A quick overview on Medical Linac Problems

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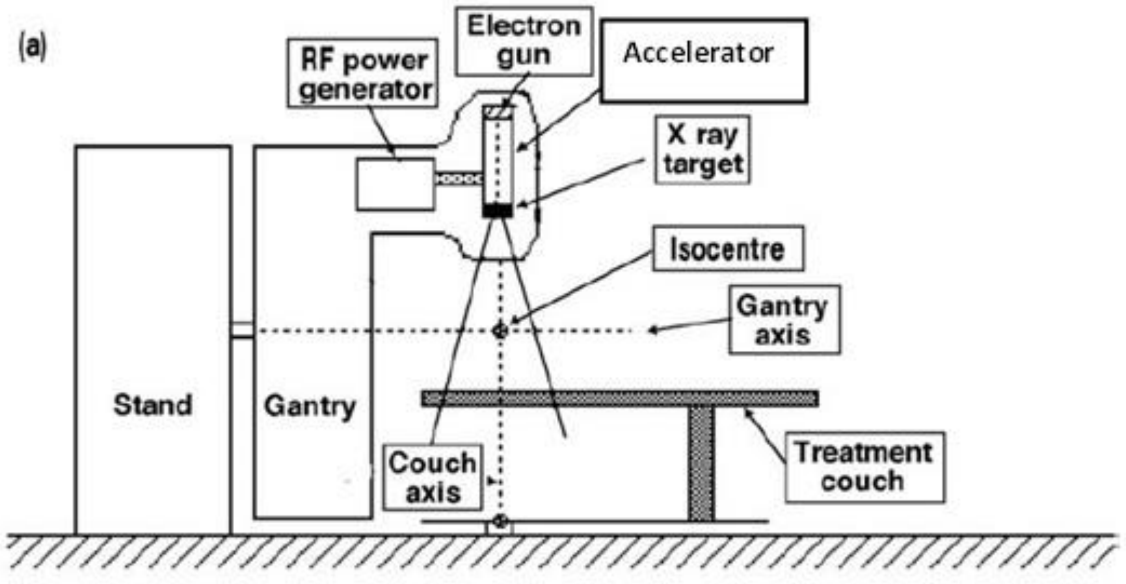
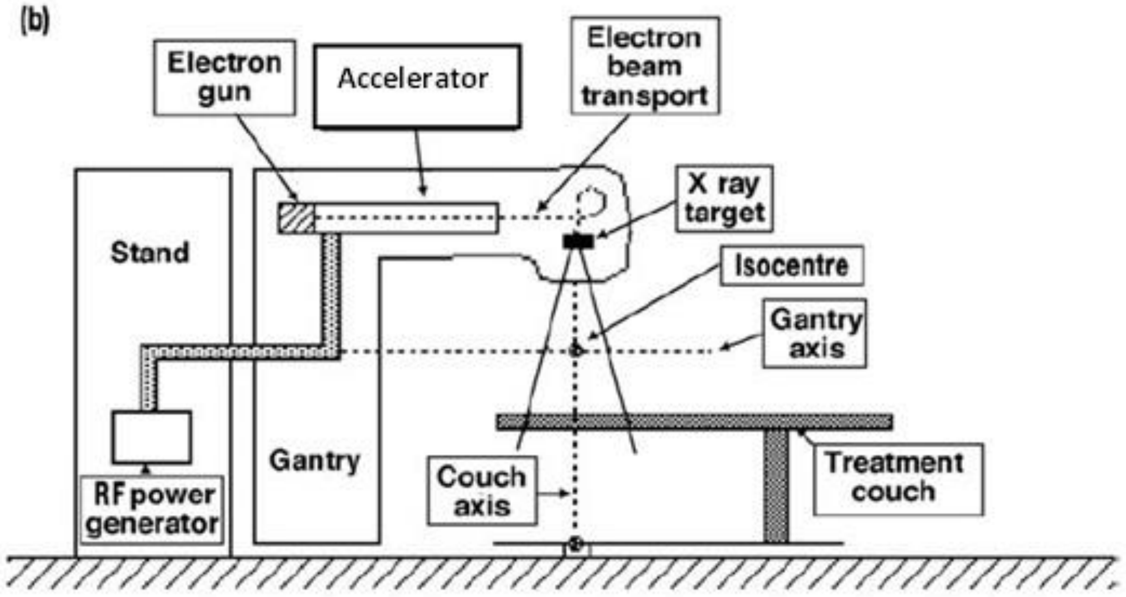
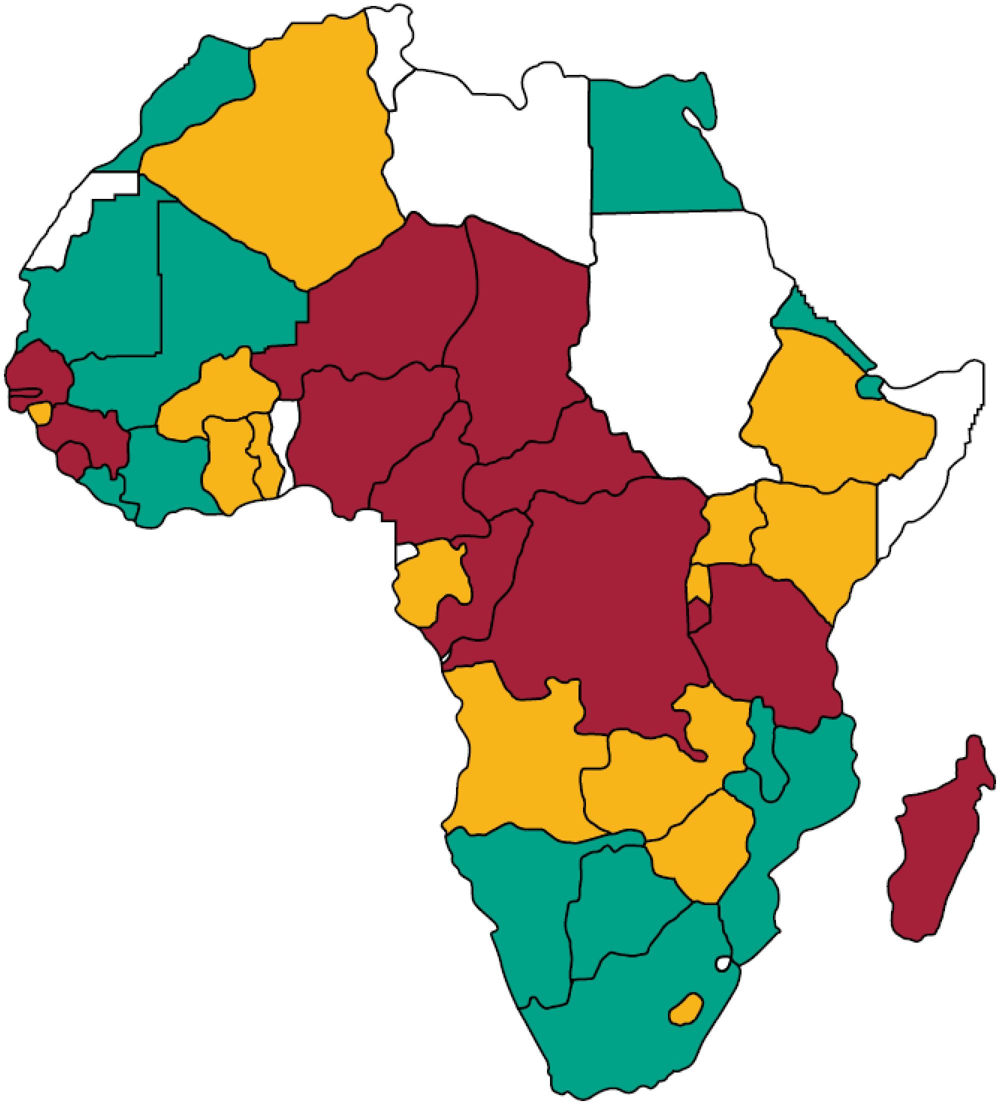

(a)
Electron gun
Accelerator
RF power generator
X ray target
Isocentre
Gantry axis
Stand
Gantry
Couch axis
Treatment couch


(b)
Electron gun
Accelerator
Electron beam transport
X ray target
Stand
Isocentre
Gantry axis
Gantry
Couch axis
Treatment couch
RF power generator



	Mean Number of Outages per Month	Range of Outage Duration (hours)
Many Outages	[9.1, 31.5]	1.0-29.6
Some Outages	[3.3, 9.1]	1.9-14.9
Few Outages	[0, 3.3]	0.5-3.0
No Data		

Model for Estimating Power and Downtime Effects on Teletherapy Units in Low-Resource Settings

Rachel McCarroll, Bassem Youssef, Beth Beadle, Maureen Bojador
Rex Cardan, Robin Famiglietti, David Followill, Geoffrey Ibbott
Anuja Jhingran, Christoph Trauernicht, Peter Balter, Laurence Court

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Our results underscore and re-emphasize the importance of power infrastructure characteristics at the site of implementation. It is clear that a complete understanding of the power availability in the region of projected implementation is, without doubt, critical in estimating potential machine performance.

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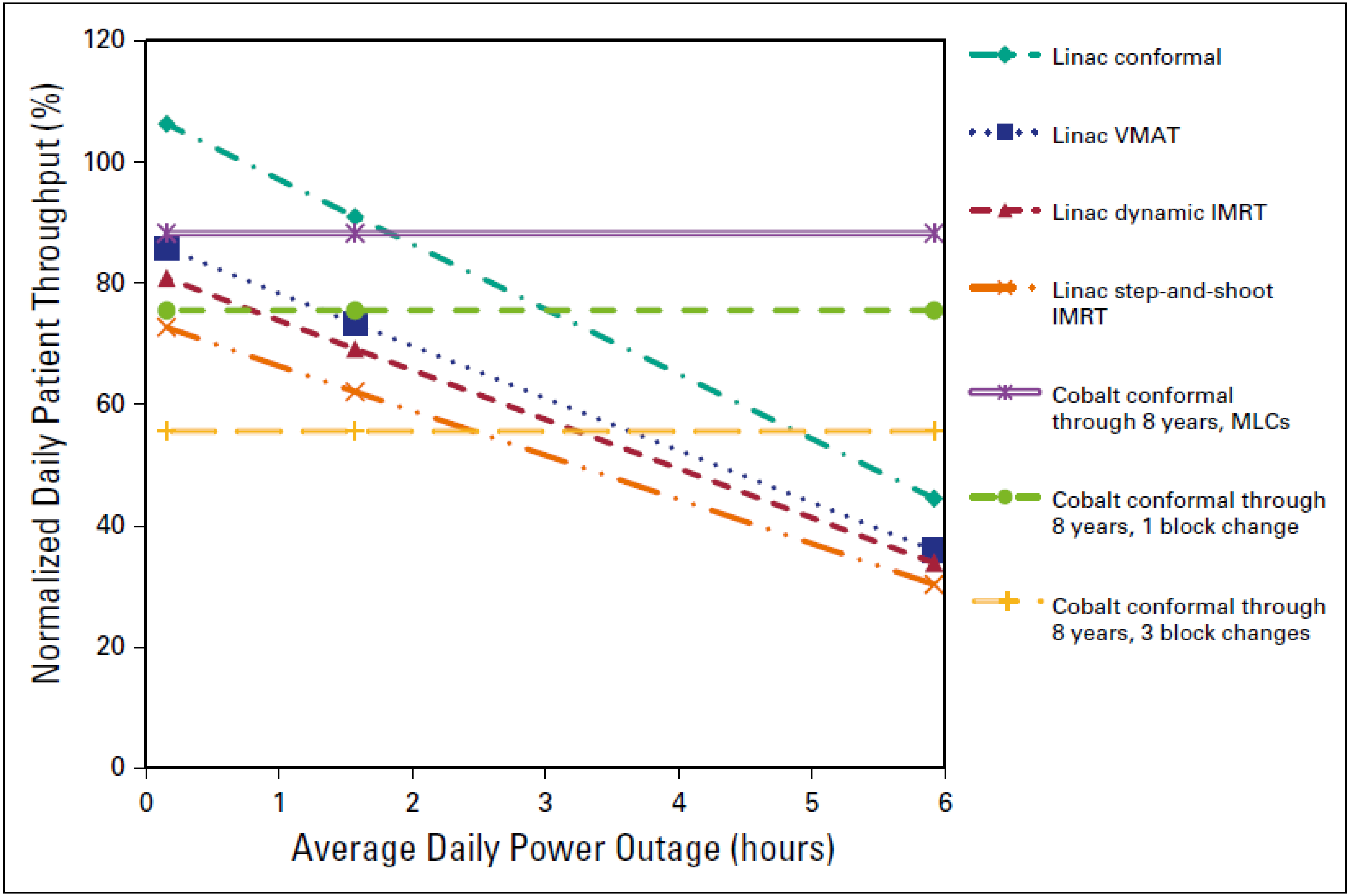
Power outages and machine downtime

Discrete interruptions in machine operation not only limit average throughput but may interrupt treatment of patients, staff work times, and scheduling. In addition, sudden power cuts may be damaging to teletherapy machines or auxiliary equipment.

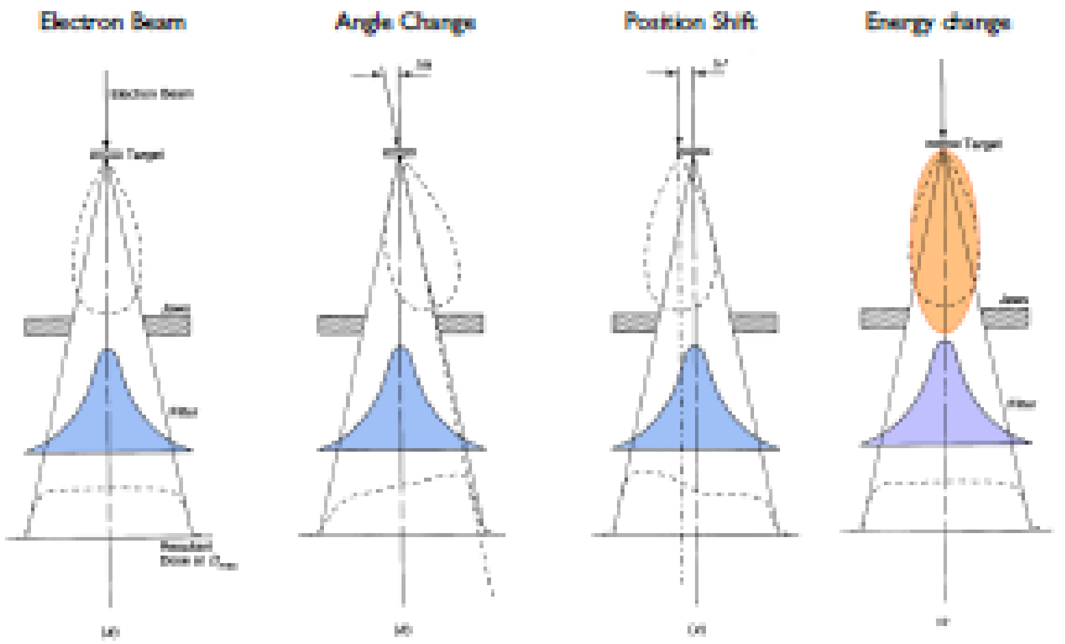
Service parts and personnel

Accessibility, geographical and otherwise, of service parts and personnel specific to the radiotherapy machine is essential to machine operation. Extended interruptions in treatment can dramatically decrease the efficacy of treatments and the treatment units to individual patients and to the population as a whole.



Normalized Daily Patient Throughput (%)
120
100
80
60
40
20
0
0
1
2
3
4
5
6
Average Daily Power Outage (hours)
Linac conformal
Linac VMAT
Linac dynamic IMRT
Linac step-and-shoot IMRT
Cobalt conformal through 8 years, MLCs
Cobalt conformal through 8 years, 1 block change
Cobalt conformal through 8 years, 3 block changes

Flatness and Symmetry



Medical Physics

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Med Phys. 2016 Nov; 43(11): 5903–5914.
Published online 2016 Oct 7. doi: 10.1118/1.4963216
PMCID: PMC5055534
PMID: 27806583

Performance of a clinical gridded electron gun in magnetic fields: Implications for MRI-linac therapy

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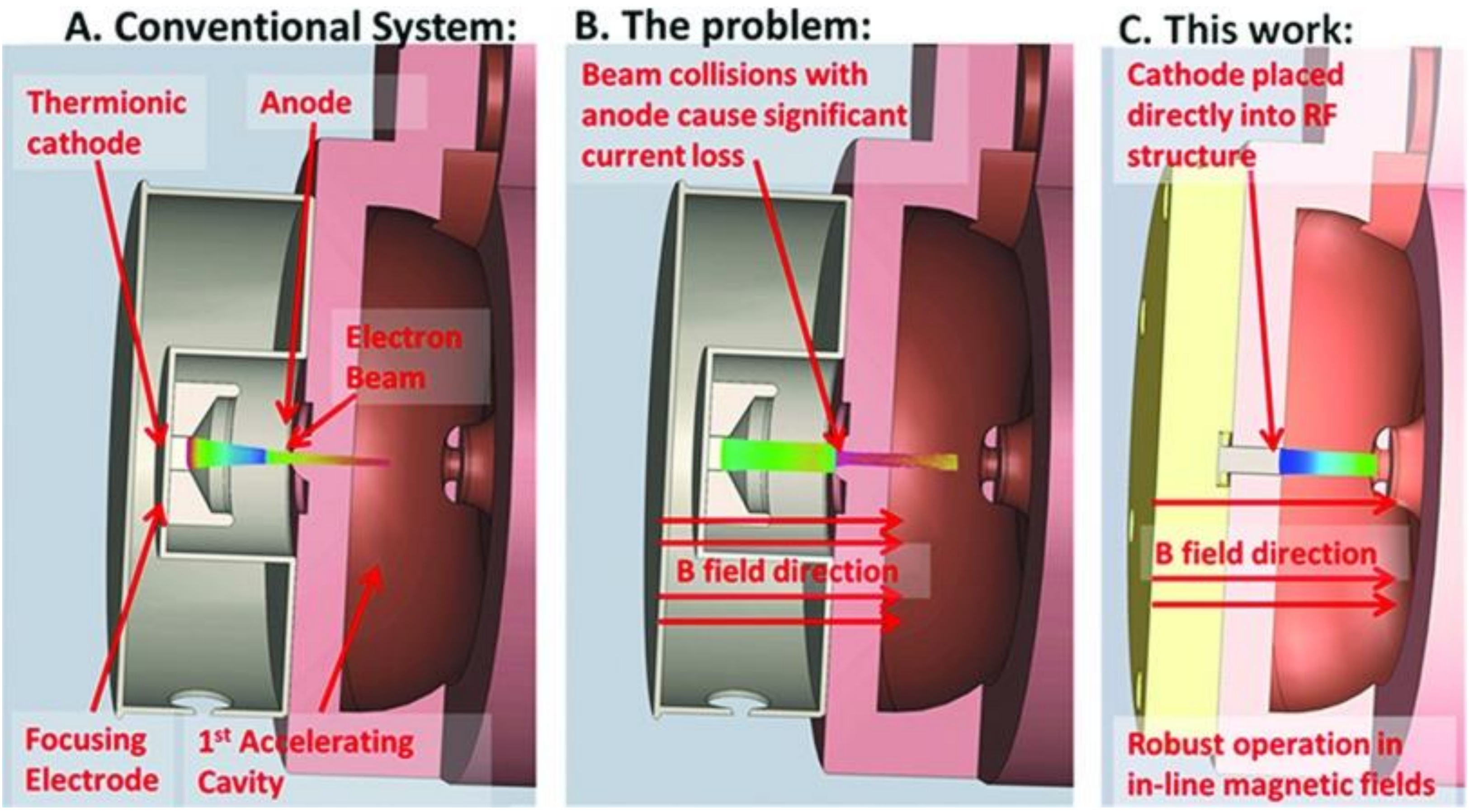
A novel electron accelerator for MRI-Linac radiotherapy

Brendan Whelan[a)] Med Phys. 2016 Mar; 43(3): 1285–1294.



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International Conference on Computer Information Systems and Industrial Applications (CISIA 2015)

Analysis on Several Typical Faults of Medical Linear Accelerator

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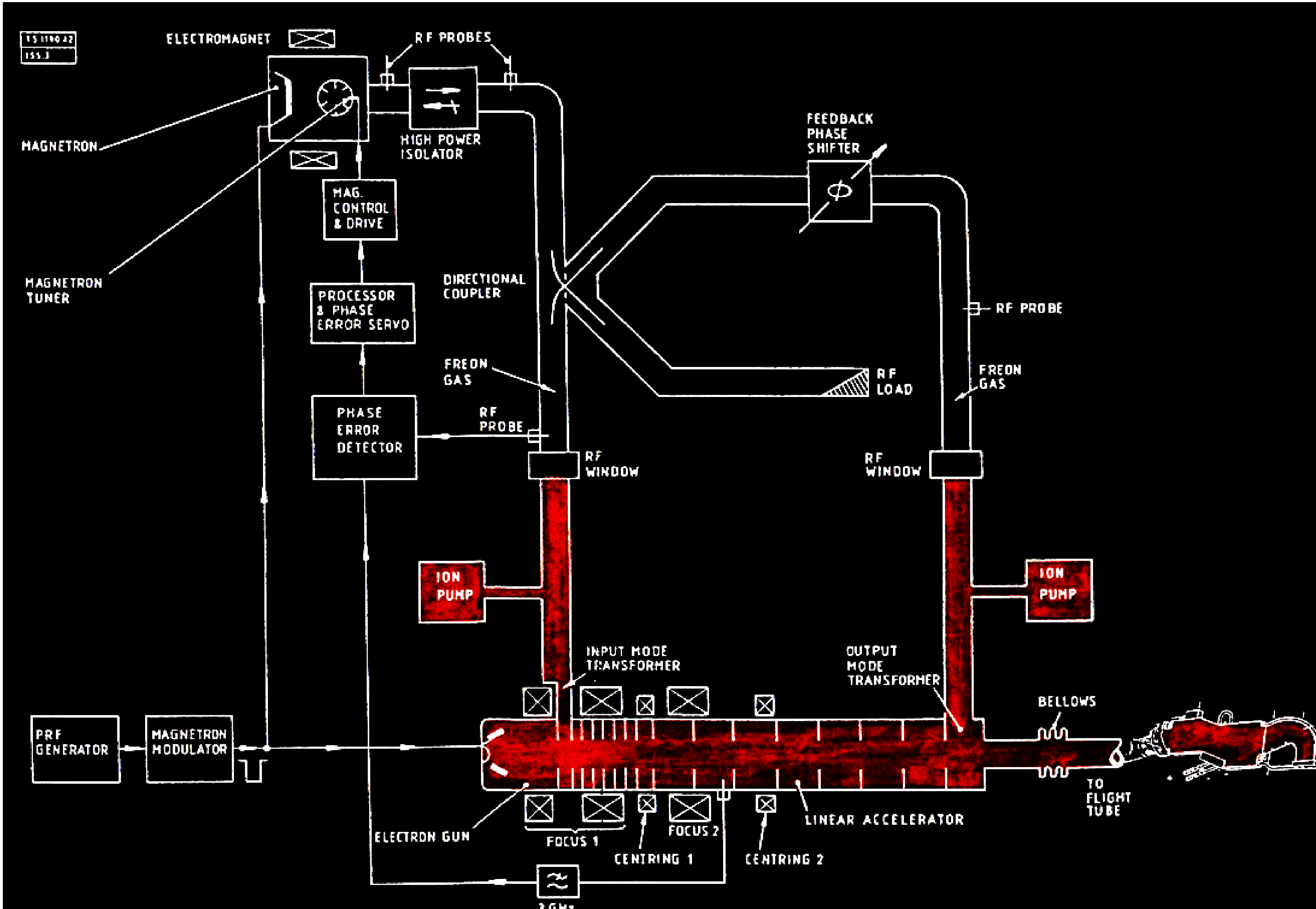
This paper introduces fault reasons, fault analysis and maintenance plan to several typical common faults of medical linear accelerator in detail, which is FLOW interlocking fault, MLC, dose rate instability fault, multi-leaf collimator fault and pressure-oil tank fault, which is significant to the maintenance work of medical linear accelerator to some extent.

Zhongguo Yi Liao Qi Xie Za Zhi. 2016 May;40(3):232-4.
[The Analysis of MLC Failure in Elekta Precise Linear Accelerator].
[Article in Chinese]
Wan S, Zhang H, Hong C.
Abstract
The causes of common MLC failure in Elekta Precise linear accelerator were detailed analyzed. And the methods of repairing and handling MLC faults were also presented in detail. It is hoped that some repairing experience for the maintenance engineers of linear accelerator can be provided by this paper.



ELECTROMAGNET
RF PROBES
MAGNETRON
HIGH POWER ISOLATOR
FEEDBACK PHASE SHIFTER
MAG. CONTROL & DRIVE
MAGNETRON TUNER
PROCESSOR & PHASE ERROR SERVO
DIRECTIONAL COUPLER
RF PROBE
FREON GAS
RF LOAD
FREON GAS
PHASE ERROR DETECTOR
RF PROBE
RF WINDOW
RF WINDOW
ION PUMP
ION PUMP
INPUT MODE TRANSFORMER
OUTPUT MODE TRANSFORMER
BELLOWS
PRF GENERATOR
MAGNETRON MODULATOR
TO FLIGHT TUBE
LINEAR ACCELERATOR
ELECTRON GUN
FOCUS 1
FOCUS 2
CENTRING 1
CENTRING 2
3 GHz

HEALTH CARE

Nihon Hoshasen Gijutsu Gakkai Zasshi. 2014 Dec;70(12):1445-54. doi: 10.6009/jjrt.2014_JSRT_70.12.1445.
[Failure analysis of medical linear accelerator with reliability analyses].
[Article in Japanese]
Zakimi K[1], Watanabe H, Ishida H, Take T, Kato M, Iwai T, Nitta M, Kato K, Nakazawa Y.

We analyzed a number of cases about the Linac troubles in our hospital and have examined the effect of preventive maintenance with Weibull analysis and exponential distribution from April 2001 to March 2012. The total failure by irradiation disabled was 1, 192. (1) Medical linear accelerator (MLC) system was 24.0%, (2) radiation dosimetry system 13.1%, and the (3) cooling-water system was 26.5%. It accounts for 63.6% of the total number of failures. Each parameter value m, which means the shape parameter, and the failure period expectancy of parts μ were (1) 1.21, 1.46 / 3.9, 3.8 years. 3.7, 3.6 years. (2) 2.84, 1.59 / 6.6, 4.3 years. 6.7, 5.9 years. (3) 5.12, 4.16 / 6.1, 8.5 years. 6.1, 8.5 years. Each shape parameter was $m > 1$. It is believed that they are in the worn-out failure period. To prevent failure, MLC performance should be overhauled once every 3 years and a cooling unit should be overhauled once every 7 years. Preventive maintenance is useful in assessing the failure of radiation therapy equipment. In a radiation dosimetry part, you can make a pre-emptive move before the failure by changing the monitor's dosimeter board with a new part from the repairs stockpiled every 6 months for maintenance.

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