ISOLDE YETS 2016

ALARA committee
4th February 2016

AP.Bernardes on behalf of EN/STI/RBS section

CERN | EN ENGINEERING DEPARTMENT

Outline

- Maintenance and upgrade of the ISOLDE Front-Ends
- Modifications needed in ISOLDE for the LIEBE project
- Feedback from the ISOLDE intervention August 2015

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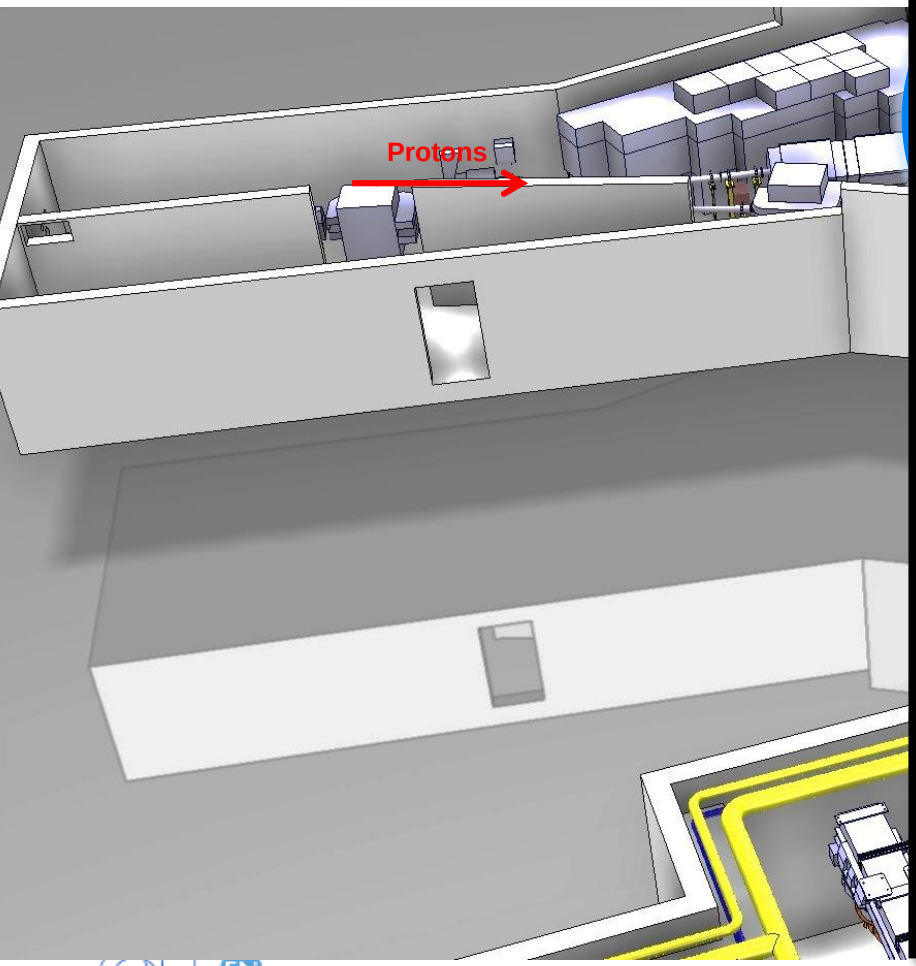
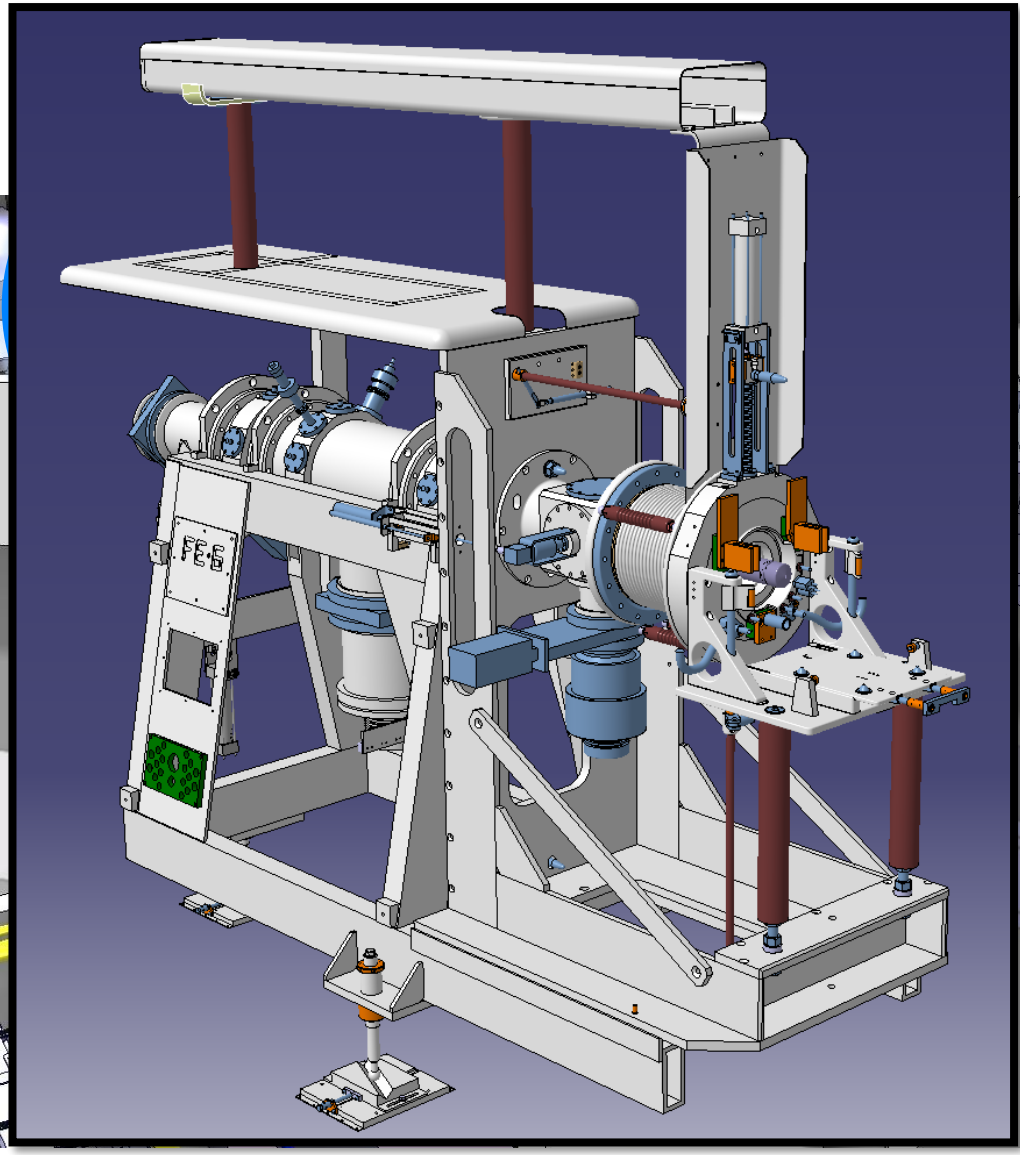
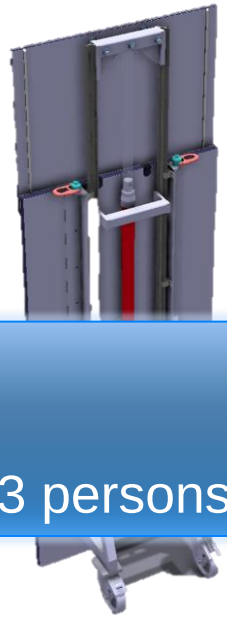
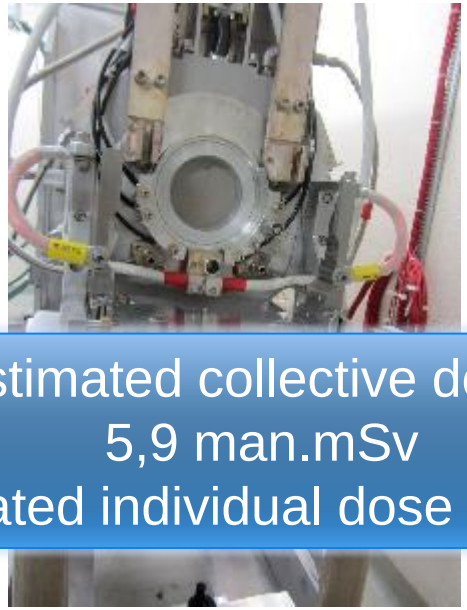
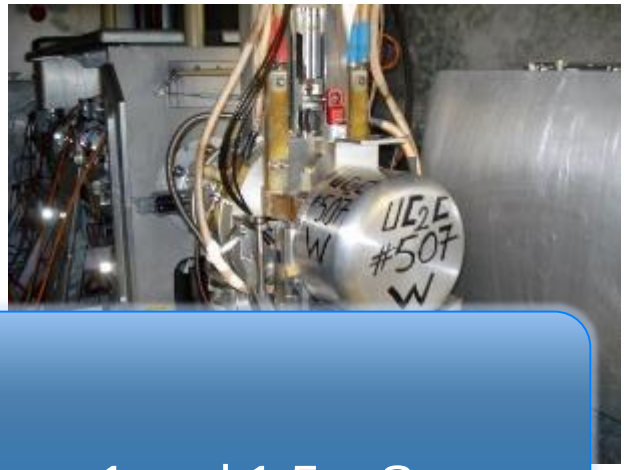
FE intervention

ISOLDE Target Area





FE intervention

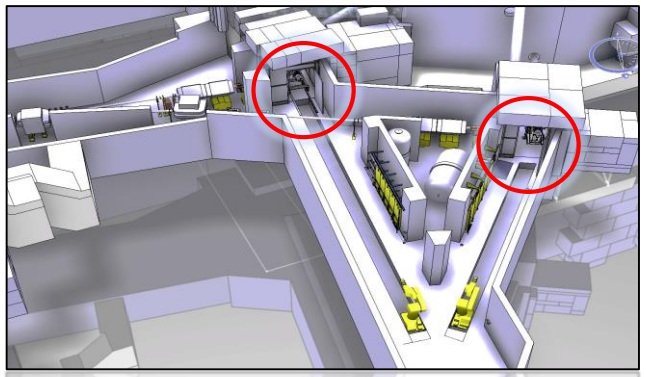
Phase I	Phase II	Phase III
		
Worksite preparation and shielding installation	Coupling table upgrade 2016	Annual FE maintenance 2016
Collective ≈ 1,5 man.mSv	Collective ≈ 2,5 man.mSv	Collective ≈ 1,9 man.mSv

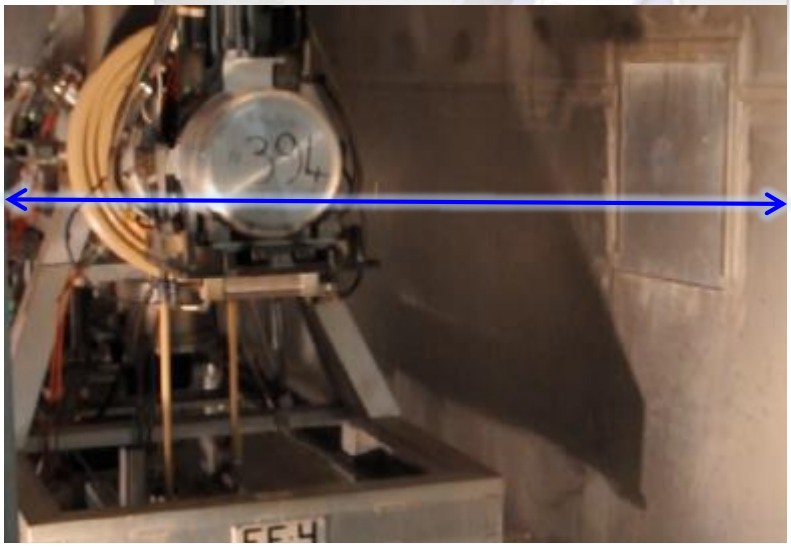
Estimated collective dose :
5,9 man.mSv
3 persons with estimated individual dose between 1 and 1.5 mSv

FE intervention

Phase I – Shielding (2 shielding types)

Shielding installation on dumps and beam windows → Dose rate reduced by up to 50%



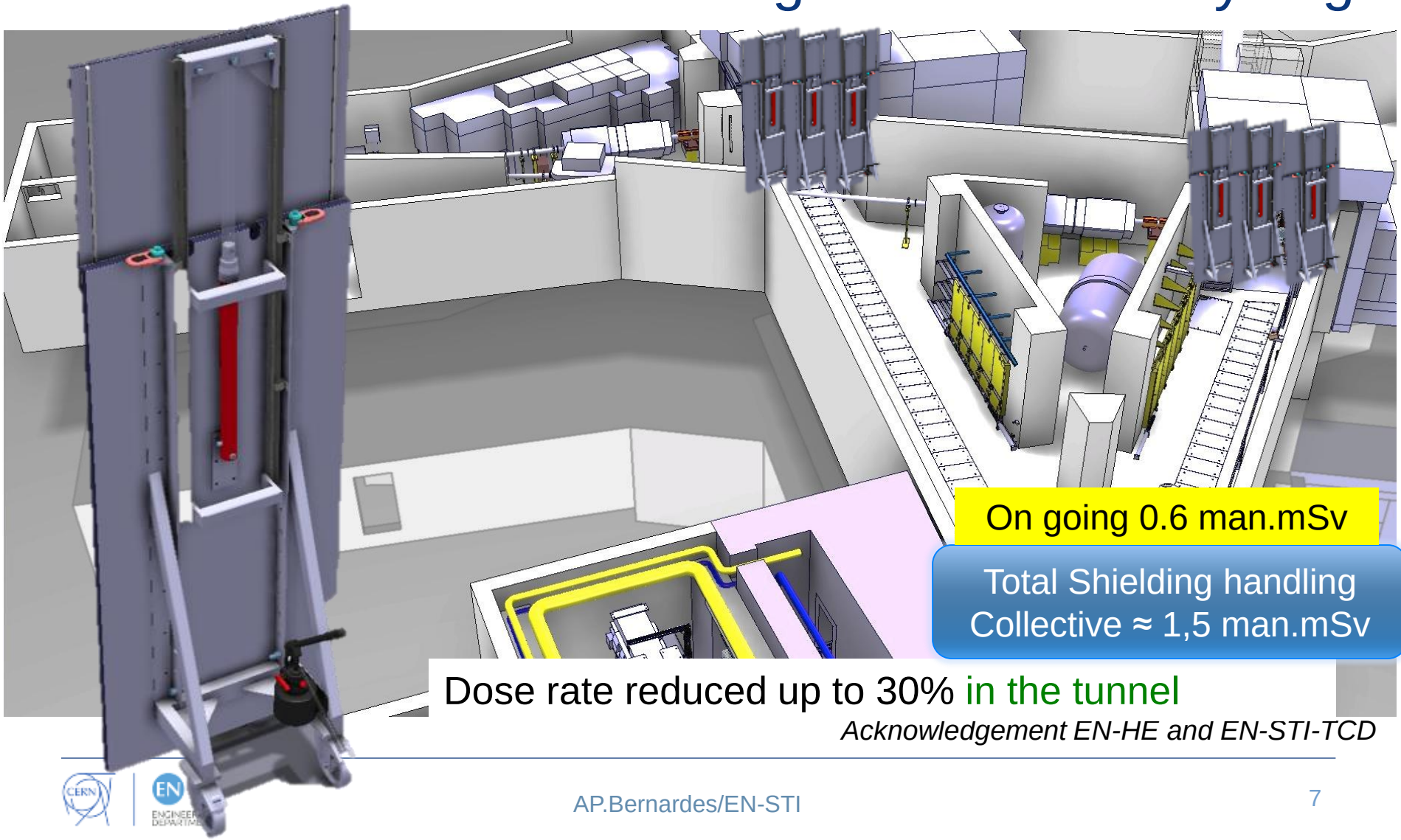


In order to reduce doses for other YETS interventions in the area, and after agreement from RP-OP and EN-RSO, the shielding was installed before ALARA-committee approval.

FE intervention

Phase I – Shielding

- Shielding outside Faraday cage



On going 0.6 man.mSv

Total Shielding handling
Collective ≈ 1,5 man.mSv

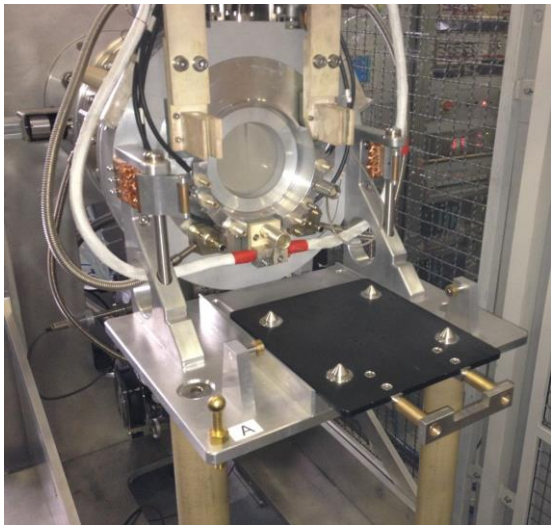
Dose rate reduced up to 30% in the tunnel

Acknowledgement EN-HE and EN-STI-TCD

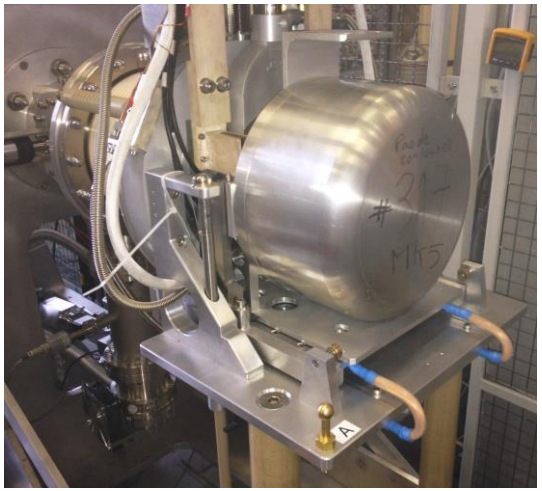
FE intervention

Phase II – Coupling table upgrade 2016

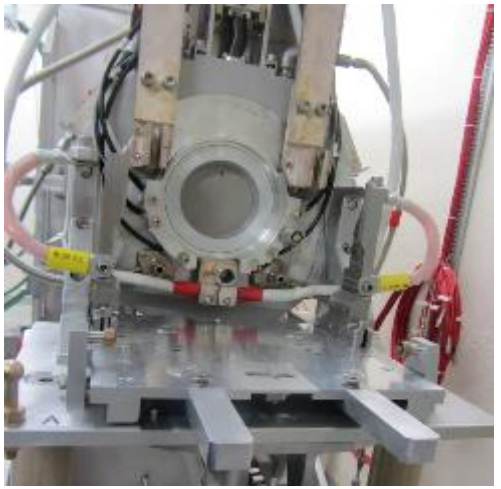
Old configuration



New design 2014



Upgrade new design 2016

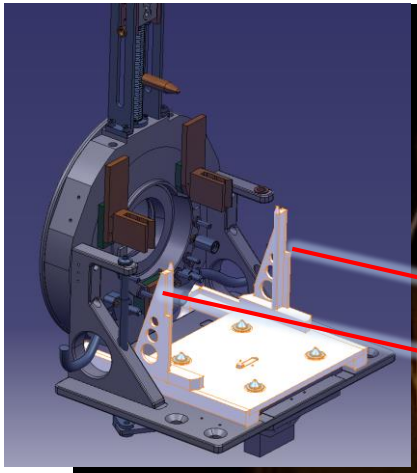


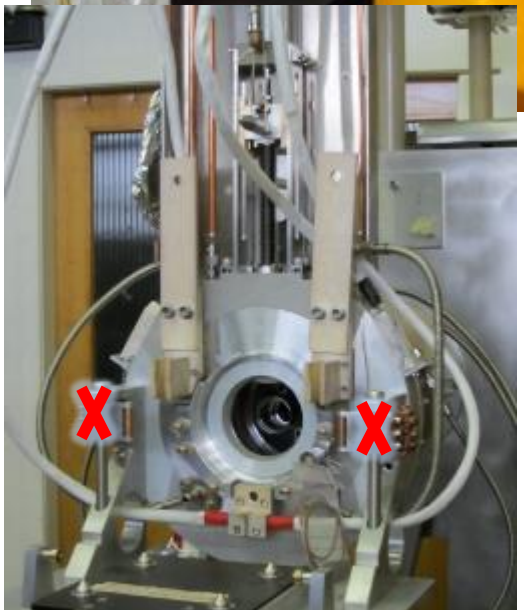
Acknowledgment S.Marzari EN-STI

	New design 2014	Design 2014 upgrade (2016)
ALARA committee	Approved in March 2014	For approval February 2016
Collective dose	Real dose: ≈ 3.9 mSv (including repair of failures new table) (3.1mSv for installation, 0.8 mSv for failure interventions)	Estimated dose: 2,5 man.mSv

FE intervention

Contact between coupling table and robot suppressed

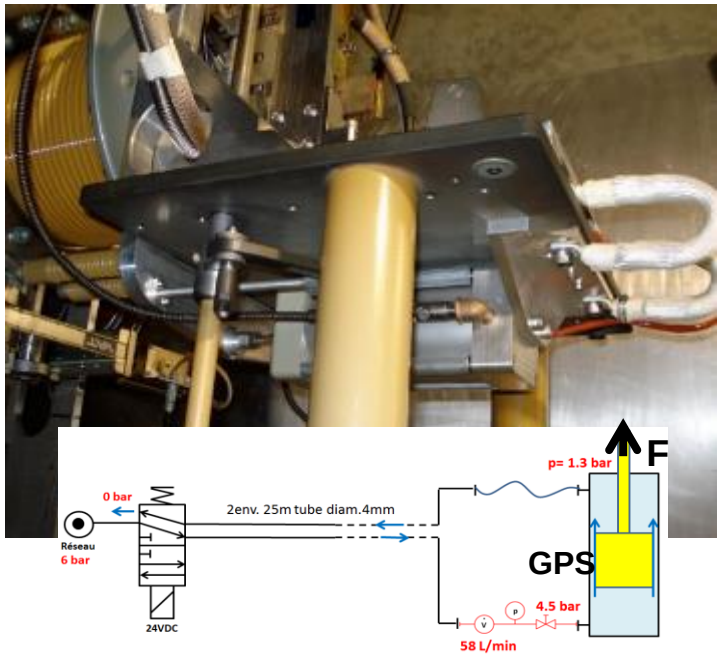


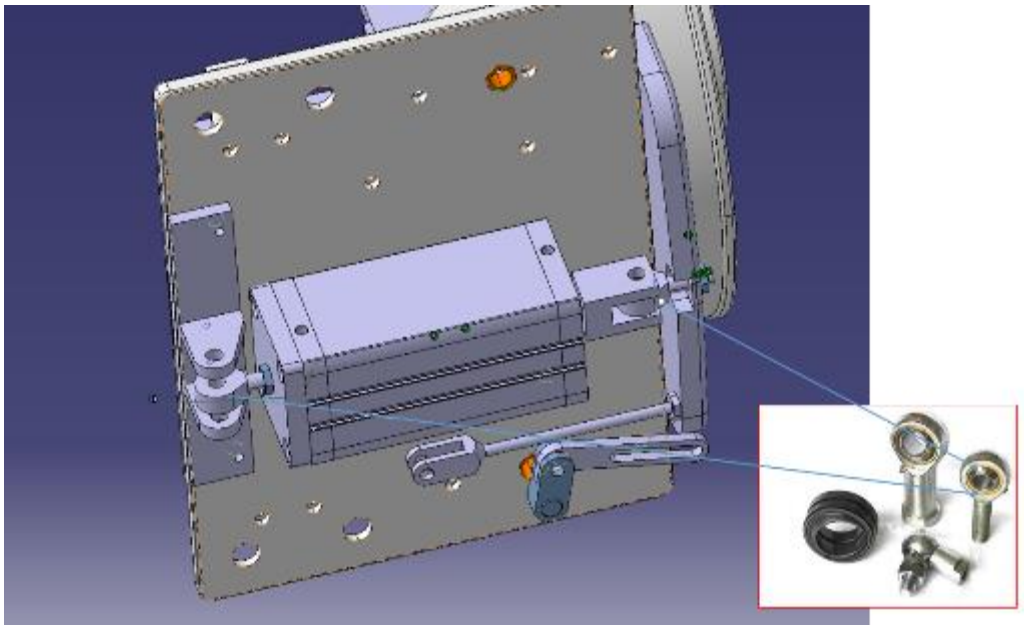


Clamps suppressed

Moving table equipped with a sensor to detect target on coupling table (Design 2014) + clamps position given by a potentiometer reused for table position

FE intervention





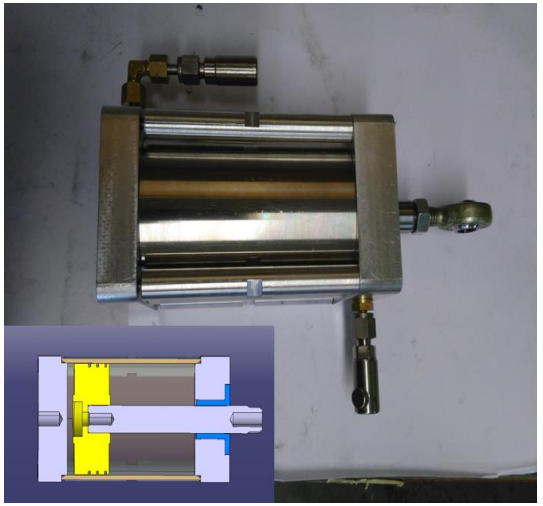
	Not enough room on axis	Too much air leak on piston (160 KgF instead of 300 KgF)
Immediate actions	Rotative connections installed to give room on the piston axis	Replace piston by a commercial solution to reduce air leak (6 months life time from feed-back 2015)
Actions done in 2015	Solution implemented on GPS	• Extensive air measurements on piston where performed during 2015 shut-down. • Compressed air pipes changed
Action planned on 2016		A new rad-hard piston (reduce air leaks) is under development to be installed in 2016

FE intervention

Phase II – Coupling table upgrade 2016

	New design 2014	Design 2014 upgrade (2016)
Changes based on Feed-Back to increase reliability and lifetime	Piston fixation changed during 2014 operation✓	• Installation of newly developed radiation hard piston as announced in 2014 • Test on-line done in 2015 for 1 month following failure of commercial piston

1000 Cycles OFF-Line

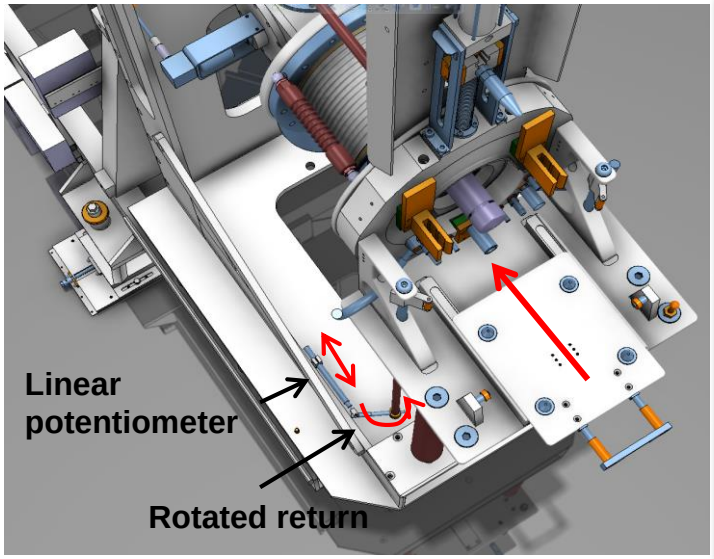


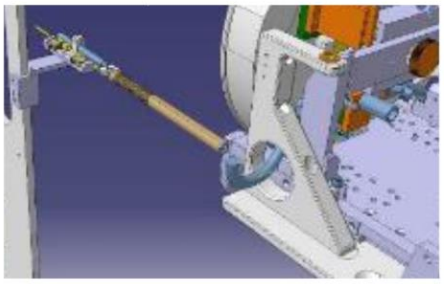
Acknowledgment M.Vagnoni EN-STI

FE intervention

Phase II – Coupling table upgrade 2016

	New design 2014	Design 2014 upgrade (2016)
Changes based on Feed-Back to increase reliability	Re-use the potentiometer of old clamps to monitor the position of the coupling table → feed-back showed that precision is lost with the rotation system (several coupling failures in 2015 not detected by potentiometer)	Installation new table with integrated potentiometer and switches



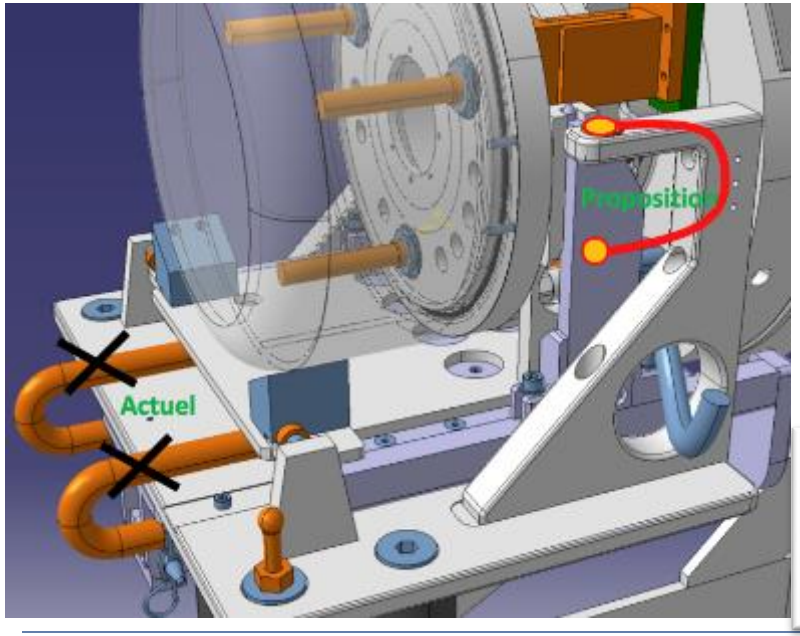


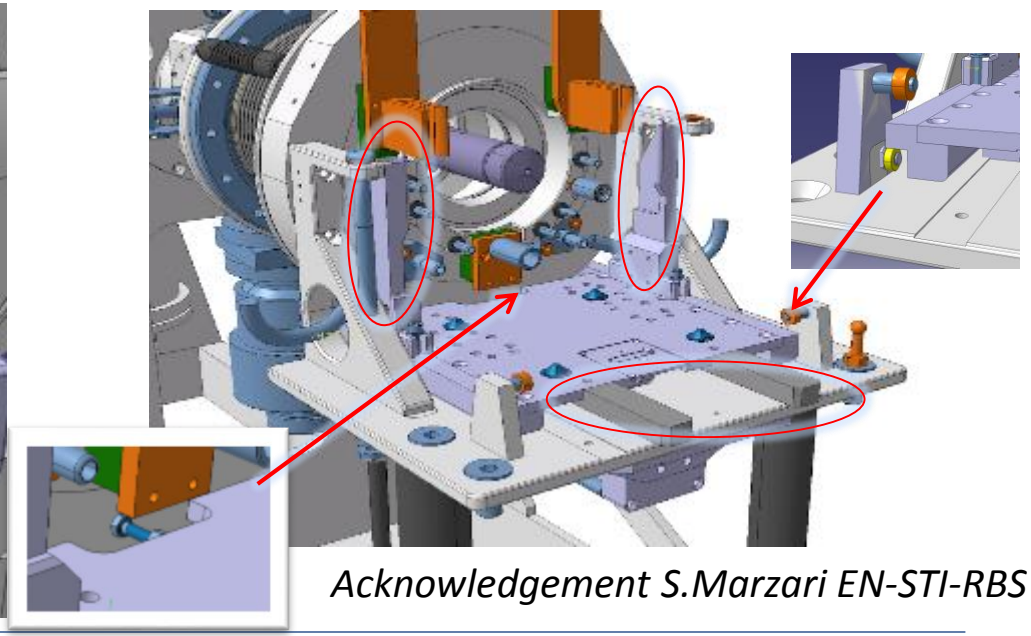
Acknowledgement S.Marzari EN-STI-RBS and C.Mitifiot EN-STI-TCD

FE intervention

Phase II – Coupling table upgrade 2016

	Design 2014 upgrade (2016)
Various changes	Profit from coupling table dismantling to integrate minor modifications, including: - Electrical connection support displacement - Addition of 2 passive supports for LIEBE target

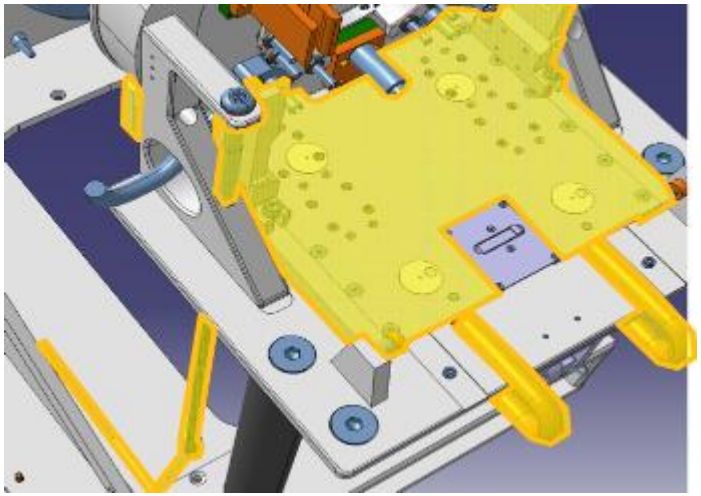




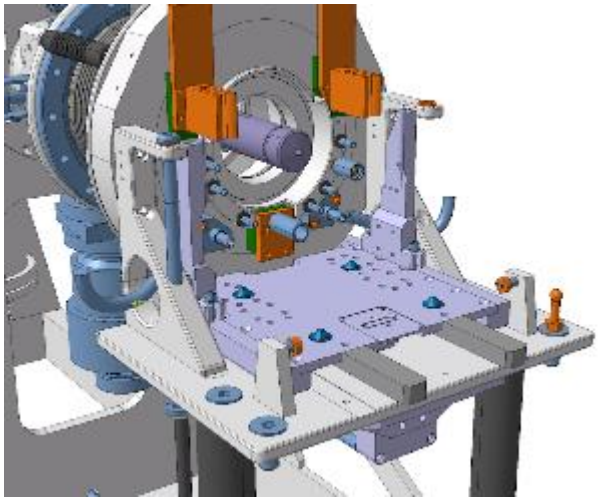
Acknowledgement S.Marzari EN-STI-RBS

FE intervention

Phase II – Coupling table upgrade 2016



Dismantling coupling table 2014



Mount coupling table 2016
(new, not irradiated)

	Dismantling	Re-installation
GPS + HRS Including tests	905	1598
Total	**≈ 2,5 man.mSv**	
Ind. Max	**≈1,3 man.mSv**	

Total coupling table
Collective ≈ 2,5 man.mSv

Phase III – Annual FE Maintenance

Procedure presented and approved during ALARA committee 2011 and 2013

Annual preventive maintenance

- Extraction electrode exchange
- Lubrication
- Cleaning
- Visual inspection

Added: Faraday cage piston maintenance (215 man.µSv) including compressed air filters

Activation of Montrac, installed for MEDICIS
→ Higher dose rate in HRS

Total FE maintenance
≈ 1,9 man.mSv

FE : Justification

Phase I

Dose reduction of subsequent interventions

Example: Coupling table exchange without shielding
≈ 6 man.mSv instead of 2,5 man.mSv

Phase II

Coupling table position is a crucial information:

- Avoid internal contamination
- Minimize release to environment (gas storage tanks needed emptying during operation 2015)
- Reduce waste (2 targets were suspected to be faulty and sent to waste)

Phase III

- Lubricate to avoid failure over the operation year
- New extraction electrode exchange to avoid sparking
- Clean to avoid sparking between mass and HV
- Failure of GPS piston on the faraday cage

FE : Optimisation

Phase I

- Intervention after 1month cooling time Must be first intervention before activity start inside target area

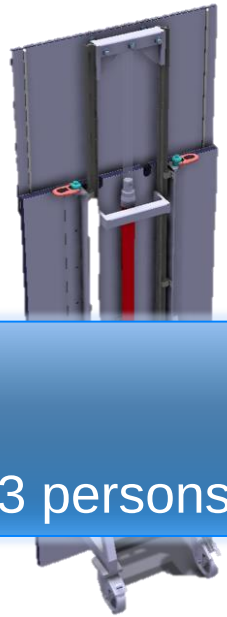
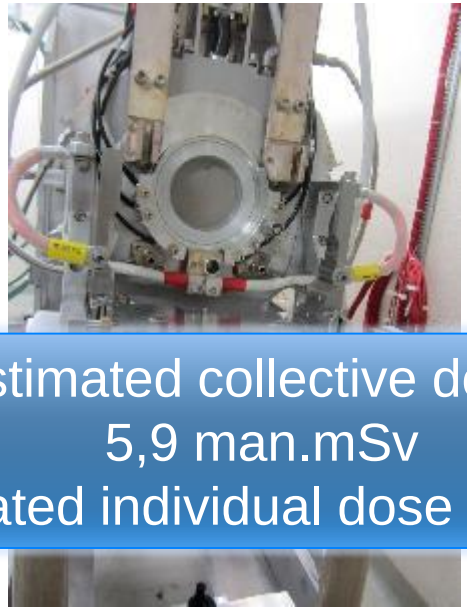
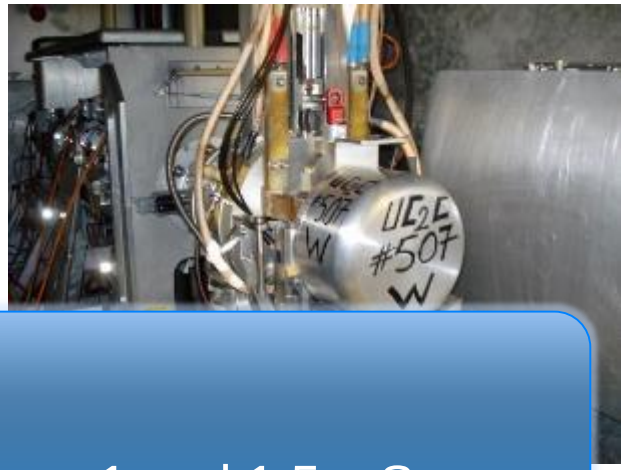
Phase II

- Shielding in place
- Intervention after 2 months cooling time
- Pre-assembly outside area to minimise time in hot area
- Rehearsal on OFF-Line FE
- Tests on coupling table piston done
- Tests of the new coupling table on going to increase reliability

Phase III

- Shielding in place
- Intervention after 2 months cooling time
- Faraday cage piston door design allows for a fast intervention (ALARA design)
- Dedicated tool for electrode extraction exchange

FE intervention

Phase I	Phase II	Phase III
		
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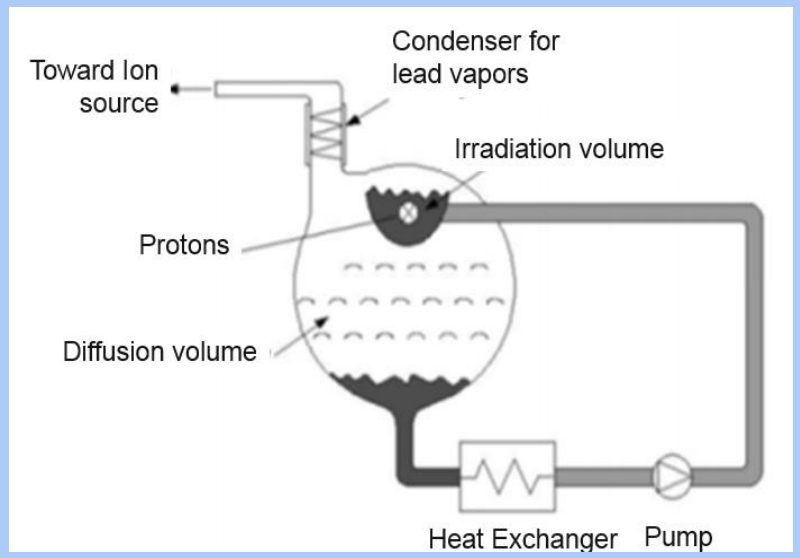
- Maintenance and upgrade of the ISOLDE Front Ends
- Modifications needed in ISOLDE for the LIEBE project
- Feedback from the ISOLDE intervention August 2015

LIEBE project

What is LIEBE? : **Li**quid **E**utectic Lead **B**ismuth Loop Target for **E**urisol

An ISOLDE target (static)



A loop target (dynamic)

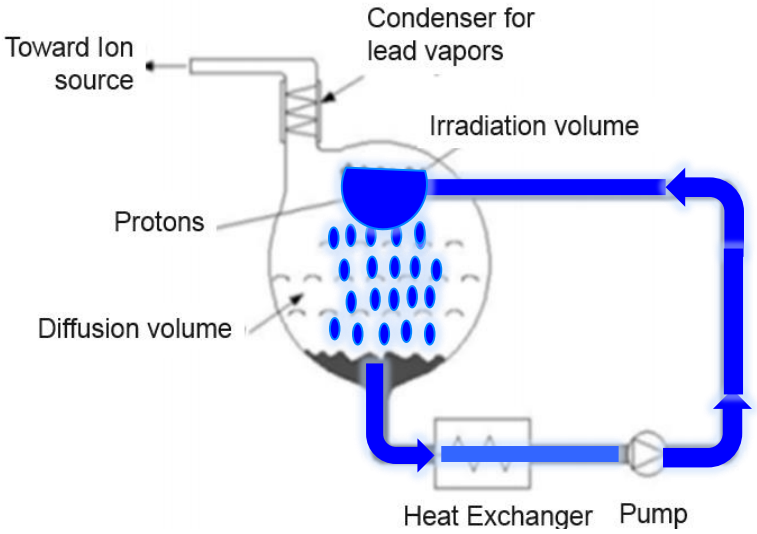
Collaboration started in May 2012 between 6 institutes: CEA, CERN, IPUL, PSI, SCK-CEN and SINP

LIEBE project

Why LIEBE? : Validation of a conceptual design for a high power Eurisol direct target by operating a prototype On-Line at ISOLDE

HIE-ISOLDE - IS563 (182-184 Hg),

ISOLDE:IS539 (182-184 Hg),
IS545 (116-118Ba),
IS478 (72Kr)



Acknowledgement: M.Delonca

Challenging target

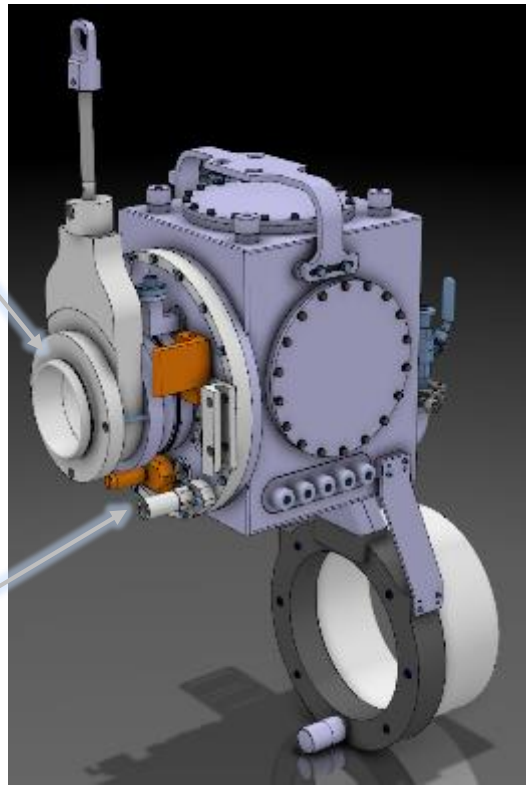
- First ISOLDE target with a circulating loop (pump)
- First shower target → Allows a faster diffusion release *(Expected released efficiencies between a factor 5 to 10 higher than static target on exotic species ^{177}Hg (130 ms half life))*
- First target with a heat exchanger → Allows higher power proton-beam deposition in anticipation of LINAC 4 upgrade

LIEBE project

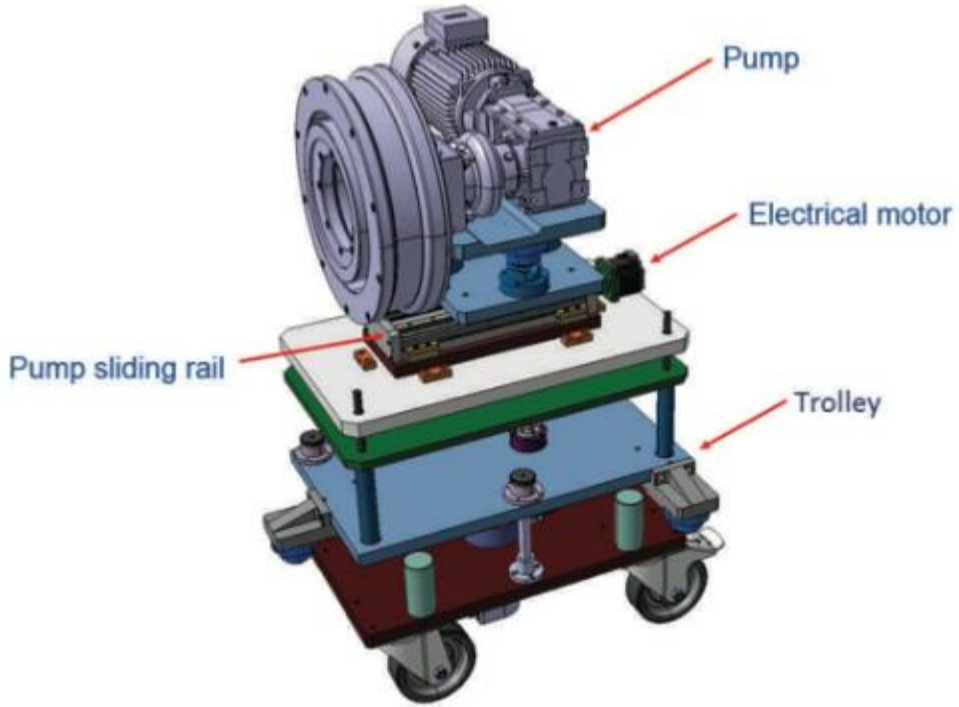
How? : Collaboration started in 2012. Successful Thesis (EDMS 1572809) on the LIEBE target thanks to the work of **M.Delonca EN-STI.** High involvement from EN-STI-TCD and RBS with experts inputs from CEN-SCK

Standard ISOLDE interface

Standard ISOLDE base

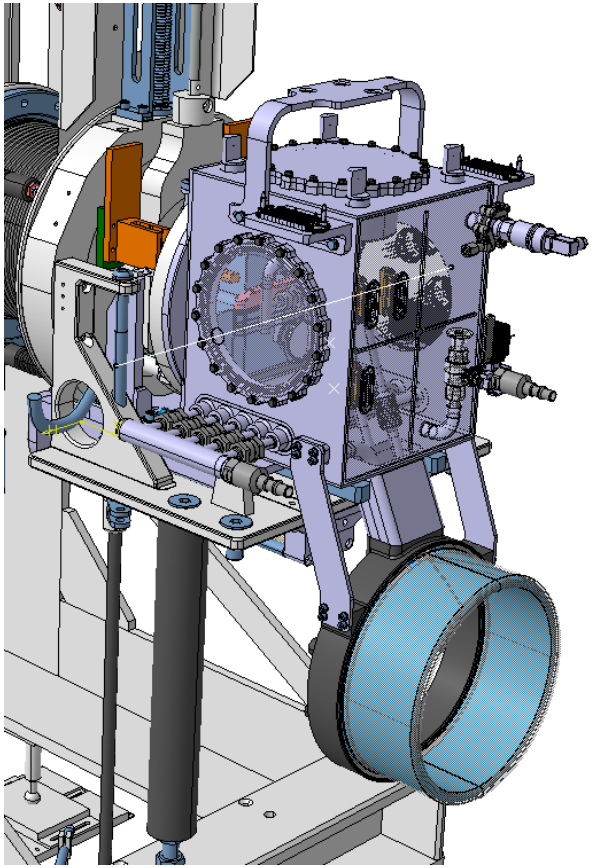


Acknowledgement: M.Delonca (Design) and V.Barozier (3D)



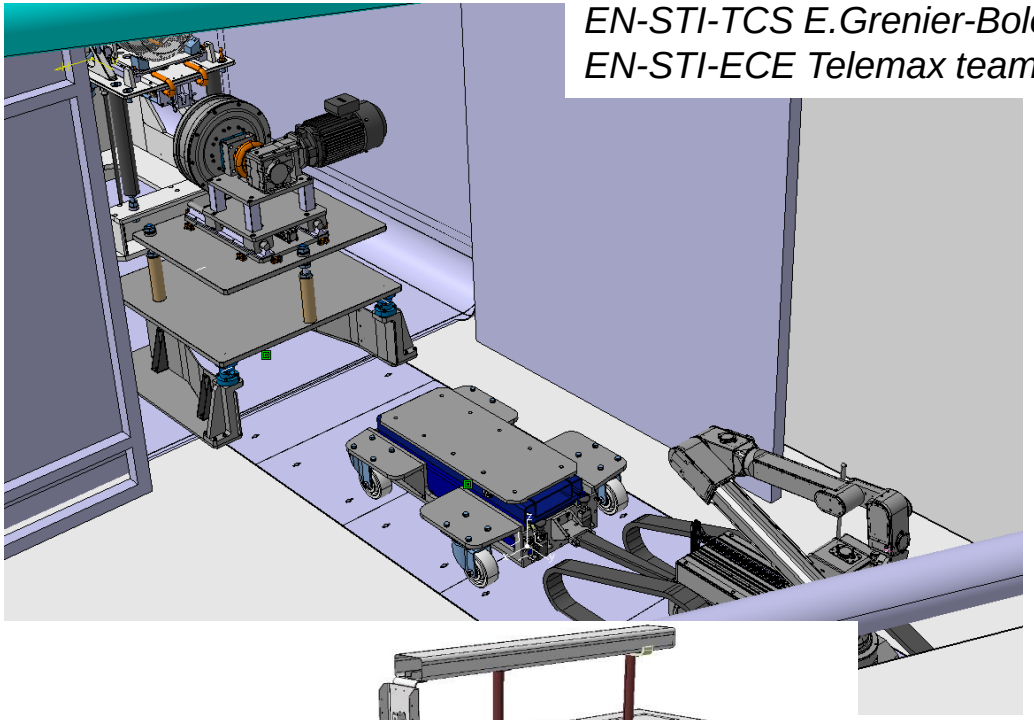
Acknowledgement: IPUL (Pump Design) and E.Grenier-Boley (3D and Pump support Design)

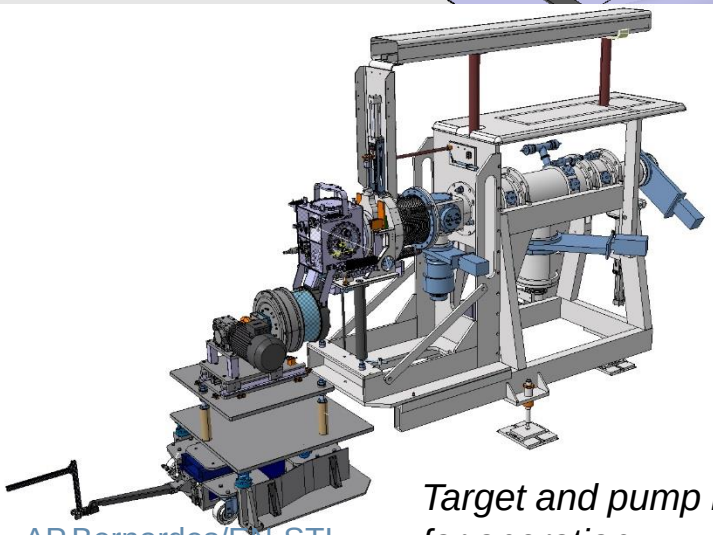
LIEBE project



Acknowledgement:
EN-STI-RBS M.Delonca, V.Barozier
EN-HE JL.Grenard

Acknowledgement:
EN-STI-TCS E.Grenier-Boley
EN-STI-ECE Telemax team





Target and pump ready for operation

LIEBE project

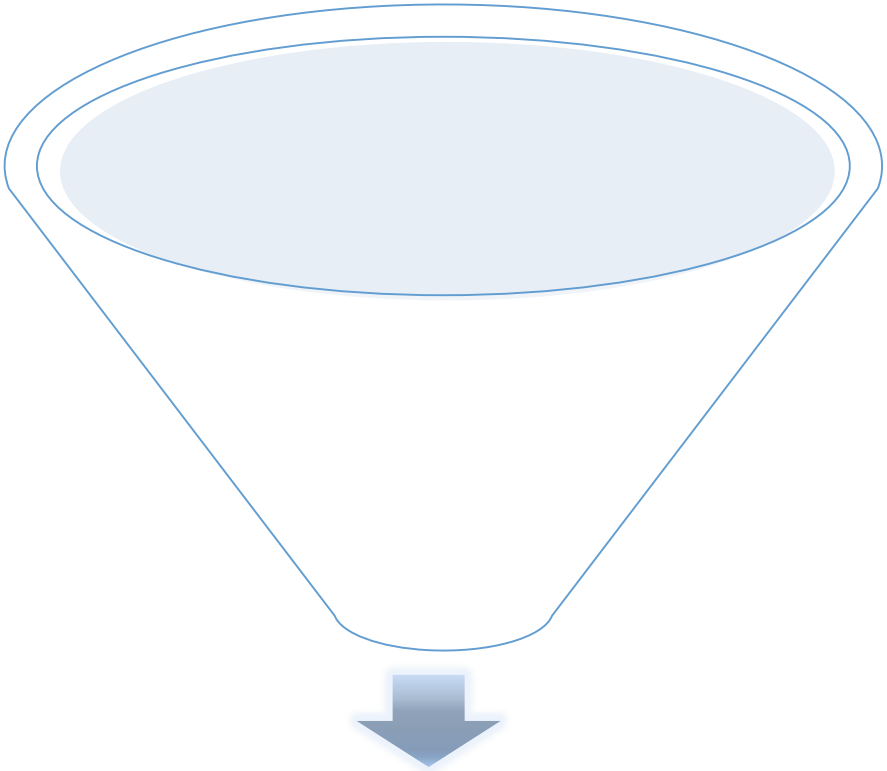
When ? : Two options on schedule to be defined after the **review in June 2016**

Option 1: Run LIEBE target as **last target of the 2016 year**

Option 2: Run LIEBE target as **first target of the year 2017**

Tests to be presented at the **LIEBE review** in June 2016 → selection of the best option

Fe… target handling and disconnection feasibility



OFF-LINE Tests of the target and pump to be done between March and June 2016

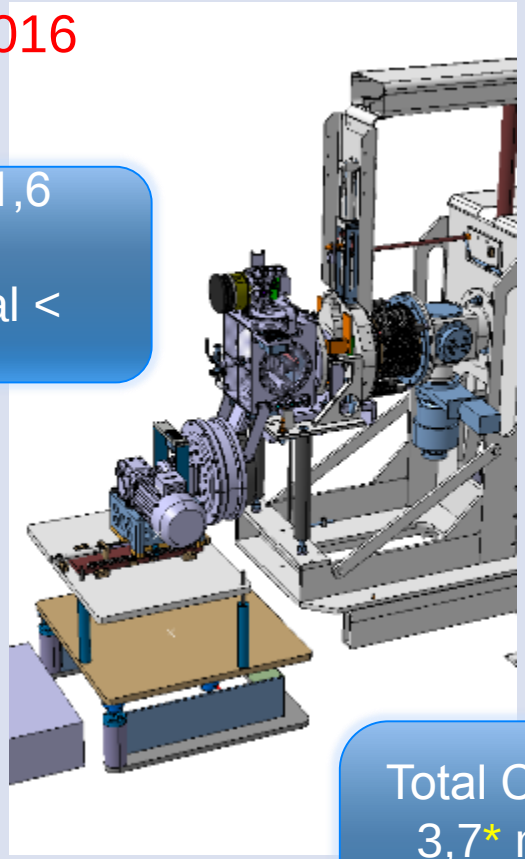
Presentation at the **ALARA committee in October 2016 with dose estimation of the selected option**

LIEBE project

Phase I: Modifications needed in the ISOLDE area and on GPS Front-End for LIEBE operation – to be done during YETS 2016

Collective ≈ 1,6 man.mSv
Max Individual < 1mSv

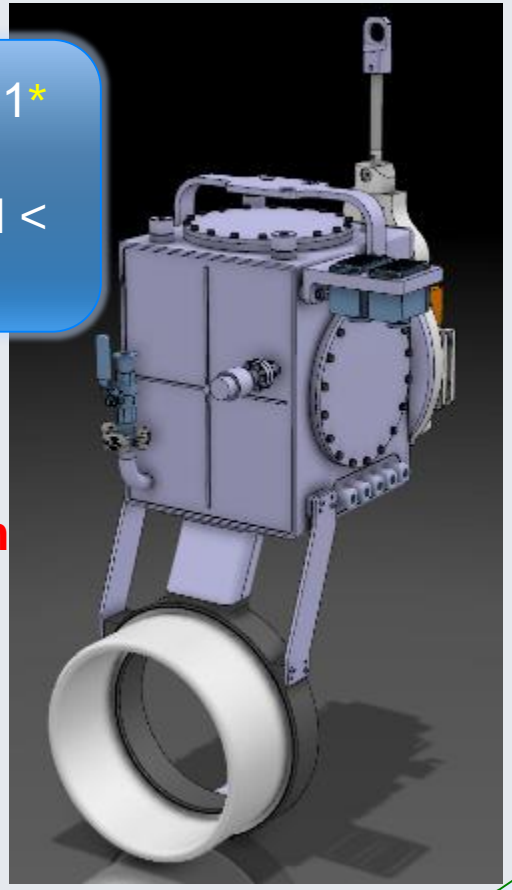
For approbation now



Phase II: LIEBE target installation, operation and transport

Collective ≈ 2,1* man.mSv
Max Individual < 1mSv

Approbation in October 2016



Total Collective ≈ 3,7* man.mSv
Max Individual < 1mSv

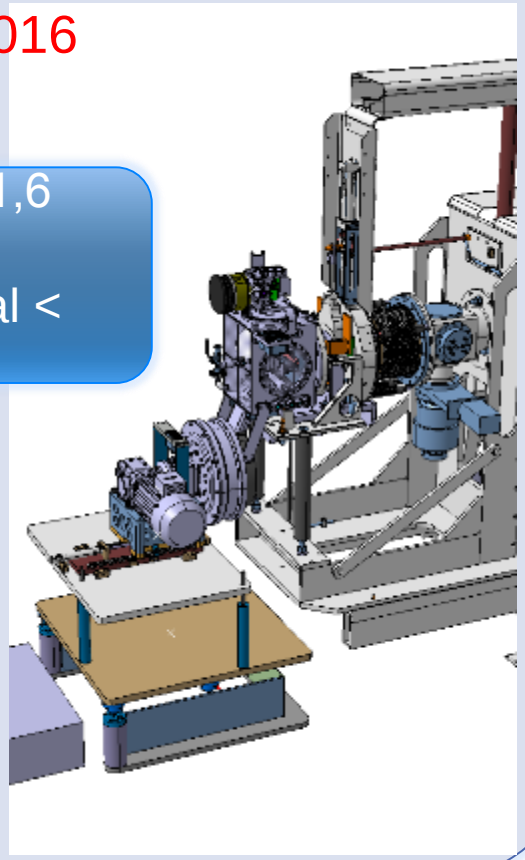
* To be revised after review in June

LIEBE project

Phase I: Modifications needed in the ISOLDE area and on GPS Front-End for LIEBE operation – to be done during YETS 2016

Collective ≈ 1,6 man.mSv
Max Individual < 1mSv

For approbation now



LIEBE project

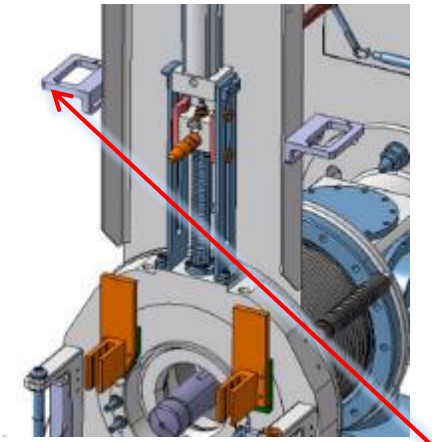
Acknowledgement: T.Feniet EN-STI-ECE

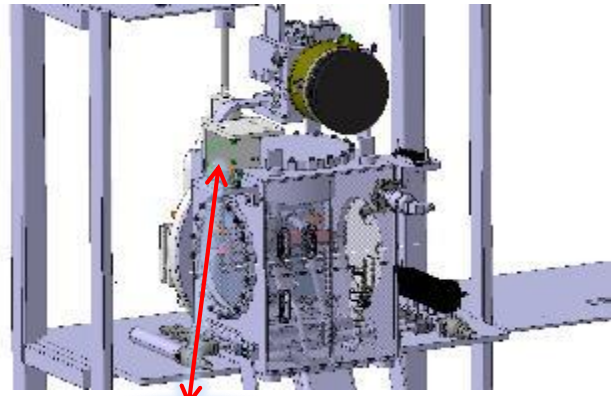
Task	Status
TARGET AREA MODIFICATION (during shut-down YETS 2016)	
• Add cables to Boris Tube	• Integration study done ✓ • Rehearsal done ✓ • Operation well known with FE exchange ✓ • Material at CERN ✓

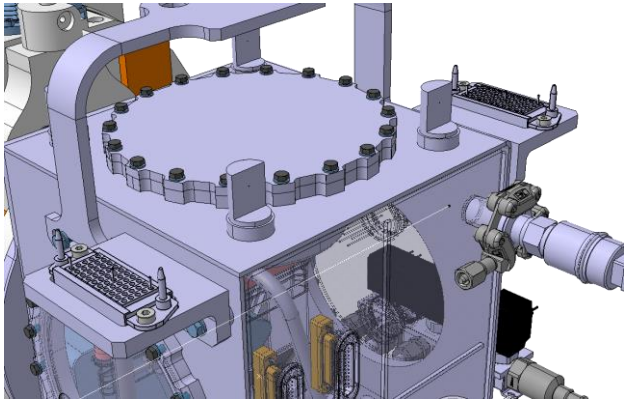
LIEBE project

Acknowledgement: T.Feniet and JL.Grenard

Task	Status
TARGET AREA MODIFICATION (during shut-down YETS 2016)	
• Add Hypertac support on FE and test automatic Hypertac disconnection	• Integration study on FE done ✓ • Test automatic disconnection (with robot if not possible with telemax) • Material at CERN ✓

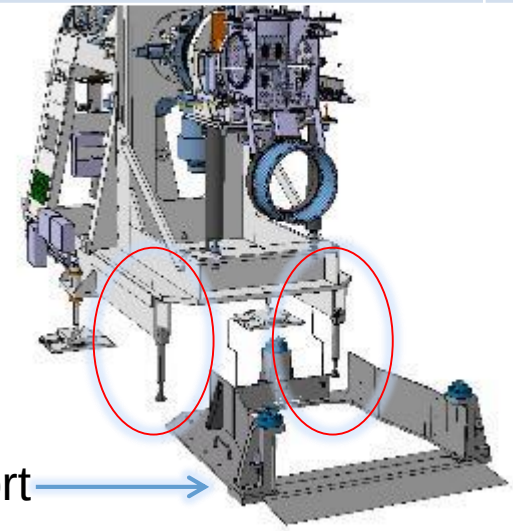




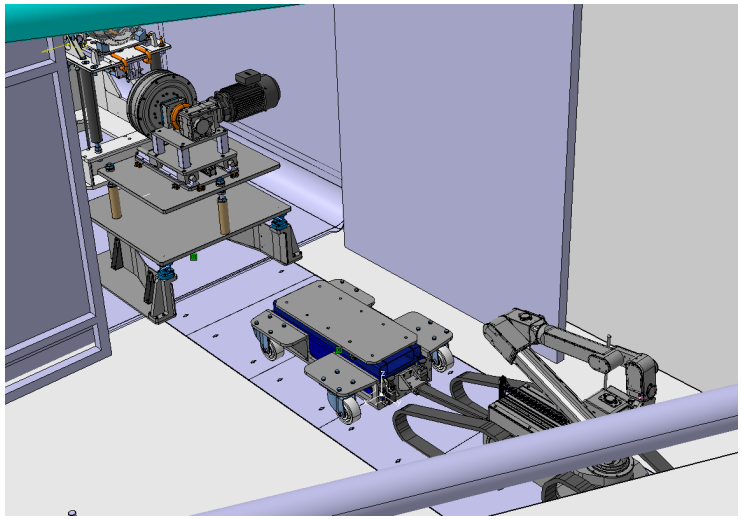


LIEBE project

Task	Tests
TARGET AREA MODIFICATION (during shut-down YETS 2016)	
• Reinforced GPS FE	• Integration study done ✓ • Material at CERN ✓
• Metallic plate installation for trolley support of the pump	• Integration study done ✓ • Waiting for material delivery • Test with telemax to be done inside or outside target area in February/March • To be removed after tests

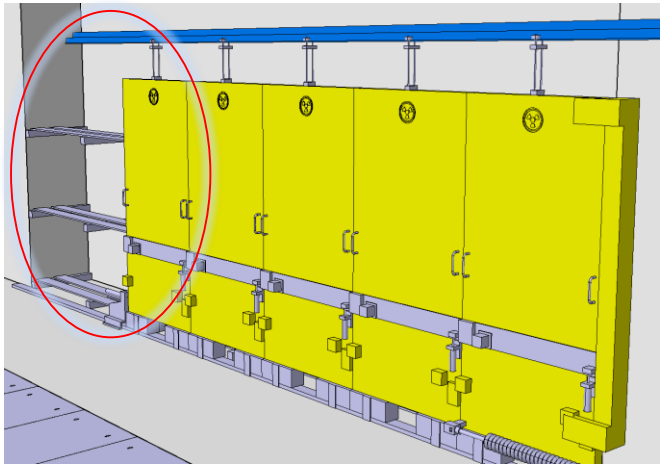


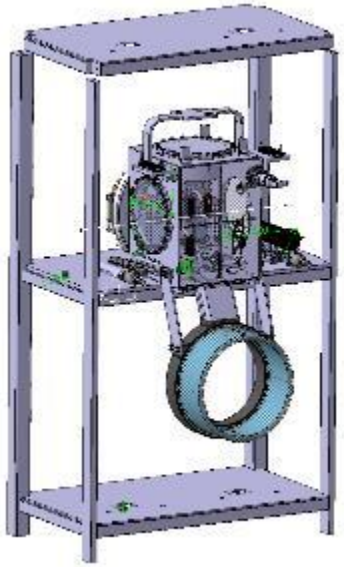
Trolley support



LIEBE project

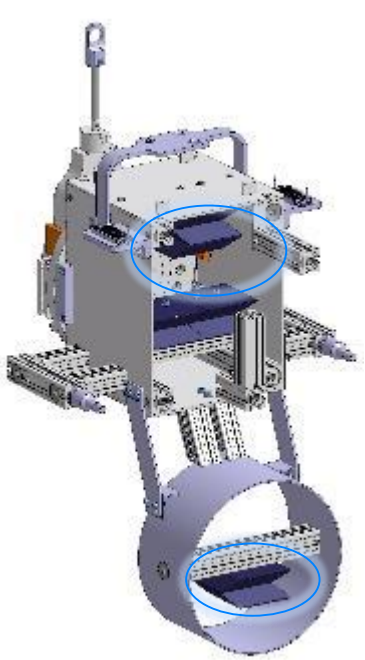
Task	Tests
TARGET AREA MODIFICATION (during shut-down YETS 2016)	
• Shelves modification	• Integration study done✓ • Material at CERN ✓
• Valve for target water cooling (water plug-in compatible with telemax robot)	• Material at CERN ✓ • Test automatic disconnection (with telemax robot) in February

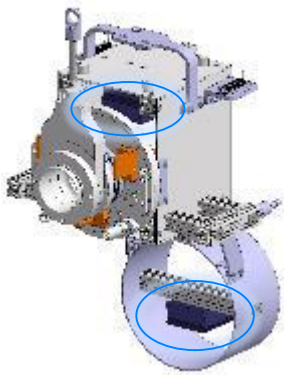




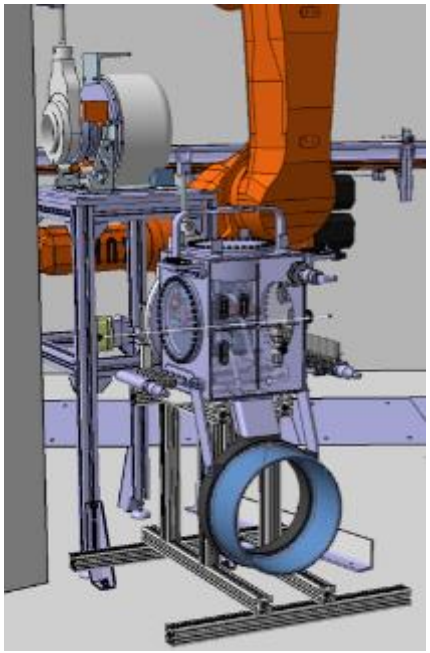
LIEBE project

Task	Status
TEST (during shut-down YETS 2016)	
• Robot target programming and tests with a simplified target mock-up	• Simplified target mock-up under construction • Mobile exchange point under construction • Test target handling and robot programming in February/March





Various lead brick positions to take into consideration the change in the center gravity of the LIEBE target

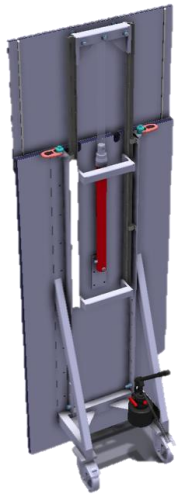


LIEBE : Justification

LIEBE Target

- To run LIEBE target modification/tests on FE and target area are needed
- To decide if LIEBE target should be run in 2016 or 2017, modification and tests inside target area should be done during YETS 2016 (needs several months cool-down)
- Collective dose cost for target area and FE modification are the same whether modifications are done during YETS 2016 or EYETS 2017
- To keep the 2 options open we would like to perform phase 1 during YETS 2016

LIEBE : Optimisation



- Shielding will be used to reduce dose rate
- To be done as late as possible (end of February, after 3 months cool-down)

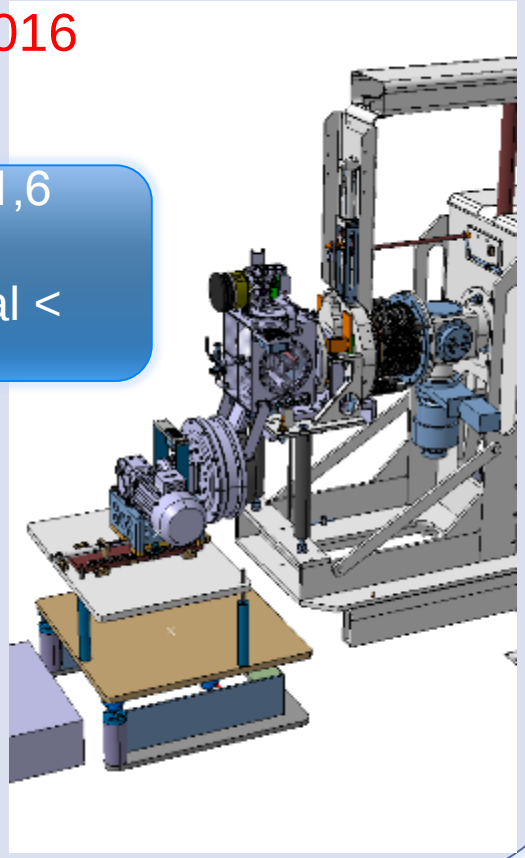
- Cable testing with hypertac connection done before installation and after installation
- Extra cables and connections are added to avoid further modifications
- Rehearsal on cable installation done
- Cable pulling will be done from the building 170 (low dose rate)

LIEBE project

Phase I: Modifications needed in the ISOLDE area and on GPS Front-End for LIEBE operation – to be done during YETS 2016

Collective ≈ 1,6 man.mSv
Max Individual < 1mSv

For approval now



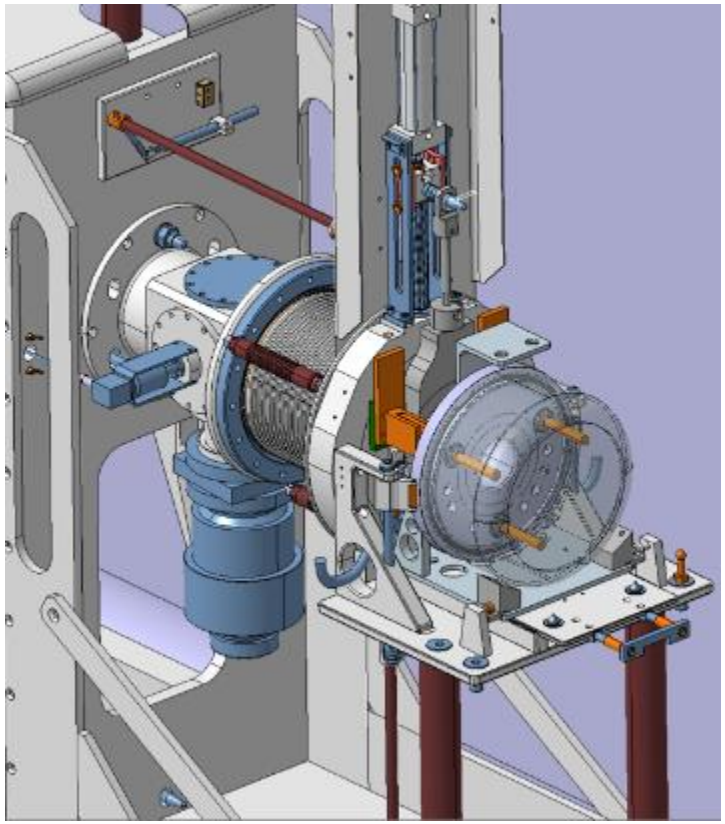
Outline

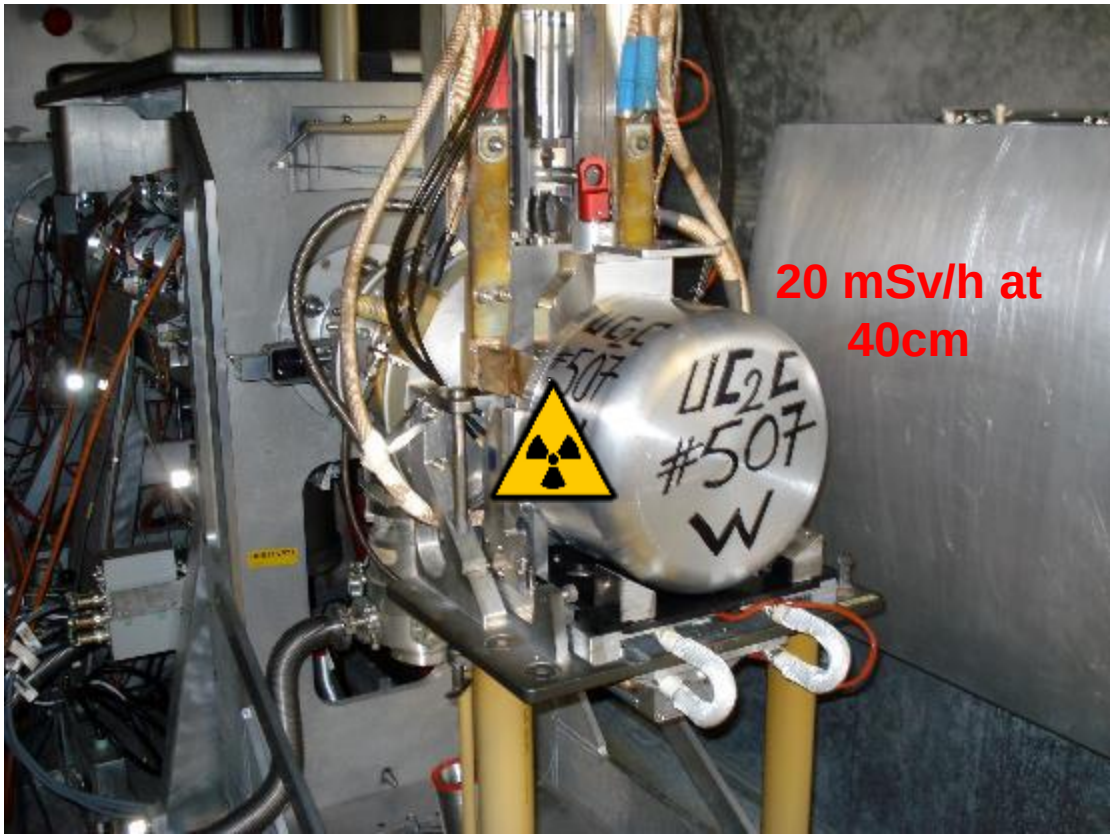
- Maintenance and upgrade of the ISOLDE Front Ends
- Modifications needed in ISOLDE for the LIEBE project
- Feedback from the ISOLDE intervention August 2015

Feed-Back incident

- Front-End and Target shutters blocked open with an irradiated target on FE (High dose rate)

→ Not possible to decouple the target, physics program on hold





Feed-Back incident

- Rehearsal done on OFF-line Front-End (without target)
- Intervener was an expert and experienced
- Dose estimation done on WDP, based on recorded rehearsal times
- Intervention classified ALARA I – group 1 and ALARA level III – group 2 (Dose rate > 2mSv/h)*
- Impact 67919 with WDP signed by EN RSO and RP based on information exchanged on the phone and WDP

**The ARWG proposes that interventions in which the Group 2 Level III criteria are attained do not require prior approval by the ALARA committee, but ... group 2 criteria will be subject to a radiological risk assessment by the RSO and RP prior to the ALARA level classification of the intervention."*

Feed-Back incident

Manual intervention planned for:

→Step 1: Measure compressed air (a few seconds)

→Step 2: Close manually shutter (a few seconds)

→Step 3: Change piston after target removal by the robot

During step 1 DMC dosimeter alarm started.

- Intervener left the place immediately leaving everything in place.
- RP stopped the intervention and forbid access to the target area
- Hierarchies and RSO informed

Feed-Back incident

Excess of estimated collective and individual dose well above 150% and 130%

67919 - HRS shutter piston exchange

ll, Richard (EN-STI-RBS) View Daily Report

To: 13-Aug-2015

)ose: **300 µSv** Estimated Individual Dose: **100 µSv**

	Group	Company	Dose (µSv)
	EN-STI-RBS		1,471
	DGS-RP-AS	CERAP (FR) - CERAP (UK) GROUPEMENT	11
	DGS-RP-AS		3
	EN-STI-RBS		0
	BE-OP-PSB		0
		Total (µSv)	1485

The disconnection of the compressed air solved the problem. Telemax used to retrieve the manometer.

Feed-Back incident

Intervention was well prepared and the ALARA approval procedure was followed. However...

- Rehearsal without a target present on Off-line FE lead to an underestimation of the intervention location (40cm estimate, less in reality)
- The radiological risk analysis (for Group 2 - Level 3) was not documented nor archived. The EN-RSO has now provided a template for the risk analysis and requires a completed analysis attached to the WDP as base for approval.
- Behavior from intervener very good when DMC alarm went ON
- Very good support from RP before and during intervention (briefing was done in situ)
- Code A2 was not done on time

Feed-Back incident

For future intervention

- Establish WDP as before (close collaboration with RP-OP)
- Request presence of RSO and RP during off-line test (if D>2mSv/h)
- Complete Radiological Risk analysis, add to WDP

  (only if ALARA Level 3 for Group 2 criteria)
- Complete intervention Folder on EDMS, which should contain information on justification, optimization, feedback and work procedures

  (only if ALARA Level 2 for Group 1 criteria)
- Inform hierarchies after intervention in case of incident
- Write and release Code A2 within 48hours in case of incident
- Inform of ALARA Committee Secretary in case of incident

Acknowledgements

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EN/DHO: R.FOLCH

EN/MEF: V.BAROZIER, A.PARDONS

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Thank you very much for your attention

Back-up slides

LIEBE project

When ? : Two options on schedule to be defined after the **review in June 2016**

	Last target of 2016 (transport in January 2017)	**First target of 2017**
Impact on planning **Same collective dose for phase 1**	Target area and FE modification during YETS 2016	Target area and FE modification during YETS 2016 or EYETS 2017
Impact on dose	3 728* µSv collective dose	2227* µSv collective dose No estimation of collective dose for EYETS 2017
Impact on physic schedule	→ 3 weeks stop in GPS (decay time+ installation) → 3 days decay time in HRS (at minima if UCx) prior LIEBE installation	No impact
Impact in case of failure	1 month of decay time without impact on physic program **estimation to be confirmed*	1 month decay time may be requested prior to intervention for 5.10^{18} protons (impact on HIE-ISOLDE)


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