OP review in light of higher intensity

Are operations' really ready to deal with the real destructive potential of 0.5 – 1 MJ?

Introduction

- Case 1: Loss of beam due to stuff up
  - in principle caught by BIS
- Case 2: Putting the machine in a dangerous state so that if something does go wrong it is not properly protected
  - Collimation, protection devices in wrong positions
  - Local orbit bumps

- These can be:
  - genuine mistakes
  - incomplete sequence execution
  - complacency and/or a gung ho attitude
  - experts messing around when they shouldn't
  - equipment failures or glitches
  - …

Examples 1/2

- C1: ramp-down with beam still in machine (sequencer run through)
- C2: RQD not at injection level
- C1: coupling trim wrong order of magnitude
- C1: repeat trim of collimators by mistake
- C2: out of date sequence for collimators
- C1: Q’ measurement by mistake during squeeze
- C1: Mega-chirp at 3.5 TeV
- C1: use of 1/3 order to scrape beams
- C1: rogue RT packets

Examples 2/2

- Collimator actual trim – end of ramp
- New orbit in ramp with 1e11 with FB off
- Energy jumps in OFB system
- Injection Kicker didn’t fire – into fault
- Vacuum attempting to mask interlock with unsafe beam
- Transverse feedback by-passing hierarchy in V-plane
- Zeroing separation bump actual settings in stable beams
- Squeeze to 2 m with tertiary not in position

Preparation

Subject	Issue	Action	Responsible	Criticality
BIS pre-Ops checks	still on v0	Extend	CO	?
BLM MCS check	keeps failing, move to ramp down	fix, edit sequence	BLM, OP	2
BLM sanity check	failing erractically	fix	BLM	2
BCT	Systematic calibration	Sequencer task for standard ops, expert action otherwsie	OP	2
Extended settings check	Check against last time, check against limits	Sequencer task	LSA	2
Extended settings check	Check machine	MAD on the machine - sequencer task?	Gabriel	2

Should be straightforward to create reference beam processes and perform standard checks from sequencer

Injection

Subject	Issue	Action	Responsible	Criticality
Systematic checks of line trajectory and injection oscillations		make this automatic - should go to IQC	OP - Verena	2
Capture every shot	Do we?	Capture every shot and store (SDDS)		1
Transfer line collimators	To injection BIC. Do we check beam position, interlocks?			
Post injection beam tests	Orbit, tune, chromaticity		OP	2
Copy SPS users	How can we guarantee this is done?		OP	2
Scraping	Should this be done systematically?		OP	3
Automatic gain changes to BQM, BPMs etc	high/low sensivity. low sensitivty is set by hand before over-injection	to be set automatically by what?	BI	2. Beam will be dumped
MKI disabled	in principle task in the sequencer; but does not interlock if disabled	SIS		
MKI don't fire	it happens - why?		ABT	1
Over inject: beam not extracted	pilot dumped	SIS?		2
Machine not at injection	1.) Check for nominal hardware groups		OP	1
Machine not at injection	2.) No check for RF		OP	1
IQC	IQC: more straight-forward diagnostics (e.g. MKI not pulsed), RF bucket stuff should be sorted out, change of logic if no beam extracted and MKI/BLM problem.			2 - inconvenient
IQC	BLM IQC thresholds on D2, Q5, close to TCDIs still missing.			2
Injection sequencer	possibility to run > 1 schemes per beam?			2

Transverse damper to be made operational (& POC etc)

Ramp

Subject	Issue	Action	Responsible	Criticality
Incorporation & re-generation	wide open	Sequencer task for standard ops, expert action otherwise - take away the application	LSA	1
Tune feedback	stops - no alarm	audio alarm from application as stop-gap	Ralph	2 - beam will be loss via BLMs
No Sequence for squeeze	In preparation - commissioning to be finished	Create hardware group. Create sequence	OP - in progress	1
Beating not measured in squeeze		Measure - test squeeze	OP - scheduled	1

Controls

Subject	Issue	Action	Responsible	
gateways, networks (band width, response), servers, databases, timing loss of critical signals, displays, functionality etc, for post mortem, XPOC etc	Front-end monitoring - alarms - tend not to notice until we need them	Continual monitoring and bug fixes	CO	2
Alarms systems	Essentially not used	Configure properly,	OP	2
Change management	Unit tests following releases, TEST enviroment, dedicated machine testing time		CO	1
RBAC	Fully strict?	Strict in all modes. All hardware groups?	CO - done	1
BACK DOORS	Everywhere	CLOSE THEM		1
DIAMOND - frontends, servers	What's what? Often problems, status green, no-one knows what to reboot.			2
Use JIRA for registering controls issues			OP	2

LSA

Subject	Issue	Action	Responsible	Criticality
Actual trims	Limits	Improve GUI	Mario	1
Function trims	Wide open	Track all trims - display, sequencer?	LSA/OP	1
Function trims	Wide open	MAD on the machine	Emanuel	
BP space	Random walk possible	Enforce hypercycle, drive from sequencer only, otherwise lock applications	Greg	1
Production database	Wide open	shut the door, table level security if necessary	OP/CO	2
SOC management	completely ad hoc	who's responsible, who masks in SIS, YASP? who tracks?	OP	1
Configuration management	bumps, ramp functions etc.	manage?	OP	1
Equip state	a little too powerful	disable?	Eek	2

Sequencer

As noted yesterday – sequencer should not be relied on to ensure that things are done properly.

If a task is skipped it something else should catch it
But....

Erroneous run through	Bugs		OP/CO	1
Ergonomics	Clarity, vision	re-visit GUI	CO	2
Skipping tasks	Critical tasks missed at various phases	unskippable tasks	OP/CO	1
Out dated sequences	Things end up in the wrong state	delete	OP/CO	1
Tracking progress	check list, task output	re-do GUI	OP/CO	1
State machines	what happened?	Potential solution exists - test	CO/OP	2

Plus alternative pathways…

Orbit 1/2

BPM gain changes	How do we reliably deal with this?		LSA	1
Latching BPM interlocks				2
Orbit feedback behaviour - holding tolerances at critical locations	Can it do with the present strategy? Disable wonky BPMs - consequences?	Coherent correctors/orbit & experience	RS/JW	1
Tolerances at critical locations.	Are they tight enough? How does one deal with intensity dependance? Local orbit stablization	To be tighten with experience. Work in a fixed intensity range plus appropriate tolerances		1
Build up of local bumps	Either by operator or OFB	SIS - COD settings - tricky in ramp & squeeze. Extented SIS checks.	JW	1
Reference orbit	How do we guarantee that the correct reference is used?	Reference to database, s/w check	JW/KF	1
Correcting back to reference orbit	Is it clear how? How to avoid features creeping in? Can OFB used reference rather tha last measured?	Feedback fully deployed - strategy?	BI	1

Orbit 2/2

Locking RT references	rogue RT packets	Functionality now provided by FGC, deployed, to be used	Steve Page	1
Feedback not switched off when required	Loose beam, ramp-down with FB on	Sequencer task in ramp-down sequence	OP	2
Moving beam at tertiary collimators with lumi scan knobs	Moving the TCTs into the async beam dump danger area	Actual trim limits on bump amplitudes. SIS? Fixed display - beam at tertiary, limits	OP	1
OFB	Fair to say that this is not rock solid and not fully tested	See over…	Ralph S. & co	1
Tune interface	Push Q' measurement by mistake	Modify interface - are you sure you want to start a Q' in this mode?	Ralph Steinhagen	2
BPMS etc.	unreliable measurements	bunch tagging	Rhodri Thibaut	2

Feedbacks

- RT input into
  - Trim quads
  - Orbit correctors
  - Sextupoles
  - Skew quadrupoles
  - RF frequency
- Plus
  - Transverse dampers
  - MQKA etc

Fabulous job of course but…

Real potential for fast and major beam perturbations

05-06-2010 – mid stable beams

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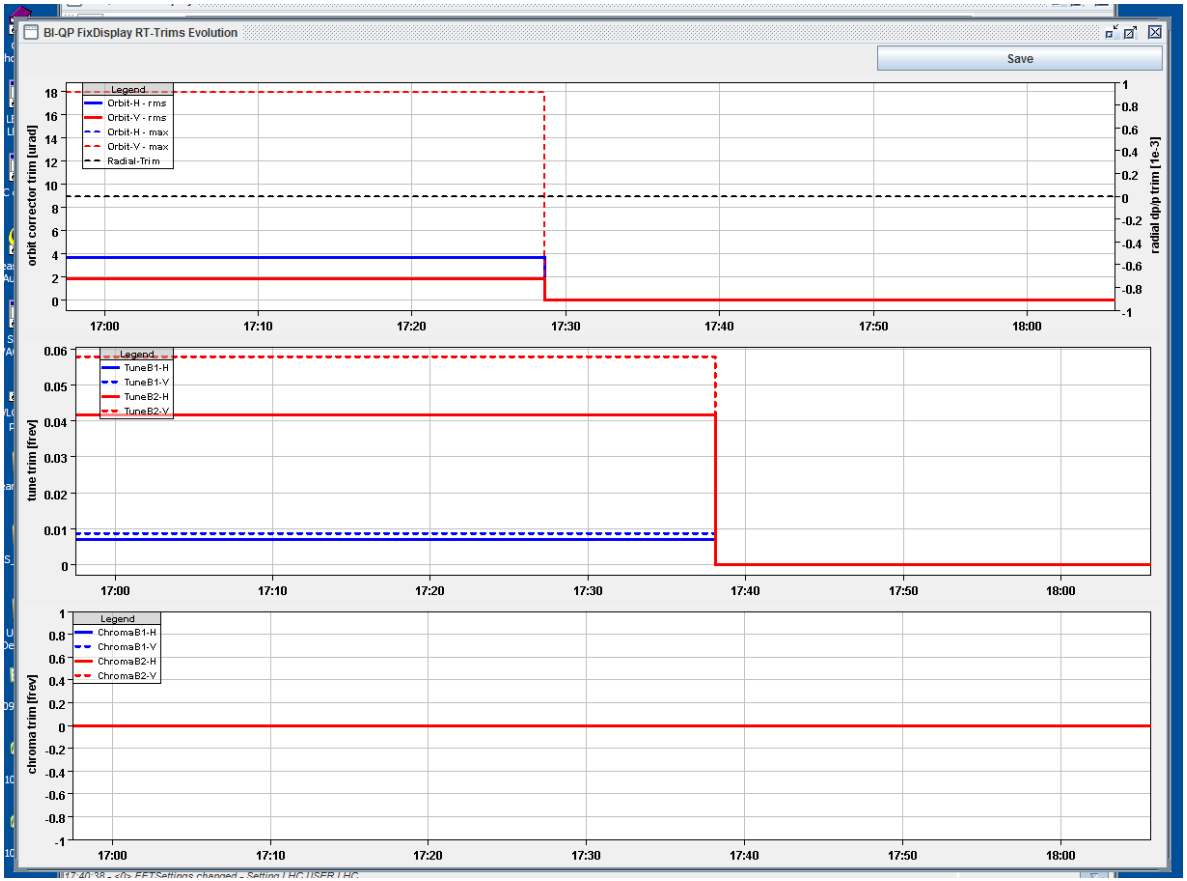


Beams lost - BLM in IP7. We are investigating why.

We noticed that the orbit feedback jumped to zero at ~17h28.

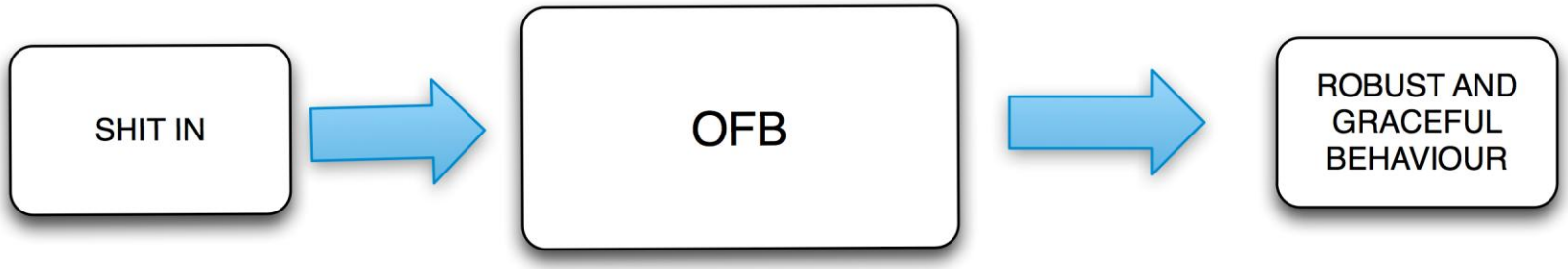
FBs

- Not a machine protection system
- But a critical system for machine performance
- Clear potential for provoking fast and total beam loss

- Thorough testing of all exceptional inputs
- Fully and thorough testing of correction strategy to make sure that dangerous features are not introduced into closed orbit
- Don’t use it when you don’t need it.
- RT inputs should be disabled at FGC level when FBs not required

OFB – system design

What we must have



Feedbacks continued

- Unnoticed stopping of tune feedback in ramp
- Programmed change of reference
- Bump strategy – have to able to perform change of separation and crossing angle bumps
- How do we stop chirp, BQK being used at inappropriate moments?

- Too dependent on single software engineering resource
- Code review
- Code repository and release mechanism
- Unit tests & standard tests with beam

Collimators

Subject	Issue	Action	Responsible	Criticality
No squeeze factor. No SIS check.	TCTs in right position		BIS	1
Energy thresholds	How does one guarantee that energy thresholds are sent and are correct?		COL	1
Beta beating	Accidental changes	settings checks, trim lock out		2
Beta beating in ramp and squeeze	Need some statistics	at least measure it fully		1
Local orbit stablization	Seen tungsten become a primary	SIS, proper orbit strategy		
Totem	?			2
TDI	Are the TDI still in at start of ramp? Are they in throughout the injection process?			2
Drive in TDIs at inappropriate moment	How do we prevent this?		COL/OP	2
Full and proper management of collimator/protection device state space	Has to be fully guaranteed			1

Operations - general

- Enforcement of operational envelope
- PM sign off - forced run through of additional checklist
- Systematic feed-forward – sequencer
- OP wiki or other repository for information exchange

Subject	Issue	Action	Responsible	Criticality
Mode discpline	Sloppy, by hand, error prone	State machine	CO/OP	2
Handshake discipline		despair	OP	3
Wrong timing table	Playing by hand	Load, drive from sequencer, RBAC the application		2
Misconfigured timing table	editing by everybody, by hand.	RBAC the application		2
ERGONOMICS	are a joke, non-fixed fixed displays, floating keyboards etc.	Work in progress	Alastair, Pierre	2
FIXED DISPLAYS	all over the place	fix 'em	OP	2
Machine state after MD etc	rollback required	Application in development	LSA	1
Masking, latching and skipping		Force SBF	OP	1

Conclusion

Are operations' really ready to deal with the real destructive potential of 0.5 – 1 MJ?