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Guidance on Implementing New Neutron Dose Methods

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RP Task Team on Neutron Quality Factor

Recommendations for Compliance with 10CFR835

This RP Task Team developed recommendations on neutron dose methods that are both compliant with the modified requirements in Amended 10CFR835 and consistent with ICRP 60 recommendations

The Task Team was later tasked to provide guidance on assessing conservatism of measured neutron dose against Effective Dose (Hp(10) vs E) as recommended by ICRP 60



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The Team

- **Neutron Dose Task Team Members:**

- Ken Crase, SRS (Chair)
- Dan Strom, PNNL
- Ken Veinot, Y-12
- Radoslav Radev, LLNL
- Don Cossairt, FNAL
- Tom McLean, LANL
- Hung-Cheng Chiou, WIPP

(Neutron dosimetry subject matters experts)



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Recommendations

- **Use Operational Quantities for Neutron Dose Determination:**

- Personal Dose Equivalent $H_p(10)$ at 0 degrees for neutron (and beta/gamma) dosimeter calibrations
 - ICRP 74, p. 182, Table A.24 for photons
 - ICRP 74, p. 200, Table A.42 for neutrons
- Ambient Dose Equivalent $H'(10)$ for instrument calibrations
 - ICRP 74, p. 200, Table A.42 for neutrons
- For facility design dose calculations use $H_p(10)$ at 0 degrees
 - ICRP tables for $H_p(10)$ referenced above



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Impact of Recommendations

- Photon doses do not change, and there is no need to change the way photon measurement instruments are calibrated
- Neutron doses are increased by 21% for bare Cf and moderated Cf spectra
 - Some spectra may see larger or smaller increases (17%-39%)
- Instrument calibrations increase by somewhat smaller amounts ($H^*(10)$ goes up 17% for bare Cf source)
- Introduces need to verify work place neutron doses are conservative compared to Effective Dose (E)

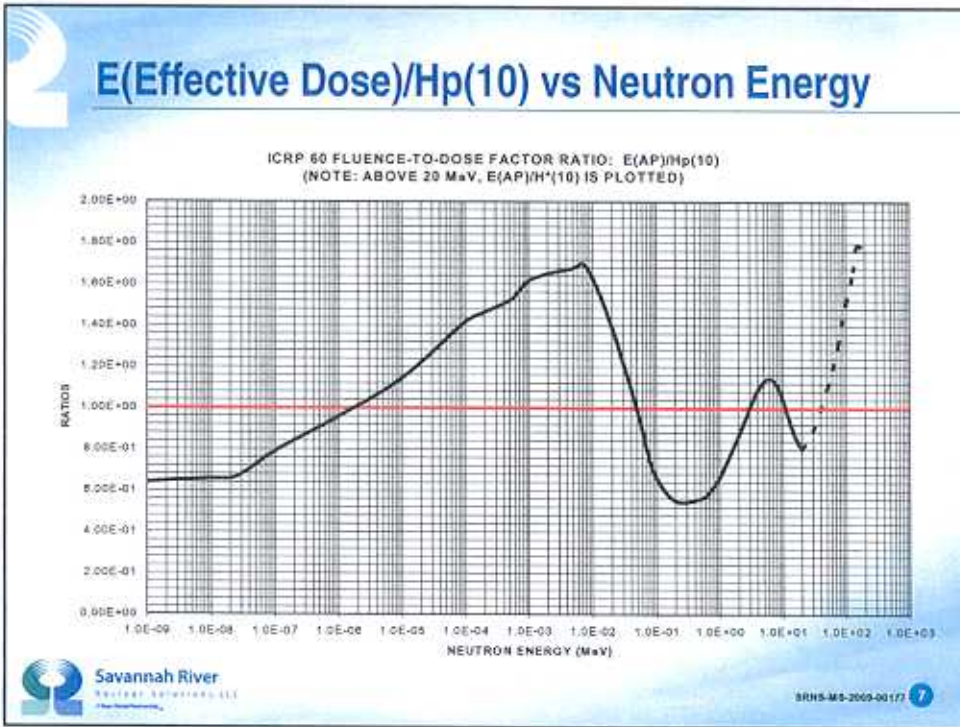


Guidance on Conservatism Relative to E

Numerous (more than 600) neutron spectra evaluated for spectrum-averaged E vs Hp(10):

- Fission Sources, Selected (Alpha, n) Sources
 - Bare Cf, Moderated Cf, PuF_4 , PuBe, PuO
 - Surrounded by Various Thicknesses of Common Materials
- Spectra From IAEA Compendium



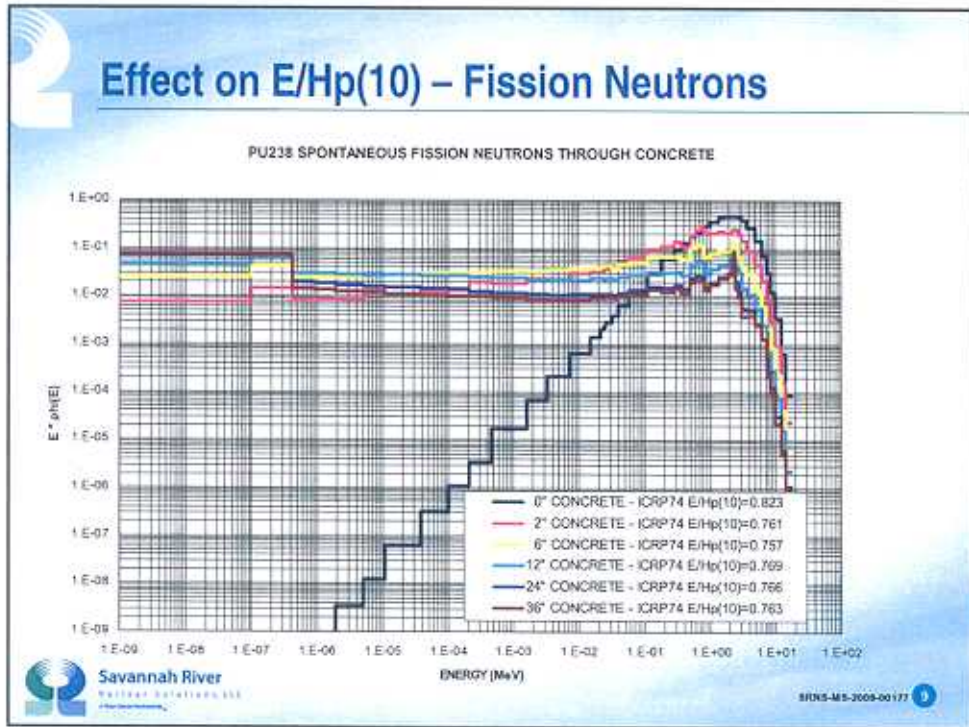


Conclusions

- **The maximum ratio of spectrum-averaged E vs Hp(10) was 1.03**
 - Fission and most alpha-n spectra are conservative, even when surrounded by common shielding materials.

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- ## 2 Summary
- Measure Neutron Dose as Hp(10) at 0 degrees
 - Calibrate Neutron Dose Survey Instruments as H*(10)
 - Only Those Facilities with Very Low Energy or Very High Energy Neutron Spectra may have to assess whether their spectra are conservative relative to E
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