HIE-ISOLDE (High Intensity and Energy) project
Protection of superconducting solenoids

MPE work shop – December 14, 2010

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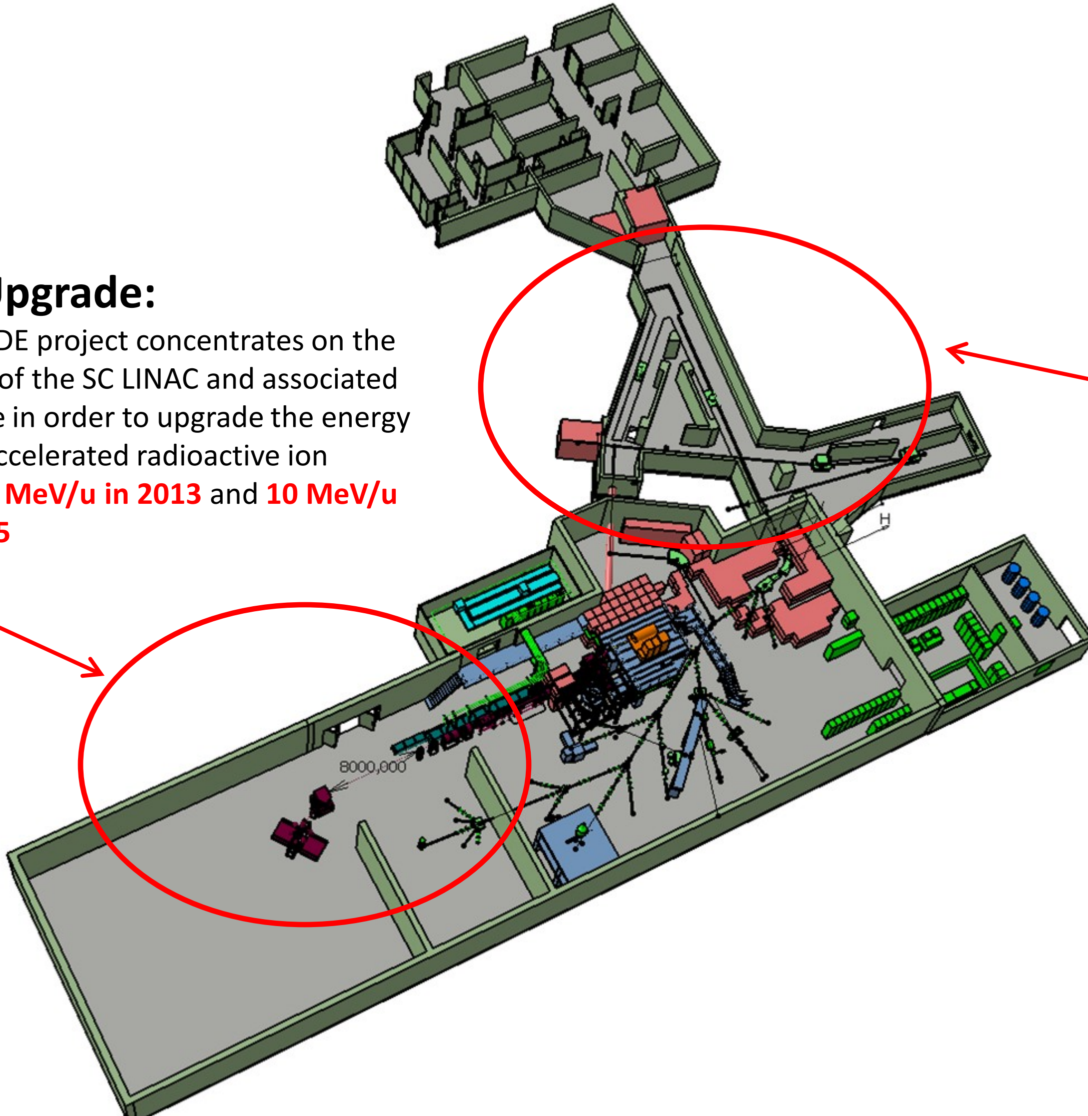
Overview

- HIE-ISOLDE Project
  - Overview, layout, work structure, QPS budget
- Circuits to protect
- Quench Detection
  - Magnet, Current Leads
- Energy Extraction
- Resources

Scope of HIE-ISOLDE



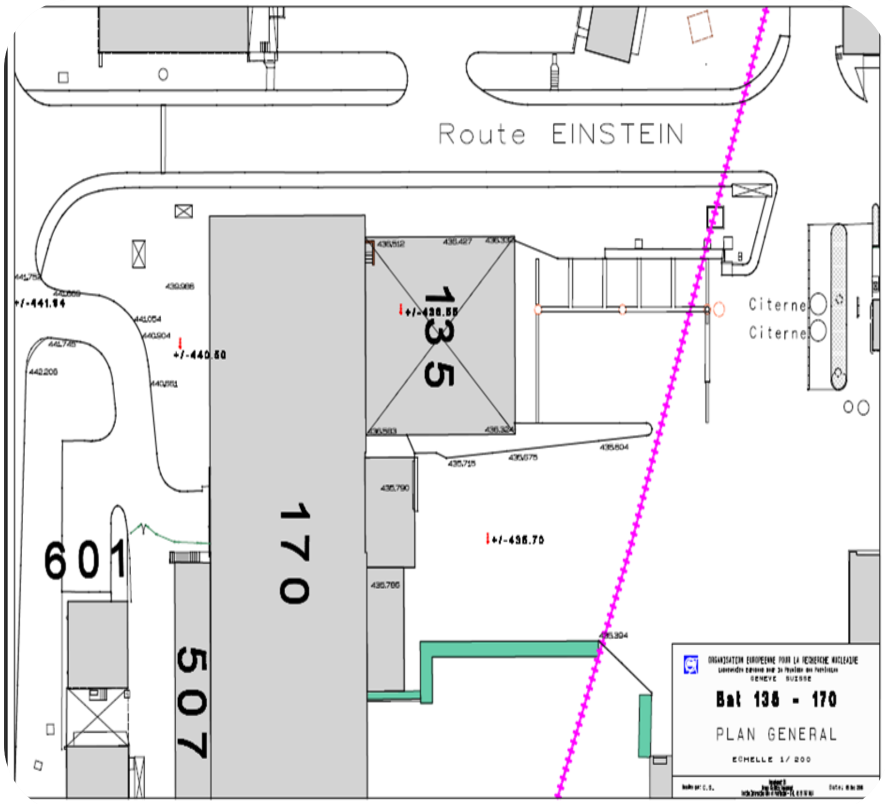
Energy Upgrade:

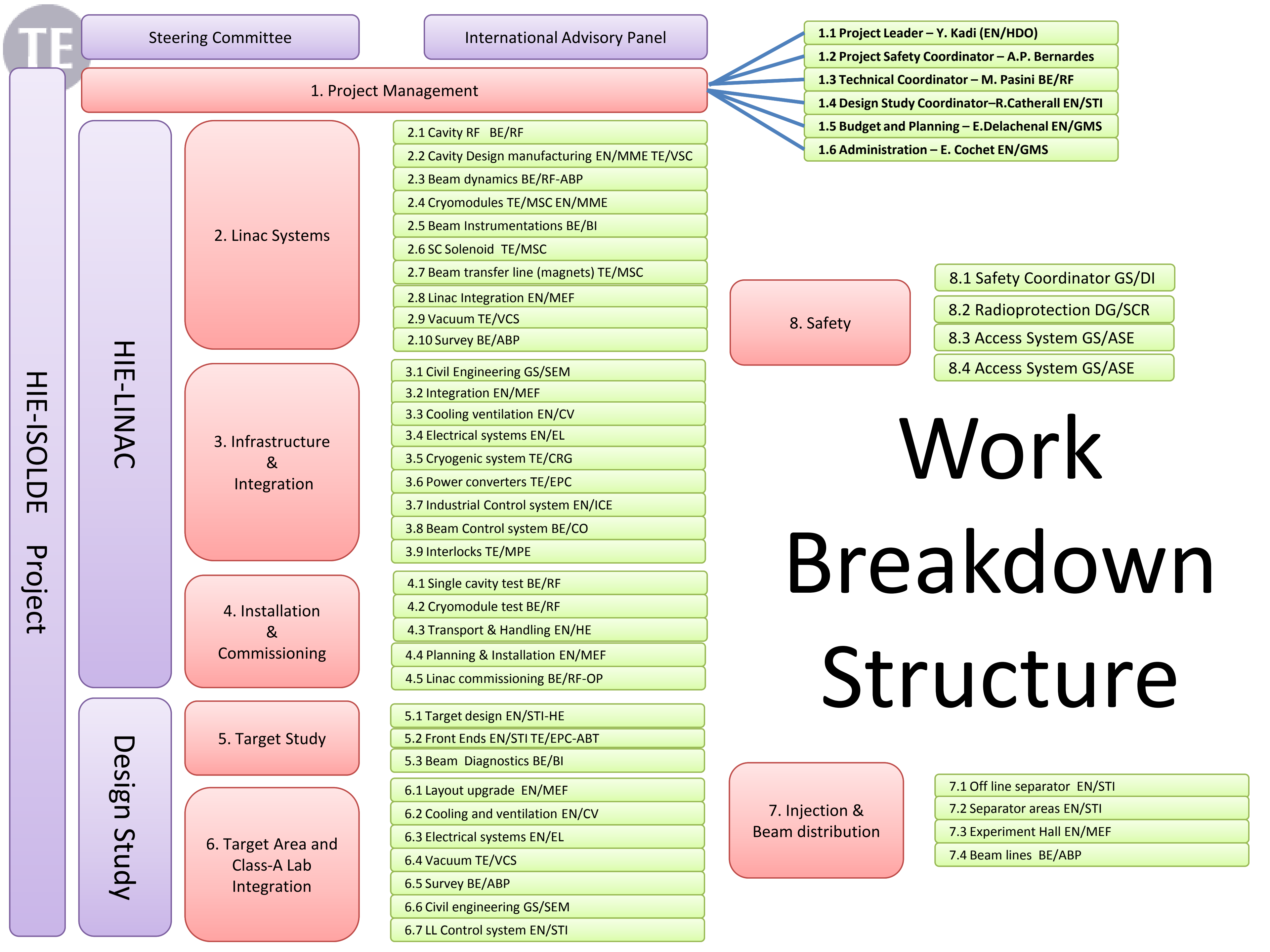
The HIE-ISOLDE project concentrates on the construction of the SC LINAC and associated infrastructure in order to upgrade the energy of the post-accelerated radioactive ion beams to **5.5 MeV/u in 2013** and **10 MeV/u by 2014/2015**

Intensity Upgrade:

The design study for the intensity upgrade, also part of HIE-ISOLDE, **starts in 2011**, and addresses the technical feasibility and cost estimate for operating the facility at **10 kW** once LINAC4 and PS Booster are online. **The 30 kW option (SPL beam) will be studied at a later stage**

HIE-ISOLDE Layout

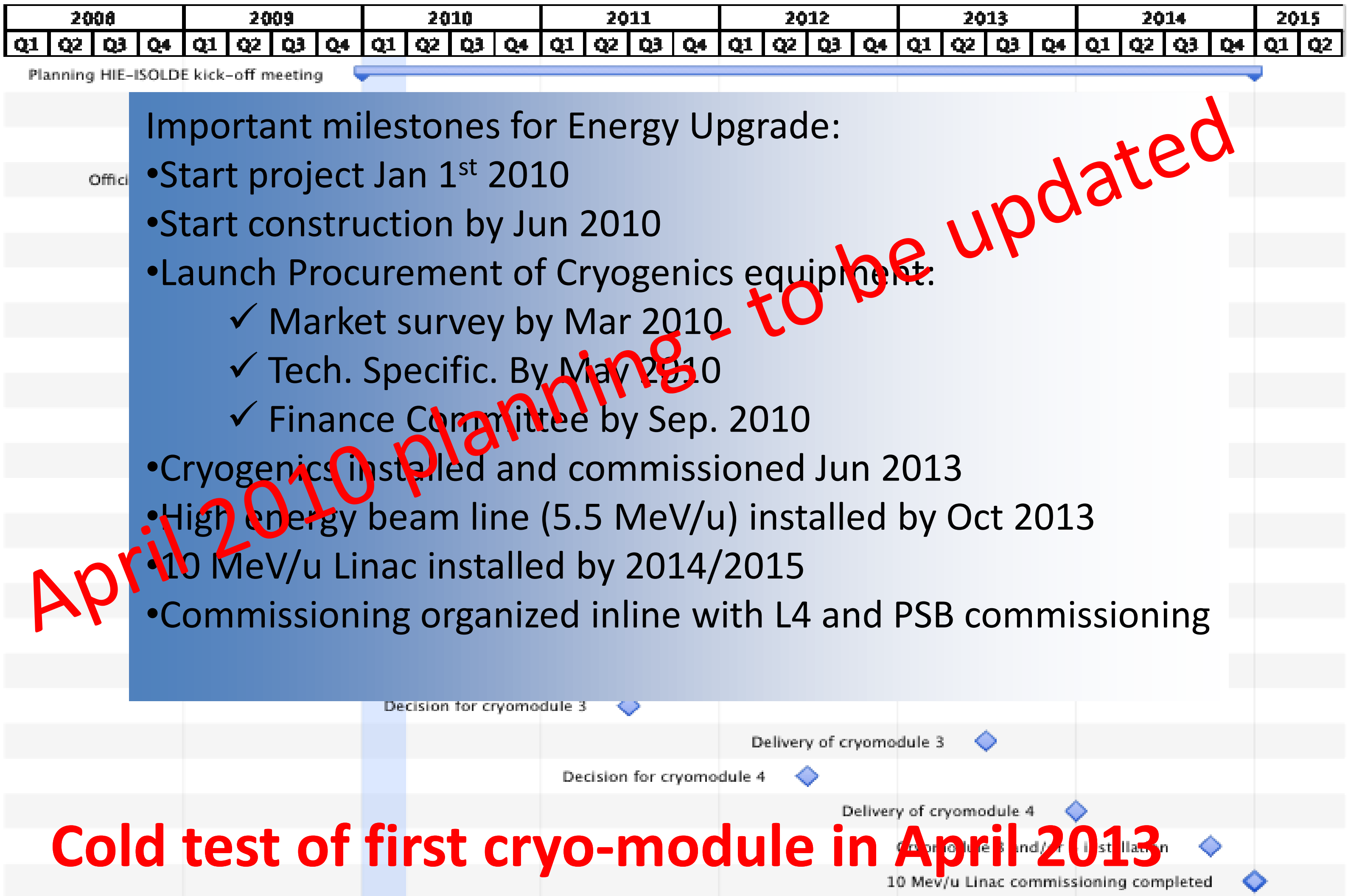



Steering Committee
International Advisory Panel
1.1 Project Leader – Y. Kadi (EN/HDO)
1.2 Project Safety Coordinator – A.P. Bernardes
1.3 Technical Coordinator – M. Pasini BE/RF
1.4 Design Study Coordinator–R.Catherall EN/STI
1.5 Budget and Planning – E.Delachenal EN/GMS
1.6 Administration – E. Cochet EN/GMS
1. Project Management
HIE-ISOLDE Project
HIE-LINAC
2. Linac Systems
2.1 Cavity RF BE/RF
2.2 Cavity Design manufacturing EN/MME TE/VSC
2.3 Beam dynamics BE/RF-ABP
2.4 Cryomodules TE/MSC EN/MME
2.5 Beam Instrumentations BE/BI
2.6 SC Solenoid TE/MSC
2.7 Beam transfer line (magnets) TE/MSC
2.8 Linac Integration EN/MEF
2.9 Vacuum TE/VCS
2.10 Survey BE/ABP
3. Infrastructure & Integration
3.1 Civil Engineering GS/SEM
3.2 Integration EN/MEF
3.3 Cooling ventilation EN/CV
3.4 Electrical systems EN/EL
3.5 Cryogenic system TE/CRG
3.6 Power converters TE/EPC
3.7 Industrial Control system EN/ICE
3.8 Beam Control system BE/CO
3.9 Interlocks TE/MPE
4. Installation & Commissioning
4.1 Single cavity test BE/RF
4.2 Cryomodule test BE/RF
4.3 Transport & Handling EN/HE
4.4 Planning & Installation EN/MEF
4.5 Linac commissioning BE/RF-OP
Design Study
5. Target Study
5.1 Target design EN/STI-HE
5.2 Front Ends EN/STI TE/EPC-ABT
5.3 Beam Diagnostics BE/BI
6. Target Area and Class-A Lab Integration
6.1 Layout upgrade EN/MEF
6.2 Cooling and ventilation EN/CV
6.3 Electrical systems EN/EL
6.4 Vacuum TE/VCS
6.5 Survey BE/ABP
6.6 Civil engineering GS/SEM
6.7 LL Control system EN/STI
8. Safety
8.1 Safety Coordinator GS/DI
8.2 Radioprotection DG/SCR
8.3 Access System GS/ASE
8.4 Access System GS/ASE
Work Breakdown Structure
7. Injection & Beam distribution
7.1 Off line separator EN/STI
7.2 Separator areas EN/STI
7.3 Experiment Hall EN/MEF
7.4 Beam lines BE/ABP

HIE-ISOLDE material budget

Title	PPA	Work Package	Code	Dep.	Group	Total Request
HIE-ISOLDE Linac (M. Pasini BE/RF)						
SC Cavity RF	EIS-PRJ	WP2.1		BE	RF	2'320
SC Cavity Design & Manufacturing	EIS-PRJ	WP2.2.1	55601	EN	MME	3'700
SC Cavity Sputtering	EIS-PRJ	WP2.2.2		TE	VSC	553
SC Cavity Sputtering (IS)	EIS-PRJ	WP2.2.2		TE	VSC	355
SC Cavity Test	EIS-PRJ	WP4.1		BE	RF	-
SC solenoids	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	656
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cryomodules	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4'600
Cryomodules (MME)	EIS-PRJ	WP2.4.1	55602	EN	MME	413
Cryomodule Test	EIS-PRJ	WP4.2	99159	TE	MSC	-
Beam Dynamics	EIS-PRJ	WP2.3		BE	RF	-
Beam Instrumentations	EIS-PRJ	WP2.5		BE	BI	1'450
Beam Transfer Line	EIS-PRJ	WP2.7		TE	MSC	1'710
Linac Integration/Installation	EIS-PRJ	WP2.8 & WP4.4	55603	EN	MEF	80
Linac Commissioning	EIS-PRJ	WP4.5		BE	RF	-
Vacuum	EIS-PRJ	WP2.9		TE	VSC	1'400
Survey	EIS-PRJ	WP2.10		BE	ABP	201
					Total	17'638

HIE-ISOLDE Schedule



Important milestones for Energy Upgrade:

- Start project Jan 1st 2010
- Start construction by Jun 2010
- Launch Procurement of Cryogenics equipment:
  - ✓ Market survey by Mar 2010
  - ✓ Tech. Specific. By May 2010
  - ✓ Finance Committee by Sep. 2010
- Cryogenics installed and commissioned Jun 2013
- High energy beam line (5.5 MeV/u) installed by Oct 2013
- 10 MeV/u Linac installed by 2014/2015
- Commissioning organized inline with L4 and PSB commissioning

April 2010 planning - to be updated

Cold test of first cryo-module in April 2013

Circuits

- 8 individually powered circuits with S.C. solenoids of 130 mH each
- Nominal current 450 A – Stored Energy 13 kJ
- Powering scheme tbd. Grounding, Series/parallel extraction
- Protection delay tbd. This will determine EM or SSt switch

Quench Detection

- Magnet Detection based on existing digital LHC – SAM detectors

  - 4 redundant voltage taps on layer 0, layer 8, layer 12 and layer 20.
  - First tap on the top and the redundant at the bottom.
    - The difference will be 0.5 turns which should be negligible for the detection system

Quench Detection & Controls

- Lead detection depending on lead type but most likely conventional cupper model will be used. Tbd.

- Controls/Data transfer to be determined – Field Bus or Ethernet?
  - Valid for Detection and Extraction
- Interlocks – PC-QPS-EE-PIC. Tbd.

Strategic Plan for EE

- Solid State Switch development recently started
  - Goal: Prototype by May/June 2011
  - Challenge to finish series production before 2.5 years from now
- In parallel: upgrade existing LHC 600 A EE system; improvements from exploitation/maintenance points of view
  - 10 systems can be delivered within 2 years
- If choice will be Solid State - use EM systems as spares for LHC

EE: Solid State or EM

- Solid State Switch: Semi-conductor IGCT
  - Integrated Gate Commutated Thyristor

  Fast and “maintenance” free vs

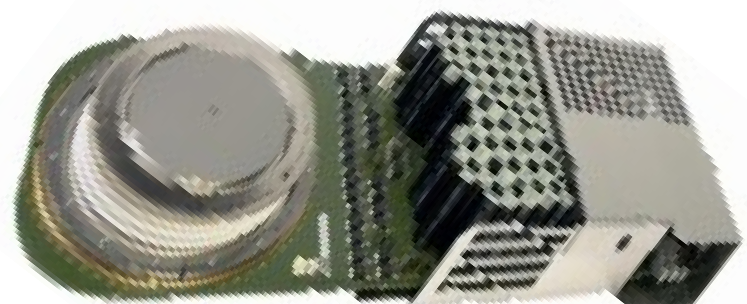
  Forward Losses – water cooling

- Electro-Magnetic circuit breaker

  very low forward losses vs

  maintenance (preventive & corrective)

Two, 600A extraction systems in a common rack



IGCT and its integrated drive electronics.

Resources 2011 - 2012

- Project Manager: 20% - 2011 15% - 2012
- Project Engineer EE: 20% - 2011 20% - 2012
- Project Engineer QPS: 25% - 6 months 2011
  10% later
- Technician: 20% - 2011 10% - 2012
- Design: 35-50% - 6 months 2011 10% later

Thank you for your attention