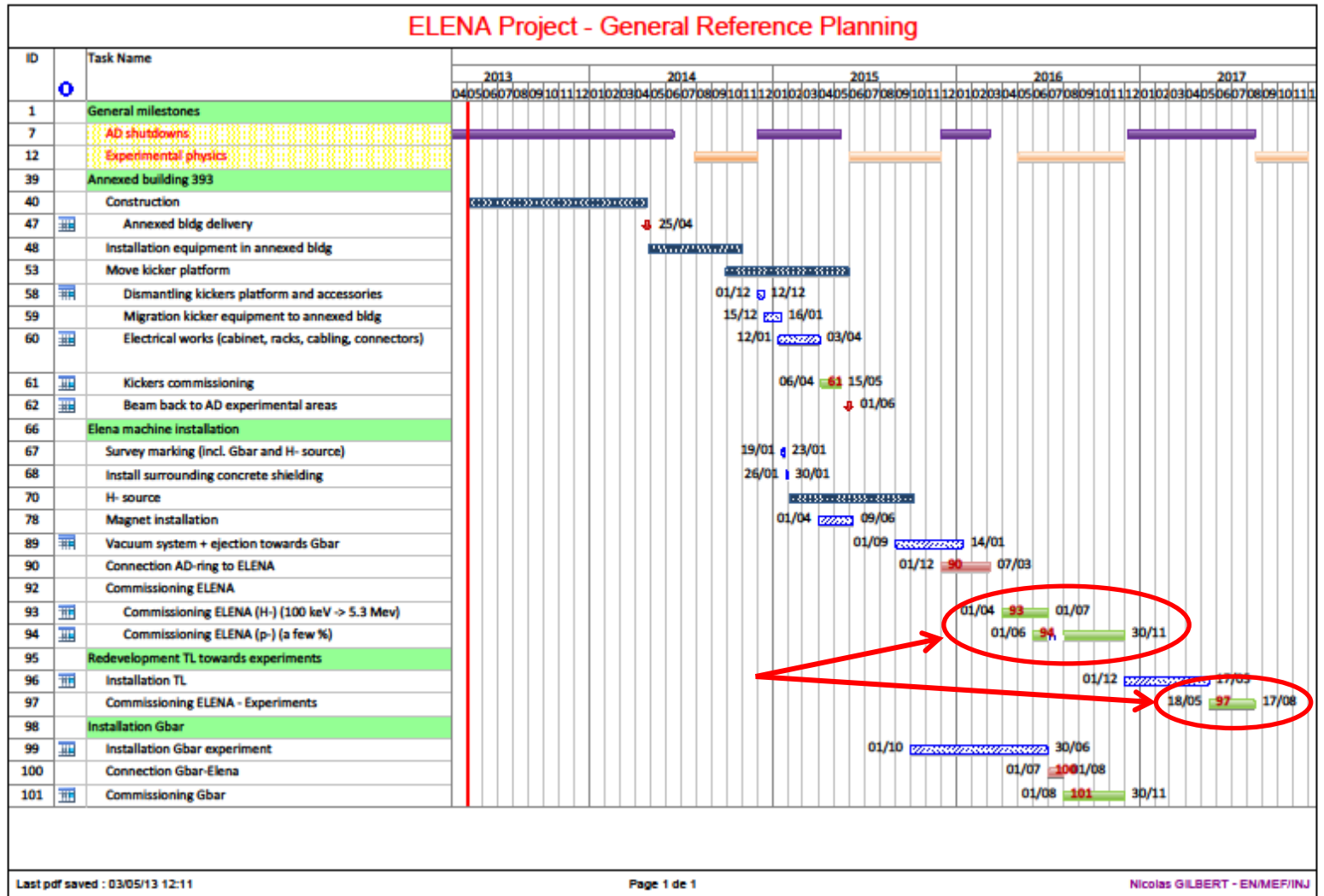


# ELENA: Commissioning & operation

# Introduction

- AD commissioning experience:
  - Very slow s-u due to long cycle and destructive diagnostics
  - Beam cooling at low energies very sensitive to beam alignment & drifts
  - Difficulties somewhat underestimated => longer set-up than foreseen
- ELENA has much smaller energy range and 50% less beam cooling systems !

## ELENA Project - General Reference Planning



# Key dates

- ELENA HW installation: ~ 2015
- In 2015 and until 04/2016; commissioning & tests (without beam) of:
  - All machine HW (Magnets, Power supplies, RF, e-cooler, Vacuum, Kickers, Septum etc.)
  - Diagnostics (BPM:s, GEM:s, I. pickup, Schottky system, ej.line pickups, tune msmnt, scrapers, BTV:s etc.)
  - Control system/timing/sequencing
  - SW tools: Cycle Editor/OASIS/YASP etc.
  - H-/p source
  - Access/interlock/safety system

# Key dates

- ELENA commissioning with beam:
- Setting-up with H-/p: 1/4/2016 – 1/7/2016
- Setting-up with pbars: 1/6/2016 – 30/11/2016
  - Shifts to be planned in agreement with the physics program
- Physics stop for dismantling of old ejection lines and installation of new 100 keV lines 1/12/2016 – 18/8/2017
  - Setting-up of new transfer lines with beam: 18/5/2017 – 17/8/2017

# ELENA setting-up 1

- 100 keV *protons* @ 1 Hz, ring in normal polarity & reverse direction:
  - Set up xfer line from source incl. electrostatic “cross”: need BPM, BTV:s
  - First injections & circulating beam: need ring BPM:s, tune msmnt/correction, Schottky system
  - Orbit/tune/coupling/chromaticity: validation of systems, corrections: need RF
  - Acceptance check/studies: need scraper system
  - Lifetime/blow-up rates
  - Lattice validation with orbit response msmnts
  - Study effects of e-cooler solenoids
  - Acceleration tests & ramp corrections: further RF setup needed
  - Repeat at intermediate & top plateau

# ELENA setting-up 2

- 100 keV  $H^-$  @ 1 Hz, ring in normal polarity & normal direction:
  - Set-up e-cooler
  - If  $H^-$  lifetime is too short: use *protons*, ring in reverse polarity & normal direction, additional corrections might be necessary later for *pbar* operation due to remanence effects
  - Recombination detection (*protons*), additional tool for alignment/tuning
  - Extensive use of scraper system for profile and emittance msmnts
  - Schottky analysis for long. Emittances
  - Cooling time studies
  - Lifetime/blow-up rates

# ELENA setting-up 3

- 100 keV *protons* or *H-* @ 1 Hz, ring in reverse or normal polarity & normal direction:
  - Initial setting-up of the extraction and ejection lines (only short sections installed at this stage for main and GBAR lines)
  - Need u-wire monitors + high sensitivity intensity msmnt pickup in lines

# ELENA setting-up 4

- 5.3 MeV *pbars* @ .01 Hz, ring in normal polarity & normal direction:
  - Set-up transfer line from AD : need BTV, GEM, TFA7049, u-wire monitor. (optics validation)
  - RF synchro s-u for bunch to bucket transfer
  - Ramp studies: orbits, tunes, duration
  - Further e-cooler set-up
  - Set-up of nominal cycle; obtain nominal emittances
  - Bunched beam cooling &  $h=4+8$  @ extraction

# ELENA setting-up 5

- Further studies with *pbars*:
  - Space charge studies on higher intensity bunches (extraction on lower harmonics); compatibility with ejection lines
  - Deceleration efficiency > 60% ?
  - Synthetic B-train, validation for use in regular operation
- => ELENA ring commission completed
  - 8 months total time

# ELENA setting-up 6

- 18/5/2017:
- Extraction of 100 keV pbars
  - Setting-up of  $\sim 100\text{m}$  electrostatic xfer lines
  - u-wire “semi-non-destructive” profile monitors
  - Set-up of deflectors used for fast switching between experiments
  - Set-up of beam request/distribution SW/HW
- 3 months available

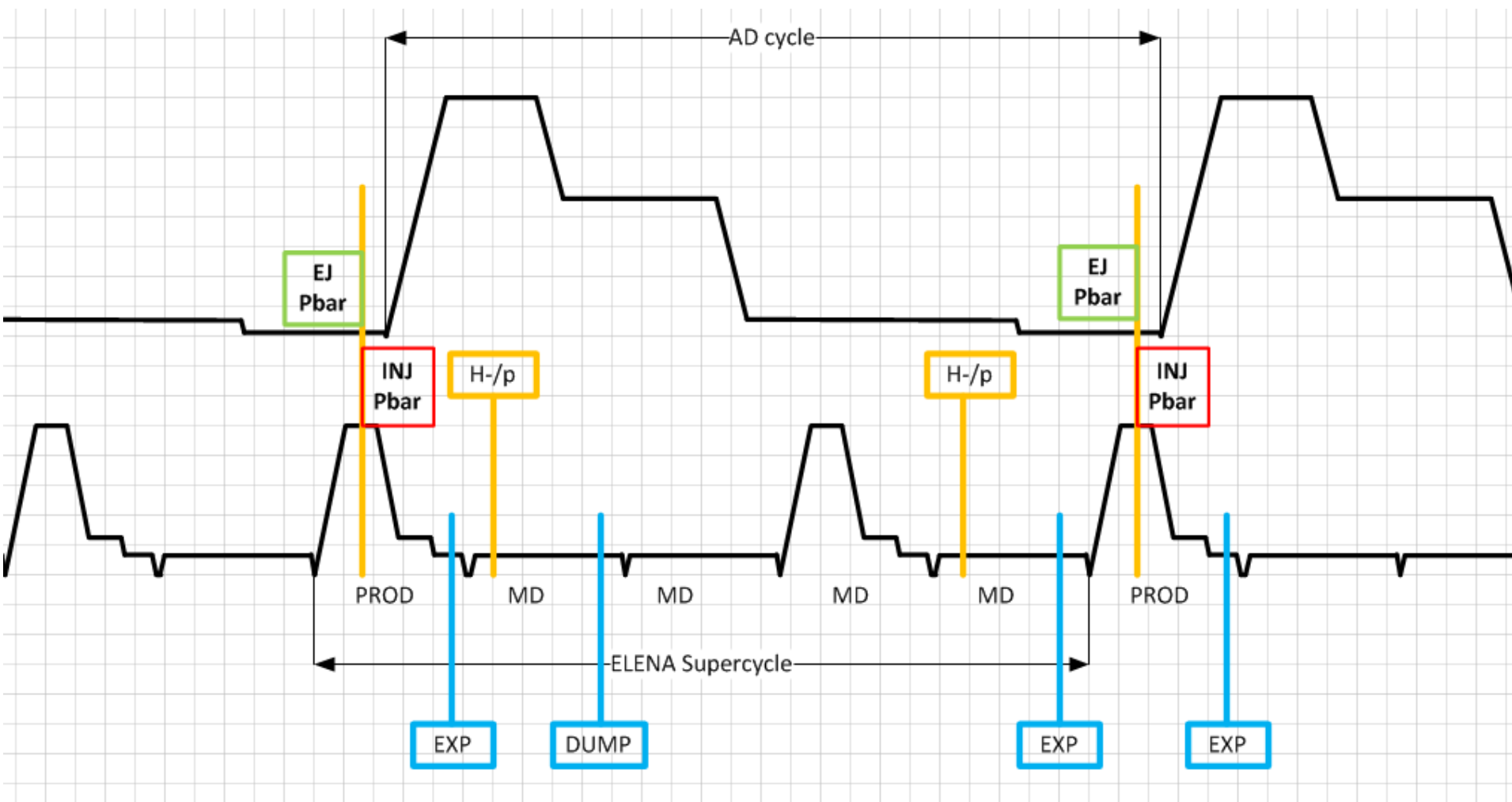
# Sequencing – 1/3

- Availability
  - Optimize the beam request in the beam production chain
  - Maximize the beam availability for experiments,
  - Maximize the MD beams
- Flexibility
  - Consider future needs
- Simplicity & Functionality
  - Cycle Editor
  - Rules based Switching

# Sequencing – 2/3

- Based on ADE sequencing concepts
- ELENA will have a super-cycle (magnetic remanence effects will determine if different cycles can be used)
- ELENA cycle can be:
  - Coupled to the Production Chain (pbar)
  - Standalone mode (H-/p)
- Bunch destination «On Demand» and prioritized

# Sequencing – 3/3



# Who ? How ?

- Commissioning:
  - Op-team (8) will work from ACR
  - 2 shifts per day can be covered
  - Eq. specialists will participate
  - External help is welcome

# Routine operation

- Once AD/ELENA operational stability obtained:
- Machine supervisor from BE/AD/OP team will look after the machines during day-time and be on-call on weekly basis 24h/24, 7d/7
- BE/OP/PS section will do routine operation + initial troubleshooting from the ccc during nights and weekends
- Equipment groups ensure “piquet” or best-effort coverage
- Note: yearly AD start-ups very time-consuming, with ELENA even more so