GUIDANCE NOTES FOR THE INSTALLATION OF ELECTRICAL SUPPLY FOR NHSBSP MAMMOGRAPHY TRAILERS

NHSBSP Equipment Report 0503
December 2005

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1. INTRODUCTION

1.1 Purpose of this document

This document has been produced to be a helpful guide to radiography managers and any other NHS staff requiring setting up the location and provision for a mammography trailer site.

The information in this document intends to provide adequate advice to be able to set up the electrical and mechanical provisions required for the mammography trailer site.

1.2 Electrical safety issues in mammography

Over the last few years the NHSBSP has produced advice and guidance for purchasing, using and testing of mammography x-ray equipment. More recently the requirements of *TRS 89 (Technical Requirements for the Supply and Installation of Equipment for Diagnostic Imaging and Radiotherapy 1989)* have been updated by the MHRA in the *Medical Electrical Installation Guidance Notes (MEIGaN) (Version 1 June 2005)* document for electrical provision and guidance for testing new and relocated general x-ray and mammography x-ray equipment.

This report supplements previous more general guidance contained in *Guidance on the Electrical and Safety Testing of Mammographic X-ray Equipment (*NHSBSP report 03/01 March 2004)**.** It specifically addresses the issue of current guidance for trailers.

2. PRE-INSTALLATION REQUIREMENTS

Any vehicle into which a medical device is permanently wired and installed, or a container which can be transported between sites, is classified as a diagnostic or treatment room in the *MEIGaN* guidance and is subject to the same requirements as a static room plus the additional points in section 2.2. The x-ray equipment itself is the most important part of the total installation, but the pre-installation requirements for the area that the equipment will be installed are also very important. A room which has not had any x-ray equipment installed into it before has certain requirements, the provisions of these requirements must be considered.

Some or all of the following provisions may be required:

- an adequate power supply for the equipment electrical demand and loading
- an adequate supply cable size and type for the equipment electrical demand and loading
- an adequate line resistance must be achieved for the x-ray equipment design specification
- the electrical system must be designed for a TN-S system: some trailers will also have an on-board generator as part of the design
- trailers with both an on-board generator or external generator and connection to the electrical mains supply must be isolated so that only one system can operate at a time
- a main x-ray equipment isolator is required and must be located in the control area if there is no remote isolator provided as part of the design
- if a contactor and remote on/off switch is provided this must be located in the x-ray equipment control area.
- an Earth Reference Bar (ERB) must be located in the control area or by the main isolator if installed out side the control area. All earth connections and equipotential bonding must be connected to this point
- all electrical trunking and conduits must be of adequate size to carry the amount of wiring provided, and continuous to take the wiring from one location to another.
- door radiation warning lights must be provided as required by the local Radiation Protection Adviser (RPA) for the room layout and design
- adequate 230 volt 13 amp power supplies must be provided for all film handling equipment, servicing engineers and the other normal requirements of an x-ray room
- final ring circuit plus 13 amp fused connection units and room lighting must be on the same phase as the x-ray equipment.

It is important to arrange that the equipment electrical supply is the same phase as the lighting and 13 amp final ring circuit, to avoid a potential of 415V between the x-ray equipment and other electrical equipment in the room. Checking the electrical provision and x-ray equipment is the responsibility of the equipment supplier or independent equipment inspection tester. The Trust/owner of the x-ray room and equipment has a

responsibility under the Health and Safety at Work Act to satisfy them selves that the equipment is safe for use, for both the operator and patient. If the equipment supplier cannot provide an adequate report with full test results for the equipment and room electrical supplies, it may be necessary to employ an independent inspection tester for the equipment and room facilities.

3. DESIGNING THE ELECTRICAL CONNECTION BOX

The following guidance and design advice is for connection boxes for mammography trailers:

- the location of the electrical connection box for the mammography trailer should be positioned, as close as possible to the parked position of the trailer when in use
- the location and height of the connection box should be sited in a position readily accessible to the operator
- the electrical supply cable that runs from the building that is to provide the electrical supply, must try to take the shortest route between the building and the trailer to help keep the cable length as short as possible; the length of the cable run will affect the final size of the cable to be installed
- the design of the connection box should allow for an isolator that is adequate to switch single or three phase power depending on the electrical supply
- the isolator and other fittings in the connection box must be designed to Index of Protection (IP) code IP44 (splash proof) or higher
- a Residual Current Device (RCD) with test and reset buttons is required
- an industrial/commando type socket outlet (BS EN 60309-2) to match the trailer interconnection cable and plug must be provided
- an Earth Reference Bar for connecting all earth wires must be installed in an open position adequate for connecting an earth bonding meter
- should the connection box be required to provide a water supply for the trailer, a barrier must be installed to prevent water transferring into the electrical part of the box
- the water supply pipe must be protected against frost, have a non return valve fitted and have a control valve to open and close the water supply in the connection box
- the provision of an access hole for the trailer interconnection cable is required in the connection box
- the access hole(normally located on the under side of the connection box) must be large enough to pass the industrial/commando connection plug through; a lockable hinged plate with cable cut out is required.
- a further access hole will also be required if a water supply hose is installed for connection to the trailer; a lockable hinged plate with hose pipe cut out is also recommended
- the front of the connection box should be able to fully open for operator access, and the door must be able to be securely locked to prevent tampering and for security purposes
- the construction of the connection box should be made of a hard wearing material such as metal for durability, be able to withstand poor weather conditions and protection against vandalism.
- the connection box and the electrical items inside will all require adequate labelling to identify function and warning of maximum voltage present.

4. ELECTRICAL PROVISION FOR MAMMOGRAPHY TRAILERS

4.1 Additional requirements for mammography trailers

Mammography x-ray equipment located on a trailer has all the same requirements as when located in a static site. The following additional issues need to be considered with electrical provision for trailers:

- the cross sectional area of the supply cable must be calculated, taking into account the mains impedance at the connection point on the distribution board and the length of cable needed to connect to the trailer connection box
- the trailer connection box should be to IP44 code (splash proof) and provided with a minimum rating of 63 amp MCB with test and re-set buttons, plus an isolator
- a 63 amp industrial/commando (BS EN 60309-2) socket outlet, (number of pins as required to match the trailer link cable) will be required, to provide for connecting to the electrical supply link cable and plug to the trailer
- the electrical supply link cable between the connection box and the trailer must be of the cross sectional area and length specified by the equipment supplier, to prevent excessive voltage drop due to high mains impedance
- the link cable requirement for a single phase unit will be a three core cable; a three phase unit will need a five core cable
- the electricity supplier may require a power consumption meter to be provided, in which case it should be installed in the trailer connection box
- the electrical supply cable should be connected to a distribution board (DB) inside the trailer; the DB should be located in a lockable cupboard, accessible to the operator
- the DB provides electrical supplies to all of the electrical services in the trailer, and should be provided with MCBs for each of the following circuits;

    - the x-ray equipment.
    - lighting and 13amp final ring circuit.
    - heating and air conditioning.
    - security lighting and alarm system
- the power supply should be available to the trailer constantly 24 hours a day and 7 days a week, to help provide a consistent environment (heating/cooling) for the x-ray equipment and imaging facilities
- in the mammography trailer x-ray room, a main equipment isolator must be located in the x-ray equipment control area, with an Earth Reference Bar (ERB) located in a separate box alongside the isolator
- if the mammography trailer has a three phase electrical supply, it is important to ensure that all single phase devices in the x-ray room are supplied from the same phase, that is, the x-ray equipment, lighting and 13 amp final ring circuit must be compatible.

4.2 Example of a common supply cable provision

The electrical supply requirements for each type of x-ray set should be clearly specified in the manufacturer's product data, or in the service documentation. The specific requirements for supply voltage and the maximum line impedance for current models should be determined before commissioning any installation. The BS/IEC standard for the electrical requirements for high voltage generators of diagnostic X-ray generators (BS EN 60601-2-7:1998) states minimum reference values for mains impedance. The impedance of a mains supply is considered sufficiently low for operation of a high voltage generator if this reference value is not exceeded.

	Minimum reference value
Distance from electrical supply to connection box	50 metres
X-ray equipment maximum permissible mains impedance at 230 volts	0.4 ohms

An armoured cable of 25mm csa should be an adequate size for the above requirements.

DEFINITIONS

BS EN 60309-2	Industrial or commando type plug and socket outlet
csa	Cross sectional area (size of cable)
DB	Electrical distribution board containing circuit fuses
ERB	Earth Reference Bar
Final ring circuit	230 volt 13amp socket outlets
Fused connection units	230 volt 13amp spur outlets for fixed equipment
Index of Protection (IP) code	Providing a degree of protection e.g. IP44 provides splash proof protection
MCB	Miniature circuit breaker (fuse)
Residual Current Device (RCD)	An isolator designed to operate automatically in high earth leakage current conditions
Single phase power	Single phase neutral and earth at 230 volts
Three phase power	Three phases' neutral and earth at 415 volts
TN-S system	Separate neutral and earth throughout the system
X-ray equipment control area	The location in the x-ray room behind the radiation protection screen
X-ray room	The room in the mammography trailer in which the x-ray equipment is installed

OTHER SOURCES OF GUIDANCE

Technical Requirements for the Supply and Installation of Equipment for Diagnostic Imaging and Radiotherapy (TRS 98) Department of Health 1989).

Medical Electrical Installation Guidance Notes (MEIGaN). MHRA, Version 1.0 June 2005.

Guidance Notes for Health Authorities and NHS Trusts on Requirements for Breast Screening Mobile Trailers and Drawing Vehicles. Medical Devices Directorate, March 1994 (Evaluation Report MDD/93/33).

Addendum to MDD/93/33 Guidance Notes for Health Authorities and NHS Trusts on Requirements for Breast Screening Mobile Trailers and Drawing Vehicles. NHS Breast Screening Programme, September 2001 (NHSBSP Occasional Report 01/08).

Guidance Notes for NHS Trusts on Requirements for Mobile Trailers for Breast Screening., MHRA, June 2003 (MHRA Evaluation Report 03043).

Guidance on the Electrical and Mechanical Safety Testing of Mammographic X-ray Equipment. NHS Cancer Screening Programmes, March 2003 (NHSBSP Occasional Report 03/01).

Transit Fixing of Fuji Loaders and Unloaders on Mammography Trailers. NHS Cancer Screening Programmes, October 2003 (NHSBSP Equipment Report 0301).