



Another EMC resource
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Medical Banana Skins

Helping you solve your EMC problems

Some of the many stories of Medical EMI

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I have been collecting stories about EMI for a long time, publishing many of them in the 'Banana Skins' column of The EMC Journal, www.theemcjournal.com. Some come from official reports, some from anonymous whistleblowers, some are amusing, and some concern deaths and injuries. At the present time I have published 855 of them, all indexed by application and by type of EMI, all downloadable from www.emcstandards.co.uk where I will soon start posting some more. I recently collected together all the stories of medical EMI, and got 41 pages' worth – here are a few of them, with their original numbering preserved.

3) RF interference in ambulance causes death

Medical technicians taking a heart-attack victim to the hospital in 1992 attached her to a monitor/defibrillator. Unfortunately, the heart machine shut down every time the technicians turned on their radio transmitter to ask for advice, and as a result the woman died. Analysis showed that the monitor unit had been exposed to exceptionally high fields because the ambulance roof had been changed from metal to fibreglass and fitted with a long-range radio antenna. The reduced shielding from the vehicle combined with the strong radiated signal proved to be too much for the equipment.

(An article in the Wall Street Journal reported in Compliance Engineering Magazine's European edition September/October 1994, www.ce-mag.com.)

16) More medical incidents:

The magnetic field caused by ground currents in a water pipe system made it impossible to use sensitive electronic instruments in part of a hospital.

A patient-coupled infusion pump was damaged by an electrostatic discharge, but thankfully the alarm system was not affected and a nurse was alerted.

An operation using a plastic welding machine caused interference with a patient monitoring and control system, causing failure to detect that the circulation had stopped in a patient's arm, which later had to be amputated.

(Taken from Compliance Engineering European Edition March/April 1998, www.ce-mag.com)

20) Licensed TV transmissions interfere with intensive care, kills babies

While taking classes in the early 80's, my professor got involved with a terrible incident down in New Jersey. Seems a hospital had a high incidence of infant deaths in the intensive care section of the maternity ward. Late at night, the alarms on the babies' monitors would go off for no apparent reason. Annoyed, the nurses would turn them off and do the rounds on foot.

After some preliminary investigations, my Prof found out that a nearby TV transmitter was allowed by their FCC license to increase their output wattage by some enormous amount after say midnight but had to reduce it prior to 6am, or some such arrangement. The cable interconnecting the nurse's station to the various baby monitors sang like a lark with these frequencies and set off alarms with the induced voltages.

Not sure now of all the specifics except what I have related above, nor the name of the hospital, but they lost something like 6 kids before fixing it.

(From Doug Mckean, via emc-pstc@ieee.org, 29th July 1998)

38) Cell phones can interfere with pacemakers

The Therapeutic Goods Administration of Australia (TGA) continues to review findings of clinical and laboratory research indicating a potential for temporary interaction or interference between mobile phones and the operation of pacemakers and implantable defibrillators. The findings have indicated that interference may be caused by holding the phone within about 150mm of the implanted device, or in direct contact between the phone antenna and the user's skin. Interference can occur with the phone in standby mode, as well as in use.

Some phones incorporate magnets, at least in their loudspeakers, and while held close to the implanted device these can cause them to go into their “magnet” mode, which for a pacemaker is a fixed pace.

Based on the most recent testing, simply moving the phone away from the implanted devices will return it to its correct state of operation. Recommendations for users of implanted pacemakers or defibrillators include: not keeping the phone in a pocket over the site of an implant; using the ear that is furthest away from the site of the implant when using the phone; and not allowing the phone antenna to touch any part of the body.

(From Compliance Engineering’s European edition Jan/Feb 1998, www.ce-mag.com)

55) New kidney dialysis machines very susceptible to power quality issues

Power quality is especially critical in hospitals, where life-sustaining processes demand clean reliable electrical supplies. This was recently highlighted at Glan Clwyd Hospital in North Wales where a problem became apparent on the renal dialysis unit during the testing of emergency generators. The switch from mains power to generator power was causing the newer, computer-controlled dialysis machines to close down and generate an alarm. This caused distress to patients and problems for staff who needed to reset several machines quickly before their blood began to coagulate.

Resets were generally successful, though occasionally a unit would not respond so a patient would need to be moved onto a spare machine. The problem was solved with uninterruptible power supplies to provide continuity of operation at the hospital during generator testing. Ten 2.5kVA UPSs are now used in the dialysis unit and one on a treadmill in the cardiovascular unit to safeguard patients from injury should power failure cause the treadmill to stop suddenly.

(Extracted from page 121 of IEE Review, May 1999, www.theiet.org. Take care: not all UPSs appear to be as reliable as we might wish!)

72) Trams fitted with inverter drives interfere with hospital equipment along their route

The Helsinki City Transport (HKL) rolling stock is ageing fast. In each tram there were six ventilation fans with DC motors cooling the passenger compartment, brake resistor, and traction motor. The thinking was that one big inverter supplying six AC motors was going to be cheaper than several smaller inverters supplying one motor each, so a 15kW unit was mounted in the main electrical panel of one of the trams. The existing cabling was retained because of cost considerations and this connected the various motors in parallel. EMC problems very quickly surfaced. Not only was the vehicle’s own radio system badly affected, but crucially – third party electrical equipment also suffered interference, including that of a hospital on the tram’s route. The problem was solved in the end by siting individual inverters close to the motors they controlled.

(From an article by Les Hunt in dpa Magazine, March 99, Drives Supplement page 29, www.dpaonthenet.net.)

80) Anti-theft devices interfere with pacemakers

Retail shops use anti-pilferage devices (the hoops that are to either side of their doors), which operate in the USA between 510 and 1705 kHz. The goods to be protected have a small label stuck on them that resonates at the appropriate frequency and disturbs the field produced by the hoops, allowing detection. It was found that heart pacemakers were susceptible to the anti-pilferage fields, so pacemaker manufacturers had to improve their designs to make them less susceptible.

(From comments by Art Wall (Associate Chief of the Policy and Rules Division of the USA’s Federal Communications Commission) during an EMCTLA seminar on FCC requirements on the 18th May 2000, www.emctla.co.uk.)

577) RFID interferes with critical-care medical equipment

In 123 EMI tests (3 per medical device), RFID induced 34 EMI incidents: 22 were classified as hazardous, 2 as significant, and 10 as light. The passive 868-MHz RFID signal induced a higher number of incidents (26 incidents in 41 EMI tests) compared with the active 125-kHz RFID signal (8 incidents in 41 EMI tests). The passive 868-MHz RFID signal induced EMI in 26 medical devices.

(From: “Electromagnetic Interference from Radio Frequency Identification Inducing Potentially Hazardous Incidents in Critical Care Medical Equipment”, van der Togt, R., E. J. van Lieshout, et al, JAMA 299(24): 2884-90, 2008, Jeff Silberberg (US FDA) to the 20th Annual AAMI/FDA International Conference on Medical Device Standards and Regulation, March 9, 2010.)

578) EMC of Pacemakers and ICDs exposed to RFID readers

Implantable Pacemaker Reaction to RFID

At least one reaction was observed in 21 of the 22 pacemakers tested. While being exposed to each of the two 134 kHz RFID readers a pacemaker reaction was observed for 34 of the 44 possible tests (77%). While being exposed to each of the four 13.56 MHz RFID readers a pacemaker reaction was observed for 21 of the 88 possible tests (24%).

Implantable Cardioverter Defibrillator Reaction to RFID

At least one reaction was observed in 18 of the 19 ICDs that were tested. While being exposed to the two 134 kHz RFID readers an ICD reaction was observed for 27 of the 38 possible tests (71%). While being exposed to the four 13.56 MHz RFID readers an ICD reaction was observed for 8 of the 76 possible tests (11%).

(From: "Electromagnetic Compatibility of Pacemakers and Implantable Cardiac Defibrillators Exposed to RFID Readers", Seidman S, Ruggera P, Brockman R, Lewis B, Shein M., International Journal of Radio Frequency Identification Technology and Applications, Vol. 1, No. 3, 2007:237-246, , Jeff Silberberg (US FDA) to the 20th Annual AAMI/FDA International Conference on Medical Device Standards and Regulation, March 9, 2010.)