



# 4-6 GeV CEBAF Reliability Overview

Operations StayTreat

6/28/16

Steve Suhring

# Early Challenges at CEBAF

- New machine
  - From the ground up
  - First large scale application of SRF
  - No 'statistics' on system/component performance
- New People
  - No shared experience
- New Management
  - Clarity of vision
  - Practices under development
    - HCO, on-call, repair escalation

# Vocabulary

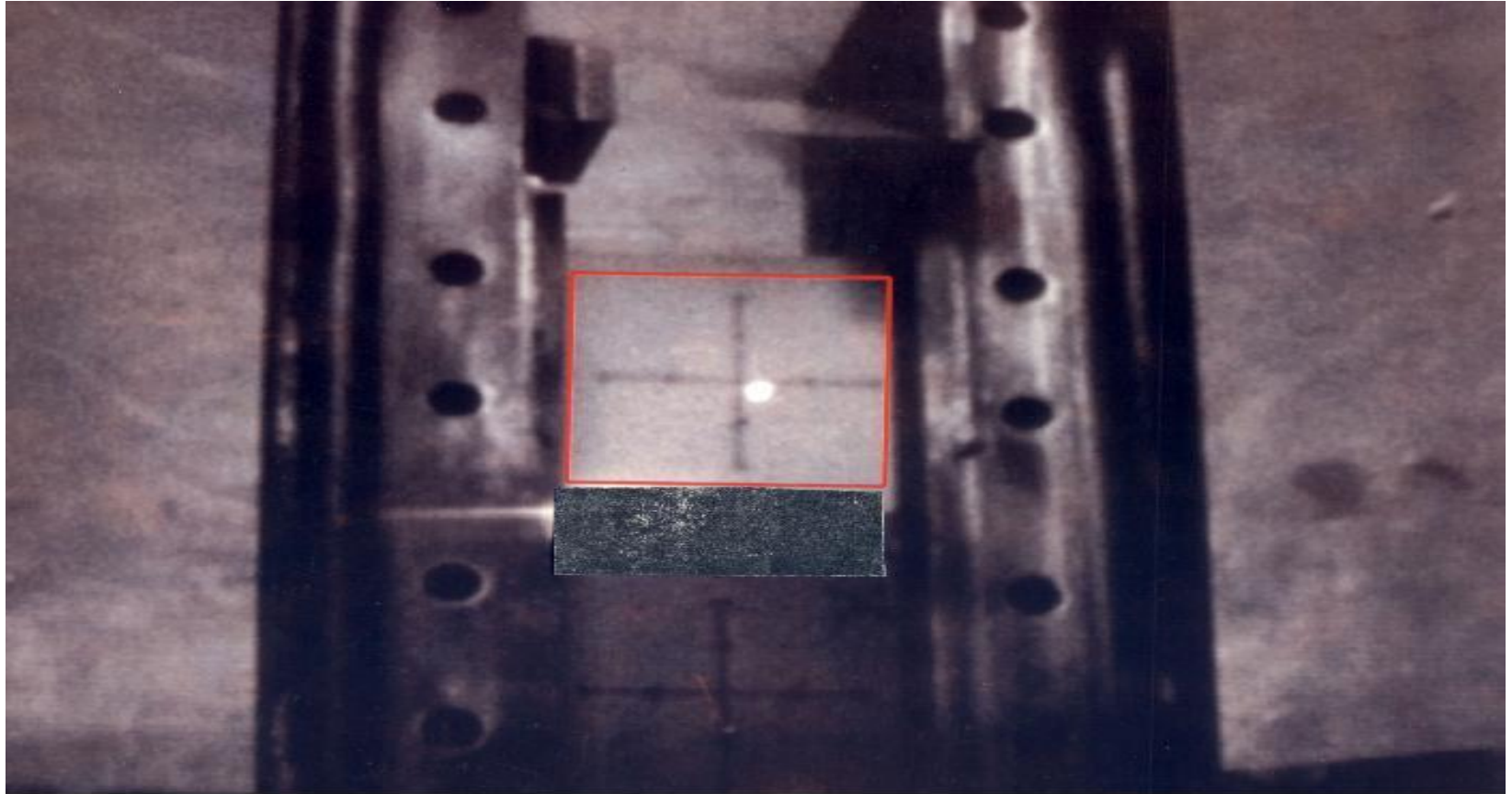
- Availability / Reliability
  - Not cleanly understood
  - Machine? System? Component?
- MTTR, MTBF\*, etc.
  - Theoretically useful
  - Difficult early on when statistics weren't there

\*Mean Time To Repair, Mean Time Between Failures

# CEBAF Vocabulary

- Lost Time: Not doing Physics, for whatever reason
  - New phrase
  - No 'free ride' for simultaneous failures
  - Accountability for Beam Studies time
- Whack-a-Mole: a. An ancient arcade game revolving around a mallet and a mole.  
  
b. CEBAF slang for putting effort where effort is due.

# 1994 First Beam on Target at JLab



# Lost Time Tracking

1<sup>st</sup>: Dredging through paper logbooks

2<sup>nd</sup>: Simple web interface for Operations to use

- Records dumped into an Excel spreadsheet.
- Labor intensive to edit, parse, use.

This effort resulted in a large database used

- a. to guide CEBAF improvement efforts, and
- b. for reliability statistics as new machines were in the planning stages.

# Lost Time Spreadsheet Eye Chart

Date	T. Down	T. Up	Beam Up	Sys. Down	Recovery	Total	System	Item	Location	Entry	e log	new ts	Description
11/6/01	6:08	6:15	6:15	0:07	0:00	0:07	RF	2L08-7	tune24	da vidg	163388	13035	Keyword: 2L08-7 faults Entry: 2L08-7 tripped repeatedly on
11/6/01	20:04	20:31	20:34	0:27	0:03	0:30	RF	1L15-2	bypass	kellyk	163504	13043	Keyword: 1L15-2 problems Entry: Repeated problem w/1
11/6/01	21:47	21:49	21:50	0:02	0:01	0:03	RF	1L18	HV trip	kellyk	163508	13044	QuickPic - 1L18 dropped out of hv
11/7/01	2:57	9:05	9:05	6:08	0:00	6:08	Magnets	XSEP6T	waterflow	da vidg	163570	13050	Keyword: Hall C down due to XSEP6T MPS WATERFLO
11/7/01	5:23	5:23	6:16	0:00	0:53	0:53	OpsUT	Hall_B	bleedthru	da vidg	163543	13048	TUNE:Keyword: Hall B Bleedthru Adjustments Entry: Ad
11/7/01	8:41	11:06	11:06	2:25	0:00	2:25	RF	RF Separator	Amp 6	laning	163569	13049	Keyword: RF Separator AMP #6 Entry: RF Separator An
11/7/01	14:25	14:25	15:00	0:00	0:35	0:35	OpsUT	Hall_B	assemetry	housman	163587	13054	TUNE:"Hall B assemetry and phase adjustments"
11/7/01	15:00	15:00	15:45	0:00	0:45	0:45	OpsUT	Hall_B	current insta	roman	163599	13056	TUNE:Keyword: Hall B current still unstable. Entry: We t
11/7/01	16:37	16:57	16:57	0:20	0:00	0:20	RF	2L08-7	tune24	zkursun	163601	13057	Keyword: Zone 2L08-7 keeps SOSing. Entry: We have tri
11/7/01	20:35	20:40	20:40	0:05	0:00	0:05	RF	0L04	comm	zkursun	163616	13058	Keyword: Zone 0L04 dropped out of communication probl
11/7/01	21:03	21:03	21:12	0:00	0:09	0:09	OpsUT	4L	setup	zkursun	163622	13059	TUNE:Keyword: Cheking the orbits for the vacuum proble
11/7/01	22:06	22:27	22:28	0:21	0:01	0:22	RF	2L21-5	SOS	kellyk	163626	13061	Keyword: 2L21 dropped out of hv Entry: zone restored bu
11/7/01	22:28	22:50	22:53	0:22	0:03	0:25	Vacuum	2L21-5	BLIPC	kellyk	163628	13062	Keyword: VIP2L14 card replacement Entry: We suspect
11/8/01	5:22	5:33	5:33	0:11	0:00	0:11	Gun	PGun3	QE measure	da vidg	163646	13066	"QE Measurement"
11/8/01	11:39	11:39	12:27	0:00	0:48	0:48	StHLA	Burt	magnet nam	roman	163721	13075	TUNE:Keyword: late entry: hall c moller run Entry: Hall c
11/8/01	12:50	12:54	12:54	0:04	0:00	0:04	Magnets	DOG6E	door fault	roman	163684	13070	Keyword: Magnet DOG6E tripped off. Entry: Magnet sup
11/8/01	22:38	0:01	1:25	1:23	1:24	2:47	Magnets	MARC5A	shunt adder	zkursun	163740	13077	Keyword: Shunt Adder in ARC5A tripped off Entry: MAN!
11/9/01	4:58	5:17	5:17	0:19	0:00	0:19	Magnets	MBC8T03V	trim card sw	da vidg	163748	13078	Keyword: MBC8T03V Trim Card Replaced Entry: MBC8T
11/9/01	5:51	6:02	6:02	0:11	0:00	0:11	Gun	PGun3	QE measure	da vidg	163760	13080	"QE measurement"
11/9/01	18:33	20:03	20:05	1:30	0:02	1:32	Control Net	iocha1	card swap	kellyk	163824	13090	Keyword: Hall-A Controlled Access Entry: Access neces
11/9/01	23:32	23:42	23:42	0:10	0:00	0:10	RF	Capture	reflected pow	zkursun	163845	13095	Keyword: Injector Capture dropped off over reflected pow
11/10/01	8:36	8:43	8:43	0:07	0:00	0:07	RF	1L02-2	gset	jaulknr	163892	13100	Keyword: 1L19 1 and 2 SOSing Entry: Lowered GSET to
11/10/01	12:27	12:37	12:37	0:10	0:00	0:10	RF	2L06-4	tune24	jaulknr	163902	13101	Keyword: RF 2L06-4 continuous SOSing Entry: Lowered
11/10/01	18:58	19:10	19:10	0:12	0:00	0:12	RF	2L03-1,2,3,4	fault	smyers	163919	13105	"Late entry:SL3 1,2,3,4 tripped off and wouldn't reset"
11/11/01	6:50	8:49	8:49	1:59	0:00	1:59	OpsST	Beam Sync test	Beam Sync	adams	164987		Beam sync delay tests complete
11/11/01	9:44	9:44	10:10	0:00	0:26	0:26	OpsST	Beam restoration	Beam restora	suhring	163991		Beam restoration to Physics
11/11/01	23:48	23:51	23:51	0:03	0:00	0:03	Gun	PGun3	QE measure	smyers	164042	13112	"QE measurement"
11/12/01	1:16	3:21	3:54	2:05	0:33	2:38	RF	1L02-2	klystron	spraggin	164067	13114	Keyword: 1L02 dropped out of HV Entry: 01:16 1L02 dro
11/12/01	8:50	9:11	9:11	0:21	0:00	0:21	St	iocsl1b	reboot: mem	jaulknr	164089	13117	"Reboot IOC SL1B due to low memory"
11/12/01	13:14	13:29	13:33	0:15	0:04	0:19	Magnets	DOG6E	door fault	lehmann	164102	13119	Keyword: DOG 6 faults on door open Entry: DOG 6 fault:
11/12/01	23:11	23:21	23:21	0:10	0:00	0:10	Gun	PGun3	QE measure	smyers	164163	13125	"QE measurement"





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Magnets	XSEP6T	waterflow	da vidg	163570	13050	Keyword: Hall C down due to XSEP6T MPS WATERFLO							
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RF	RF Separator	Amp 6	fanning	163569	13049	Keyword: RF Separator AMP #6 Entry: RF Separator A							
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# Lost Time Trending

- Weekly Reports
  - Recent Opportunities for Improvement
  - Comparison to previous week
- Lost Time Roll-Up
  - Included Availability numbers taken from DOE Metric / Contract definitions

# Weekly Report *Example*

## Downtime 11/6/01 - 11/12/01

	Hardware	Software	Tune	FSD	Availability*
<b>Lost Time</b>	<b>33:11</b>	<b>1:09</b>	<b>6:32</b>	<b>9:40</b>	<b>78.0%</b>
<i>Last Week</i>	<b>26:04</b>	<b>7:44</b>	<b>0:14</b>	<b>11:52</b>	<b>68.7%</b>

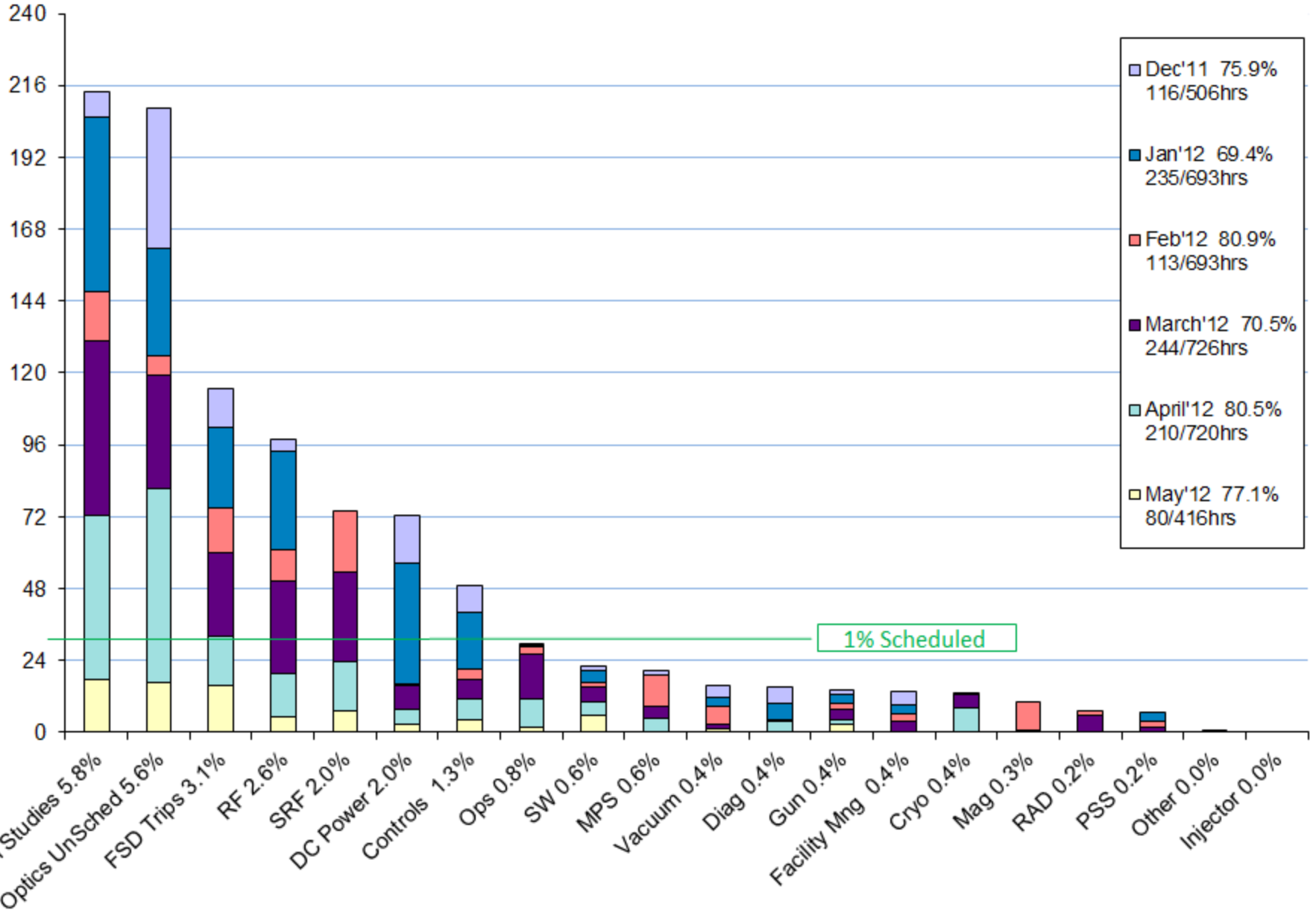
## Major Sources of Accelerator Downtime

Time Lost	Description	Action	Resp.
9:40	FSD trips		
8:48	Underground pipe failure	Saddle & seat replaced 11/13/01	Plant
6:08	XSEP6T PS water flow meter	Temp flowmeter 11/7/01	AES / HPEE
2:47	MARC5A shunt power supply	Replaced 11/8/01	AES
2:38	1L02-2 Klystron	Bypassed 11/12/01	AES
2:25	RF Separator Amp 6 failure	Repaired 11/7/01 (No Spare)	AES / RFES
2:13	Beam bleedthru and asymetry trouble	Multiple Injector checks	Gun
1:32	MBS04B11 trim card KMOL	Bypassed 11/13/01	AES
1:32	iocha1 card	Replaced 11/9/2001	AES
<b>37:43</b>	<b>Total Accelerator Major Sources</b>	<b>75% of 50:32</b>	

\* Best delivery to a Hall with FSD trips removed

# CEBAF FY'12 Lost Time by System

Hours Lost



Dec'11	75.9%	116/506hrs
Jan'12	69.4%	235/693hrs
Feb'12	80.9%	113/693hrs
March'12	70.5%	244/726hrs
April'12	80.5%	210/720hrs
May'12	77.1%	80/416hrs

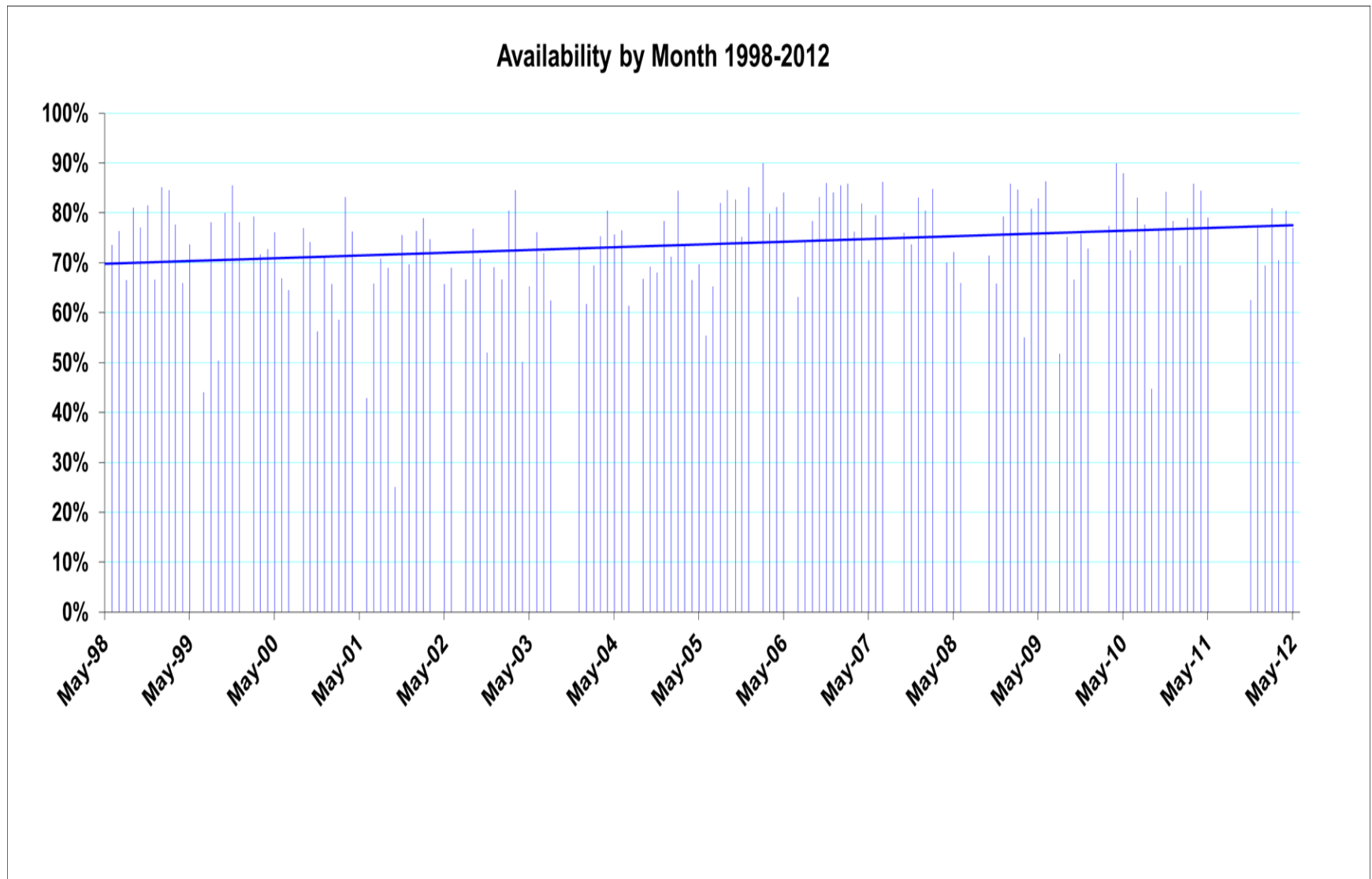
# Summary from **2002** Accelerator Reliability Workshop

- We do a good job responding to problems as they arise.

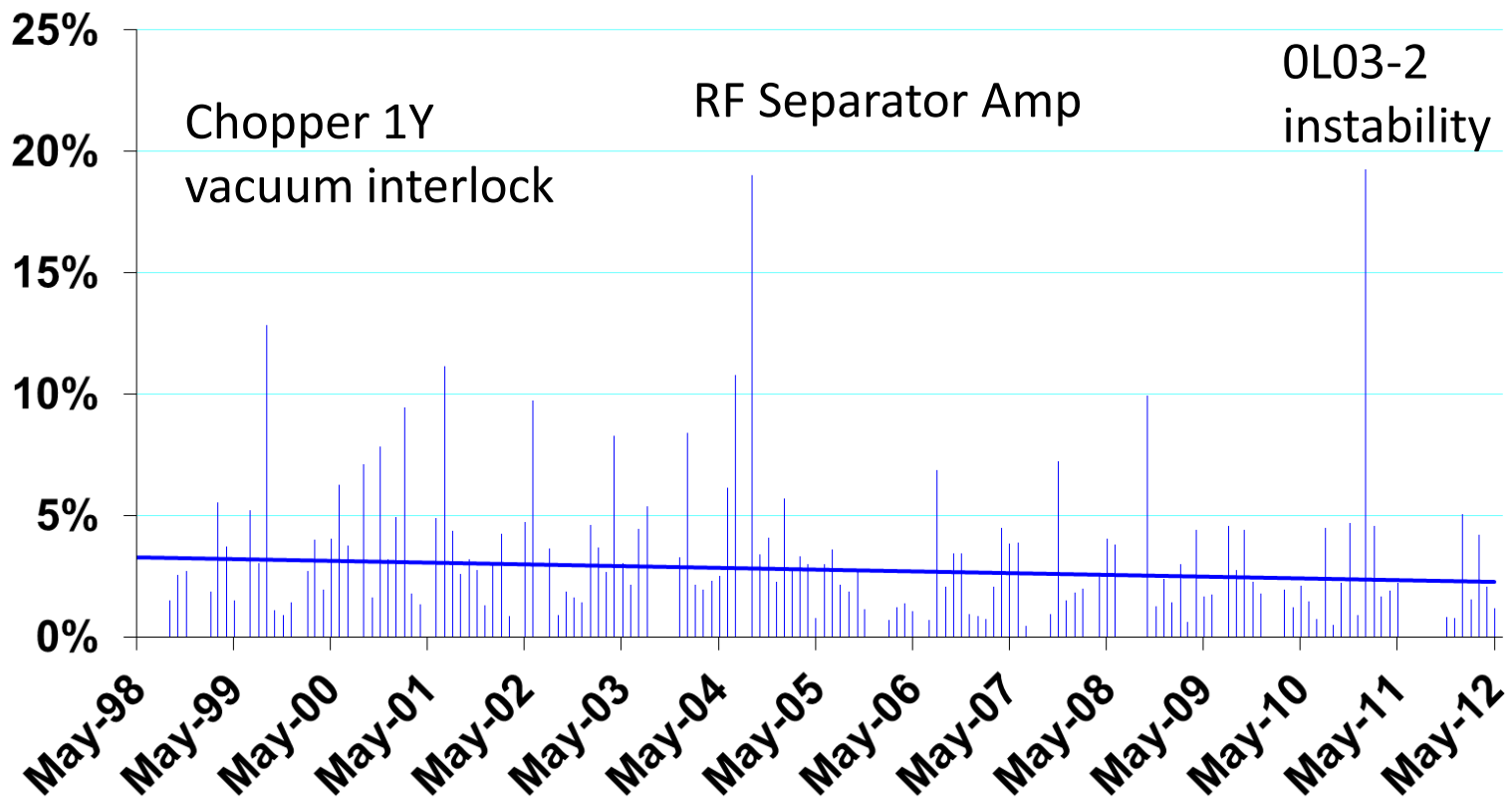
BUT

- Engineering support is needed for expanded early warning (predictive) diagnostics.
- Detailed analysis of system failures is necessary to raise machine availability to >80%.
- Maintaining machine availability over the long term will require significant resource commitment.

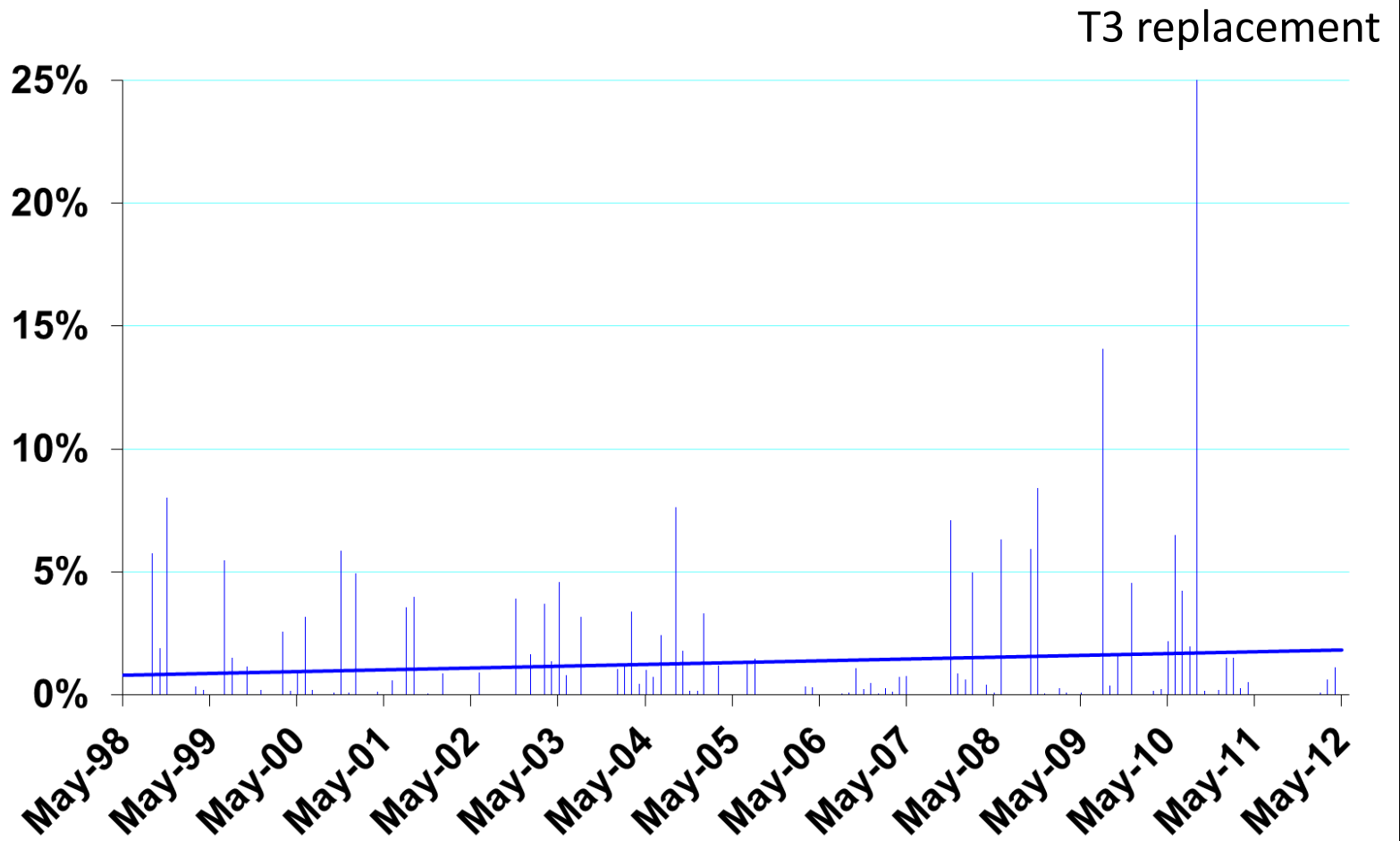
# 4/6GeV Availability Trend



# RF % Lost Time by Month

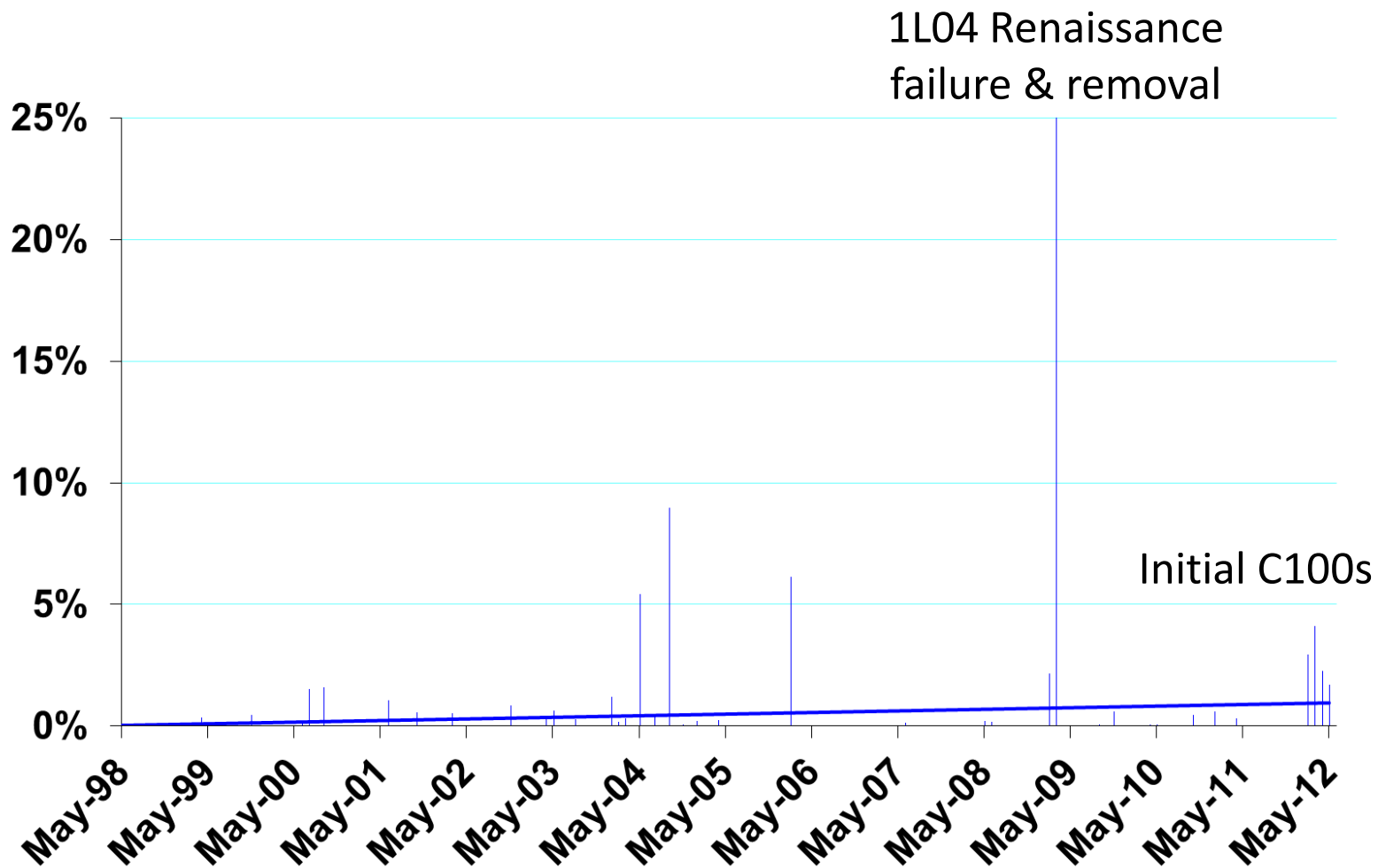


# Cryo% Lost Time by Month





# SRF% Lost Time by Month



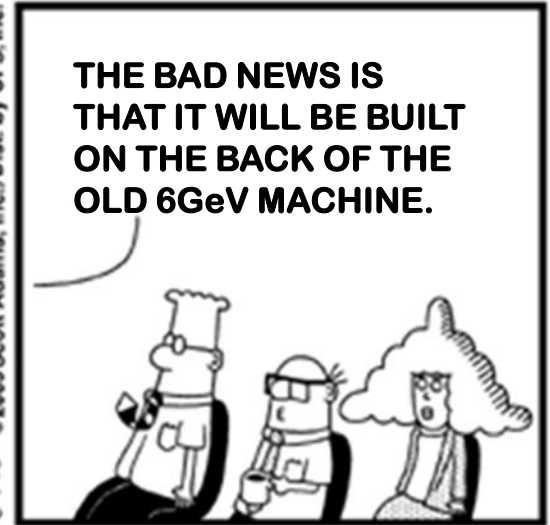
# UPGRADE CAPTION CONTEST



www.dilbert.com  
scottadams@aol.com



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# Issues and Open Questions

How can the machine reliability and availability numbers be improved?

# The Reliability Challenge





# DC Power % Lost Time by Month

