



Installation to commissioning of a turn-key LINAC and transition to user operation

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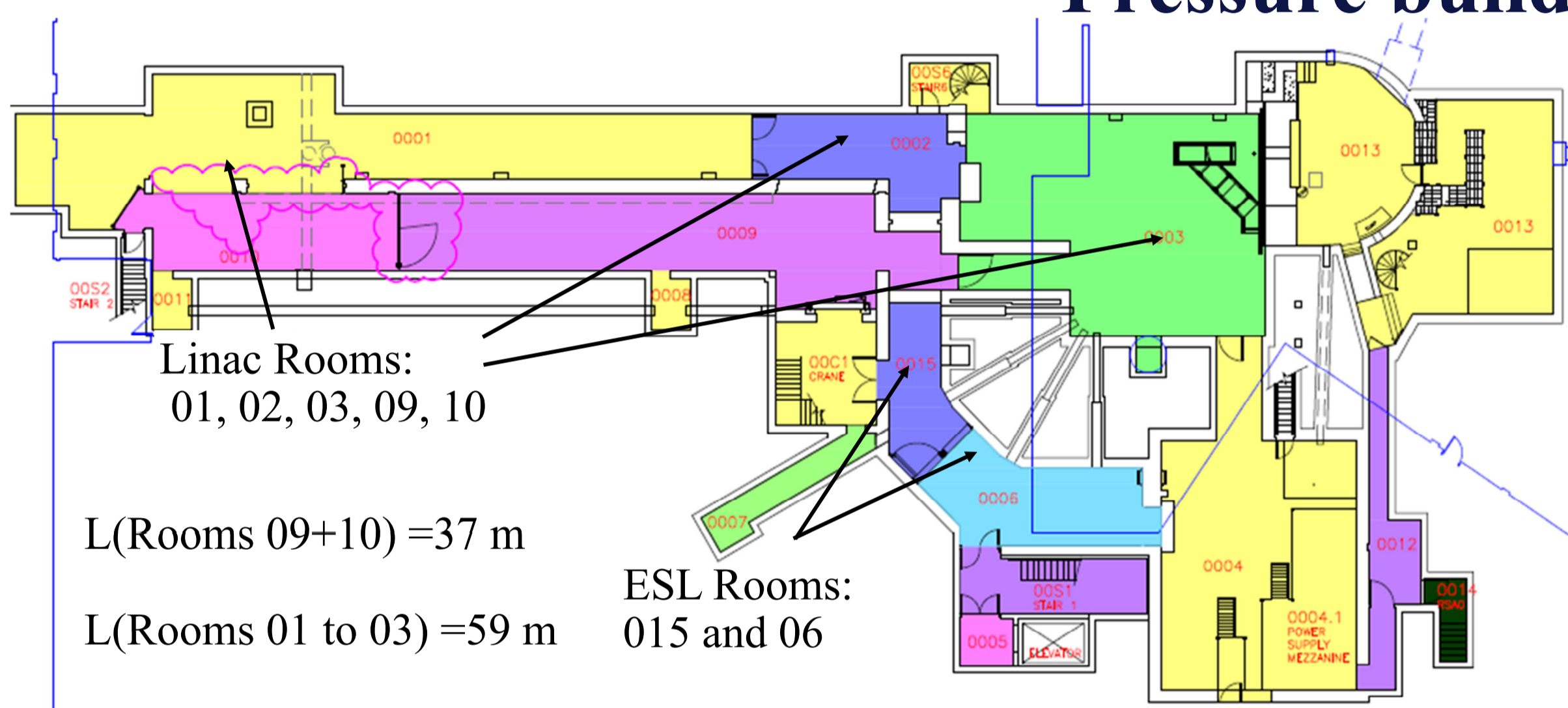
Summary

CLS will soon - Mid-April 2024 - install a “turn-key” 250 MeV injector, based on a normal conducting S-band (3000.24 MHz) linac fed from a thermionic gun. The machine will be shorter than the existing 2856 MHz linac thanks to the addition of SLED system that saves on RF power stations. One of the challenge for the supplier is to handle the knowledge and rebuttal of experts, hence the supplier cannot quite deliver a turn-key system. After the installation, the commissioning starts. First without beam when components are tested for operation. Some of the steps will require the host institutes to provide the adequate green light in terms of safety (i.e live work). This requires understanding and lining up of the supplier to the host institutes policies and the adequate explanation and support from the institute to the supplier, the misunderstanding can impact the entire “ready to operate” schedule.

Beyond, the installation a complete ecosystem is perturbed. Science needs to take advantage of the downtime to ameliorate its services to the users. New techniques, new BL set-up, BL scientists publications, tackling issue discovered during runs (require Accelerator physicist time - competition). A major downtime for an upgrade has to provide better performance - The machine alone is not enough and this require investment.

Location - Overall schedule - Planning and Staffing Requirements

Pressure build-up / failure is not an option



Phase	Start	Finish
Dismantling/CLS Service Installs	April 10, 2024	May 26, 2024
RI Installation and Testing	May 27, 2024	July 10, 2024
*Commissioning, Conditioning, and SAT	June 28, 2024	September 17, 2024
**Finalization and LINAC Handing Over	September 17, 2024	October 21, 2024
CLS Development Shifts - Startup for Operations	October 21, 2024	November 5, 2024

Task	Start	Finish
4.1 Installation...	8	8
4.1.1 Linac mechanical installation	8	8
4.1.2 Waveguide holder installation (According to P167183)	8	8
4.1.3 Linac mechanical installation (According to P157099)	8	8
4.1.4 Final alignment of the LINAC	8	8
4.1.5 Full back testing of the assembled Linac and the WG	8	8
4.1.6 Start pumping down	8	8
4.2 Modulator system mechanical installation	8	8
4.2.1 Placement of the modulators	8	8
4.2.2 Installation of the Mystron	8	8
4.2.3 Oil filling	8	8
4.3 Water and pressurized air	9	9
4.3.1 Installation between CLS water header and components / manifolds	9	9
4.3.2 Installation between RI Manifold and linac component, Lambda chiller circuit	9	9
4.3.3 Connection to the CLS pressurized air system	9	9
4.4 Electrical installation	9	9
4.4.1 Installation and wiring of emergency off / linac off buttons	9	9
4.4.2 Cable tray installation	9	9
4.4.3 Bundling cable installation	9	9
5 Commissioning	8	11
5.1 Control system commissioning and test	8	11
5.2 Test control of each component	8	11
5.3 Temperature testing	8	11
5.4 Component commissioning	8	11
5.5 Environmental conditions	8	11
5.6 Water system	8	11
5.7 Magnet system	8	11
5.8 RF conditioning from RFID mode	8	11
5.9 High power RF test	8	11
5.10 Beam diagnostics	8	11
5.11 Modulator and Mystron	8	11
5.12 Electron source	8	11
5.13 High power RF operation	8	11
5.14 RF conditioning from RFID mode	8	11
5.15 High power RF test	8	11
5.16 Test of the linac test	8	11
5.17 Beam commissioning	8	11
5.18 Operation with beam	8	11

Bullet point Plan vs Procedural Plan

- We know what to do but not necessarily how it will be executed.
- Supplier responsible but work force is local - problem handling & Interfaces (Nothing New - Drawing on other experiences)
- Efficiency gain - Start testing before end of installation Flexibility of Staffing (obvious but company culture)

Division	Resource Type	~6.5 Weeks		~6.5-10.5 Weeks		~11 Weeks		~4.5 Weeks		~2.5 Weeks	
		Dismantling April 10, 2024 to May 26, 2024	Integration (CLS Service Installs)	RI Installation May 27, 2024 to July 10, 2024	*Commissioning, Conditioning and SAT June 28, 2024 to Sept. 17, 2024	**Finalization and LINAC Handing Over Sept. 18, 2024 to Oct. 21, 2024	Startup For Operations Oct. 21, 2024 to Nov. 5, 2024				
QTS	MTECH	+8 hours/day/person +4 max hours OT/day/person +Max 48 hours/week/person	+8 hours/day/person +4 max hours OT/day/person +Max 48 hours/week/person	+10 hours/day/person +Additional overtime as needed +Max 48 hours/week/person	+8 hours/day/person +On-call as needed	+8 hours/day/person +On-call as needed	+8 hours/day/person +On-call as needed				
	ETECH										
Engineering	MENG	+8 hours/day/person +4 max hours OT/day/person +Max 48 hours/week/person	+8 hours/day/person +4 max hours OT/day/person +Max 48 hours/week/person	+10 hours/day/person +Additional overtime as needed +Max 48 hours/week/person	+8 hours/day/person +On-call as needed	+8 hours/day/person +On-call as needed	+8 hours/day/person +On-call as needed				
	EENG										
	MCAD	+8 hours/day/person	+8 hours/day/person	+8 hours/day/person	+8 hours/day/person	+8 hours/day/person	+8 hours/day/person				
	ECAD	+8 hours/day/person	+8 hours/day/person	+8 hours/day/person	+8 hours/day/person	+8 hours/day/person	+8 hours/day/person				
HSE	HSE RAD	+8 hours/day/person, staggered shifts flex start time +After hour coverage shift change (short notice will need overtime for in scope)	+8 hours/day/person +After hour coverage shift change (short notice will need overtime for in scope)	+8 hours/day/person +After hour coverage shift change (short notice will need overtime for in scope)	+8 hours/day/person +After hour coverage shift change (short notice will need overtime for in scope)	+8 hours/day/person +After hour coverage shift change (short notice will need overtime for in scope)	+8 hours/day/person +After hour coverage shift change (short notice will need overtime for in scope)				
	HSE OHS	+8 hours/day/person +After hour coverage shift change (short notice will need overtime for in scope)	+8 hours/day/person +After hour coverage shift change (short notice will need overtime for in scope)	+8 hours/day/person +After hour coverage shift change (short notice will need overtime for in scope)	+8 hours/day/person +After hour coverage shift change (short notice will need overtime for in scope)	+8 hours/day/person +After hour coverage shift change (short notice will need overtime for in scope)	+8 hours/day/person +After hour coverage shift change (short notice will need overtime for in scope)				
	HSE General	+On Call as needed	+On Call as needed	+On Call as needed	+On Call as needed	+On Call as needed	+On Call as needed				
	HSE										
CID	Control Analyst	+8 hours/day/person +On-call as needed	+8 hours/day/person +On-call as needed	+8 hours/day/person +On-call as needed	+8 hours/day/person +On-call as needed	+8 hours/day/person +On-call as needed	+8 hours/day/person +On-call as needed				
	ACCEL PHYS	+8 hours/day/person +On-call as needed	+8 hours/day/person +On-call as needed	+8 hours/day/person +On-call as needed	+Normal operations shift schedule +Shift coverage minimum 16 hours/day for 6 days/week	+Normal operations shift schedule +Shift coverage minimum 16 hours/day for 6 days/week	+Normal operations shift schedule				
AOD	OPERATORS	+8 hours/day/person +Flex start time as needed	+8 hours/day/person +Flex start time as needed	+8 hours/day/person +Flex start time as needed	+Normal operations +Shift coverage 24/7	+Normal operations +Shift coverage 24/7	+Normal operations +Shift coverage 24/7				
	INSTRUMENTATION	+8 hours/day/person +After hour coverage On-call or shift change	+8 hours/day/person +After hour coverage On-call or shift change	+8 hours/day/person +After hour coverage On-call or shift change	+8 hours/day/person +After hour coverage On-call or shift change	+8 hours/day/person +After hour coverage On-call or shift change	+8 hours/day/person +After hour coverage On-call or shift change				
Finance	RF IV	+8 hours/day/person +On-call as needed	+8 hours/day/person +On-call as needed	+8 hours/day/person +On-call as needed	+8 hours/day/person +On-call as needed	+8 hours/day/person +On-call as needed	+8 hours/day/person +On-call as needed				
	BUYERS	+8 hours/day/person	+8 hours/day/person	+8 hours/day/person	+8 hours/day/person	+8 hours/day/person	+8 hours/day/person				
	STORES	+8 hours/day/person	+8 hours/day/person	+8 hours/day/person	+8 hours/day/person	+8 hours/day/person	+8 hours/day/person				

ID	Task	Start	Finish	Resources
1	Design, Procurement, Manufacturing	2024-04-10	2024-05-26	Design, Procurement, Manufacturing
2	Transport	2024-05-27	2024-07-10	Transport
3	Installation	2024-05-27	2024-07-10	Installation
4	Commissioning	2024-06-28	2024-09-17	Commissioning
5	Finalization and Handing Over	2024-09-18	2024-10-21	Finalization and Handing Over
6	Startup for Operations	2024-10-22	2024-11-05	Startup for Operations

Ensuring User Operation

Competitive needs: Machine

- Injector can pass the SAT, but it is not an absolute guarantee that beam goes to the rest of the chain
- Need time to pass beam from Injector to SR
- Accelerator complex needs Maintenance. How to take advantage of 6 months downtime to enhance the overall facility - Manpower and \$
- Training of Operators Care of not losing their Qualifications during downtime

Competitive needs: Science

- Ensuring return of the users*
- Beam Lines need upgrade 6 month downtime competition for Manpower and \$
 - BL scientists time for own Science write up publications - Career development
 - Tackling the Photon Beam Quality issues Resources needed from Accelerator and from BL scientists

Questions before & after:

- Risks well evaluated & appropriate mitigation plans in place? Holding Schedule
- User operation: Will we show improvements (Up-time, Beam Quality)?

Acknowledgement: The author would like to thank his AOD colleagues that are part of the journey and provided along the way their criticisms.



Particle Accelerator Upgrade - Removal and Installation, Trieste, Italy 2024