Injection Sequencer Requirements

What do we want to do:

1. Get a list of the different Injection Scenarios

2. Work out in great detail one of them, as starting point, e.g. Nominal Injection

3. When working out this Use Case we want to address things like:

- how and when the injection equipment is switched on/prepared;
- how and when different beams will be requested;
- when different timing tables are loaded;
- when and which equipment (state? Setting?) changes are needed;
- what (beam? equipment?) checks have to be made and with what methods;
- what states and modes are needed;
- what are the (entry, exit) conditions for state and mode changes;
- when and which critical settings need to be loaded;
- the machine protection aspects (SBF, BPF, TDI/TCDI setting-up);
- Abort scenarios and conditions to proceed;
- sets of 'tasks', sub-sequences and sequences;
- and a long etc.

4. How do we do this:
- first compiling all the existing information (which is a lot)
- we have created wiki pages
  http://wikis/display/LHCOP/LHC+Injection+Scenarios
- periodic discussions with the different people

5. What is expected to be the final product:
- UML description of the different scenarios
- Implement this description in the software, taking into account the requirements document specifications

LHC-CQ-ES-0001: LHC SEQUENCER – OPERATIONAL FUNCTIONALITY, INTERFACES AND REQUIREMENTS

- **LHC (Injection) Sequencer**

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LHC Nominal Scenario

THESE ARE STATES.
THE ASSOCIATED SEQUENCES
ARE EXCUTED WITHIN THEM

NB: All transitions to "Beam Dump Fired"
supressed for the sake of clarity. Can clear
go there from anywhere.

MODE: SET UP

Ready for Injection Plateau
event OP request/ ramp to injeciton level

Pre-Injection Plateau
event OP request/ perform pre-injection plateau sequence
entry/ start timer
event OP request/ Ramp to injection

[SPS ready]

ramp finished

Injection Plateau - no beam
entry/ Check all settings
do/ Prepare for first pilot sequence
exit/ Change Mode to "INJECT PILOT"

OP request

MODE: Pilot Injection

Ready for pilot

OP request

Injecting Pilot - ring 1
entry/ Check Settings
do/ Pilot injection request

pilot injected

R1 beam lost

Circulating Pilot - ring 1
entry/ Check injection sequence
do/ Circulating pilot checks
do/ Prepare intermediate sequence
entry/ BPFlag to true

Injecting pilot - ring 2, circulating pilot ring 1
entry/ check settings
do/ pilot injection request R2

pilot ring 2 injected

Circulating pilot both rings
do/ two beam checks

MODE: Intermediate Injection

Inject Intermediate - ring 1
entry/ Check settings
do/ Monitor Pilot
do/ Intermediate injection request sequence

intermediate ring 1 injected

Circulating Intermediate - ring 1
entry/ Check injection
do/ Intermediate sequence
do/ Check tune, orbit, chromaticity

OP request[protection devices positioned] / dump intermediate

inject intermediate ring 2, circulating intermediate ring 1
do/ intermediate injection request [ring 2]
exit/ SafeBeamFlag ring 2 to false

circulating intermediates both rings
entry/ Check injection
do/ intermediate sequence - R2

MODE: Nominal Injection

Reinject Pilot for Nominal - R1
do/ pilot injection sequence
do/ check injection
do/ Circulating pilot checks
exit/ SafeBeamFlag to false

OP request[R1 pilot]

reinject pilot for nominal ring 2
do/ pilot injection sequence
do/ check injection
do/ circulating pilot checks
exit/ SafeBeamFlag R2 to false

OP request[protection devices positioned etc etc]

Ready For Nominal Injection
entry/ Alert Injectors
do/ Check everything!!!
do/ monitor pilots

OP request

MODE: Injection Nominal
do/ Nominal Injection sequence

Circulating Nominal
do/ Pre-ramp checks

Ramping Down
entry/ Perform Rampdown sequence
do/ Monitor power converters
exit/ Check all power converters
exit/ Change mode

ramp finished

Recover

Beam Dump Fired
entry/ XPOC
entry/ Post Mortem

OP request[Experiments OK]

Unstable Beams

Sudden degradation

Stable Beams

Large adjustment required[Experiments OK] / Mode change

OP request

OP request / Mode change

OP mode change

Beam Dump Warning

OP request / Mode change

Adjust

Squeeze

Flat Top

End Ramp

Prepare ramp
do/ prepare ramp sequence

Ready to ramp

Send Ramp Timing

Ramping
do/ monitor PC, RF
do/ periodic measurem…

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