40m upgarde plan scrutiny

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Rev. A: 2009/08/22
Rev. B: 2009/09/22
Rev. C: 2009/09/29

40m upgarde plan scrutiny

- **Purpose**
- **People**
- **Task list up**

  By category ~ What has been done / what should be done
  - Interferometer design
  - Optics
  - Electronics
  - Mechanics
  - Digital control

  By development phase

- **Time Line**

Reference:

LIGO-T080074-00-R

40m upgrade Wiki

Purpose of the upgrade

Demonstration of the AdvLIGO interferometer technologies

- **Prototyping of AdvLIGO LSC**

  Lock acquisition

  "Prove AdvLIGO LSC actually works"

  Green laser locking

  "Realize lock of the arms independently from the main beam"

  "Achieve semi-deterministic lock & smooth handing off"

  Noise mechanisms / DC readout

  "Discover and/or confirm by a model RSE specific noise couplings"

- **Tuned / Detuned RSE comparison**

  "Address advantage and disadv. of the tuned/detuned configuration"

  "Demonstrate smooth transition"

- **RGC based digital control system**

  "Demonstrate complicated LSC code on the connected multiple systems"

  "Establish rapid prototyping methods with simulated plants on the processors"

Purpose of the upgrade

To do anything useful to make the AdvLIGO easier / faster

- DC&Dither technologies

Offset lock and handoffs

AF WFS technique

"Develop and characterize various new useful techniques"

- Interferometer Diagnosis

Cavity characterization using aux. laser injection

"Provide a method of precise in-situ characterization of the interferometer"

- Development / test bench of advanced technologies

GigE CCD WFS technique

Adaptive noise cancellation

"Demonstrate how it works"

"Understand and improve its limitations"

People

Alan	Supervising
Rana	Supervising / Project control / (adaptive)
Steve	Vacuum / Purchasing / Mechanics
Bob	Vacuum
Koji	Project control / Optics / Electronics / Mechanics / Digital
Peter	Digital control / Locking / LSC
Joe	Digital control / Computing / (phase camera)
Alberto	Electronics / Locking / LSC / noise
Jenne	Mechanics / Optics / Electronics / (adaptive)
Kiwamu	Optics / Electronics / Locking / LSC / noise
Aidan	Green lock planning / installation
David	Green lock planning / installation
Zach	Mechanics / Installation assistance

Category-wise task list up

Interferometer design

- **"Done" (or decided)**

Interferometer design

AdvLIGO like optical configuration
Same level arm finesse (F~450) => main concern: test of central part
PR gain decided for carrier, SR gain decided by sensitivity
Small asymmetry, extraction of f2 by a undercoupled SEC
=> good through put of f2 to the dark port

Use of PRTT1 Trans as POP

Put less importance on WFS

No change in MC => fine tuning of mod freq. will be necessary

- **"To Do"**

Revisiting the optical parameters

Summarize power budget and resonant conditions in the cavities
Compare with current finesse / loss / reflectance (coupling)
Current recycling gain ~6.3 -> Rcom=86%, loss?

Summarizing lock acquisition / signal extraction scheme

Make diagrams

Tuned or detuned?

Tuned / offset detuning
What should be compared?

Optics / Optical layout

- **"Done"**

Main Optics order

ITM2+2 / PRM1+1 / SRM1+1
Polisher: Coastline Optics
Coater: ATF

Repolish of ITMs (+2weeks)
Coating (3weeks)

Detailed optical layout in vacuum

- **"To Do"**

Checking specs of the mirrors / lenses in the vacuum
Making optical layouts of the tables / Update the table layout

Specs of the folding mirros to be investigated and purchased
Specs of the MMT mirrors to be investigated and purchased (see next page)
Specs of various aux mirrors and mounts in vacuum
General on table mirrors and mounts
Check unfavorable optics on the PSL table

Quoting & order of ETMs

Specs for the green

Optics / Optical layout

- **"To Do" (cont'd)**

Consideration of the effect of the wedge angles

Wedge deflection design

Blank wedge plates for installation?

Schedule some tasks

Realignment of MC to have beams centered on the mirrros

Mirror wiping of the current FP mirrors ~ ask suggestions of Bob

Optics characterization with GariLynn for mirror metrology

Optics ~ PSL table layout

- **"To Do"**

Possible PSL replacement by 2W innolight

Need detailed design of the PSL table

Reference Cavity after the PMC?

Upgrade of the intensity stabilization
(Optics/Electronics)

Green injection

- **"On going"**

Fiber noise cancellation experiment
SHG phase noise measurement

- **"To Do"**

Deciding the ETM specs
Revisit the green frequency noise spec
Decide finesse of the cavity (~50?)
Ask for the new substrate / coating

Making detailed design of the transmission tables
Mode macthing / alignment procedure
Table layout / Optical components and mounts
Need lasers? Need new tables and enclosures?

Detailed consideration of handing off from green to IR
RGC implementation

Electronics

- **"Done"**

Multiplier circuit quote

Prototype triple resonant modulator

- **"To Do"**

Making detailed diagrams for the detection chain

Modulation / Detection / Demodulation

Fabrication of modulation electronics

Modulation electronics assembly & test

Triple freq modulator (detailed test & finalization)

Fabrication of detection electronics

Fabrication of the resonant PDs (11MHz/33MHz/55MHz / DD PDs?)

Demodulator (single / double)

Mechanics

- **"To Do"**

MMT mechanics design&fabrication

Extend bases?
How to actuate the length?
Mode matching procedure?

Passive TT development

Basic test (f_res, Q)
Isolation test?

Mounts for the in-vac mirrors

Installation assistance jigs (x3)

To record and point the spot position in the vac cahmber
Should have the same foot print as the SOS

SOSs (x2)

Check with Steve
Preparations (clean? bake?)

Digital control system

- **"Done"**

RGC code running on megatron (with ADC/DAC or with SHM)
Interface blocks from ADC to AA/AI connectors under development

- **"To Do"**

Detailed plan for the upgraded system
List up needed components
Design LSC codes
Development of new EPICS panels

Single machine test ~ integration of RFM
Stand alone test / Connection test
Cavity control test

Multiple machine test
Simple test with one FP?
(suspension control / cavity lock / alignment script)

Full system upgrade

Mode spacing measurement

- **"Done"**

Demonstration for the arm cavities

FSR measurement

Cavity g-factor measurement

Characterization for the SRC/SEC on going.

- **"To Do"**

Measurements for the new PRC/SEC

Measurements for the asymmetry / BS branching ratio

Reflect the info to the fine adjustment

Measurements for the new arm cavities

Miscellaneous

- "To Do"

Cleaning of the cabling?

Optical lever?

Upgrade of the console desk?

Milestone oriented task listing

Development phases

Preinstallation preparation (~XX/XX/2009)

Test with the current configuration
Purchasing Optics / Mechanical design / Electronics preparations
Digital control

Installation (XX/XX/2009~XX/XX/2010)

Works in vacuum chambers / Works on the tables
Electronics preparations / Digital control

Phase1 experiment (XX/XX/2010~XX/XX/2010)

DRMI investigation
(Full lock achievement)

Phase2 experiment (XX/XX/2010~XX/XX/2011)

ETM replacement
green laser installation / locking
Full lock achievement

Preinstallation preparation *(~XX/XX/2009)*

- Non-invasive works

[IFO design] revisit optical parameters / Comparison with the current meas.
[IFO design] summarize lock acq. / signal extraction scheme

[Optics] check specs in-vac optics / order
[Optics] making/updating optical layouts of the tables
[Optics] check unfavorable optics on the PSL table
[Optics/Green] decide ETMs specs / order ETMs
[Optics] check wedge effects / consider blank wedge plate
[Optics] new main optics inspection / characterization

[Mechanics] MMT mechanics design / fabrication
[Mechanics] passive TT development (fabrication / basic test / further test?)
[Mechanics] order in-vac mounts
[Mechanics] check SOSs / Assembling
[Mechanics] installation-jig design / fabrication

[Electronics] detailed diagrams
[Electronics] detection electronics (PD/Demod/Mudulation electronics)
[Electronics] multiple resonant EOM

[Digital] detailed planning / hardware preparations
[Digital] single machine RFM test

[Green] SHG / Fiber noise experiment at Bridge lab.

Preinstallation preparation (~XX/XX/2009)

- Invasive works

[Digital] single machine cavity test / multiple machine tests
[Digital] multiple machine tests

[Optics] MC realignment
[Optics] mirror wiping experiment

- Invasive work on the PSL table

Mach Zehnder removal / EOM placement & modulation check
Unfavorable optics replacement (periscope, etc)
MC lock confirmation

Laser replacement / intensity stab (after the vent)

Installation (XX/XX/2009~XX/XX/2010)

[Digital] Full system upgrade (before the installation? after?)
[Green] Detailed design of the transmission tables
[Green] Detailed consideration of handing off from green to IR

Installation procedure

- Work in the vacuum chambers

Removal of PRM/SEM/ITM/MM
Spec check for existing optics, if necessary

MC output mode ~ beam scan
Rough estimation of MM telescope length
MMT placement
MMT output mode ~ beam scaning / adjustment

PRC Folding Mirror TT placement
Hit both ETM center
- need PRM wedge correction
- jig+dummy wedge simulator (1064AR coat?) x 3

PO ports alignment (need a pilot beam???)

Some facts & ideas
- there is no gate valves
- very weak trans. through MC even for P pol
- use very weak S pol resonance
- align beams without ITMs
- correct ITM wedge with dummy optics
- hit the center of ETMs (use a target plate with hole)
- put ITMs
- use script to find first fringes

Installation *(XX/XX/2009~XX/XX/2010)*

- Work in the vacuum chambers (cont'd)

ITMx2/PRM/SEM placement / cabling / damping control

Michelson Fringe
SEM folding placement

OMMT/OMC (lock & mode matching)

SEM placement
SEM placement / alignment

Out-vac alignment / Optical lever adjustment / pointing record

Vacuum work completed -> evacuation

- Post installation adjustments

Coarse alignment / fringes?

FP arm lock / IMMT tuning
OMC lock / OMMT tuning?

Phase1 experiment *(XX/XX/2010~XX/XX/2010)*

DRMI investigations
[Commissioning] TBD

Full lock achievement if possible
[Abs Length] Abs length measurements for the arm cavities/PRC/SEC

[IFO design / Green] new ETM optics inspection
[Green] Transmission table construction

Phase2 experiment *(XX/XX/2010~XX/XX/2011)*

ETM replacement
[Commissioning] TBD

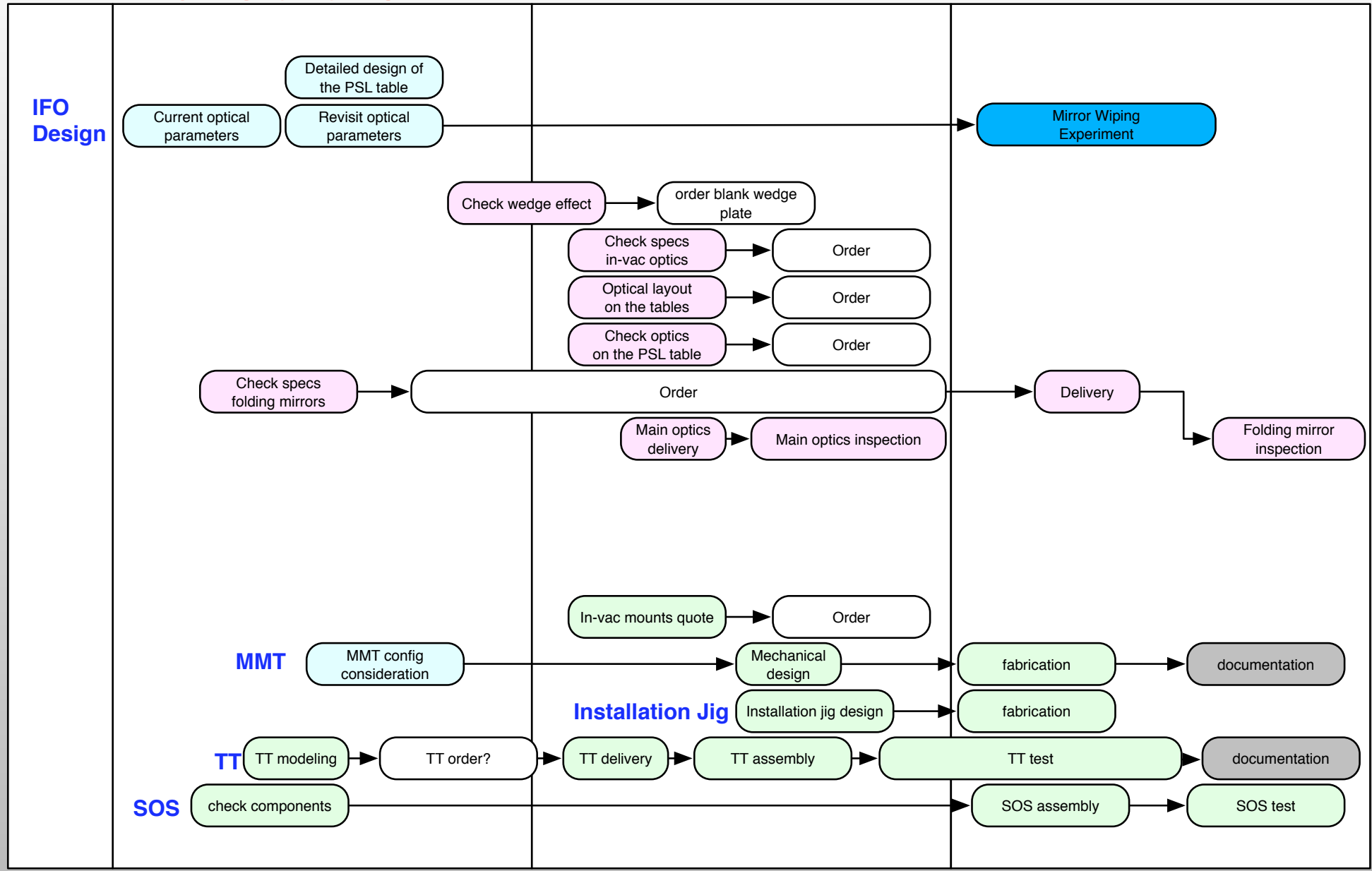
Green laser installation / locking
[Green] Handing off from green to IR ~ RGC implementation

Full lock achievement
[IFO design] Tuned / detuned comparison

Time line

Time line

Preinstallation



Installation

Laser replacement

MC realignment

[Optics] Laser Replacement??
[Optics] MC realignment

- Invasive work on the PSL table
Mach Zehnder removal / EOM placement & modulation check
Unfavorable optics replacement (periscope, etc)
MC lock confirmation

Installation procedure

- Work in the vacuum chambers
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PO ports alignment (need a pilot beam???)

- Work in the vacuum chambers (cont'd)
ITMx2/PRM/SEM placement / cabling / damping control

Michelson Fringe
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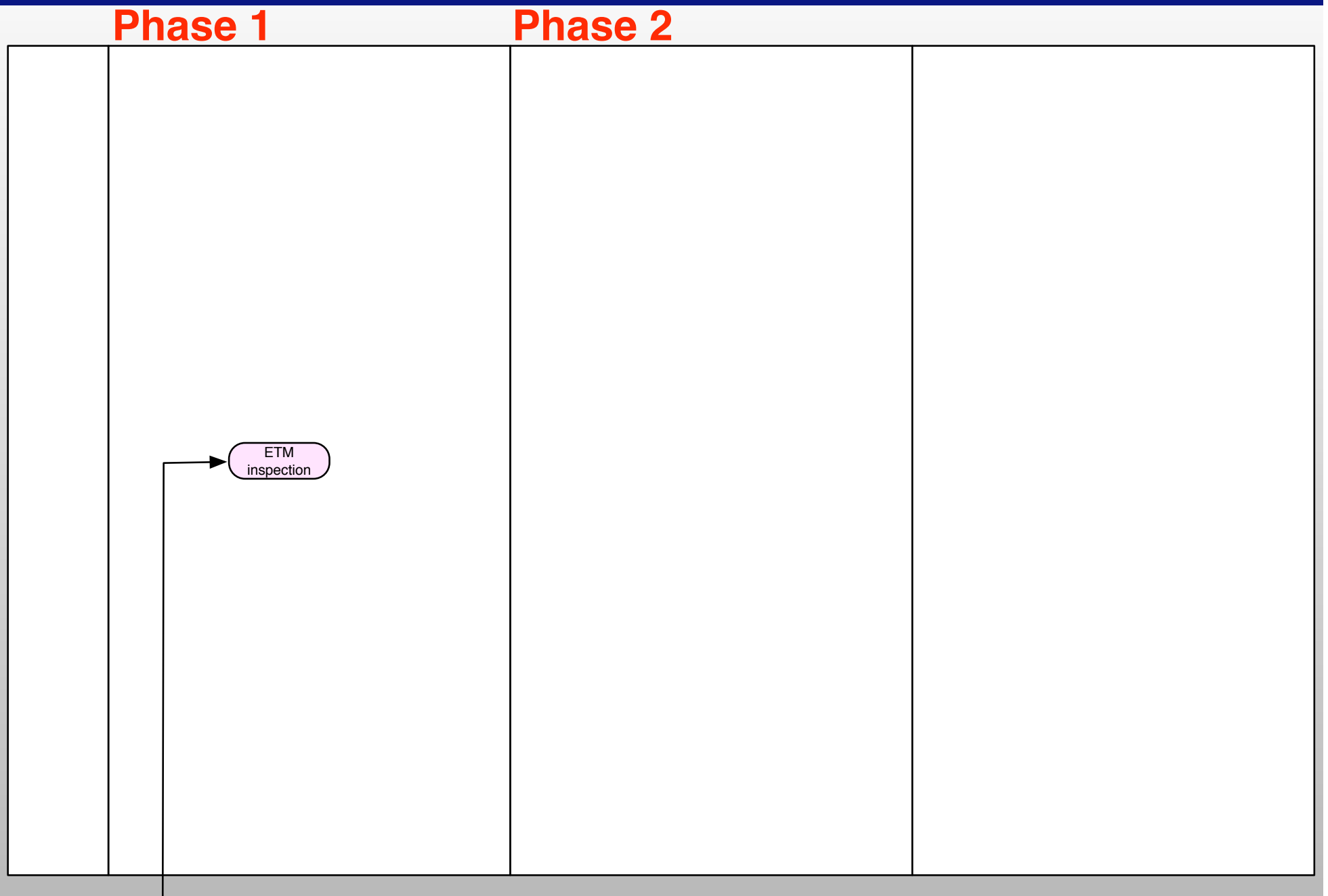
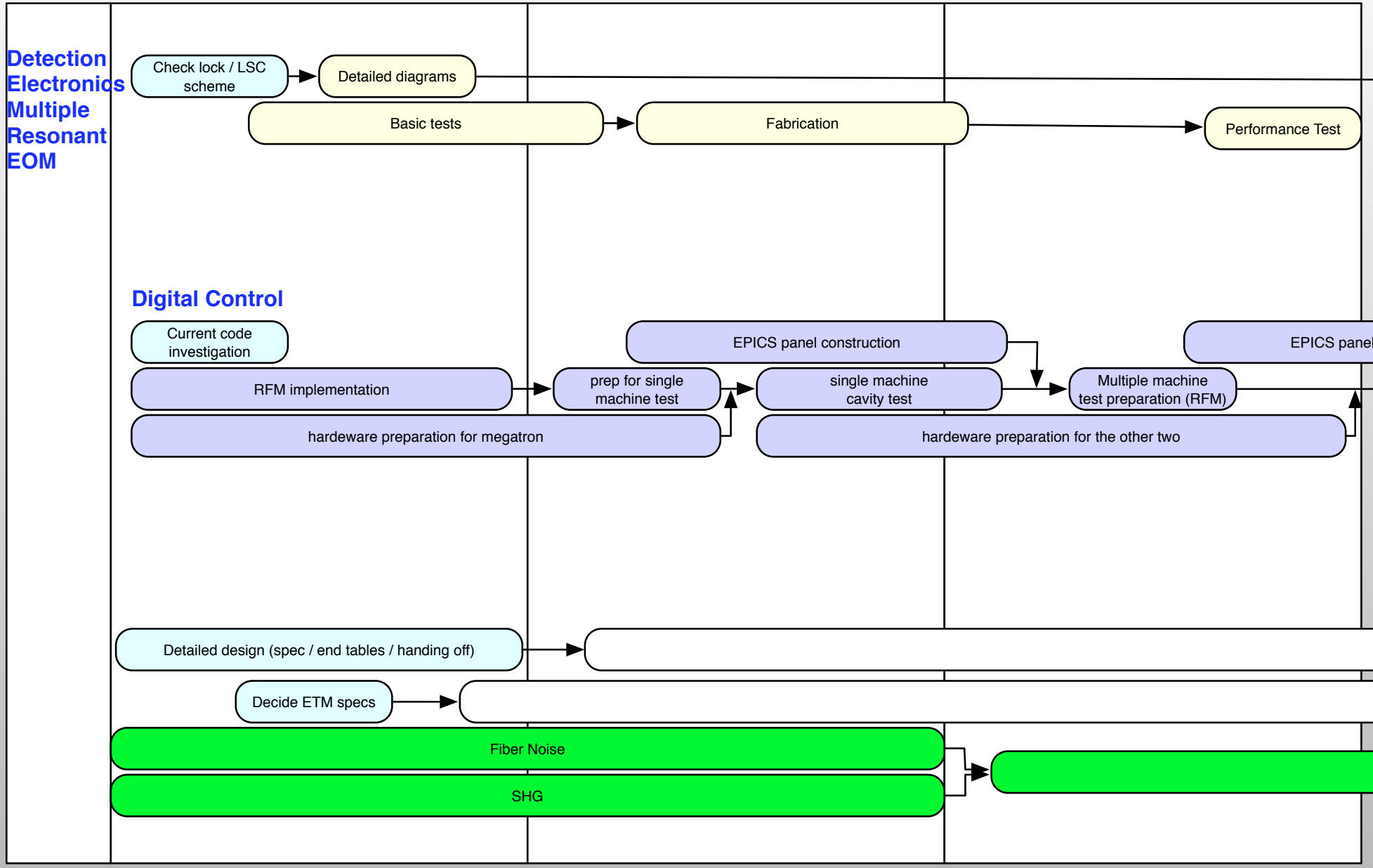
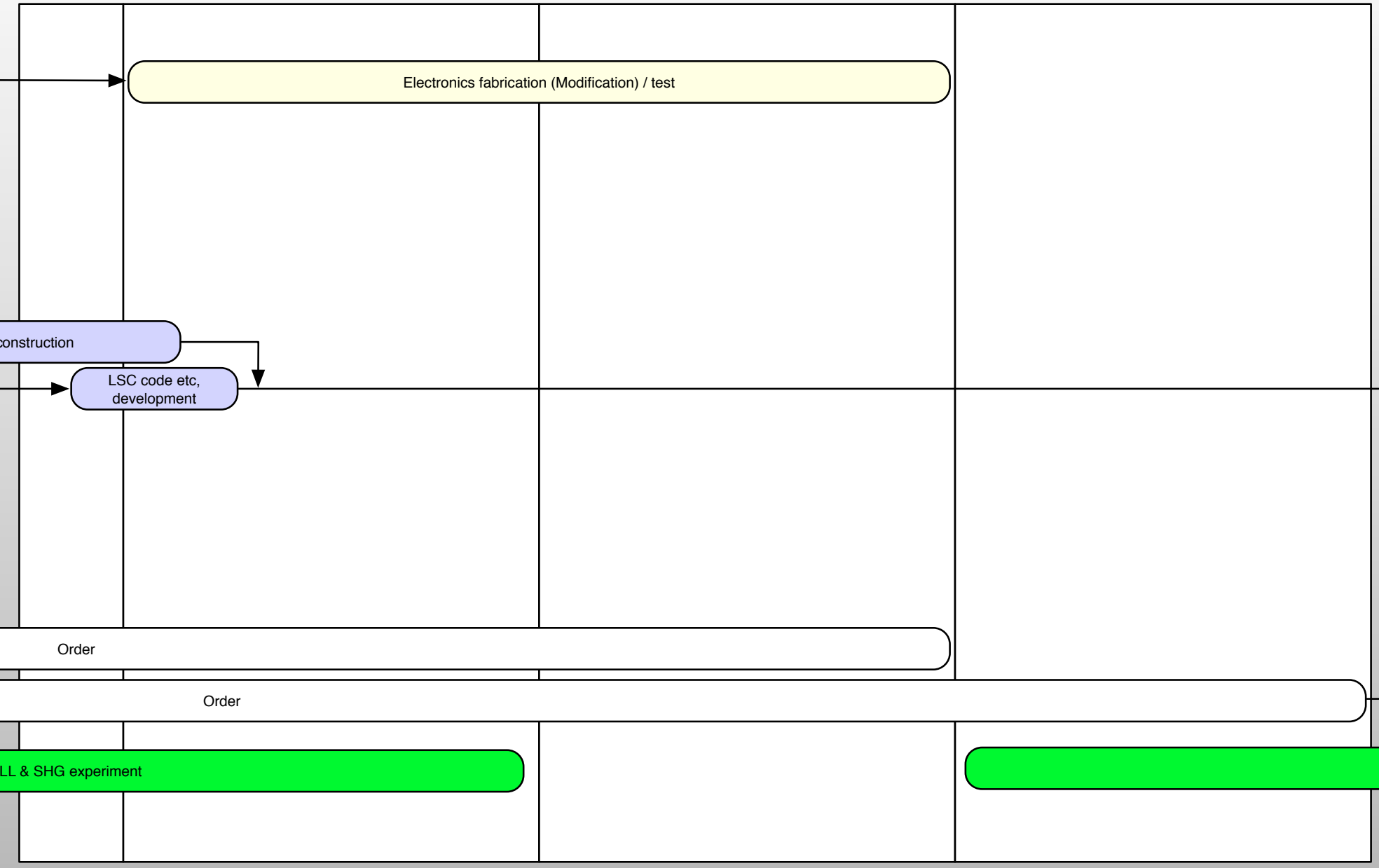

Phase 1
Phase 2
ETM inspection

Time line

Preinstallation



Installation



Phase 1

DRMI investigations
[Commissioning] TBD

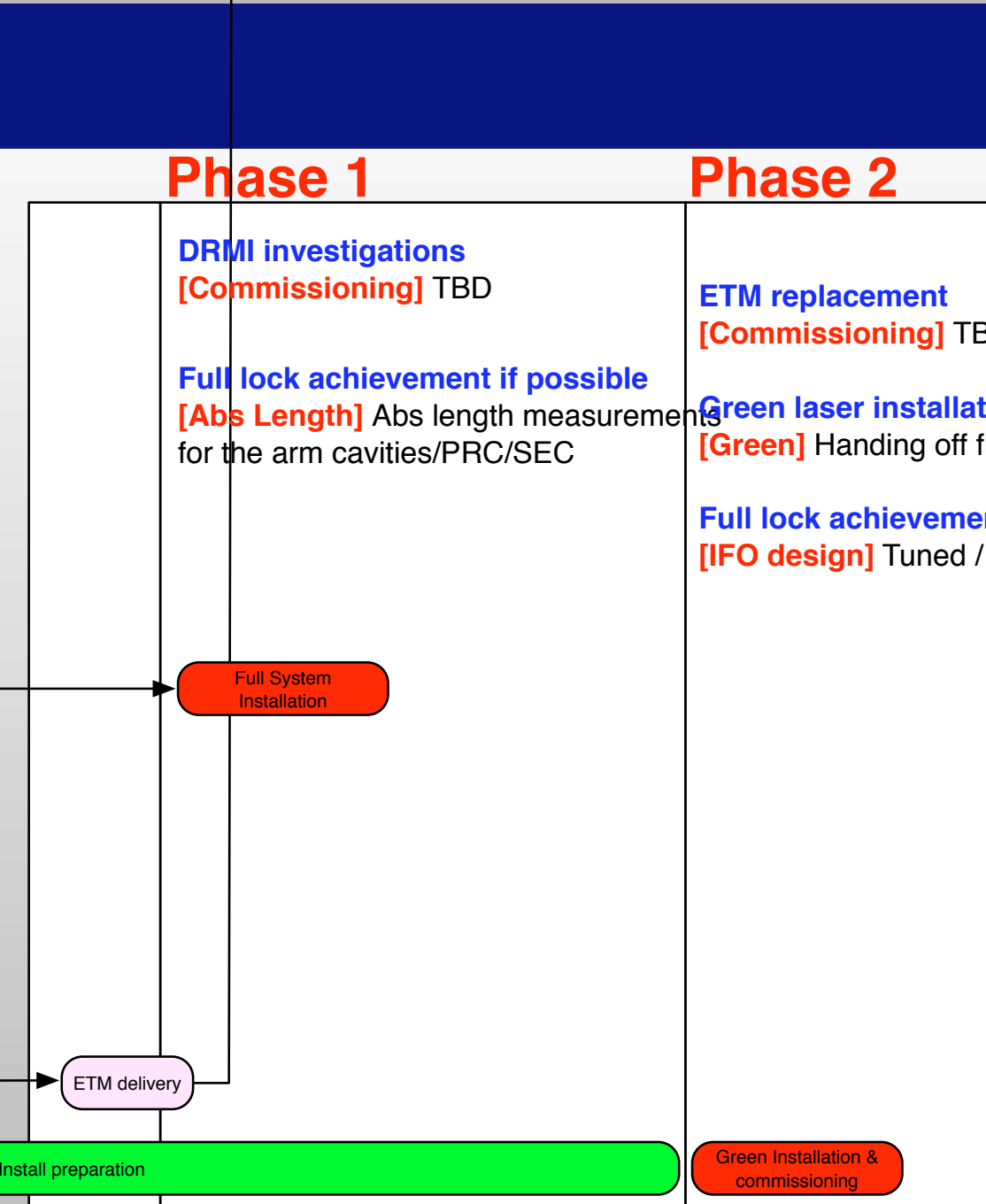
Full lock achievement if possible
[Abs Length] Abs length measurements for the arm cavities/PRC/SEC

Phase 2

ETM replacement
[Commissioning] TBD

Green laser installation / locking
[Green] Handing off from green to IR ~ RGC implementation

Full lock achievement
[IFO design] Tuned / detuned comparison



In short ...

Lots of work still left

Optics (in vacuo, PSL), Mechanics, Digital system
Some electronics
Plan of green injections for long term

Vent 1 (small): for mirror wiping

To see whether we can improve the finesse or not.
Late Nov / Early Dec?

Vent 2 (big):

Laser replacement

Before the 2nd vent?

Full install of the new digital system

After the mirror installation

Tasks for now ~ as of 30 Sept 2009

Rana:	Ask Bram for the TT, Arrange 2W laser purchasing
Steve / Bob:	Help us as usual
Koji:	Review optical system towards purchasing
Joe:	Plan new digital system / diagram
Peter:	Let RFM working on megatron
Rob:	Give us various inputs!
Alberto:	Plan new LSC / diagram
Jenny:	Check SOSs with Steve & MMT design
Kiwamu:	Design works on the PSL table
Aidan/David:	Plan for the green injection
Zach:	Make the current PSL table photo/diagram (and for the other tables too!)