12th Neutron and Ion Dosimetry Symposium
3-7 June 2013 - Aix-en-Provence, France

EURADOS IC2012n

Irradiations at NPL

Graeme C. Taylor
Neutron Metrology Group, NPL

June 4th 2013

NPL
National Physical Laboratory

Outline

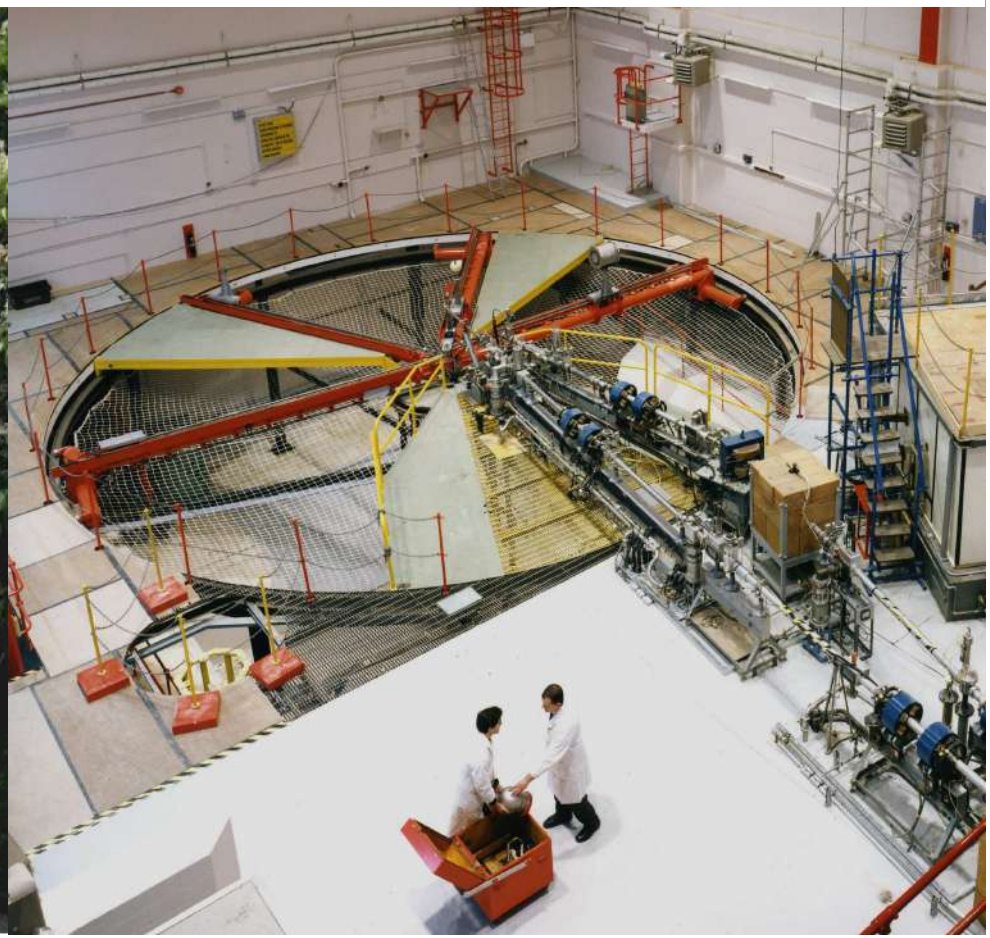
- NPL Irradiation Facility
- Dosimeter Storage
- Irradiation Details
- Exposure Validation
- Summary of Uncertainties

NPL
National Physical Laboratory

Neutron Group Building

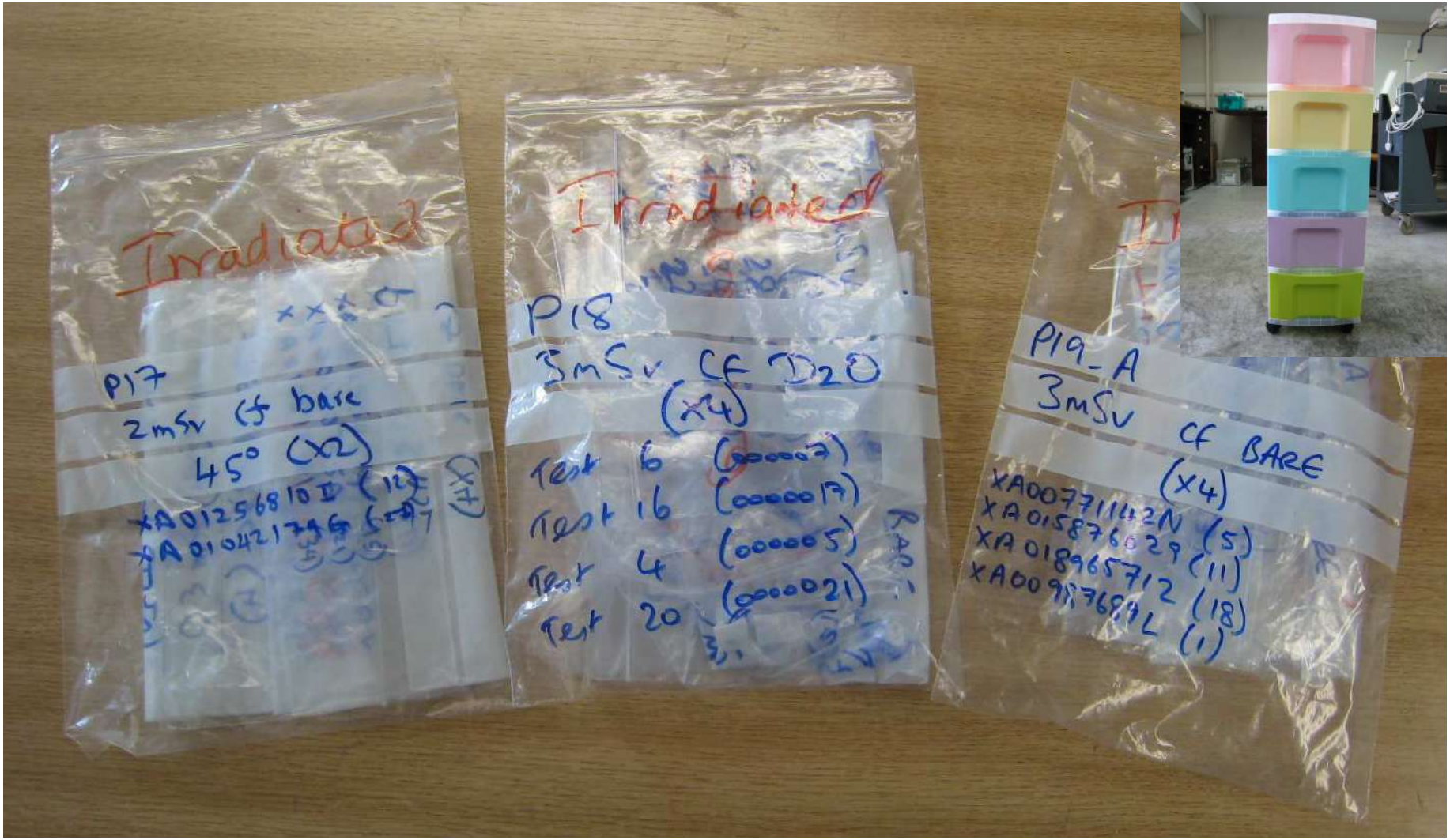
Chadwick Building

Low Scatter Facility



Dosimeter Storage

Dosimeters bagged as unpacked and placed in storage units



Irradiation Details

Source emission rates measured in NPL Manganese Bath

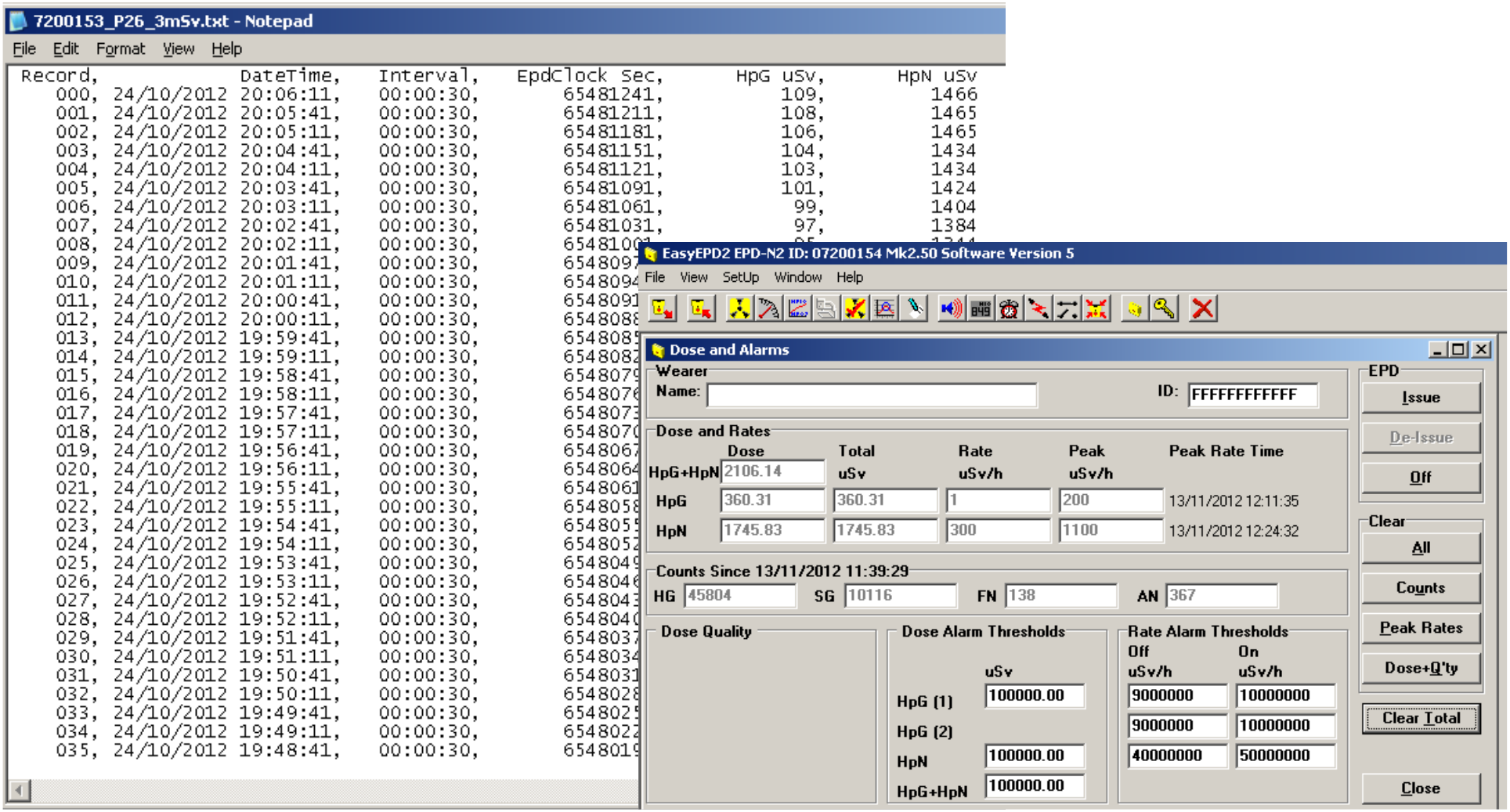
Source anisotropy measured in same facility as exposures

Dose (mSv)	Angle	Source Type	Source ID	Emission rate* (s^{-1})	% of ^{250}Cf	Exposure time (hh:mm)
0.3	0^o	^{252}Cf (bare)	5000NC	$3.4x10^7$	13%	00:26
3	0^o	^{252}Cf (bare)	1254NU	$2.9x10^8$	negligible	00:30
15	0^o	^{252}Cf (bare)	1254NU	"	"	02:27
2	45^o	^{252}Cf (bare)	1254NU	"	"	00:20
3	0^o	^{252}Cf (moderated)	1254NU	"	"	02:06

*On 31/10/2012

Exposure Verification

Reference EPD-N2s mounted on top of phantoms during exposures



7200153_P26_3m5v.txt - Notepad

File Edit Format View Help

Record,	DateTime,	Interval,	EpdClock Sec,	HpG uSv,	HpN uSv
000,	24/10/2012 20:06:11,	00:00:30,	65481241,	109,	1466
001,	24/10/2012 20:05:41,	00:00:30,	65481211,	108,	1465
002,	24/10/2012 20:05:11,	00:00:30,	65481181,	106,	1465
003,	24/10/2012 20:04:41,	00:00:30,	65481151,	104,	1434
004,	24/10/2012 20:04:11,	00:00:30,	65481121,	103,	1434
005,	24/10/2012 20:03:41,	00:00:30,	65481091,	101,	1424
006,	24/10/2012 20:03:11,	00:00:30,	65481061,	99,	1404
007,	24/10/2012 20:02:41,	00:00:30,	65481031,	97,	1384
008,	24/10/2012 20:02:11,	00:00:30,	6548100		
009,	24/10/2012 20:01:41,	00:00:30,	654809		
010,	24/10/2012 20:01:11,	00:00:30,	654809		
011,	24/10/2012 20:00:41,	00:00:30,	654809		
012,	24/10/2012 20:00:11,	00:00:30,	654808		
013,	24/10/2012 19:59:41,	00:00:30,	654808		
014,	24/10/2012 19:59:11,	00:00:30,	654808		
015,	24/10/2012 19:58:41,	00:00:30,	654807		
016,	24/10/2012 19:58:11,	00:00:30,	654807		
017,	24/10/2012 19:57:41,	00:00:30,	654807		
018,	24/10/2012 19:57:11,	00:00:30,	654807		
019,	24/10/2012 19:56:41,	00:00:30,	654806		
020,	24/10/2012 19:56:11,	00:00:30,	654806		
021,	24/10/2012 19:55:41,	00:00:30,	654806		
022,	24/10/2012 19:55:11,	00:00:30,	654805		
023,	24/10/2012 19:54:41,	00:00:30,	654805		
024,	24/10/2012 19:54:11,	00:00:30,	654805		
025,	24/10/2012 19:53:41,	00:00:30,	654804		
026,	24/10/2012 19:53:11,	00:00:30,	654804		
027,	24/10/2012 19:52:41,	00:00:30,	654804		
028,	24/10/2012 19:52:11,	00:00:30,	654804		
029,	24/10/2012 19:51:41,	00:00:30,	654803		
030,	24/10/2012 19:51:11,	00:00:30,	654803		
031,	24/10/2012 19:50:41,	00:00:30,	654803		
032,	24/10/2012 19:50:11,	00:00:30,	654802		
033,	24/10/2012 19:49:41,	00:00:30,	654802		
034,	24/10/2012 19:49:11,	00:00:30,	654802		
035,	24/10/2012 19:48:41,	00:00:30,	654801		

EasyEPD2 EPD-N2 ID: 07200154 Mk2.50 Software Version 5

File View SetUp Window Help

Dose and Alarms

Wearer
Name:
ID: FFFFFFFFFFFF

EPD
Issue
De-Issue
Off

Dose and Rates

	Dose	Total	Rate	Peak	Peak Rate Time
	HpG+HpN 2106.14	uSv	uSv/h	uSv/h	
HpG	360.31	360.31	1	200	13/11/2012 12:11:35
HpN	1745.83	1745.83	300	1100	13/11/2012 12:24:32

Clear
All
Counts
Peak Rates
Dose+Q'ty

Counts Since 13/11/2012 11:39:29

HG 45804 SG 10116 FN 138 AN 367

Dose Quality

Dose Alarm Thresholds

	uSv
HpG (1)	100000.00
HpG (2)	
HpN	100000.00
HpG+HpN	100000.00

Rate Alarm Thresholds

	Off uSv/h	On uSv/h
	9000000	10000000
	9000000	10000000
	40000000	50000000

Clear Total

Close

NPL National Physical Laboratory

Summary of Uncertainties

Table 2: Percentage standard uncertainties associated with the determination of the personal dose equivalent at the reference distance.

Uncertainty component	Irradiation				
	^{252}Cf 0° 0.3 mSv	^{252}Cf, 0° 3 mSv	^{252}Cf 0° 15 mSv	^{252}Cf(D_2O) 0° 3 mSv	^{252}Cf 45° 2 mSv
Type B (non-random)					
Reference irradiation distance*	± 0.53%	± 0.53%	± 0.53%	± 0.53%	± 0.53%
Source emission rate ($MnSO_4$ bath) (includes component for half-life)	± 0.60%	± 0.40%	± 0.40%	± 0.40%	± 0.40%
Source anisotropy correction	± 0.50%	± 0.50%	± 0.50%	± 0.0%	± 0.50%
Timing	± 0.26%	± 0.22%	± 0.04%	± 0.05%	± 0.33%
Scatter	± 1.0%	± 1.0%	± 1.0%	± 1.0%	± 1.0%
$H_p(10,\theta)$ conversion coefficient	± 1.0%	± 1.0%	± 1.0%	± 4.0%	± 1.0%
Total Standard Uncertainty Components added in quadrature	**± 1.7%**	**± 1.7%**	**± 1.6%**	**± 4.2%**	**± 1.7%**
Expanded uncertainty ⊛	**± 3.4%**	**± 3.4%**	**± 3.2%**	**± 8.4%**	**± 3.4%**

* The figures quoted for the uncertainty in the reference irradiation distance includes a sensitivity factor of 2, taking into account the inverse square dependence of the neutron fluence rate on the distance between the source centre to reference point.

⊛ Obtained by multiplying the total standard uncertainty by a coverage factor k=2. (This provides an uncertainty estimate at a confidence level of approximately 95%.)