DEPARTMENT OF THE NAVY
NAVY ENVIRONMENTAL HEALTH CENTER
620 JOHN PAUL JONES CIRCLE SUITE 1100
PORTSMOUTH VA 23708-2103

NEHC TM 6470.03-1; CH-1
Ser 111336
06 AUG 2004

NAVENVIRHLTHCEN TECHNICAL MANUAL 6470.03-1 CHANGE TRANSMITTAL 1

From: Commanding Officer, Navy Environmental Health Center

Subj: NAVY RADIOLOGICAL SYSTEMS PERFORMANCE EVALUATION MANUAL

Encl: (1) Cover page
(2) Table of Contents
(3) Chapter 20: Policy for the Use, Care, Evaluation and Disposal of Lead Aprons
(4) Policy for Maintaining Qualifications and/or Re-Qualification of Radiological Systems Surveyors

1. Purpose. To add the guidance for the use, care, evaluation, and disposal of lead aprons used for the shielding of radiation to personnel from diagnostic radiology procedures, and to add the policy and procedures for surveyors of radiological systems to maintain their qualifications and to re-qualify as a radiological systems surveyor.

2. Action. Replace existing cover page and table of contents in the technical manual with enclosures (1) and (2) of this change transmittal, respectively. In addition, insert enclosure (3) after Chapter 19 and add enclosure (4) to the end of Appendix A of the technical manual.

3. Retain. For record purposes, keep this change transmittal in front of the basic technical manual.

D. A. HILAND

Distribution:
AIGs:
352
7764
7783
11251

Copy to:
BUMED (M3F71)
Medical Physics Advisory Board (MPAB)

Navy Environmental Health Center
Technical Manual NEHC – TM 6470.03-1; CH-1 (Aug 2004)

Navy Radiological Systems Performance Evaluation Manual

Version: August 2004

Navy Environmental Health Center

BUREAU OF MEDICINE AND SURGERY

Navy Radiological Systems Performance Evaluation Manual

Prepared by

Navy Environmental Health Center
620 John Paul Jones Circle Suite 1100
Portsmouth VA 23708-2103

August 2004

Reviewed and approved by

CAPT D. A. HILAND MC, USN

Navy Radiological Systems Performance Evaluation Manual

Table of Contents

Chapter	Title	Pages
	Record of Page Changes	i
	Table of Contents	ii to iv
1	Navy Radiological Systems Performance Evaluation Manual – Introduction	1-1 to 1-3
2	General Radiographic Units - Fixed and Portable Table 2.1 General Radiographic Unit Survey Requirements	2-1 2-2 to 2-4
3	Dental Radiographic Units - Intraoral and Panoramic Table 3.1 Dental Intraoral Unit Survey Requirements Table 3.2 Dental Panoramic Unit Survey Requirements	3-1 3-2 3-2
4	General Fluoroscopic Units Table 4.1 General Fluoroscopic Unit Survey Requirements	4-1 4-2 to 4-4
5	Digital Subtraction Angiography (DSA) Units Table 5.1 Digital Subtraction Angiography Unit Survey Requirements	5-1 5-2
6	Linear Tomographic Units Table 6.1 Linear Tomographic Unit Survey Requirements	6-1 6-2
7	Computerized Tomographic (CT) Units Table 7.1 Computerized Tomography Requirements	7-1 7-2 to 7-4
8	Mammographic Units	8-1
9	Ultrasound Scanners Table 9.1 Ultrasound Scanner Survey Requirements	9-1 9-2
10	Magnetic Resonance Imaging (MRI) Units Table 10.1 Magnetic Resonance Imaging Survey Requirements	10-1 10-2
11	Nuclear Medicine Imaging Quality Control *(Reserved for Future Addition)*	11-1
12	Linear Accelerators	12-1
13	Film Processor and Darkroom Quality Control Table 13.1 Processor and Darkroom Quality Control	13-1 13-3 to 13-4
14	Repeat Rate Analysis	14-1
15	Entrance Skin Exposure	15-1
16	Radiation Shielding of Medical Diagnostic X-Ray Facilities	16-1
17	Computed Radiography Systems Table 17.1 CR Systems Survey Requirements	17-1 17-2

18	Mini C-arm Units Table 18.1 Mini C-arm Unit Survey Requirement	18-1 18-2
19	PACS Monitor Testing Table 19.1 Monitor PACS QC Requirements	19-1 19-2
20	Guidance for the Use, Care, Evaluation and Disposal of Lead Aprons	20-1
Appendix	**Title**	**Pages**
A	X-Ray Surveyor Qualification Levels Qualification Card Policy for Maintaining Qualifications and/or Re-Qualification of Radiological Systems Surveyors	A-1 A-2 to A-3 A-4
B	Performance Tests for General Radiographic Units Table B-1 Minimum Half Value Layer Requirements (HVL) Figure B-1 Half Value Layer Plot General Radiographic Equipment Data Forms	B-1 to B-9 B-10 B-11 B-12 to B-20
C	Performance Tests for Dental Units General Dental Radiographic Equipment Data Forms	C-1 to C-4 C-5 to C-10
D	Performance Tests for Fluoroscopic Equipment Figure D-1 Setup for Fluoroscopic Entrance Exposure Rate Measurement Figure D-2 Entrance Exposure Rate Equipment Setups for Various Fluoroscopic Systems Table D-1 Entrance Exposure Rate (ERR) Measurements 21 CFR Maximum Allowed ERR Table D-2 Entrance Exposure Rate (ERR) Measurements 21 CFR ERR Locations Table D-3 Entrance Exposure Rate (ERR) Measurements Representative ERR Values for Various Equipment Table D-4 High Contrast Resolution Measurements General Fluoroscopic Equipment Data Forms	D-1 to D-10 D-11 D-12 D-13 D-14 D-15 D-16 D-17 to D-23
E	Performance Tests for Linear Tomographic Units Figure E-1 Tomographic angle (test film image) Figure E-2 Determining the tomographic exposure angle Tomographic Equipment Data Forms	E-1 to E-5 E-6 E-7 E-8 to E-10
F	Performance Tests for Computerized Tomographic Units	F-1 to F-9
G	Film Processor and Darkroom Quality Control Table G-1 Evaluation of Film Sensitivity Test	G-1 to G-5 G-6
H	Repeat Rate Analysis Table H-1 Technically Unsatisfactory (TU) Film Categories Table H-2 Example	H-1 to H-2 H-3 H-4
I	Entrance Skin Exposure Entrance Skin Exposure Data Sheet	I-1 to I-3 I-4

J	Radiation Shielding Design and Evaluation for Medical and Dental X-Ray Facilities	J-1 to J-5
	Table J-1 Suggested Occupancy Factors for Non-Occupationally Exposed Persons	J-6
	Table J-2 Occupancy Factors for Occupationally Exposed Persons	J-7
	Table J-3 Unshielded Primary Doses	J-8
	Table J-4 Equivalent Thicknesses	J-9
	Table J-5 Unshielded Secondary Doses	J-9
	Figure J-1 Broad Beam Primary Transmission Through Lead	J-10
	Figure J-2 Broad Beam Primary Transmission Through Concrete	J-11
	Figure J-3 Broad Beam Primary Transmission Through Steel	J-12
	Figure J-4 Broad Beam Primary Transmission Through Plate Glass	J-13
	Figure J-5 Broad Beam Primary Transmission Through Gypsum	J-14
	Figure J-6 Transmission of Secondary Radiation Dose Through Lead	J-15
	Figure J-6 Transmission of Secondary Radiation Dose Through Concrete	J-16
	Figure J-6 Transmission of Secondary Radiation Dose Through Gypsum	J-17
	Figure J-6 Transmission of Secondary Radiation Dose Through Steel	J-18
	Figure J-6 Transmission of Secondary Radiation Dose Through Plate Glass	J-19
	Figure J-6 Transmission of Secondary Radiation Dose Through Wood	J-20
	Radiation Shielding of Diagnostic X-Ray Facilities Data Form	J-21 to J-24
K	Performance Tests for Computed Radiography Systems	K-1 to K-3
	Computed Radiography Equipment Data Forms	K-4 to K-10
L	Performance Tests for Magnetic Resonance Imaging Units	L-1 to L-8
	Magnetic Resonance Imaging Equipment Data Forms	L-9 to L-18
M	Performance Tests for Mini C-arm Units	M-1
N	Performance Tests for Monitors in PACS	N-1
O-W	Reserved for future use	Blank
X	Performance Testing Instruments and Accessories	J1
Y	References and Recommended Reading	K1 to K-2
Z	Glossary	Z-1 to Z-10

Chapter 20

Guidance for the Use, Care, Evaluation and Disposal of Lead Aprons

Ref: (a) Implementation of an X-ray Radiation Protective Equipment Inspection Program, Operational Radiation Safety; 82(2): S51-S53, 2002.
(b) Inspection of Lead Aprons: Criteria for Rejection, Operational Radiation Safety; 80(5): S67-S69, 2001.

Background:

The Environment of Care standards set forth by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) require performance inspections on medical equipment. Lead aprons are considered medical equipment. In addition, all state radiation control programs require evaluations of lead aprons. In recent years, references (a) and (b) have addressed the topic of the proper care, evaluation and disposal of lead aprons.

Guidance:

The Bureau of Medicine and Surgery (BUMED) guidance for the use, care, evaluation and disposal of lead aprons (including thyroid and gonadal shields) utilized in medical facilities is as follows:

a. **Use of Lead Aprons**: Based on National Council on Radiation Protection and Measurements (NCRP) recommendations, lead aprons of a minimum of 0.5 mm lead-equivalency should be used for fluoroscopic applications and for shielding direct gonadal exposures. Lead aprons of a minimum of 0.25 mm lead-equivalency shall be sufficient for all other radiographic applications.

b. **Care of Lead Aprons**: Properly cared for lead aprons have a life expectancy of approximately 10 years. They should be properly hung on hooks/racks when not in use. They should never be folded, creased or draped across another piece of equipment. They should be kept clean of dirt, grease and other contaminants.

c. **Evaluation of Lead Aprons**: Pursuant to references (a) and (b), lead aprons shall be evaluated at least annually. This evaluation shall consist of a visual inspection, with x-ray evaluation of suspicious areas. The visual inspection will consist of looking for obvious tears. The x-ray evaluation may be done with either fluoroscopy or standard x-rays (depending on availability). The x-ray images are not required to be retained. In lieu of keeping the x-ray images, a tracking system must be utilized. The tracking system must document the dates of testing, aprons tested and the specific results. It is expected that an inspector will be able to verify that x-ray evaluations have been done by either looking at the aprons and/or the aprons and the documentation system. In addition, lead aprons shall be rejected and replaced if the sum of the areas of the defects exceeds a 1 ⅛-inch diameter hole size. If the defect(s) occur in an area that would cover the reproductive organs, and the area exceeds a

3/16-inch diameter hole size, the apron shall be replaced. If the defect(s) occurs on a thyroid shield, and the area exceeds a 5/16-inch diameter hole size, the lead thyroid shield shall be replaced.

d. **Disposal of Lead Aprons**: Lead aprons contain hazardous materials, and it is illegal to dispose of lead aprons in a landfill. For the disposal of lead aprons that remain in a condition to warrant their re-use, it is recommend that commands contact their nearest Defense Reutilization & Marketing Office (DRMO) through their host or activity Environmental Department. For lead aprons damaged beyond their safe use as defined in the paragraphs above, it is recommended that commands process the aprons for disposal through either their hazardous materials (HAZMAT) office or through Navy Public Works Center (PWC). Alternately, some manufacturers of lead aprons may take them back for recycling or disposal.

Policy for Maintaining Qualifications and/or Re-Qualification of Radiological Systems Surveyors

Background:

It should be noted that qualifications for individuals initially qualified as Level I, Level II, Level IIM, Level III or Level IIIM radiological systems surveyors are valid for a period of only 5 years, and that their qualifications will be required to be renewed at that time. Each surveyor will be required to initiate the renewal of his/her own qualifications. Note that a current listing of qualified surveyors can be found at: http://radhealth.usuhs.mil/responsibilities.xls

Policy:

Regarding the issue of surveyor re-qualification, the Medical Physics Advisory Board (MPAB) has determined that individuals shall be required to submit to NEHC, a list of the radiographic units surveyed in the past 5 years after initial qualification (starting with the most current units surveyed) utilizing the forms in this Appendix for experience and continuing education. Each individual should maintain additional documentation, such as copies of survey reports, CME certificates, etc. with their personal records. These additional records need not be forward to NEHC.

a. **General Radiological Surveyors**:

To re-qualify, each surveyor should have surveyed in the 5 years since the previous qualification, at least:

(1) One general radiographic unit and one fluoroscopic unit to re-qualify as Level I; and
(2) One CT scanner to re-qualify as Level II; and
(3) One acceptance test for either a CT, MR, Angiography, Cardiac Cath, or Nuclear Medicine Camera, to re-qualify as Level III.

In addition, each individual should also submit a listing of his or her most recent CMEs (last 5 years) using the forms in this Appendix.

For individuals that have not performed surveys in quite some time, recommend the following options:

(1) Try going to a site and performing surveys in each category in which qualifications are being requested; or
(2) Decline re-qualification at this time, and re-qualify at a later date with a more specific number of surveys.

b. **Mammography Surveyors**:

Individuals qualified as surveyors of mammography systems must meet the experience and training requirements of the American College of Radiology (ACR) for initial and re-qualifications. The MPAB has determined that NEHC will not be required to maintain individual's qualifications for mammography, and that each surveyor will be required to maintain his/her own qualifications in accordance with ACR and applicable State certification requirements. NEHC will issue qualification certificates only at the surveyor's request.

c. **Additional Comments**:

Those surveyors certified by the American Board of Radiology (ABR) in Diagnostic Radiologic Physics are by virtue of certification, Level III qualified. However, these individuals must comply with the requirements for re-qualification.

The MPAB will have final approval authority for surveyor initial qualifications and re-qualifications, especially in cases where qualification documentation may be questionable or incomplete.