



# HIE-ISOLDE Project Status Report

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68th ISOLDE Collaboration Committee

CERN, 22 October 2013



# OUTLINE

- Financial Situation
  - Identification of the extra costs
  - Review of the expenditures on the external funds
  - Future expenses
- Technical Advances
  - SC Linac
  - HEBT
- Installation works
- Schedule
- Conclusions

*Acknowledgment:*

*W. Venturini Delsolaro; E. Siesling, A.P. Bernardes and R. Catherall*

# Financial Situation 2012

Cost of the Machine Part as presented at the Cost & Schedule Review in 2012

	Phase 1	Phase 2	Phase 3	Total
Expenses	8'600	4'300	4'600	17'500
- R&D	2'600	-	-	2'600
- SC Linac	3'300	3'600	4'000	10'900
- HEBT	2'700	700	600	4'000
Income	7'900	-	-	7'900
<b>Cash balance</b>	<b>- 700</b>	<b>- 4'300</b>	<b>- 4'600</b>	<b>- 9'600</b>

The following elements should have been incorporated:

- ✧ R&D expenditures on Team account
- ✧ Correcting the Machine costs to match the MTP2010
- ✧ Adjustment of the income

	Phase 1	Phase 2	Phase 3	Total
Costs (as estimated at CSR 2012)	8'600	4'300	4'600	17'500
- R&D and Design office work on Team Codes	2'359	-	-	2'359
- Correcting the Machine Costs to match the MTP2010 and re-scoping of the HEBT	607	-354	805	1'058
Income adjusted	7'724	-	-	7'724
<b>Cash balance</b>	<b>- 3'842</b>	<b>- 3'946</b>	<b>- 5'405</b>	<b>- 13'193</b>

# Financial Situation 2013

Since CSR 2012, the following elements have to be considered:

- ✧ Additional R&D Costs
- ✧ Additional Machine Costs
- ✧ Adjustment of the income: not used CATE funds
- ✧ Advance procurement of Phase 2 components

	<b>Phase 1</b>	<b>Phase 2</b>	<b>Phase 3</b>	<b>Total</b>
Costs (as estimated at CSR 2012)	8'600	4'300	4'600	17'500
- <i>R&amp;D and Design office work on Team Codes</i>	2'359	-	-	2'359
- <i>Correcting the Machine Costs to match the MTP2010 and re-scoping of the HEBT</i>	607	- 354	805	1'058
- <i>Additional R&amp;D Costs since 2012</i>	103	-	-	103
- <i>Additional Machine Costs since 2012</i>	1'512	- 355	- 200	958
- <i>Advance procurement for Phase 2</i>	753	-753	-	
Income to fund the expenses	7'724	-	-	7'724
CERN Loan	700	-	-	700
Not used CATE funds	- 288	-	-	- 288
<b>Cash balance</b>	<b>- 5'798</b>	<b>- 2'838</b>	<b>- 5'205</b>	<b>- 13'841</b>

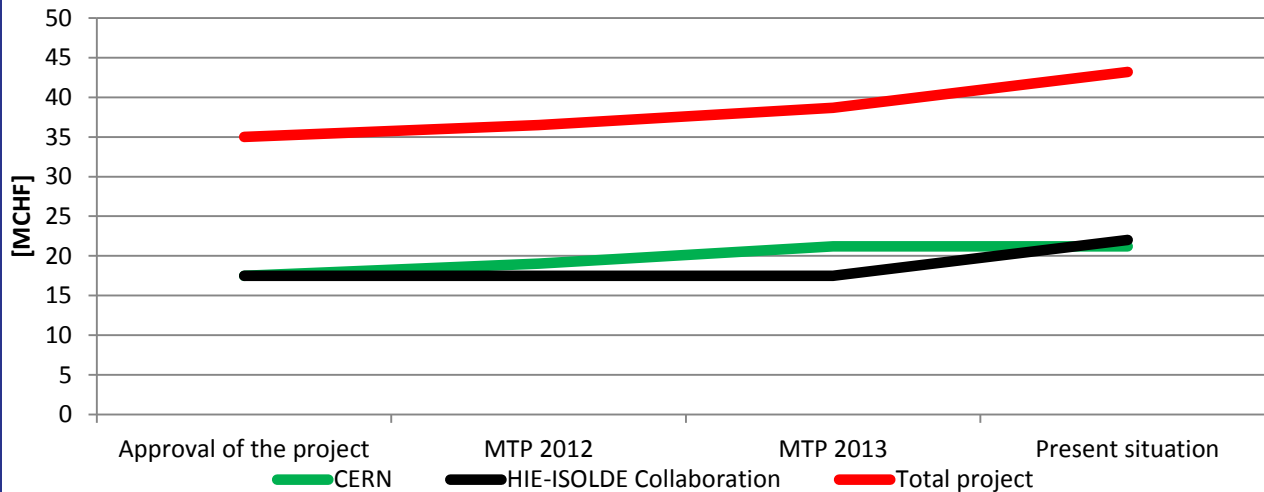
# Actual Cost

Cost of the Machine Part of the HIE-ISOLDE Project as assessed in September 2013

	[MCHF]	Phase 1	Phase 2	Phase 3	Total
R&D	2007-2012	1.08	0.00	0.15	1.23
	Continued prototyping	0.13	0.00	-0.05	0.08
	Continued upgrade & consolidation of production facilities	-0.03	0.00	0.05	0.02
	<b>Sub-total R&amp;D</b>	<b>1.18</b>	<b>0.00</b>	<b>0.15</b>	<b>1.33</b>
Machine					
	Design office work	2.25	0.04	0.00	2.28
	SC Linac	4.84	3.72	4.29	12.85
	HEBT	1.36	1.00	0.22	2.58
	Installation & Commissioning	0.62	0.19	0.13	0.95
	<b>Sub-total machine</b>	<b>9.07</b>	<b>4.95</b>	<b>4.64</b>	<b>18.66</b>
Rescoping of HEBT					
	Phasing	1.23	-1.00	-0.22	0.00
	3rd beam line	0.00	0.00	0.83	0.83
	Magnets	0.20			0.20
	<b>Sub-total rescoping of HEBT</b>	<b>1.43</b>	<b>-1.00</b>	<b>0.61</b>	<b>1.03</b>
Increased components costs					
	Design office work	1.12	-0.04	0.00	1.09
	SC Linac	0.22	-0.16	-0.14	-0.09
	HEBT	-0.16	0.00	0.04	-0.12
	Installation & Commissioning	0.34	-0.16	-0.10	0.08
	<b>Sub-total increased components costs</b>	<b>1.51</b>	<b>-0.36</b>	<b>-0.20</b>	<b>0.96</b>
Advanced phase 2 procurement		0.75	-0.75		0.00
<b>Total</b>		<b>13.94</b>	<b>2.84</b>	<b>5.21</b>	<b>21.98</b>

# Summary of the evolution

[MCHF]	CERN	HIE-ISOLDE Collaboration	Total	CERN Contribution
Approval of the Project	17.5	17.5	35.0	50%
MTP 2012	19.0	17.5	36.5	52%
MTP 2013	21.2	17.5	38.7	55%
Present Situation	21.2	22.0	43.2	49%
Total				



The current income of the collaboration is

7.44 MCHF +  
0.7 MCHF loan

# Expenses on Team Codes

T299558

Activity	2007	2008	2009	2010	2011	2012	2013	Future	Total
Prototyping		211	139	107	0	0	0		457
Production facilities		90	77	72	0	0	0		239
Design office work		153	217	79	14	0	0		463
<b>Total</b>		<b>455</b>	<b>432</b>	<b>258</b>	<b>14</b>	<b>0</b>	<b>0</b>		<b>1'160</b>

Only material and Design Office hours

T299559

Activity	2007	2008	2009	2010	2011	2012	2013	Future	Total
Prototyping	0	0	0	0	0	0	0		0
Production facilities	0	0	0	0	0	0	0		0
Design office work	35	155	167	176	0	37	41		612
<b>Total</b>	<b>35</b>	<b>155</b>	<b>167</b>	<b>176</b>	<b>0</b>	<b>37</b>	<b>41</b>		<b>612</b>

RF Engineers:  
M. Pasini (2007-2010)  
A. D'Elia (2012-2013)

T131910

Activity	2007	2008	2009	2010	2011	2012	2013	Future	Total
Prototyping				7	0	0	0		7
Production facilities				0	0	0	0		0
Design office work				189	255	179	104	110	837
<b>Total</b>				<b>196</b>	<b>255</b>	<b>179</b>	<b>104</b>	<b>110</b>	<b>844</b>

BE/RF: 1 PhD; 1 RF engineer; 1 tech. student; 1 accel. Phys  
BE/BI: 1 tech. student  
EN/MME: 1 mech. Engineer  
EN/STI: 1 RP expert  
TE/MSC: 1 mech. Engineer + 1 Designer

Total

Activity	2007	2008	2009	2010	2011	2012	2013	Future	Total
Prototyping	0	211	139	114	0	0	0	0	464
Production facilities	0	90	77	72	0	0	0	0	239
Design office work	35	309	383	445	269	216	145	110	1'912
<b>Total</b>	<b>35</b>	<b>610</b>	<b>599</b>	<b>630</b>	<b>269</b>	<b>216</b>	<b>145</b>	<b>110</b>	<b>2'615</b>

EN/MME: 1. mech. Engineer  
BE/RF: 1 tech student  
TE/MSC: 1 designer

# Status of Expenditures

## Machine part

		Phase 1	Charged + Committed	%
Costs	R&D	1'179	1'035	88%
	- <i>Prototyping</i>	848	704	83%
	- <i>Upgrade and consolidation of production facilities</i>	331	331	100%
	Design office work	3'369	3'172	94%
	SC Linac	5'059	1'974	39%
	HEBT	2'620	401	15%
	Installation & Commissioning	956	0	0%
Advanced procurement of phase 2 components	753	753	100%	
	<b>Total expenses</b>	<b>13'936</b>	<b>7'335</b>	<b>53%</b>
Income	Income to fund the expenses including CERN loan	8'049	7'248	90%
	CATE funds	375	87	23%
	<b>Total income</b>	<b>8'424</b>	<b>7'335</b>	<b>87%</b>



# Technical Advances

## ● SC Linac

- Cavity series production started
- RF coupler and **tuner** systems are being validated
- LLRF prototype successfully tested => series production underway
- SC solenoid design approved=> fabrication starting
- Cryomodule design finalized => procurement underway for long-lead items

## ● High-Energy Beam Transfer lines

- Layout frozen => tracing on the floor
- Dipole and quadrupole Magnets + supports ordered
- H/V corrector magnets by end of November
- vacuum chambers design to be finalized soon
- Diagnostic boxes under procurement

## ● Installation works @ ISOLDE

## ● Design Study for the Intensity Upgrade well underway

- Target + Front-end (FE8 and 9)
- **Offline separator test bench**
- HVAC + Cooling => nuclearization
- **Charge Breeder => assembly of electron gun, test at BNL (US)**

# Latest sputtering developments

- Remaining issues with cavity performance were solved in Spring 2013:
  - Sputtering configuration modified to achieve higher deposition rate on the cavity top
  - Poor surface quality in the peak E field region fixed
  - Sputtering protocol for production defined and validated on 2 test cavities (proof of principle but no statistics)

# Surface quality of the inner conductor tip → source of field emission



Central electrode: 20 mm diameter, at earth potential



No central electrode

# Adhesion on the lower edge (RF contact) was improved using a longer cathode

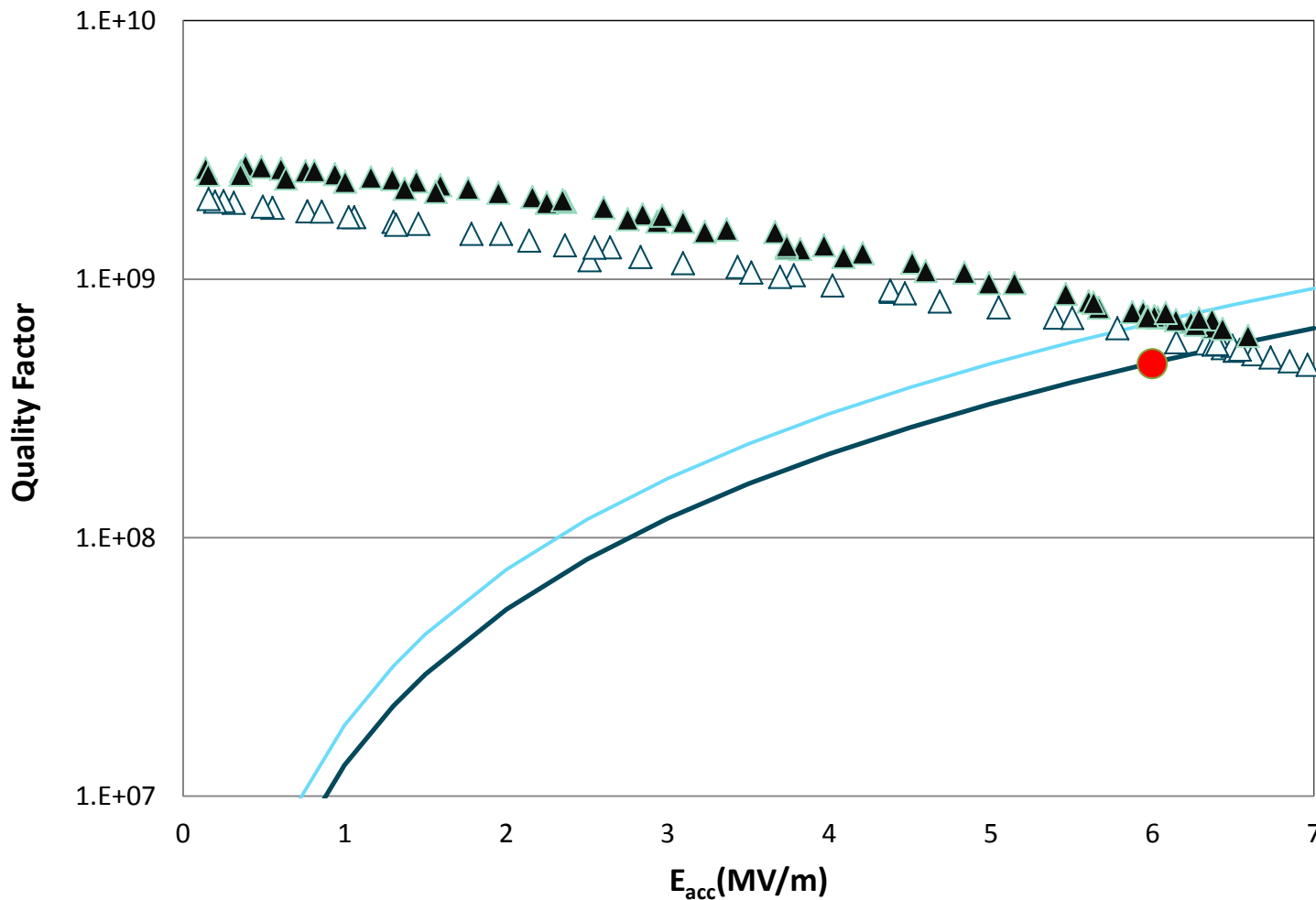


with 840 mm cathode



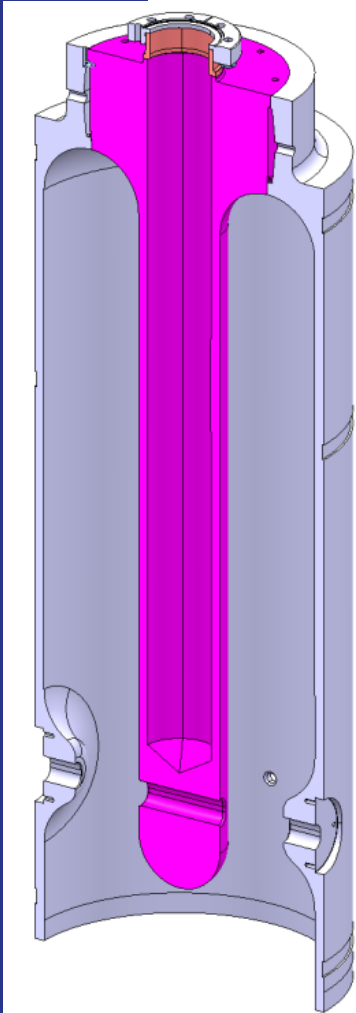
length increased to 870 mm

# Ready to start series cavity production



# High beta cavity procurement

Version 2



Two series cavities (QP2 and QP3)  
ready at CERN to start series coating

Contract attributed to industry for  
production

Few welding issues still being  
finalized: parameters of the welding  
machine to be set in collaboration  
with CERN

Kick-off meeting pending

Delivery of first series unit before  
the end of the year

# Low Level RF status



First prototype LLRF controller commissioned in SM18

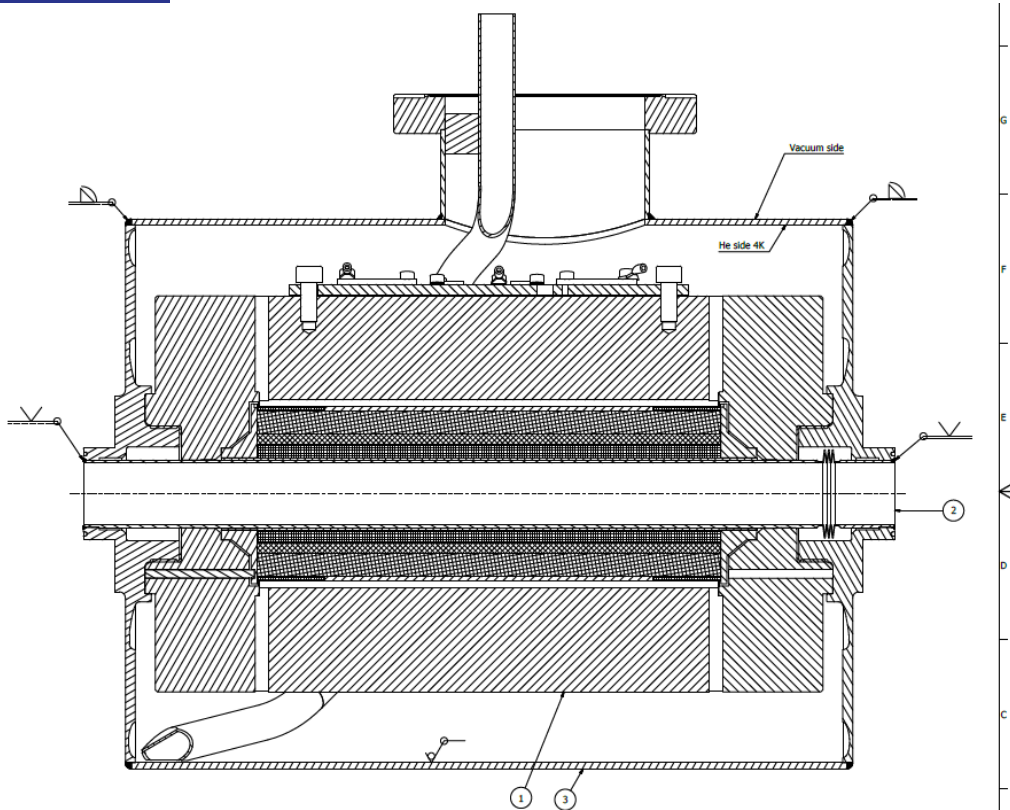
Monitoring of RF signals, locking in Self Excited Loop mode, control of Coupling and Tuning

FESA class operational, high level software to be developed

Manufacturing on-going of 3 LLRF controllers for SM18 cryomodule test

Components for 10 controllers already in house, will start assembly early 2014

# Superconducting Solenoid



Production procedure:  
 General welding:  
 Full welding outside and tag welding inside.  
 TIG with a high alloy welding wire for low ferrite content.  
 Recommended wires: SANDVIK 20.25.5 L Cu.

Electro Polishing  
 Ra 0,1 (Super finish/ Mirror finish)

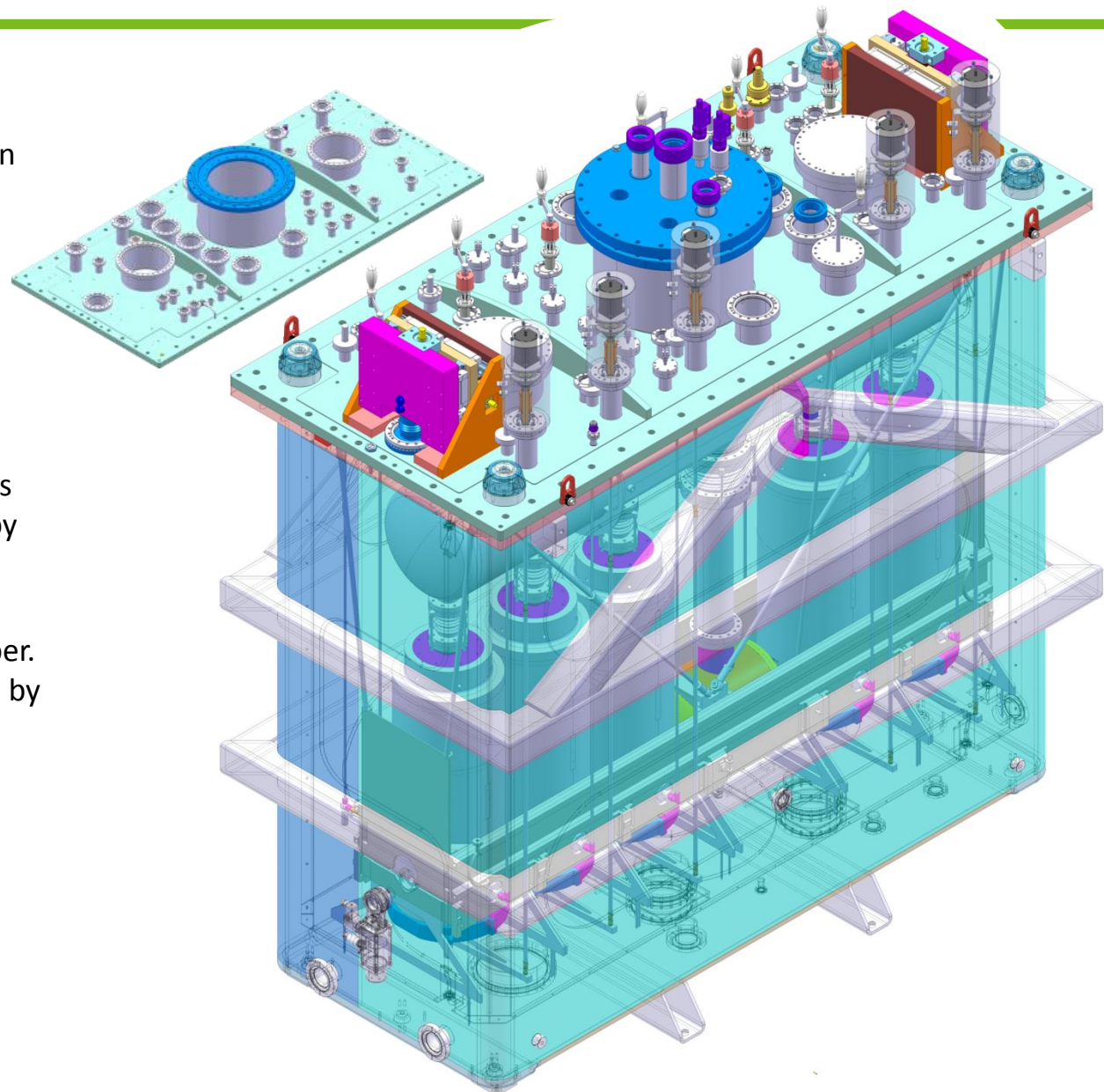
3	1	He vessel cover	720302891	
2	1	Beam pipe	720302708	
1	1	Solenoid Magnet Assembly	720302708	

- Design was revised in June to cope with differential thermal contractions during cool down transients
- Final Design Report
- Company working on manufacturing drawings and tooling (mandrel, etc.)
- Winding scheduled to start in November
- First solenoid delivery foreseen end February 2014
- Second end March 2014



# Cryomodule assembly

- Vacuum vessel (leading item): tendering process is complete. On 21/10/2013 visiting the (lowest bidder) company. If OK, place contract; delivery:  $T_0 + 6$  months (end April 2014)
- Helium vessel: same stage as vacuum vessel, shorter manufacturing times
- Thermal shield: detailed drawings being produced  $\rightarrow$  price inquiry by end November
- Suspension system: design complete; final review 6 November. Detailed design and specification by the end of year; price inquiry. Present plan to sign contract in February 2014 for a just in time delivery in May
- Support adjusters: two systems passed acceptance tests, will be delivered at CERN next month.

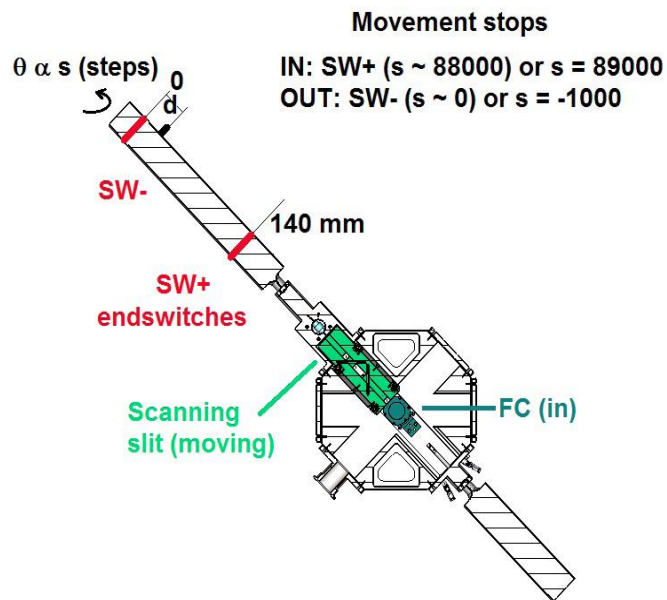


# SM18 infrastructure: clean room

- Status of clean room:
  - Rail installed and precisely positioned
  - Ground prepared
  - Clean room mounting started last week



# Failure of the prototype short DB



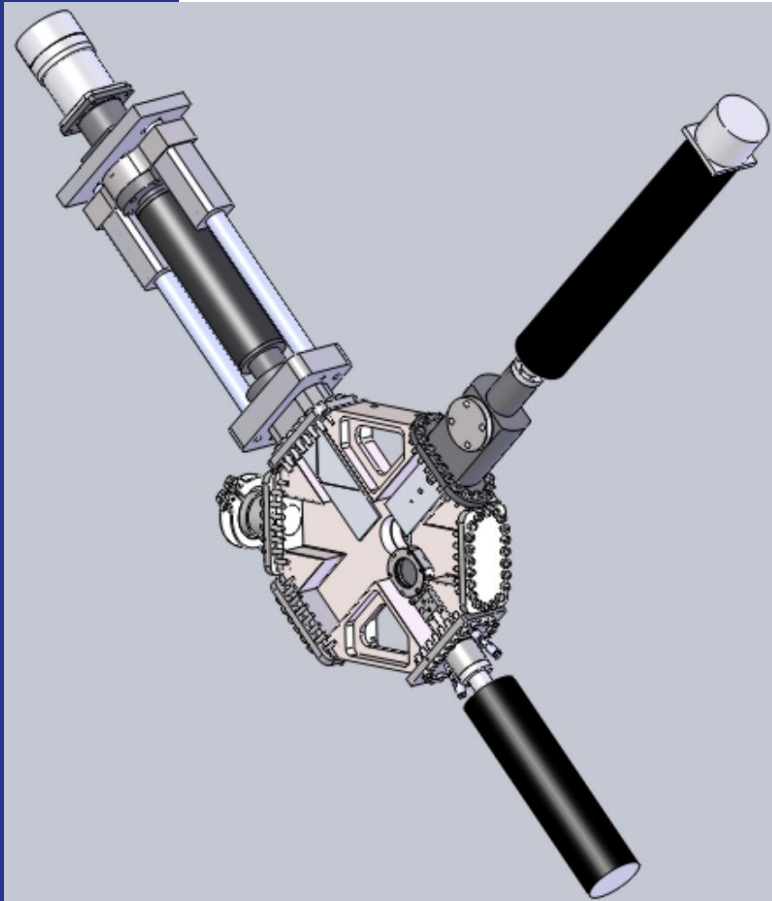
History log of the experimental test done with the HIE DB:

- 20 August 2012: Installation of HIE DB in REX-ISOLDE Hall
  - From 20 August 2012 to 5 February 2013: Experimental measurements with stable beams ( $A/q = 4$  and  $A/q = 3.5$ ); mainly Faraday cup test but also beam profile measurement including movement of the scanning slit (during this period, about 100 IN-OUT scans of the scanning slit were performed).
  - 8-9 April 2013: Tests of the scanning slit software, approx. 350 IN-OUT cycles.
  - 10-15 April 2013: Stress test of the scanning slit mechanism (run of 1340)
- Total number of IN-OUT cycles of the scanning slit mechanism: approx. 1800.

**HIE-BDB-TN-0001 (edms# 1284254)**



# Beam Instrumentation



New design with external actuators

The concept of an external actuator was tested successfully at CERN

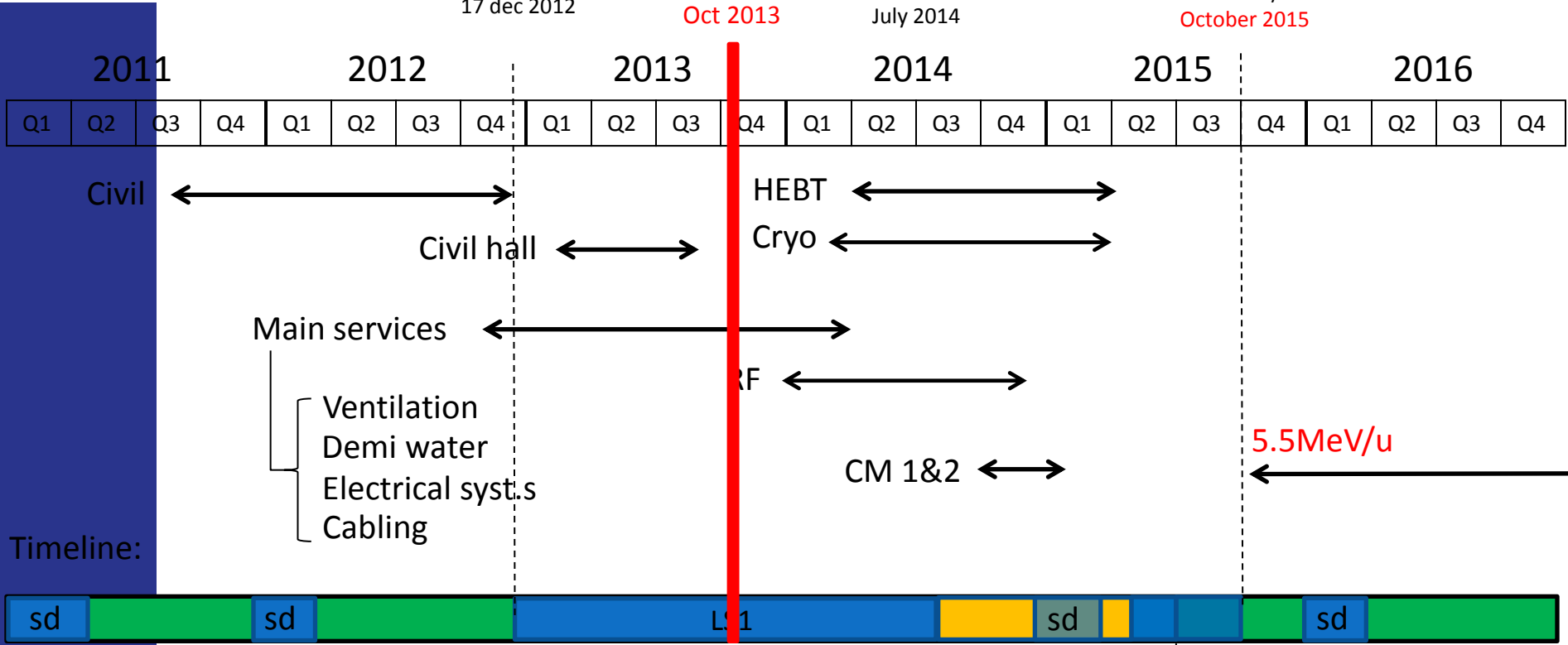
Contract with AVS is about to be signed for Short Diagnostic Boxes → 6 SDB boxes by August 2014

Supply T0=contract date. T1=Slit prototype acceptance	Latest Delivery dates
Revised manufacturing drawings	8 November 2013
Test of the scanning slit linear motion at AVS	T0+9 weeks (15 January 2014)
Batch of prototype short diagnostic box	T1+7 weeks (5 March 2014)
Batch of three series short diagnostic boxes	T1+31 weeks (6 August 2014)
Batch of two optional series short diagnostic boxes, if option taken up by CERN	T1+31 weeks (6 August 2014)
Batch of two optional spare short diagnostic boxes, if option taken up by CERN	To be advised

Tendering for Long boxes (LDB) needed in the transfer lines will start by end of this year as soon as CERN has recuperated the intellectual property of the drawings

# HIE Simplified Planning

Start Isolde shutdown 17 dec 2012      **We are here:** Oct 2013      End LS1: Start Low E physics July 2014      HIE physics at 5.5MeV/u October 2015



17 Dec 2012 - Q3 2014

Beam commissioning 3 months

- shutdown
- Isolde Ops
- HIE installations and tests (Isolde normal operations)
- Machine Check-Out (Isolde normal operations)
- Beam Commissioning (Isolde normal operations)



# Conclusions (1/2)

- Technical Activities: progress is tangible on most of the machine parts => however one has to carefully monitor the following items:
  - ✓ Series cavity production
  - ✓ Tuning system procurement
  - ✓ Procurement of CM parts and instrumentation
  - ✓ Tooling for clean room assembly
  - ✓ Cryogenics for SM18 test
  - ✓ Transport solutions
  - ✓ Reliability issues
  - ✓ Safety
  
- Installation Works: High activity in the hall and service buildings; Despite delays we are still in line with the overall schedule which aims for low energy physics during 2014 and HIE physics as of Oct 2015. Critical paths for some activities are being addressed (cryogenics & cryomodule installation)

# Conclusions (2/2)

## Safety:

- ✓ Shielding study finished – Report under preparation
- ✓ Beam losses and dump study to be finished
- ✓ CFD simulations of He leaks done by EN/CV have helped to discuss the access to the tunnel during steady state
- ✓ Safety folder => Demonstrative part to be finished
- ✓ Safety review planned for November 2013

## Budget and Resources:

- ✓ Financial situation analysed in-depth:
  - ✧ 5.8 MCHF shortfall for the completion of Phase 1 (5.5 MeV/u)
  - ✧ 8.6 MCHF shortfall in total up to Phase 2 (10 MeV/u)
  - ✧ 13.8 MCHF shortfall including Phase 3 (10 MeV/u + Low-Beta)
- ✓ Staffing of clean room assembly is an issue
- ✓ Extension of CATHI fellows beyond 31<sup>st</sup> Oct. 2014 => no funding available

## Planning: consolidation ongoing