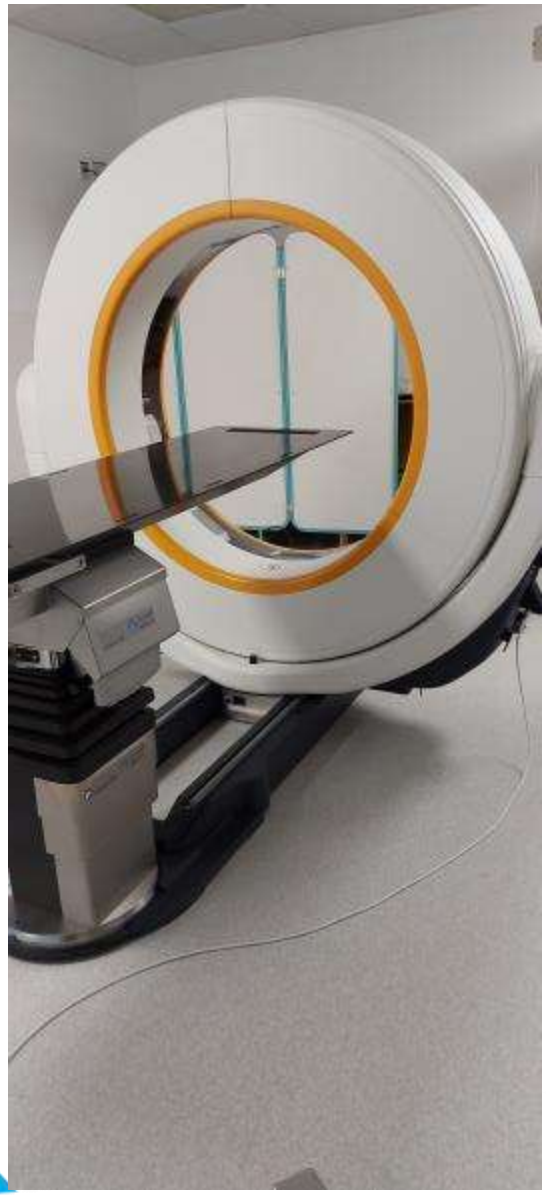
COMMISSIONING AN AIRO MOBILE CT SCANNER

Adrian Porter

Radiation Protection &
Imaging Physics
Queen's Hospital
Romford
Essex



TAKING PRIDE IN OUR CARE

Barking, Havering and Redbridge University Hospitals NHS Trust

Presentation will cover

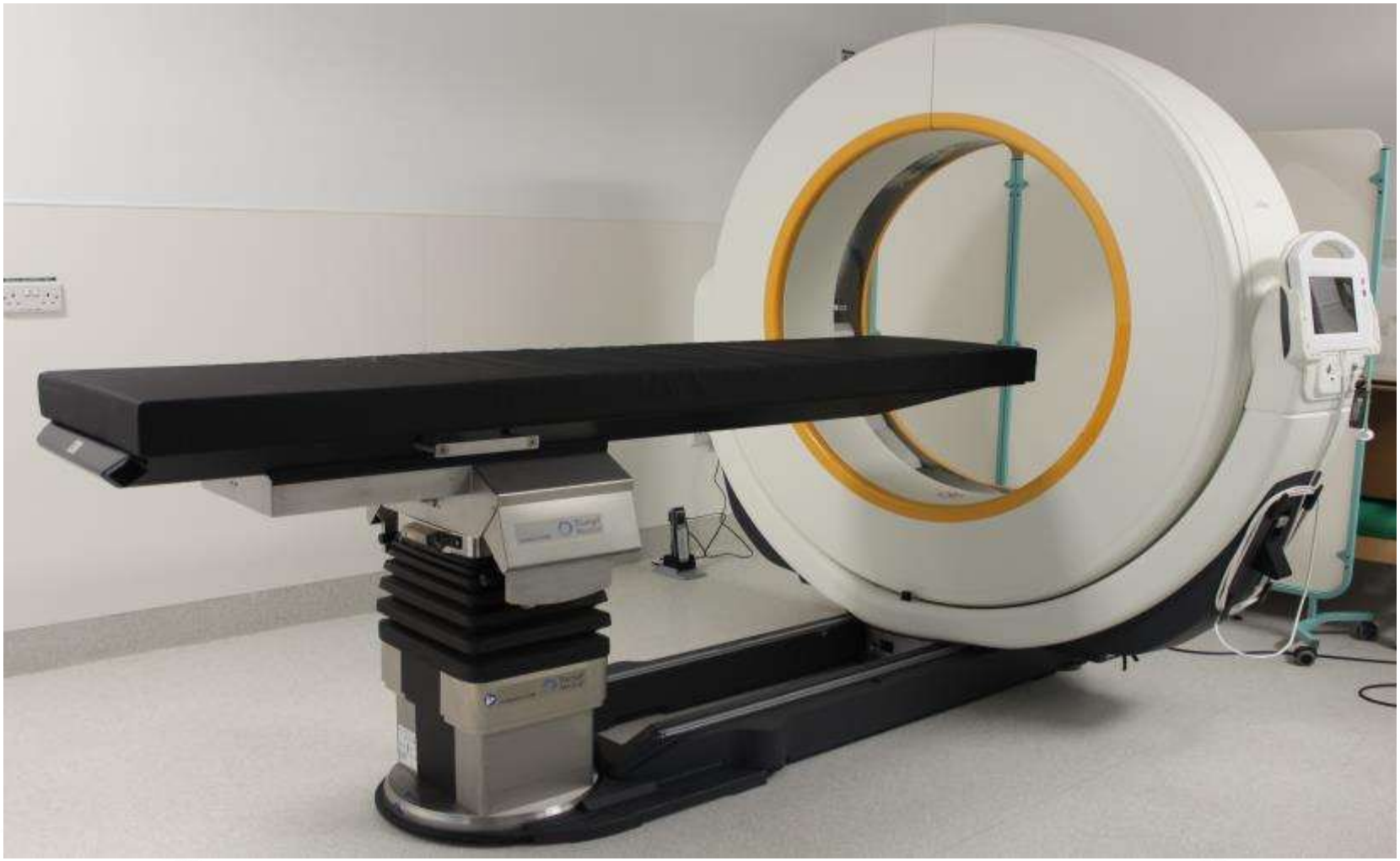
- The AIRO Mobile CT system
- Shielding requirements
- Tube & Generator
- Patient Doses
- Imaging
- Conclusions

Work in progress

BACKGROUND

- Bid made to NHSE form COVID Response funding for three mobile CT scanners
- ED has no dedicated CT scanner and this would reduce the pressure on existing scanners, which would allow more time between patients for cleaning
  - Expected to scan 17 patients per day
- Originally thought that it could be located in RESUS
- Only one AIRO mobile CT scanner purchased
- Located in a shielded pacing room in ITU, just round the corner from ED
  - Shielded with 3.15 mmPb (code 7)
- Prove to Trust that a dedicated CT scanner was required closer to ED

AIRO MOBILE CT



AIRO MOBILE CT

- Manufactured by Mobius Imaging and supplied by BrainLab
- 32 slice helical scan detector array
- Intended use
  - "General Radiology, ICU, ED, Surgical/Operating Room, Clinic or Office"
  - "CT images that assist in a range of clinical applications which includes neuro, ENT, head & neck, orthopaedic and general surgery"
- "Not designed to be relied on as the principal means of guidance during invasive procedures when real time imaging is needed (eg CT Fluoro)"

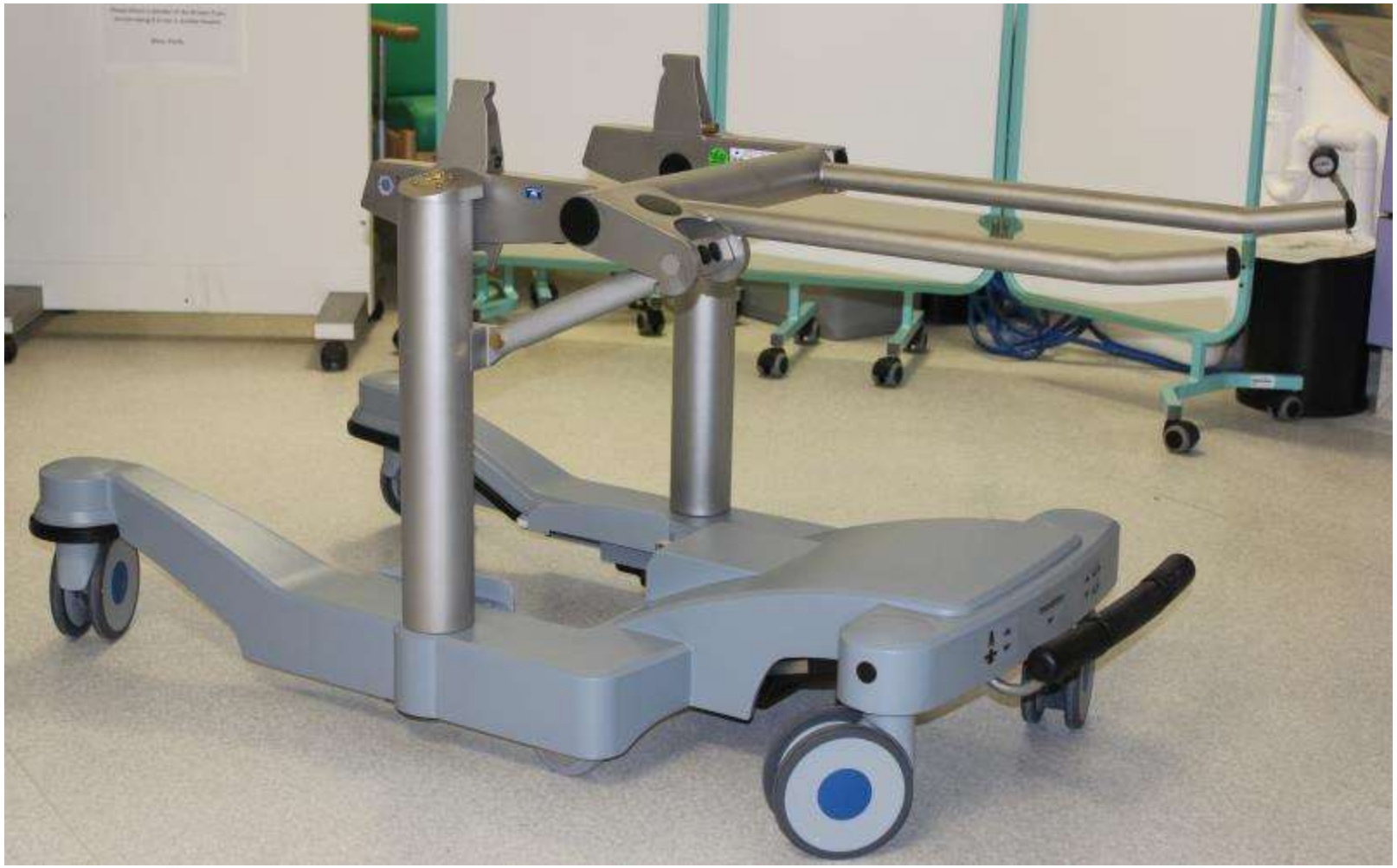
PHYSICAL CHARACTERISTICS

- Height 1.9 m
  - 1.97 m (transport mode)
- Length 3.3 m – including table
  - 2.29 m (transport mode)
- Width 1.93 m
  - 0.6 m (transport mode)

- Weight 975 kg – without table top
- Gantry opening 107 cm

- Table can move, but during the scan it is the gantry that moves

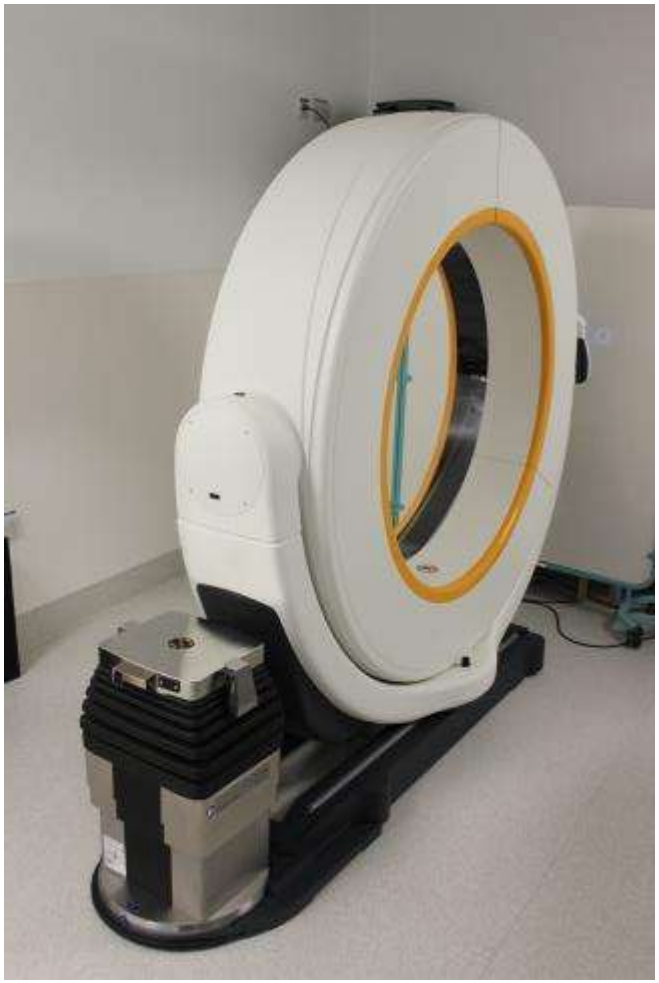
AIRO MOBILE CT



AIRO MOBILE CT

AIRO MOBILE CT

Width 60 cm
Length 2.29 m
Height 1.98 m



AIRO MOBILE CT

- Motorised drive
- Front view camera

EXPOSURE FACTORS

- Adult or Paediatric
- Head, Sinus, Orbit, Shoulder, Chest, Abdomen, Pelvis, C-spine, T-spine, Extremities
- Original or Alternate
  - For Chests reduces DLP by 24%
  - For Heads reduces DLP by 8%
- Helical or Axial
  - For Chests DLP decreases 14% helical to axial
  - For Heads DLP decreases 23% helical to axial
- mA modulation

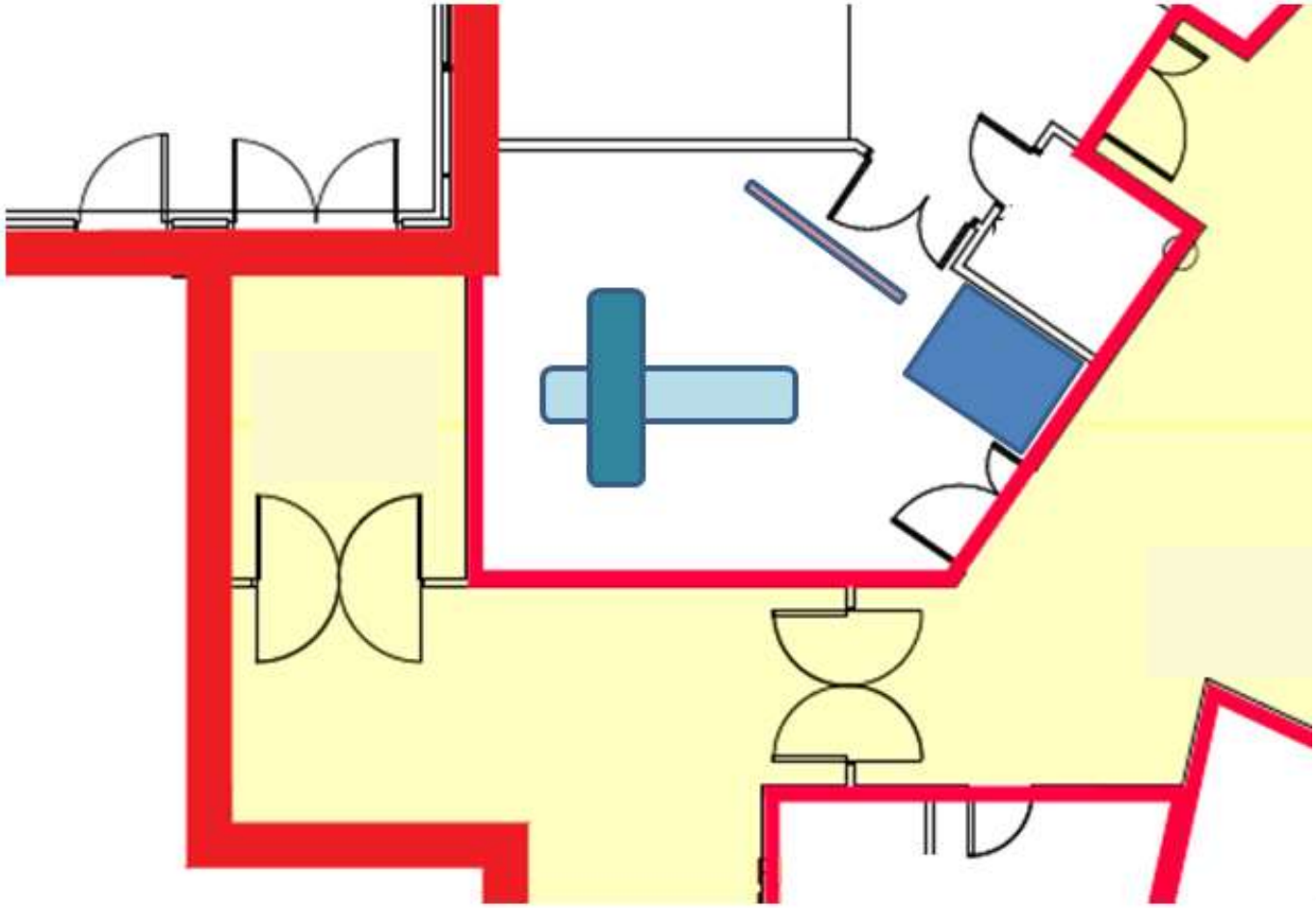
PROTECTIVE SCREEN

- Protective screen came with scanner and used by installation engineer (~6 days)
- 1 mmPb
- At 120 kV, isocentre to chamber distance 4 m
- 50 mAs (best case chest)
  - Dose rate behind screen 110 µSv/h
  - Dose 130 nSv
- 325 mAs (worst case head)
  - Dose rate behind screen 475 µSv/h
  - Dose 550 nSv (Annual dose 2.3 mSv)

THE SHED

- First issue was to provide a safe working area for the Operators
  - Extra cost
  - Delay
- Raybloc constructed lead shed
  - Code 7 - 3.15 mmPb

LOCATION OF AIRO CT SCANNER



SCATTER SURVEY

- Scatter survey completed around the room – corridors and ITU and within the Shed using RaySafe X2 survey meter
- Used Body and Head phantom – only do 14cm length
- Used worst case factors:
  - Adult, Original, Helical, Chest
  - Adult, Original, Helical, Head (Axial recommended)

- In Shed dose rate <1µSv/h, dose per examination < 10 nSv
- Outside entrance doors, corridor and back wall <2.5 µSv/h, dose per exam <5 nSv
- For 30 patients per day, annual dose < 0.1 mSv

DAILY WARM UP

- From switching on it requires 30 minutes warm up
- Warm up scan every 18 hours
- Then requires:
  - E-stop test
  - Gain Calibration
  - Helical Daily Quality Check (80, 100, 120kV)
  - Axial Daily Quality Check (80, 100, 120kV)
- Switching on to first scan - 1 hour
- Four tests all have Pass/Fail
- It will scan without performing the four checks above

TUBE & GENERATOR

- Can perform single shot exposures with tube at top of gantry

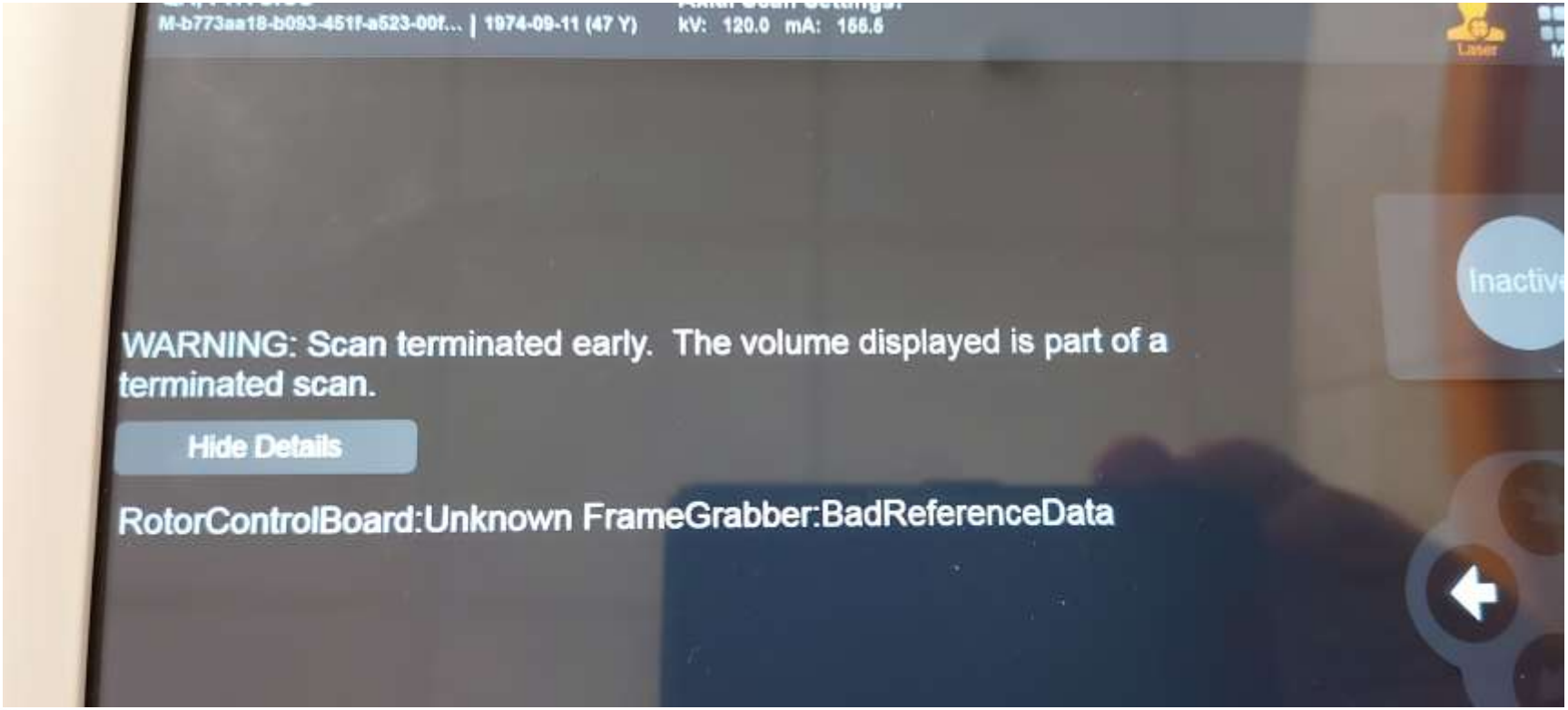
- Tube potential: clinically available 80, 100 & 120 kV but can select 70 to 120 kV in single shot
  - All kVs within 2
- Filtration : specification 6.8 mmAl
  - Measured 7.0 mmAl with Raysafe

PATIENT DOSE

- Began to measured $CTDI_{air}$ and confirm DRLs using body and head phantoms
- Problems began
- We would do a few scans and then the scanner would stop
- Reported to BrainLab, who asked for copies for scanner logs
- They said that tube overheating, although tube temperature indicator was fine

PROBLEMS

- We constantly found that the scanner would stop after 6 scans



PROBLEMS

- Eventually have agreed to replace the tube
  - 1st week in November
  - Scanner installed early April (7 months)

- Only recently got connected to PACS

- No patient dose and no image quality checks

QA TEST OBJECT

- Scanner does come with a test object for daily and full QA checks
- Daily Checks include:
  - Alignment
  - CT Noise & Uniformity
- Full QA checks include:
  - Alignment
  - Spacial linearity
  - CT Sensitometry
  - MTFs
  - CT Noise & Uniformity

Will let you continue
if any test fails

DISPLAYED DRLS

			Scan Length	DLP		nDRL
			cm	mGycm		mGycm
Chest	Original	Helical	35	405.6		610
Chest	Original	Axial	35	400		610
Chest	Alternate	Helical	35	310.5		610
Chest	Alternate	Axial	35	304.4		610
Head	Original	Helical	20	1630.8		970
Head	Original	Axial	20	1495.4		970
Head	Alternate	Helical	20	1506.8		970
Head	Alternate	Axial	20	1370.8		970

CONCLUSIONS

- Requires additional shielding for the Operator
- Scanner installed at Queen's Hospital has not proved to be reliable
- Although BrainLab have UK offices, the installation engineer came from Germany and the engineer who will replace the X-ray tube is coming from Turkey
- Cost >£600k

ACKNOWLEDGEMENTS

- This work has been done along side Dean Taylor and Laura Tonks

- Thank you for listening

- Hopefully, I can give Part B next year with some results