

# **ANSI/HPS N13.11: Current Status of Update**

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# History

1975 First Working Group formed

1983 ANSI N13.11 published

1987 2<sup>nd</sup> Working Group formed

1991 ANSI N13.11-1991 published

1996 3<sup>rd</sup> Working Group formed

2001 ANSI N13.11-2001 published

2005 4<sup>th</sup> 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	$^{137}\text{Cs}$	10-500 rad
III. Low-energy photons	6 NBS techniques (30-150 kVp)	0.03-10 rem
IV. High energy Photons	$^{137}\text{Cs}$	0.03-10 rem
V. Beta	$^{90}\text{Sr/Y}$	0.15-10 rem
VI. Photon Mixtures	30-150 kVp + $^{137}\text{Cs}$	0.05-5 rem
VII. Mixtures, Photons and Betas	$^{137}\text{Cs}$ + $^{90}\text{Sr/Y}$	0.2-5 rem
VIII. Mixtures, Neutrons and High Energy Photons	$^{252}\text{Cf}$ ( $\text{D}_2\text{O}$ 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	$^{137}\text{Cs}$	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 $^{241}\text{Am}$	0.03-5 rem
IV. High energy photons	$^{137}\text{Cs}$	0.03-10 rem
V. Beta A. General (point geometry) B. Special (slab geometry)	$^{90}\text{Sr}/\text{Y}$ and $^{204}\text{Tl}$ Uranium	0.15-10 rem 0.15-5 rem
VI. Neutrons	$^{252}\text{Cf}$ ( $\text{D}_2\text{O}$ moderated) $^{252}\text{Cf}$ (unmoderated)	0.2-5 rem
VII. Mixtures, photons  Mixtures, photons and betas  Mixtures, neutrons and photons	30-150 kVp + $^{137}\text{Cs}$  30-150 kVp + $^{90}\text{Sr}/\text{Y}$ , $^{204}\text{Tl}$ Uranium  $^{252}\text{Cf}$ ( $\text{D}_2\text{O}$ moderated or unmoderated) + $^{137}\text{Cs}$	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	$^{137}\text{Cs}$	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	$^{137}\text{Cs}$	0.3 - 100 mSv
V. Beta A. High energy B. Low energy C. General	$^{90}\text{Sr/Y}$ $^{204}\text{Tl}$ $^{90}\text{Sr/Y}$ or $^{204}\text{Tl}$	1.5 - 100 mSv
VI. Photon mixtures	30-150 kVp + $^{137}\text{Cs}$	0.5 - 50 mSv
VII. Mixtures, photons and betas	$^{137}\text{Cs}$ + $^{90}\text{Sr/Y}$ or $^{204}\text{Tl}$	2 - 50 mSv
VIII. Mixtures, neutrons and high energy photons	$^{252}\text{Cf}$ ( $\text{D}_2\text{O}$ moderated) $^{241}\text{AmBe}$	1.5 - 50 mSv
IX. Varied angles of incidence	100-150 kVp, $^{137}\text{Cs}$	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
<b>I. Accidents</b> A. General B. High energy photons C. Low energy photons	150 kV medium filtered or $^{137}\text{Cs}$ $^{137}\text{Cs}$ 150 kV medium filtered	0.1 - 5 Gy
<b>II. Photons</b> 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 ( $0, \pm 40, \pm 60^\circ$ ) NS20, NS80, $E > 500$ keV, angles for $E > 70$ keV	0.3 - 100 mSv
<b>III. Beta</b> A. General B. High energy C. Low energy	$^{90}\text{Sr/Y}$ or $^{204}\text{Tl}, ^{85}\text{Kr}$ $^{90}\text{Sr/Y}$ $^{204}\text{Tl}, ^{85}\text{Kr}$	1.5 - 100 mSv
<b>IV. Photon mixtures</b>	30-300 kVp + $E > 500$ keV	0.6 - 100 mSv
<b>V. Mixtures, photons and betas</b>	$^{137}\text{Cs} + ^{90}\text{Sr/Y}, ^{204}\text{Tl}, ^{85}\text{Kr}$	2 - 100 mSv
<b>VI. Mixtures, neutrons and high energy photons</b>	$^{252}\text{Cf}$ ( $\text{D}_2\text{O}$ moderated) $^{252}\text{Cf}$ ( $\text{D}_2\text{O}$ 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**

## **4<sup>th</sup> 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  $^{137}\text{Cs}$  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**

## **4<sup>th</sup> 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**

## **4<sup>th</sup> Committee Issues (cont.)**

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

# **N13.11 Working Group 4<sup>th</sup> 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*

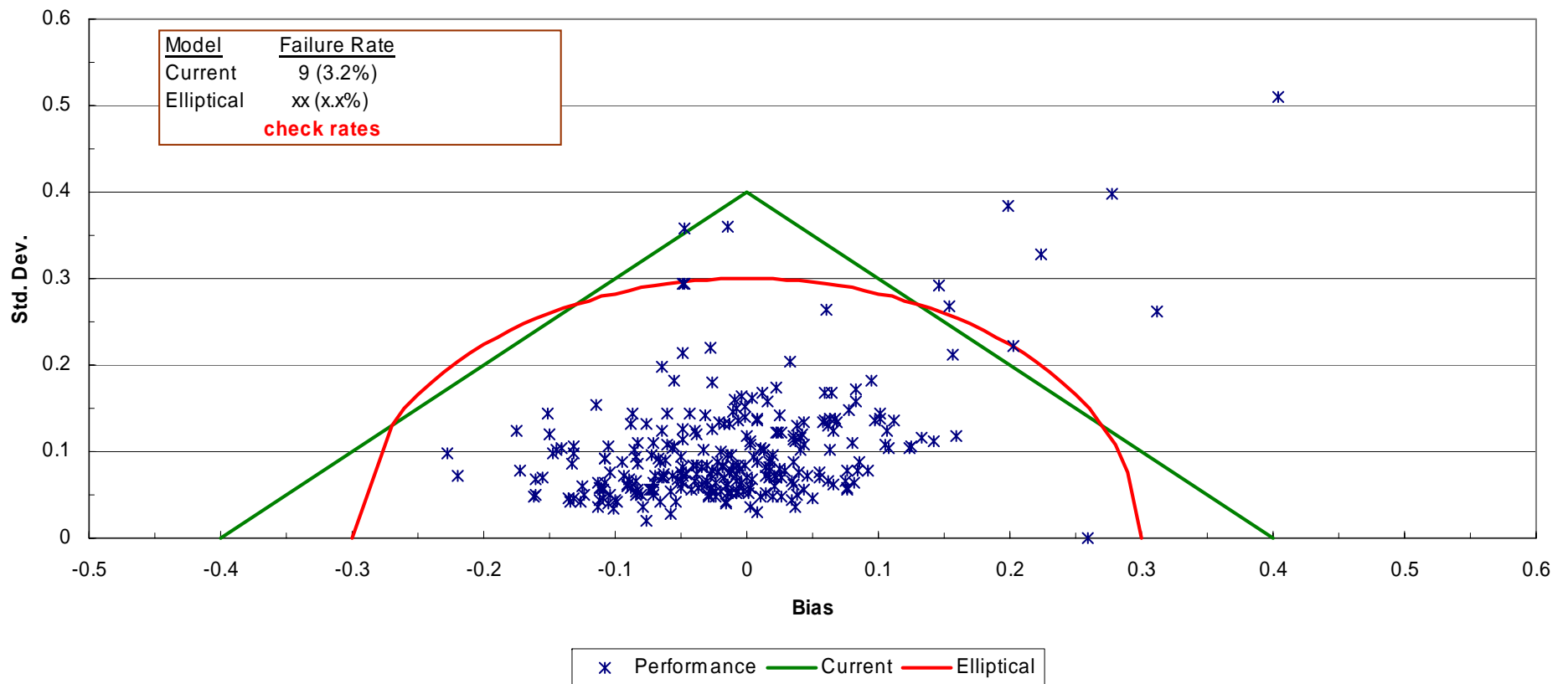
- Combine some categories (6 -> 5)
- Reduce number of bremsstrahlung beams (58 -> 33)
- Modify performance criteria (no PQL,  $B^2+S^2<L^2$ )
  - Used prior testing data for analysis of changes
- Discontinue use of  $^{204}\text{Tl}$  (this has been implemented)
- Tighten up test scheduling; allow single 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

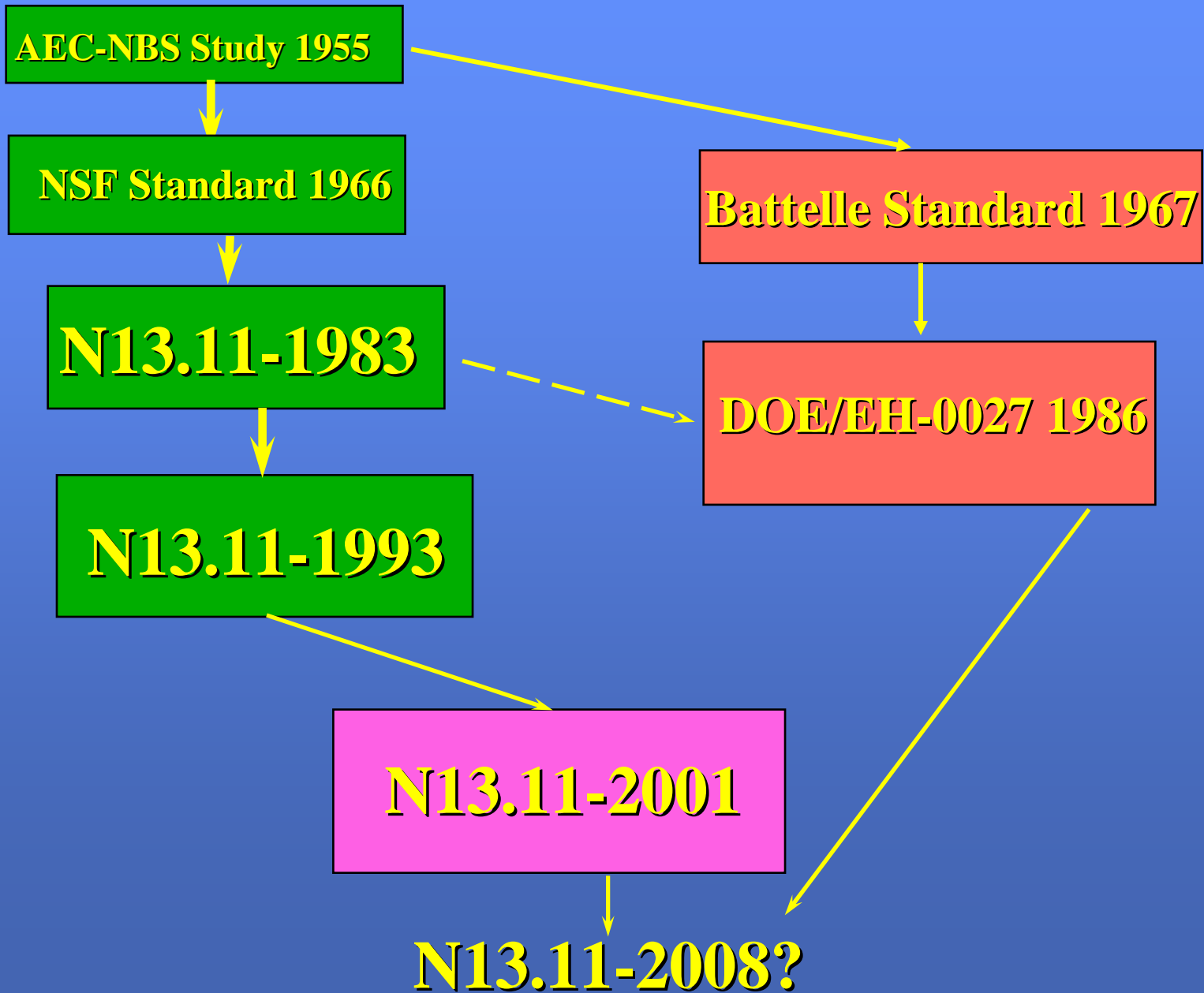
yr	Ct	Ang	1st Srce	1st Dp	1st Sh	2nd srce	2nd Dp	2nd Sh	Tot Dp	Tot Sh	Tot N	Rep Dp	Rep Sh	Rep N	Deep P	>18%?	>L?	B	S	B+S	Shlw P	>18%	>L?	B	S	B+S	
2	1	1A	+00H M150 xray-Philips	277.55	256.20		0.00	0.00	277.55	256.20	0.00	258.43	0.00	0.00	-0.069												
2	1	1A	+00H Cs-137 100 Ci	55.65	55.65		0.00	0.00	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 Ti-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 Ti-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 Ti-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 Ti-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

NVLAP Deep Performance Data from PNL (2002 - 2004)



# Evolution of a Standard



**Please send comments in writing!**

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