ANSI/HPS N13.11: Current Status of Update

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History

1975 First Working Group formed

1983 ANSI N13.11 published

1987 2nd Working Group formed

1991 ANSI N13.11-1991 published

1996 3rd Working Group formed

2001 ANSI N13.11-2001 published

2005 4th Working Group formed

ANSI N13.11-1983 Performance Test Standard (1983)

Category	Source	Range
I. Accidents, low energy photons	150 kV medium filtered	10-500 rad
II. Accidents, high energy photons	^{137}Cs	10-500 rad
III. Low-energy photons	6 NBS techniques (30-150 kVp)	0.03-10 rem
IV. High energy Photons	^{137}Cs	0.03-10 rem
V. Beta	$^{90}Sr/Y$	0.15-10 rem
VI. Photon Mixtures	30-150 kVp + ^{137}Cs	0.05-5 rem
VII. Mixtures, Photons and Betas	^{137}Cs + $^{90}Sr/Y$	0.2-5 rem
VIII. Mixtures, Neutrons and High Energy Photons	^{252}Cf (D_2O moderated)	0.15-5 rem

Dept. of Energy Performance Test Standard (DOELAP) (1986)

Category	Source	Range
I. Low energy photon, high dose	150 kV medium filtered	10-500 rad
II. High energy photon, high dose	^{137}Cs	10-500 rad
III. Low-energy photons A. General B. Plutonium environment	 4 NBS techniques (30-150 kVp) Monoenergetic 15-20 keV, 55-65 keV and ^{241}Am	0.03-5 rem
IV. High energy photons	^{137}Cs	0.03-10 rem
V. Beta A. General (point geometry) B. Special (slab geometry)	 ^{90}Sr/Y and ^{204}Tl Uranium	 0.15-10 rem 0.15-5 rem
VI. Neutrons	^{252}Cf (D_2O moderated) ^{252}Cf (unmoderated)	0.2-5 rem
VII. Mixtures, photons Mixtures, photons and betas Mixtures, neutrons and photons	30-150 kVp +^{137}Cs 30-150 kVp + ^{90}Sr/Y, ^{204}Tl Uranium ^{252}Cf (D_2O moderated or unmoderated) + ^{137}Cs	 0.2-5 rem

N13.11 - 1993 Working Group

(specific Issues that were considered)

- Philosophy of test (NVLAP/DOELAP differences)
- Angular dependence
- Tolerance levels and performance criteria
- SI units
- Unexposed dosimeter category / Lower limit of detection
- Revise/update selection of x-ray beam energies
- Beta category sources and irradiation procedures
- Neutron category sources and irradiation procedures
- Photon category sources and irradiation procedures
- Extremity dosimetry
- Blind testing
- Point to which distance from source is measured
- Photon mixture details
- Environmental concerns

ANSI N13.11-1993 Performance Test Standard (1993)

Category	Source	Range
I. Accidents, low energy photons	150 kV medium filtered	0.1 - 5 Gy
II. Accidents, high energy photons	^{137}Cs	0.1 - 5 Gy
III. Low-energy photons A. General B. High energy	5 NIST techniques (30-150 kVp) 3 NIST techniques (100-150 kVp)	0.3 - 100 mSv
IV. High energy Photons	^{137}Cs	0.3 - 100 mSv
V. Beta A. High energy B. Low energy C. General	 ^{90}Sr/Y ^{204}Tl ^{90}Sr/Y or ^{204}Tl	1.5 - 100 mSv
VI. Photon mixtures	30-150 kVp + ^{137}Cs	0.5 - 50 mSv
VII. Mixtures, photons and betas	^{137}Cs + ^{90}Sr/Y or ^{204}Tl	2 - 50 mSv
VIII. Mixtures, neutrons and high energy photons	^{252}Cf (D_2O moderated) ^{241}AmBe	1.5 - 50 mSv
IX. Varied angles of incidence	100-150 kVp, ^{137}Cs	1- 50 mSv

N13.11 - 2001 Working Group
(specific Issues that were considered)

- Type of Phantom (ANSI PMMA vs ISO water vs ?)
- Conversion Factors
- Reference Dose Point
- Type vs Periodic test
- Test Protocol
- Electronic Personnel Dosimeters
- Lower Limit of Detection
- Categories and Sources
- Pass/Fail Criteria
- Sample Size
- Dose Ranges
- Appendix Material

N13.11 - 2001 Working Group
(General Goals)

- Write a standard that can be used by both NVLAP and DOELAP testing programs.
- The testing protocol will not preclude dosimeters using new technologies (i.e., electronic dosimeters).
- Reduce the number of dosimeters required for testing (and therefore cost).
- Achieve consistency with International Organization for Standardization (ISO).
- Increase test “blindness”.

ANSI N13.11-2001 Performance Test Standard (2001)

Category	Source	Range
I. Accidents A. General B. High energy photons C. Low energy photons	 150 kV medium filtered or ^{137}Cs ^{137}Cs 150 kV medium filtered	0.1 - 5 Gy
II. Photons A. General B. High energy C. Medium energy D. Narrow spectrum	75 NIST & ISO techniques (30-300 kVp), angles for E>70 keV E>500 keV, angles E>70 keV, angles (0, ±40, ± 60°) NS20, NS80, E>500 keV, angles for E>70 keV	0.3 - 100 mSv
III. Beta A. General B. High energy C. Low energy	 ^{90}Sr/Y or ^{204}Tl, ^{85}Kr ^{90}Sr/Y ^{204}Tl, ^{85}Kr	1.5 - 100 mSv
IV. Photon mixtures	30-300 kVp + E>500 keV	0.6 - 100 mSv
V. Mixtures, photons and betas	^{137}Cs + ^{90}Sr/Y, ^{204}Tl, ^{85}Kr	2 - 100 mSv
VI. Mixtures, neutrons and high energy photons	^{252}Cf (D_2O moderated) ^{252}Cf (D_2O unmoderated)	1.5 - 50 mSv

Current (2001) Pass/Fail Criteria

- $|B| + S \leq L$ where L = 0.3 for category I and L = 0.4 for all others.
- No separate limit on |B| and on S as in the 1993 version.
- ***Performance Quotient Limit (10% rule):***

  For non-accident, non-neutron categories, **Processor will fail if P_i for more than 10% of the dosimeters in a category exceed L.**

Contentious Issues in Past Working Groups

1983: Photon conversion coefficients

1993: Angular response functions

2001: Performance quotient limit

N13.11 Working Group
4th Committee formed 2005

- Chris Soares, Chairman (NIST)
- Rick Cummings (Idaho National Laboratory)
- Bill Harris (US Army)
- Mike Lantz (Arizona Public Service)
- Kim McMahan (Oak Ridge National Laboratory)
- Lyn Myers (Pacific Northwest National Lab)
- Sandy Perle (Global Dosimetry Solutions)
- Scott Schwahn (US Dept. of Energy)

Some Recommendations

Type test or performance test?

Bring back ^{137}Cs category

Force/recommend testing to fields appropriate to facility (beta/x-ray)

Establish some relation between criteria and dose level with respect to limits

Increase number of dosimeters per category to 20

More Recommendations

Test in two rounds

Combine categories II and IV

Combine categories III and V

Extend mixture ratios to 1:10 and 10:1

Add test criteria for $H_p(3)$ for betas, photons and beta-photon mixtures

Introduce beta-beta mixtures

Still More Recommendations

Add a test category for low dose levels

Increase blindness of tests where possible

Add limits on transit dose as a condition for acceptable performance testing

Reduce Cat I upper range from 500 to 100 rem

Reduce number of random angles in Cat II

And …

Increase Cat III lower range to 250 or 500 mrem

Include photons from neutron source in Cat VI ratio

Change Cat V & VI ratios from 3:1/1:3 to 3:1/1:1

Performance criteria that tolerate high values

Deal with the Tl-204, Kr-85 problem

And Finally,

Review all of the photon beams (e.g., LK)

Review the dose ranges (accident vs routine)

Evaluate testing that takes into account a processor's radiological environment more

Evaluate the need for betas + Co-60

N13.11 Working Group
4th Committee Issues

- Test philosophy
- Performance criteria
- Utilization of performance quotient limit (PQL)
- Beta particle source specification
- Test categories
- Test procedure
- Angular testing

N13.11 Working Group
4th Committee Issues (cont.)

- Mixtures
- Dose ranges
- Phantom issues
- New sources, fields and categories
- Conversion coefficients
- Definitions
- Neutron source specification

N13.11 Working Group
4th Committee Meetings

- NIST, Gaithersburg, MD May 3-4, 2005
- Salt Lake City, Sept 12-14, 2005
- Global, Irvine, CA, Jan 9-11, 2006
- Redstone Arsenal, AL, May 24-26, 2006
- ISU, Pocatello, ID, Oct 11-13, 2007
- ORNL, Oak Ridge, TN, Jan 24-26, 2007
- Phoenix, AZ May 9-11, 2007
- (planned) NIST/CIRMS, Oct 24-26, 2007

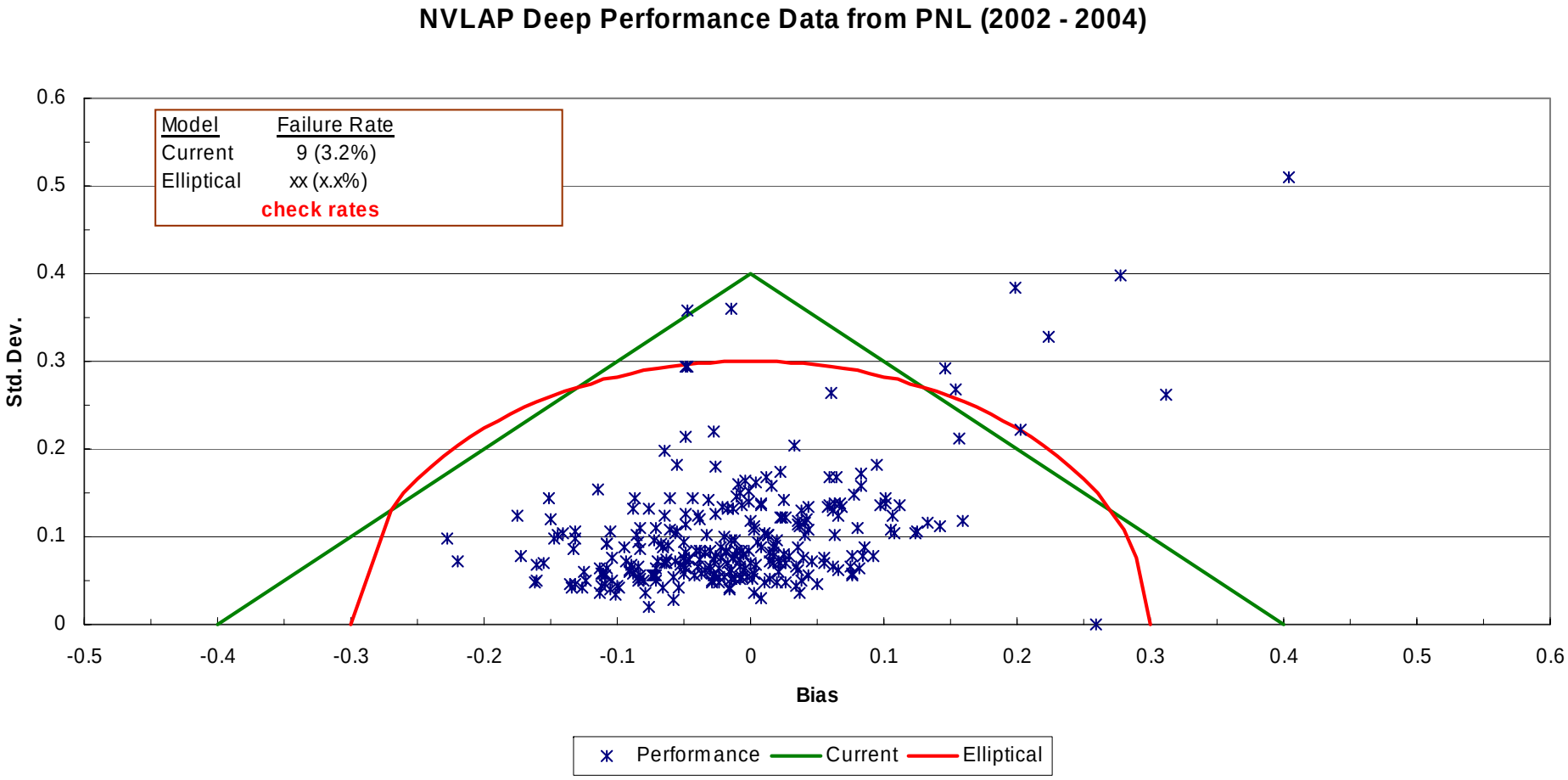
Preliminary Resolutions

- Combine some categories (6 -> 5)
- Reduce number of bremsstrahlung beams (58 -> 33)
- Modify performance criteria (no PQL, $B^2+S^2<L^2$)
  - Used prior testing data for analysis of changes
- Discontinue use of ^{204}Tl (this has been implemented)
- Tighten up test scheduling; allow single shipment
- Reduce # of non-perpendicular irradiations
- Modify dose ranges, limits on number of low and high dose irradiations and mixture ratios
- Change neutron conversion coefficients

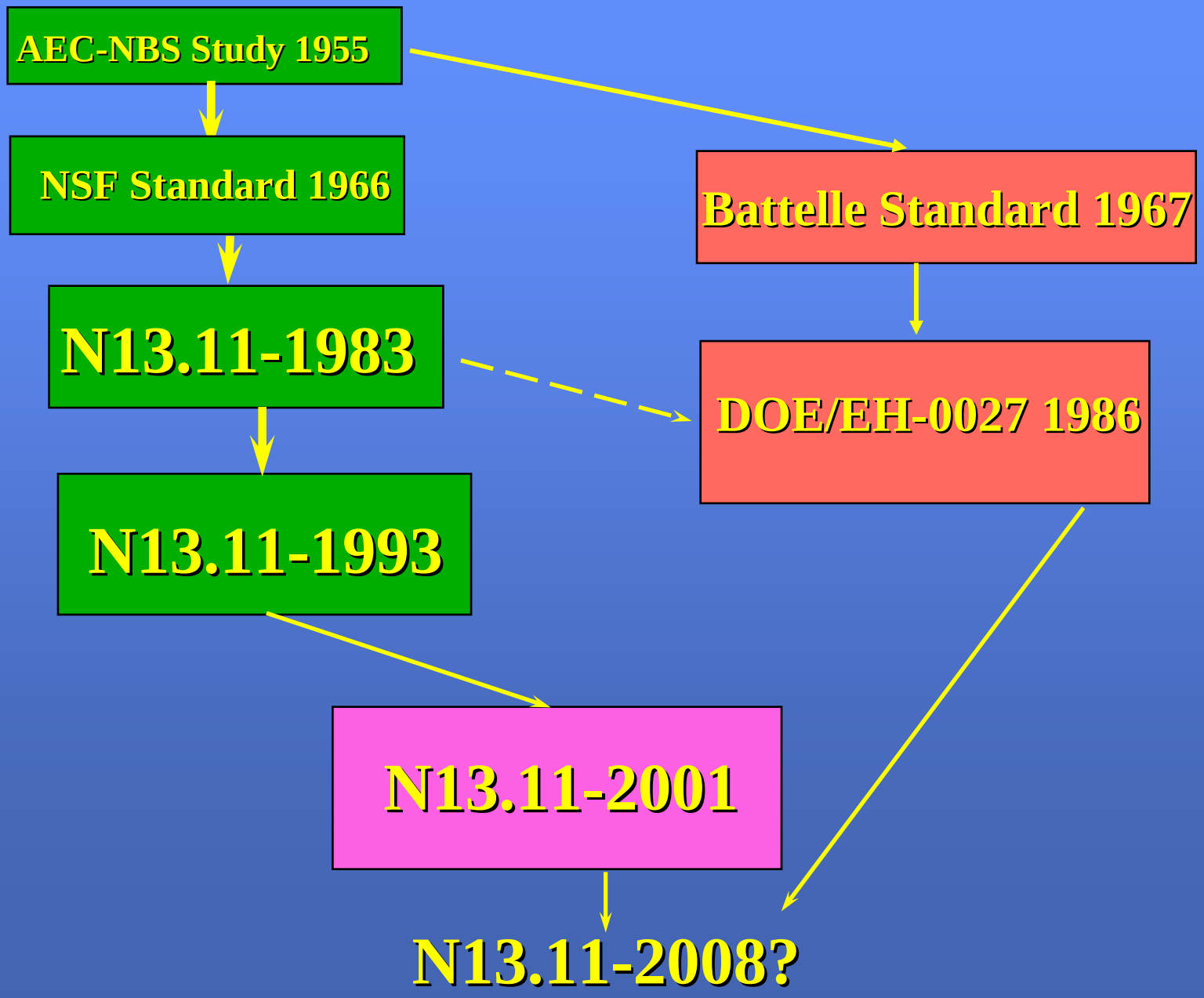
Actual Performance Data: NVLAP 2002-2004 – 6516 records

yr		Ct	Ang	1st Srce	1st Dp	1st Sh	2nd srce	2nd Dp	2nd Sh	Tot Dp	Tot Sh	Tot N	Rep Dp	Rep Sh	Rep N	Deep P	>18%?	>L?	B	S	B+S	Shllw P	>18%	>L?	B	S	B+S
2	1	1A	+00H	M150 xray-Philips	277.55	256.20		0.00	0.00	277.55	256.20	0.00	258.43	0.00	0.00	-0.069											
2	1	1A	+00H	Cs-137 100 Ci	55.65	55.65		0.00	0.00	55.65	55.65	0.00	49.29	0.00	0.00	-0.114											
2	1	1A	+00H	Cs-137 100 Ci	15.17	15.17		0.00	0.00	15.17	15.17	0.00	13.85	0.00	0.00	-0.087											
2	1	1A	+00H	M150 xray-Philips	72.60	67.01		0.00	0.00	72.60	67.01	0.00	64.12	0.00	0.00	-0.117											
2	1	1A	+00H	Cs-137 100 Ci	61.95	61.95		0.00	0.00	61.95	61.95	0.00	57.80	0.00	0.00	-0.067											
2	1	1A	+00H	M150 xray-Philips	26.32	24.29		0.00	0.00	26.32	24.29	0.00	25.64	0.00	0.00	-0.026											
2	1	1A	+00H	M150 xray-Philips	12.81	11.82		0.00	0.00	12.81	11.82	0.00	12.95	0.00	0.00	0.011											
2	1	1A	+00H	M150 xray-Philips	100.71	92.96		0.00	0.00	100.71	92.96	0.00	99.32	0.00	0.00	-0.014											
2	1	1A	+00H	Cs-137 100 Ci	11.17	11.17		0.00	0.00	11.17	11.17	0.00	11.43	0.00	0.00	0.023											
2	1	1A	+00H	Cs-137 100 Ci	118.60	118.60		0.00	0.00	118.60	118.60	0.00	119.20	0.00	0.00	0.005											
2	1	1A	+00H	M150 xray-Philips	17.80	16.43		0.00	0.00	17.80	16.43	0.00	16.77	0.00	0.00	-0.058											
2	1	1A	+00H	M150 xray-Philips	12.78	11.80		0.00	0.00	12.78	11.80	0.00	11.74	0.00	0.00	-0.081											
2	1	1A	+00H	Cs-137 100 Ci	302.91	302.91		0.00	0.00	302.91	302.91	0.00	287.36	0.00	0.00	-0.051											
2	1	1A	+00H	Cs-137 100 Ci	65.25	65.25		0.00	0.00	65.25	65.25	0.00	60.19	0.00	0.00	-0.078											
2	1	1A	+00H	M150 xray-Philips	187.17	172.77		0.00	0.00	187.17	172.77	0.00	173.71	0.00	0.00	-0.072			-0.053	0.044	0.097						
2	1	2A	+60V	H100 xray-Philips	2.33	2.46		0.00	0.00	2.33	2.46	0.00	2.83	2.61	0.00	**0.215**	Y					0.062					
2	1	2A	-60H	M200 xray-Philips	0.43	0.46		0.00	0.00	0.43	0.46	0.00	0.47	0.45	0.00	0.086						-0.035					
2	1	2A	-60V	H150 xray-Philips	0.25	0.26		0.00	0.00	0.25	0.26	0.00	0.25	0.24	0.00	0.021						-0.093					
2	1	2A	+00H	Cs-137 100 Ci	0.04	0.04		0.00	0.00	0.04	0.04	0.00	0.05	0.05	0.00	**0.233**	Y					0.258	Y				
2	1	2A	+00H	M200 xray-Philips	0.59	0.55		0.00	0.00	0.59	0.55	0.00	0.65	0.57	0.00	0.097						0.025					
2	1	2A	+40H	Cs-137 100 Ci	0.78	0.80		0.00	0.00	0.78	0.80	0.00	0.77	0.78	0.00	-0.008						-0.025					
2	1	2A	-40V	H100 xray-Philips	0.04	0.04		0.00	0.00	0.04	0.04	0.00	0.05	0.04	0.00	**0.248**	Y					0.155					
2	1	2A	+00H	NS60 xray-Philips	0.76	0.71		0.00	0.00	0.76	0.71	0.00	0.76	0.80	0.00	0.002						0.124					
2	1	2A	-40H	Co-60 (318-036)	0.91	0.93		0.00	0.00	0.91	0.93	0.00	0.87	0.88	0.00	-0.043						-0.054					
2	1	2A	+00H	Co-60 (318-036)	1.06	1.07		0.00	0.00	1.06	1.07	0.00	1.01	1.02	0.00	-0.043						-0.045					
2	1	2A	-40V	Cs-137 100 Ci	0.12	0.12		0.00	0.00	0.12	0.12	0.00	0.11	0.11	0.00	-0.072						-0.094					
2	1	2A	+40V	NS200 xray-Philips	0.51	0.51		0.00	0.00	0.51	0.51	0.00	0.51	0.49	0.00	-0.003						-0.041					
2	1	2A	+60H	HK300 xray-Philips	1.44	1.53		0.00	0.00	1.44	1.53	0.00	1.33	1.32	0.00	-0.074						-0.138					
2	1	2A	+00H	Cs-137 100 Ci	0.21	0.21		0.00	0.00	0.21	0.21	0.00	0.20	0.20	0.00	-0.058						-0.048					
2	1	2A	+00H	Am-241	2.88	2.62		0.00	0.00	2.88	2.62	0.00	2.76	2.80	0.00	-0.041			0.037	0.113	0.150	0.069			0.008	0.108	0.116
2	1	3A	+00H	Tl-204 40mCi	0.00	0.52		0.00	0.00	0.00	0.52	0.00	0.00	0.56	0.00							0.082					
2	1	3A	+00H	Sr-90/Y-90 50mCi	0.00	0.25		0.00	0.00	0.00	0.25	0.00	0.00	0.24	0.00							-0.031					
2	1	3A	+00H	Sr-90/Y-90 50mCi	0.00	0.19		0.00	0.00	0.00	0.19	0.00	0.00	0.21	0.00							0.099					
2	1	3A	+00H	Sr-90/Y-90 50mCi	0.00	7.32		0.00	0.00	0.00	7.32	0.00	0.00	7.99	0.00							0.091					
2	1	3A	+00H	Tl-204 40mCi	0.00	0.75		0.00	0.00	0.00	0.75	0.00	0.00	0.75	0.00							-0.003					
2	1	3A	+00H	Sr-90/Y-90 50mCi	0.00	3.21		0.00	0.00	0.00	3.21	0.00	0.00	3.87	0.00							0.206	Y				
2	1	3A	+00H	Tl-204 40mCi	0.00	1.86		0.00	0.00	0.00	1.86	0.00	0.00	1.92	0.00							0.033					
2	1	3A	+00H	Tl-204 40mCi	0.00	1.81		0.00	0.00	0.00	1.81	0.00	0.00	1.72	0.00							-0.046					

Example of Data Analysis



Evolution of a Standard



Preliminary Table 1

Table 1a
Test Categories, Test Irradiation Ranges, and Tolerance Levels

Test Category	Test Irradiation Range	Tolerance Level (*L*)	
		Deep	Shallow
I. Accidents, photons			
A. General (B and C, random)			
B. ^{137}Cs	0.05 to 5 Gy (5 to 500 rad)	0.24	No test
C. M150			
II. Photons/Photon Mixtures			
A. General[1] ($\overline{E} \geq$20 keV,$\perp$ if $\leq$ 70keV, $\alpha \leq 60^{o}$ if >70 keV)			
B. High E (^{137}Cs, ^{60}Co; $\alpha \leq 60^{o}$)			
C. Medium E[1] ($\overline{E}$ >70 keV,$\alpha \leq 60^{o}$)	0.5 to 50 mSv (0.05 to 5 rem)	0.30	0.30
D. Plutonium Specific[1] (see Appendix A2)			
III. Betas			
A. General (B and C, random)			
B. High E (^{90}Sr/^{90}Y)			
C. Low E (^{85}Kr)	2.5 to 250 mSv (0.25 to 25 rem)	No test	0.30
D. U Slab			
IV. Photon/Beta[2] **Mixtures**	3.0 to 300 mSv (0.30 to 30 rem)	0.30	0.30
V. Neutron/Photon Mixtures[3]			
A. General (B and C, random)			
B. ^{252}Cf + II	1.5 to 50 mSv (0.15 to 5 rem)	0.30	No test
C. ^{252}Cf(D_2O) + II			

Please send comments in writing!

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