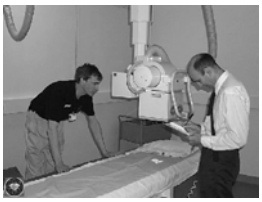
Organisation of acceptance and QA programme (example from X-ray Diagnostic Radiology)



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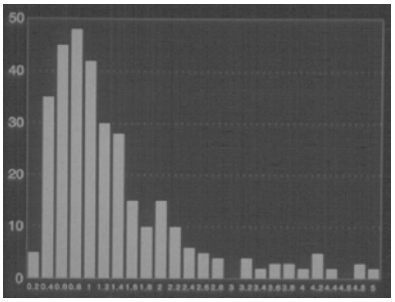
Quality Assurance is an essential part of the overall Radiation Protection activities in the Healthcare



Development of Quality Assurance measures

- Legislative basis
- Development of QA programme
- Training the staff
- Establishing of QA Group (Department)
- Development of Quality Control protocols
- Close collaboration with the Medical Staff
- Quality Management

EC Directive 97/43 EurAtom

on Radiation Protection of Patient :

…Member states shall insure that:

- appropriate quality assurance programmes including quality control measures and patient dose or administered activity assessment are implemented by the holder of the radiological installation

- Acceptance testing is carried out before the first use of the equipment for clinical purposes, and thereafter perfomance testing on a regular basis, and after any major maintenance procedure …

(introduced May 2000)

EC Directive 84/466 EurAtom : A qualified expert in radiophysics (QEr) to be available to sophisticated departments of radiotherapy, nuclear medicine, *diagn. radiology"*

EC Directive 96/29 EurAtom on Radiation Protection of Workers

EC Directive 97/43 EurAtom on Radiation Protection of Patient:

…each country to assure a **medical physics expert** to be involved in various procedures... to assure adequate training of medical physicists … introduced in May 2000

A number of Conferences and Seminars across Europe Preparations by EFOMP and all National Societies

QUALITY ASSURANCE IN DIAGNOSTIC RADIOLOGY (Regulations..)

- Quality Assurance (QA) programmes should be set up in X-ray departments to ensure the continual production of optimum quality images with the minimum necessary dose to the patient. These programmes should include checks and test measurements on all parts of the imaging system at appropriate time intervals not exceeding one year..
- A record of maintenance, including QA should be kept for each item of X-ray equipment..

(Guidance Notes for the Protection of persons against Ionising Radiation arising from Medical and Dental Use) UK

Development of a QA programme

- National requirements (Euratom > National Regulations)
- Agreement with the Healthcare Institutions (contracts)
- Necessary QC equipment (special funding)
- QC protocols for various types of equipment
- QA training of the staff
- Report keeping & filing system
- Time-schedule
- Quality meetings/reporting
- Equipment calibration procedure
- External Inspections

Development of QA protocol

- General aim
- Parameters to be measured
- QC Equipment necessary
- Calibration record
- Testing procedure
- Normal values
- Form of the QA protocol
- Protocol Updating procedure
- Address list (specialists/firms)

5.2 ASSESSMENT OF X-RAY TUBE TOTAL FILTRATION

5.2.1 Task
Short explanation of the task; Approx. time for performing the task

5.2.2 Competencies Addressed
Understand and measure the X-ray tube beam filtration

5.2.3 Equipment and Materials
List with necessary Equipment, Materials, Arrangements

5.2.4 Procedures and Measurements

5.2.4.2 For Assessment of X-ray Tube Output Total Filtration
Detailed description of a method to perform the task

Added Al (mm)	Set kV (~80)	Set mA	Set msec	Set mAs (~20-40)	Meas. exp (mGy)	Exp.decr. (%)
+0mm Al	80					100
+1mm Al	80					
+2mm Al	80					
+3mm Al	80					
+4mm Al	80					<50

5.2.5 Calculations

5.2.5.2 For Assessment of X-ray Tube Output Total Filtration
Detailed description of a method to calculate certain parameters

clusions

EMERALD

← QA protocol with Report sheet

- strictly followed
- system to update and renew QC
- any problems discussed/reported
- follow-up check
- filing:

BXCT03_115.xls

Automatic QA protocols with EXCEL

- Raw data page
- Calculative page (hidden)
- Result page
- Image quality and graphics pages
- Statistical page
- Summary and Recommendation page
- Additional protocols for AEC and other specific X-ray systems

X-RAY GENERATOR AND TUBE MEASUREMENTS

These measurements were made with a keithley kVp dividers/n 27775, digital storage oscilloscope Gould 450 s/n 14400056, and an MDH electrometer s/n 3011with 6 cc chamber.

							FDD(cm)=	100
Focus	Set kV (kV)	Set mA (mA)	Set Time (ms)	Set mAs (mAs)	Meas kV (kV)	Meas T (ms)	Meas exp (mR)	Air kerma (mGy)
B	60	200	100	20	62	101	59	0.51
B	80	200	100	20	83	105	98.5	0.86
B	100	200	100	20	104	103	151	1.31
B	120	200	100	20	123	103	224	1.95
F	50	100	200	20	50	202	46	0.40
F	70	100	200	20	73	205	101	0.88
F	90	100	200	20	88	202	167	1.45
F	110	100	200	20	111	204	221	1.92
B	80	200	100	20	82	105	104	0.90
B	80	200	100	20	83	105	106	0.92
B	80	200	100	20	83	105	105	0.91
B	80	25	100	2.5	83	107	18.4	0.16
B	80	300	100	30	84.7	105	198	1.72
B	80	500	100	50	90	103	305	2.65
B	80	200	20	4	83	19	20.5	0.18
B	80	200	400	80	83	411	440	3.82
B	80	200	800	160	83	780	814	7.07
			Half Value Layer Measurements are shown below					
B+0mm Al	80	200	100	20			114	0.99
B+0mm Al	80	200	100	20			110	0.96
B+1mm Al	80	200	100	20			83.5	0.73
B+2mm Al	80	200	100	20			67.1	0.58
B+3mm Al	80	200	100	20			50.9	0.44
B+4mm Al	80	200	100	20				#VALUE!

FDD(cm)=	100							
Meas exp (mR)	Air kerma (mGy)	Meas kV	Meas' kV^2	mGy/mAs mGy/mAs	mGy/mAs per kV^2	For lin' grad'	%age kV Accuracy	%age T Accuracy
59	0.51	62	3844	0.025636	6.67E-06	5.64E-06	3.333333	
98.5	0.86	83	6889	0.042798	6.21E-06	5.81E-06	3.75	
151	1.31	104	10816	0.06561	6.07E-06	7.35E-06	4	
224	1.95	123	15129	0.097328	6.43E-06		2.5	
46	0.40	50	2500	0.019987	7.99E-06		0	
101	0.88	73	5329	0.043885	8.24E-06	8.45E-06	4.285714	
167	1.45	88	7744	0.072562	9.37E-06	1.19E-05	-2.22222	
221	1.92	111	12321	0.096025	7.79E-06	5.13E-06	0.909091	
104	0.90	82	6724	0.045188	6.72E-06			
106	0.92	83	6889	0.046057	6.69E-06			
105	0.91	83	6889	0.045623	6.62E-06			
18.4	0.16	83	6889	0.063958	9.28E-06			7
198	1.72	84.7	7174.09	0.057354	7.99E-06			5
305	2.65	90	8100	0.053009	6.54E-06			3
20.5	0.18	83	6889	0.044536	6.46E-06			-5
440	3.82	83	6889	0.047795	6.94E-06			2.75
814	7.07	83	6889	0.04421	6.42E-06			-2.5
114	0.99	VL mm of Al	% trans					#VALUE!
110	0.96	1	100					
83.5	0.73	2	74.5535714					
67.1	0.58	3	59.9107143					
50.9	0.44	4	45.4462286					
	#VALUE!	5	#VALUE!					

Parameters		Expected		Measured		Assessmen
Radiography Mode						
Beam/LBD Alignement	displacement (cm)	<1		<1		Accept
Bucky centering	displacement (cm)	<1		<1		
Focus size (mm)	Broad Focus-(BF)	1		1X1		Accept
	Fine Focus-(FF)	0.6		0.6x0.6		Accept
O'put consistency (BF)	(%) inconsist.	<5		3.2		Normal
O'put var'n with mA (BF)	(%) variation	<10		9.49		Normal
O'put var'n with kV (BF)	Linearity (%)			4.2		Normal
Specific O'put-80kV(BF)	(uGy/mAs) @ 1m			42.74		Normal
Lin.Grad.with kV^2 (BF)	(mGy/mAs/kV^2)			6.27E-06	15	
O'put var'n with kV (FF)	Linearity (%)			8.4		Normal
Specific O'put-80kV(FF)	(uGy/mAs) @ 1m			57.47		Normal
Lin.Grad.with kV^2 (FF)	(mGy/mAs/kV^2)			8.48E-06	40	
kVp consistency (BF)	(%) inconsist.	<5		0.6		Good
kVp accuracy (BF)	(%) inaccuracy	-10<A<10		3.4		Good
kVp accuracy (FF)	(%) inaccuracy	-10<A<10		0.7		Good
	Stdev.			2.31		
kVp var'n with mA (BF)	(%) variation	<10		4.25		Good
Ripple at ~100 kV (BF)	+/- kVp ampl.			5		Accept
Timer consistency (BF)	(%) inconsist.	<5		0.00		Good
Timer accuracy (BF)	(%) inaccuracy	-10<A<10		-1.58		Good
	Stdev			3.96		
First Half Value Layer	(mm of Al eq')			2.7		Accept
Inferred Total Filtration	(mm of Al eq')	>2.5		2.6		Accept
Labelling						Accept
Stated filtration	(mm of Al eq')	2.5				
Stated Total Filtration	(mm of Al eq')					
Calcul. max. leakage	(mGy/h)@1m	<1				Accept

Dr Slavik Tabakov

Department of Medical Engineering and Physics

Radiological Protection and Quality Assurance Report

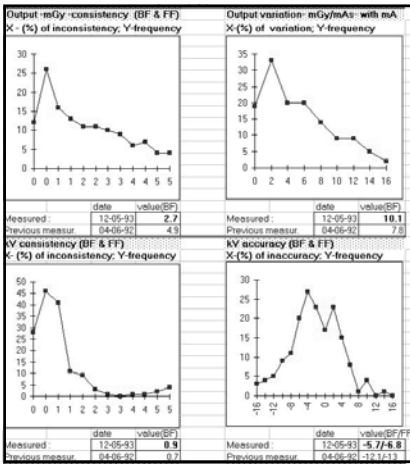
Hospital/Clinic:	Brook Hospital	**Unit type:**	Overcouch
Department:	X-ray	**Generator/Manuf.:**	Philips
		Type:	DR3T/500
Room/Unit:	3b	**X-Tube / Type:**	SRO 25 50
		Ser.No.	675449
Date of QA survey:	22/3/93	**Reference no.:**	BXDB3B.033

SUMMARY AND RECOMMENDATIONS

The X-ray generator and tube perform well.
However, the X-ray beam is about 1cm displaced from the light beam of LBD in longitudinal direction. We would advise you the bring this to the attention of the service engineer on his next routine visit.

Report compiled by:
Dr. S.D.Tabakov

Dr Slavik Tabakov



Normal values based on good statistical data

Automatic system for checking and statistical trend

Economic value of the QC results for the Hospital

Dr Slavik Tabakov

QC surveys - types and intervals

- Acceptance testing (~2d)
- Regular Quality Control
- Radiography (~1/y)
- Fluoroscopy (~2/y)
- Dental X-ray (~1/y or 1/3y)
- CT (~1/y and after some repairs and replacements)
- Other digital X-ray (~1/y)
- After new software install.
- Quality Control on demand
- Special tests/assessments

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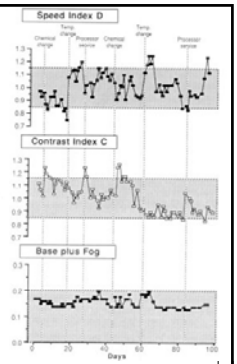
QC test performed by:

- Physicists (annually X-ray tube and Generator + Image Quality; new equip. Acceptance; on demand or after service)

- Radiographers (daily Film Processing; weekly output dose check; keep record)

- Service Engineers (normally full system check with regular maintenance)



A rough idea for the workload:

Normally 1-2 items (routine X-ray tube or II) per person/day;

A group of 3 physicists would serve a region with ~300 items/year

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QC survey general schedule

- Booking a time in the Hospital
- Travelling to the Hospital
- Check the X-ray room and equipment for major problems
- Lay out of the QA equipment
- Doing the measurements according to the QA protocol
- Making X-ray pictures
- Writing down all results
- Collecting the QA equipment
- Travelling back to the base
- Calculating the parameters
- Comparing the results with the normal&previous values
- Discussing the recommendations with the QA Officer
- Writing the QA report
- Sending the report to Hospital
- In case with QA problem, check with Hospital/Eng. its solving
- Keeping a copy in the equipment file (in the Med.Phys. base)

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How is QC appreciated (most usual pattern) by:

- The public - assuring the safety of the examination;
- Hospital administration - activity required by the law;
- Radiologists - necessary (assures the level of image quality);
- Radiographers - important for their routine work;
- Service engineers - not interested (have their own tests);
- Medical Physicists - essential for the job, but boring…;
- Scientists - not suitable for research;
- Students - enjoyed as the practical part of their learning
- Professional Organisations - very important

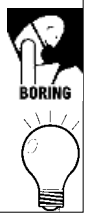

Image Quality / Patient Dose

is the main contradiction in Diagnostic Radiology

due to this reason finding the proper balance between them is the major goal of QC

To ensure:

continuing production of diagnostic images with optimum quality,

using minimum necessary dose to the patient