td>
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<tr>
<td></td>
<td>• Any beta + $^{137}$Cs</td>
<td></td>
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<tr>
<td><strong>Other</strong></td>
<td></td>
<td>10% rule?</td>
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</table>
Ratio of Dose Conversion Factors

![Graph showing the ratio of dose conversion factors against photon energy (keV). The graph includes two lines, one for 0.07mm and another for 10mm, demonstrating how the ratio changes with different photon energies.]
Example Element Response

E2/shallow dose

Photon Energy (keV)

E2-NVLAP
E2-DOELAP
Why Revise the Algorithm?

- New photon dose correction factors
  - 20% difference for M30
- Continuum of photon energies, not just six
  - Discrete bin-style corrections won’t work
- Non-perpendicular test conditions
How to Revise the Algorithm

- **Older branching style**
  - Difficult to impossible
  - NVLAP processors had to adapt in 2002

- **Function style algorithm**
  - Revise dose correction factor functions
  - Angles OK, mixtures OK

- **Hybrid branching/matrix**
  - Revise dose response factors
  - Add lines for angles
Example – Function Style

- New photon dose correction factors
  - Revise dose correction factor functions
- New photon fields
  - Accommodated with full energy range functions
- Angles
  - No changes necessary
- Mixtures
  - No changes necessary
Results – Pure Photon Fields

[Bar graph showing bias against photon energy (keV) with categories: Old-old, Old-new, New-new]
Results – Overall Performance

Equivalent performance for 95 pure and mixed fields - photon mix, photon/beta (including $^{204}$Tl+x-ray), photon + neutron
“A Consistent Set of Photon Conversion Coefficients for Personnel and Environmental Dosimetry”, Chris Soares and Paul Martin (NIST), 1995