COMMISSIONING AND CONSTANCY TESTS FOR DIGITAL ANGIOGRAPHIC UNITS

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Introduction

- The literature review reveals that practically no quality control protocol exists for flat panel detector (FD) dynamic X-ray systems which should be performed either after installation or during the use of such an equipment.
- The European Concerted Action SENTINEL «Safety and Efficacy for New Techniques and Imaging using New Equipment to Support European Legislation (FD6 – 012909) », recognizing this need, has included the creation of such protocol in one of its work packages

(**WP3: Efficacy and Safety in Cardiology**)

OBJECTIVE

- The main objective of **WP 3.1.2: Proposal for Standardisation of a Performance Assessment Protocol for New Detectors** was to create one QC protocol for commissioning and one for constancy testing of FD X-ray systems.

Materials and Methods

- ✓ Two draft protocols were written based on:

1. *IPEM Report No. 77, 1997.*
2. *IPEMB Report No 32, 1995.*
3. *IEC Report 60601, Part 2-43, 2000.*

and practical experience.

- ✓ The protocols were sent to all partners participating in WP 3.1.2.
- ✓ Various comments were received and discussed.
- ✓ The final protocols for the performance assessment of new detectors were completed by October 2006.
- ✓ The commissioning protocol was tested by SENTINEL partners who expressed an interest in checking their digital systems using this protocol.

Main parts of commissioning protocol (I)

1. General Information
2. Visual inspection
3. Tube kilovoltage (kVp)
4. Beam quality – Half Value Layer measurement
5. X-ray tube leakage test
6. Patient Entrance Air-Kerma Rate in fluoroscopy
7. Maximum Patient Entrance Air-Kerma Rate in fluoroscopy
8. Patient Entrance Air-Kerma per image
9. Detector Entrance Air-Kerma Rate in fluoroscopy
10. Detector Entrance Air-Kerma in image acquisition

Main parts of commissioning protocol (II)

11. High and Low contrast spatial resolution test
12. Limiting contrast test
13. Display monitor set up
14. Distortion
15. Radiation Field size
16. Fluoroscopic X-ray field limitation
17. Verification of isokerma maps
18. Performance assessment of protective devices
19. KAP and cumulative dose (CD) meters calibration at IRP

Main parts of constancy protocol

1. Patient Entrance Air-Kerma Rate in fluoroscopy
2. Patient Entrance Air-Kerma per image
3. Detector Entrance Air-Kerma Rate in fluoroscopy
4. Detector Entrance Air-Kerma in image acquisition
5. High and Low contrast spatial resolution test

Patient Entrance Air-Kerma Rate in fluoroscopy (I)

➢ **Test details(1):**

- ✓ Place the ionization chamber or the solid state detector on patient table.
- ✓ Place 16, 20 and 24 cm PMMA or water phantom on top of chamber to simulate for thin, normal and thick patient and the imaging detector (flat panel) at 5 cm from the phantom surface.
- ✓ The chamber should be placed at the Interventional Reference Point (IRP) i.e. 15 cm from the isocenter towards the X-ray tube focus.

Patient Entrance Air-Kerma Rate in fluoroscopy (I)

➢ **Test details (2):**

- ✓ Record the focus to detector (SDD) and focus to chamber (SCD) distances.
- ✓ Take dose rate measurements for most frequently (or all) used fluoroscopic modes and (or) pulse rate modes and field sizes.
- ✓ Record the relevant exposure parameters.
- ✓ The results have to be expressed in terms of entrance air kerma rate (including backscatter).

Patient Entrance Air-Kerma Rate in fluoroscopy (II)

➢ **Notes:**

1. Describe – if any - practical problems with diode detectors and ion chambers with metallic parts that can interfere with AEC.
2. Different diode detectors made by different manufacturers give significantly different readings at same or very similar conditions.

Example Table

Fluoroscopic mode	Pulse rate (p/s)	Field size (cm)	kV	mA	Patient entrance air kerma rate (mGy/min)
Normal	25	15			
High	25	15			

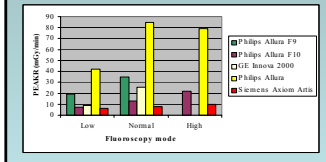
SENTINEL PARTNERS that tested the commissioning protocol

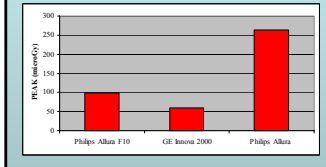
- ❑ Greece : 3 systems
- ❑ Spain: 1 system
- ❑ Luxembourg: 1 system

List of X-ray systems

- Philips Allura (3)
- Siemens Axiom Artis (1)
- GE Innova 2000 (1)

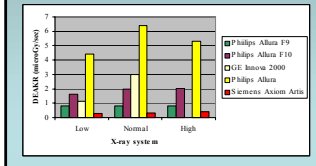
Results (1)

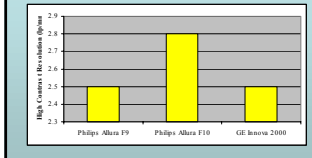




- ✓ **The values in the figures are for the 25 cm FOV**
- ✓ **PEAKR = Patient Entrance Air Kerma Rate**
- ✓ **PEAK = Patient Entrance Air Kerma per image**
- ✓ **Large range of doses values are shown**

Results (2)





- ✓ **The values in the figures are for the 25 cm FOV**
- ✓ **DEAKR = Detector Entrance Air Kerma Rate**
- ✓ **Large range of doses values are shown**
- ✓ **Similar image quality is presented for a large range of doses**

Conclusions

- ❖ Draft protocols of commissioning and constancy tests for dynamic FD X-ray angiography units are prepared as part of the SENTINEL project.
- ❖ The commissioning protocol was tried by SENTINEL partners and preliminary results show large range of doses even for the same manufacturer with no significant change in image quality.
- ❖ However, this was a preliminary study and more systematic and detailed investigation is needed in the future.