EUROPEAN SPALLATION SOURCE

ESS Accelerator Safety

Lali Tchelidze
Safety work package leader

12th Technical Board Mtg - ESS Accelerator System Project (ACCSYS)
March 5, 2015

WP13 Safety

- ✓ Lali Tchelidze (AD), safety work package leader
- ✓ Riccardo Bevilacqua (Target Division) - 40% support for MCNPX calculations for the accelerator
- ✓ Luisella Lari (AD and project planning) 30% support for FLUKA calculations for the accelerator
- ✓ Luigi Esposito – 50% support (FLUKA) from CERN for 12 months
- ✓ Duy Phan, general safety engineer
- ✓ Michał Jarosz (AD, BI group) supporting accelerator geometry development in MARS

Current status and major issues

- Work done in 2013-2014 focuses on accelerator prompt radiation shielding for normal operations and maximum credible accidents
- Baseline shielding layout ESS-0007143 (reviewed and approved)
  - Also as a requirement in Doors (coming soon)
  - 5 m thicnkess of earth berm
  - 7 m between accelerator tunnel and klystron gallery
  - Number of penetrations in the bulk shielding (as described in ESS-0007143)

- Change requests coming continuously
- No procedure to deal with the requests
  - ESS-0019931 by SDC (soon to be approved, after implementing comments from AD)
  - Currently an internal AD workflow

- Missing technical notes

Major tasks in 2015

- Priority is
  - to assist change requests related to CF
  - Work along the ES&H project plan to support the licensing process with SSM
  - Address ESHAC recommendations
  - Document progress in JIRA and CHESS

- Working towards
  - A comprehensive radiation protection report(s) for design, commissioning, operation and decommissioning of the ESS accelerator

Activities

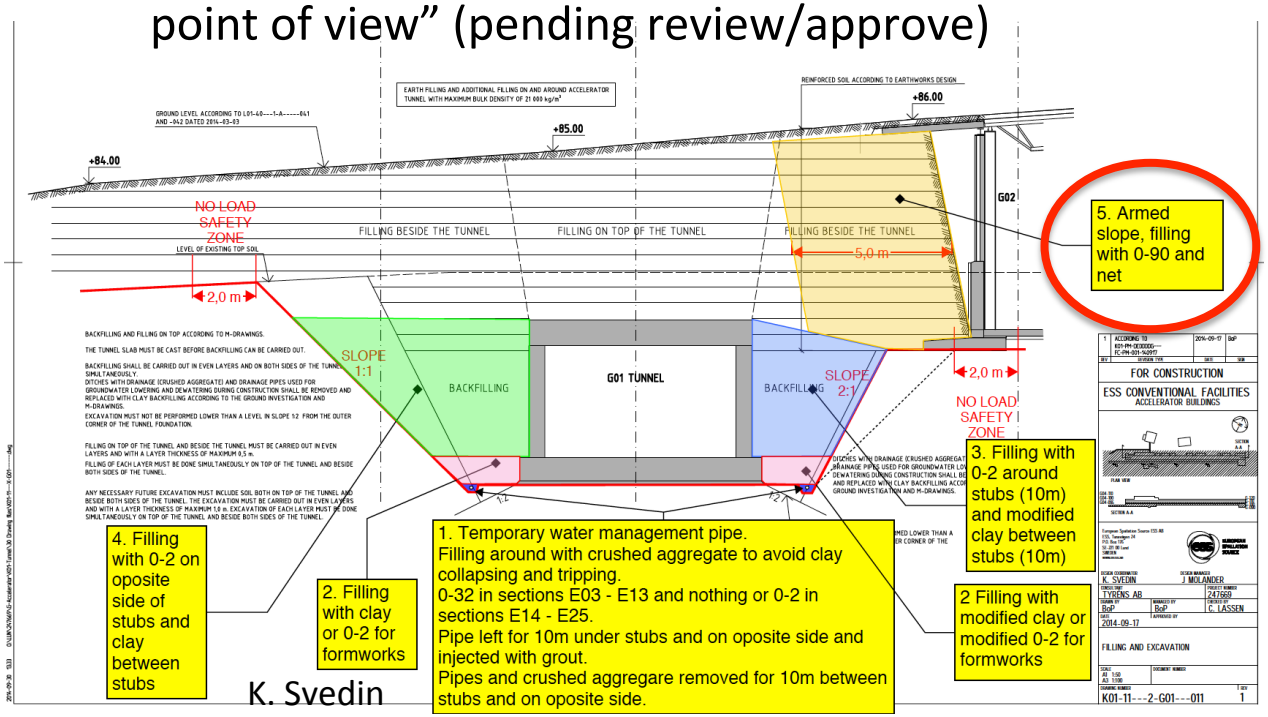
- Prompt radiation/shielding tasks
  - Entire linac, MARS. (Front-end, MCNPX).
- Activation and beam-machine interaction studies
  - WL – MCNPX
  - SCL, HEBT and A2T - FLUKA
- General safety aspects
  - E.g. linac ventilation system design, accidents, hazard analysis, etc. (including part of radiological impact analysis)

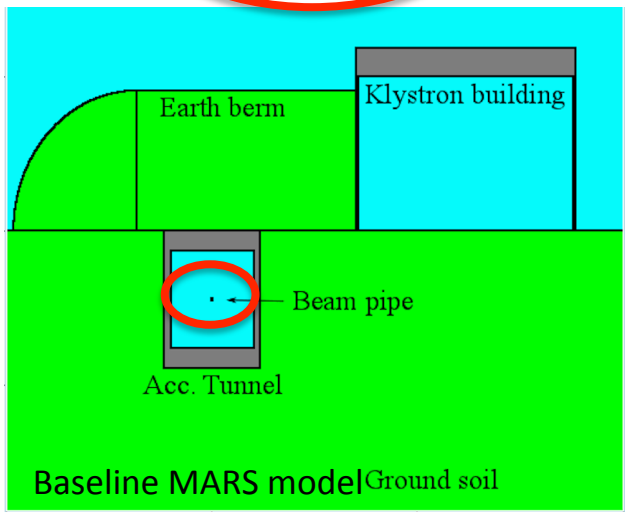
Prompt radiation: accelerator bulk shielding

- Action: Verify that an updated geometry & materials composition result in acceptable prompt radiation levels
- Comment: ESS-0025762 “First assessment of the actual filling material to be used around the ESS accelerator tunnel from the prompt radiation safety point of view” (pending review/approve)

	Clay till lera	modified clay	0-2 mm
	wt%	wt%	wt%
water	16	16	6
N	0	0	1
Mg	1	1	2
Al	4	4	5
Si	16	16	21
S	0	0	0
K	3	4	4
Ca	20	16	6
Ti	1	1	1
Mn	0	0	0
Fe	5	9	13
Rb	0	0	0
Sr	0	0	0
Ba	0	0	0
O	34	34	40
Total	100	100	100

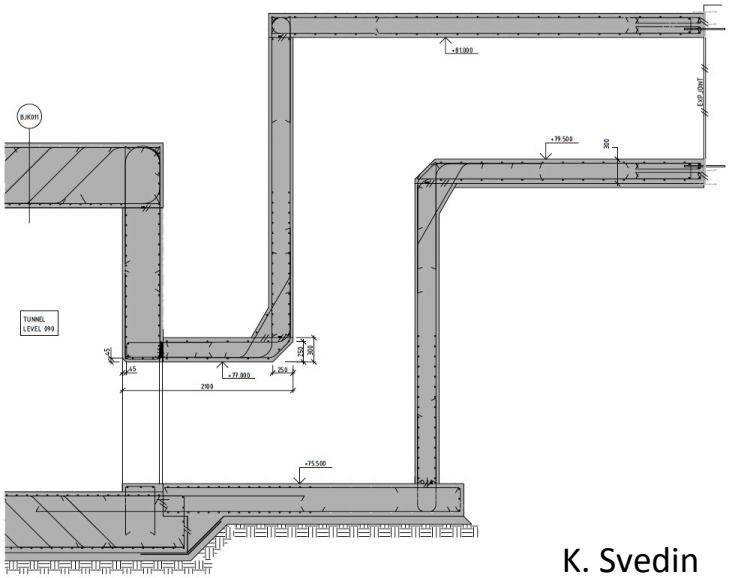
MARS baseline:
Dry soil, density 2.0 g/cc, 2.3 % H, 57.1% O, 7.2 % Al, 33.4 % Si



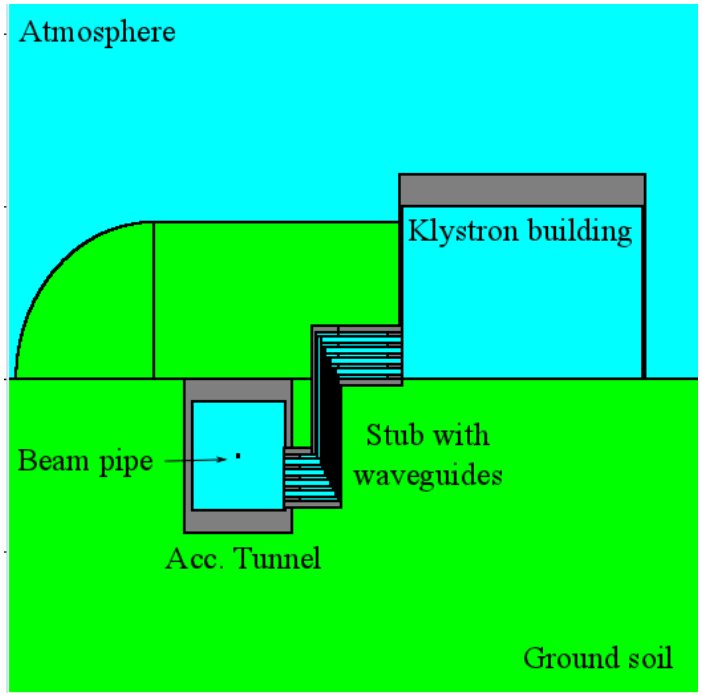


Prompt radiation: Stubs

- Changed design accepted
- Action: verify (MARS) that the new design satisfies prompt radiation safety requirements

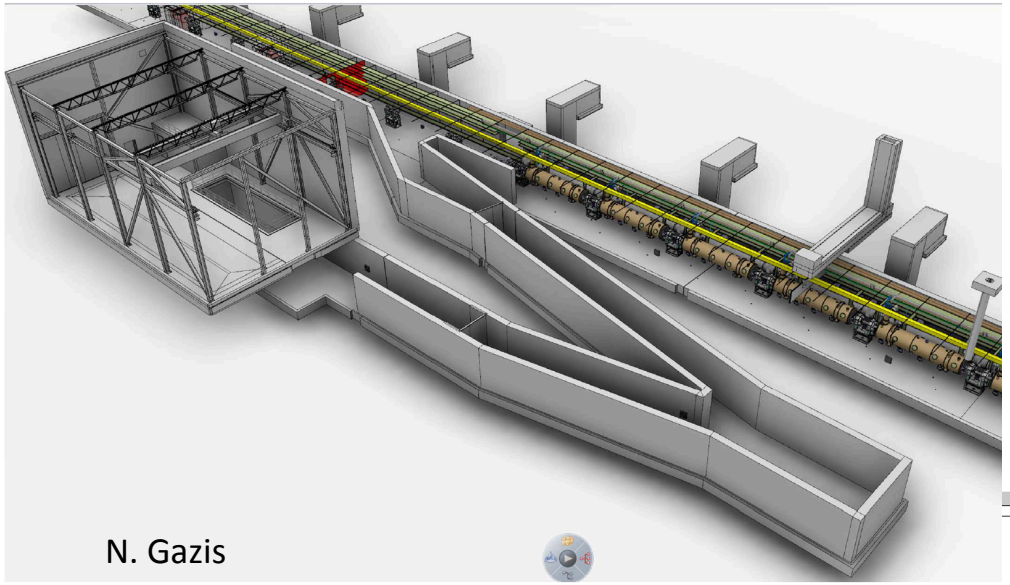


K. Svedin

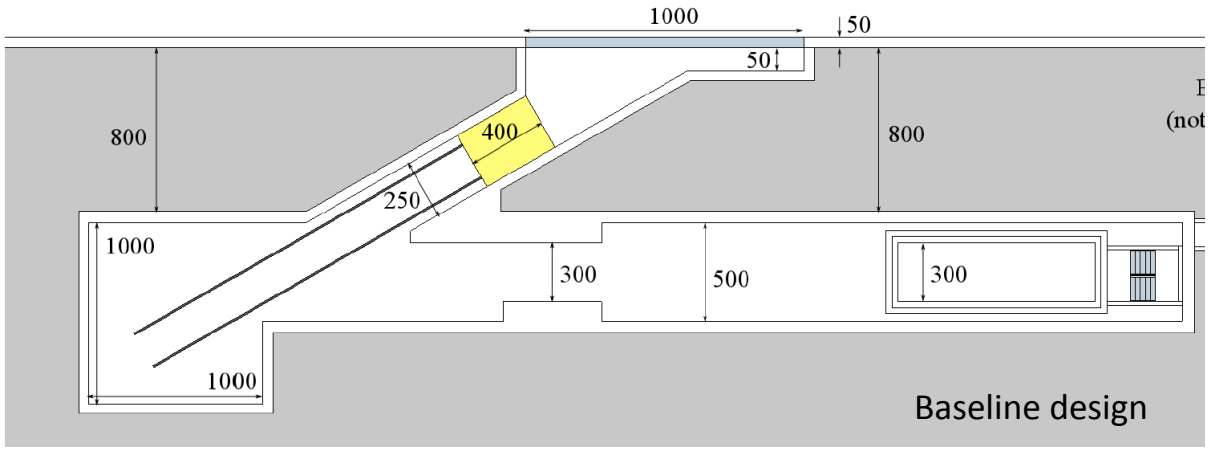


Baseline MARS model

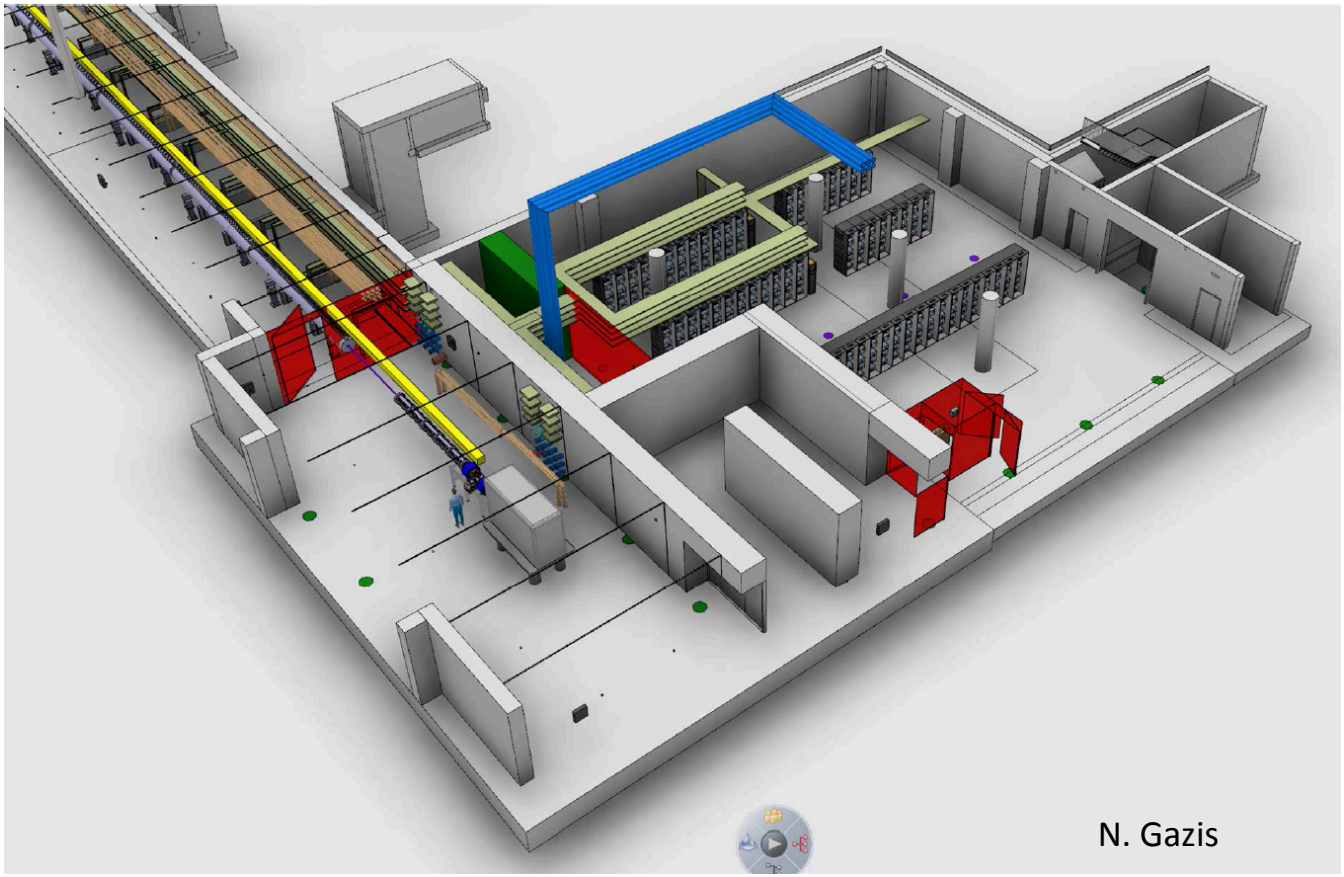
Prompt radiation: HEBT loading bay



- Changed design accepted (without a shield block)
- Action: verify (MARS) that the new design satisfies prompt radiation safety requirements



Prompt radiation: front end building



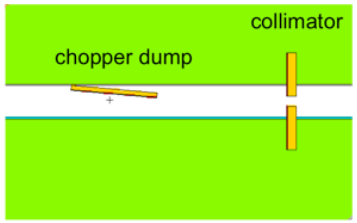
- Prompt radiation shielding analysis for the front end building: FEB labyrinth shielding, wall thickness towards the parking lot, berm thickness above the FEB, design of the shielding of a fan room above the FEB.
- Action: shielding design behind the cable penetrations. Currently on hold as requested.

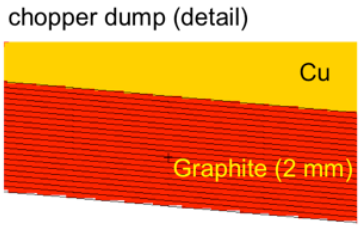
Prompt radiation: A2T, BD, BDA, etc.

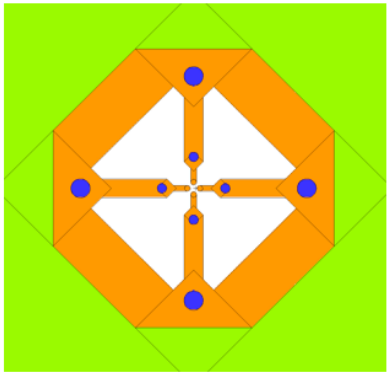
- Area is currently under the detailed design.
- BD is designed in target division.
- Upcoming actions: shielding of BDA, n-catcher.

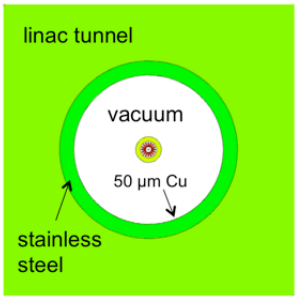
Beam line activation (WL, SCL, HEBT & A2T) and residual dose rates

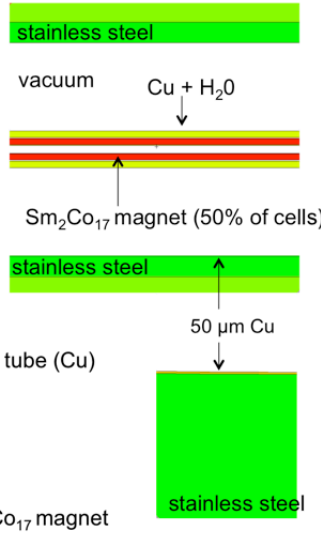
- Activation studies
  - to support HSE processes and waste management
- Residual dose rates
  - to support maintenance plan, allowable beam loss levels

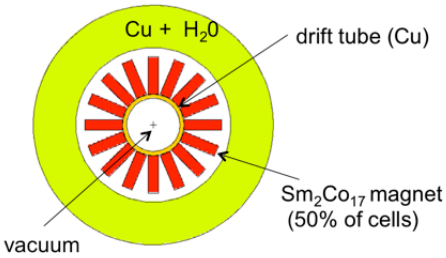


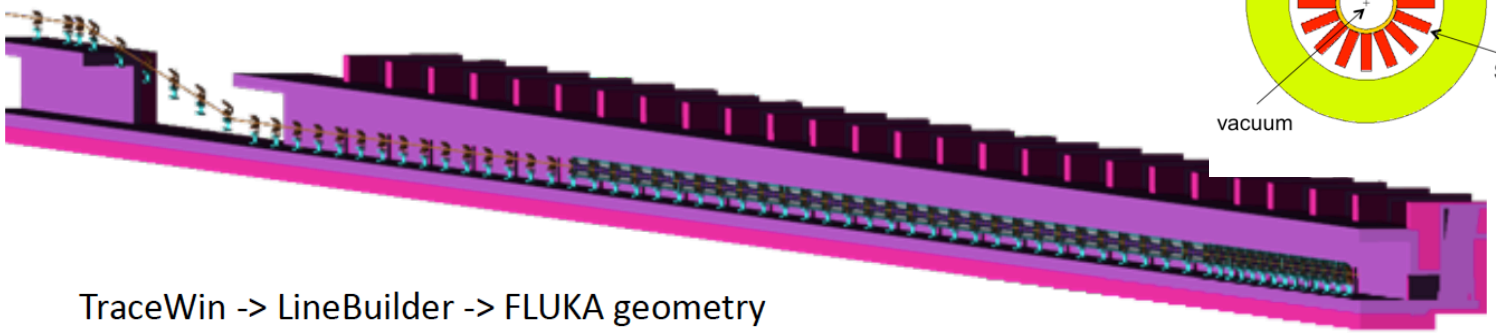










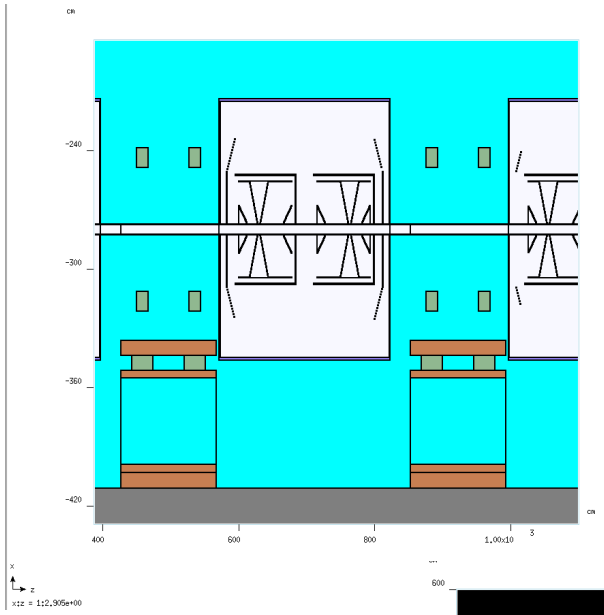


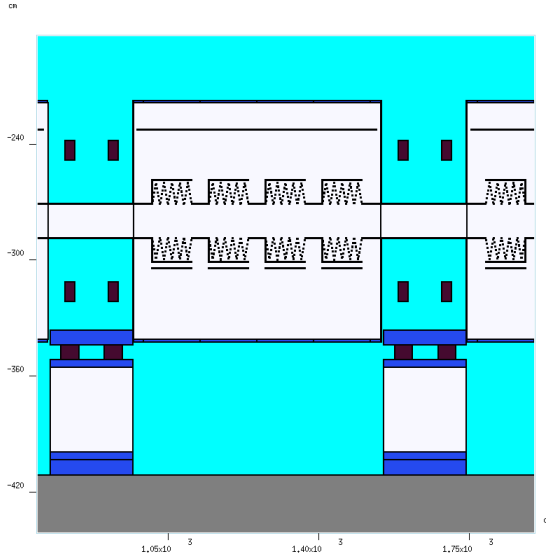
R. Bevilacqua, MCNPX model

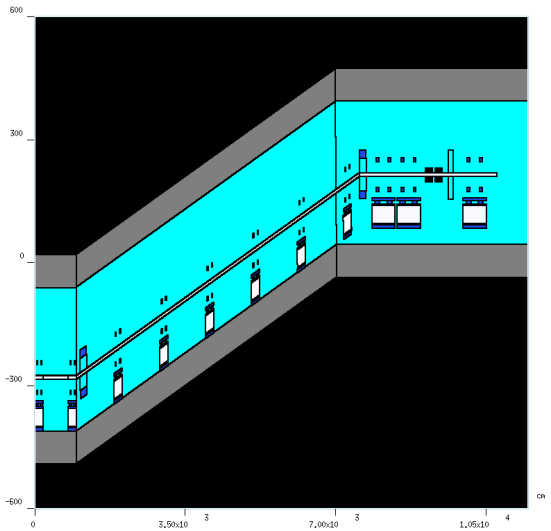
TraceWin -> LineBuilder -> FLUKA geometry

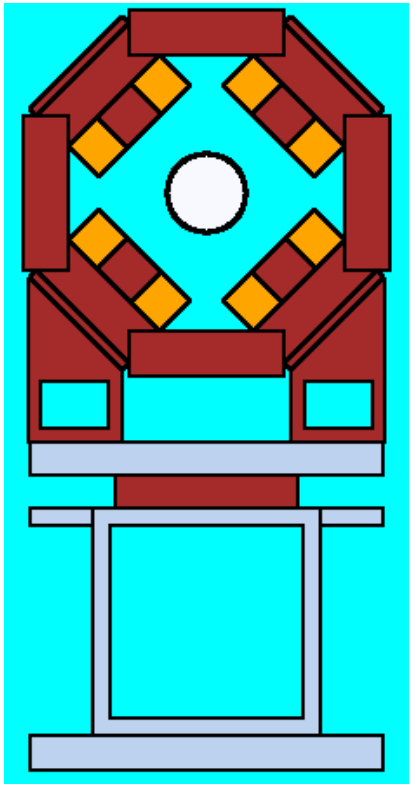
L. Esposito, L. Lari

Beam line activation (WL, SCL, HEBT & A2T) and residual dose rates









M. Jarosz,
MARS model

Some of other activities

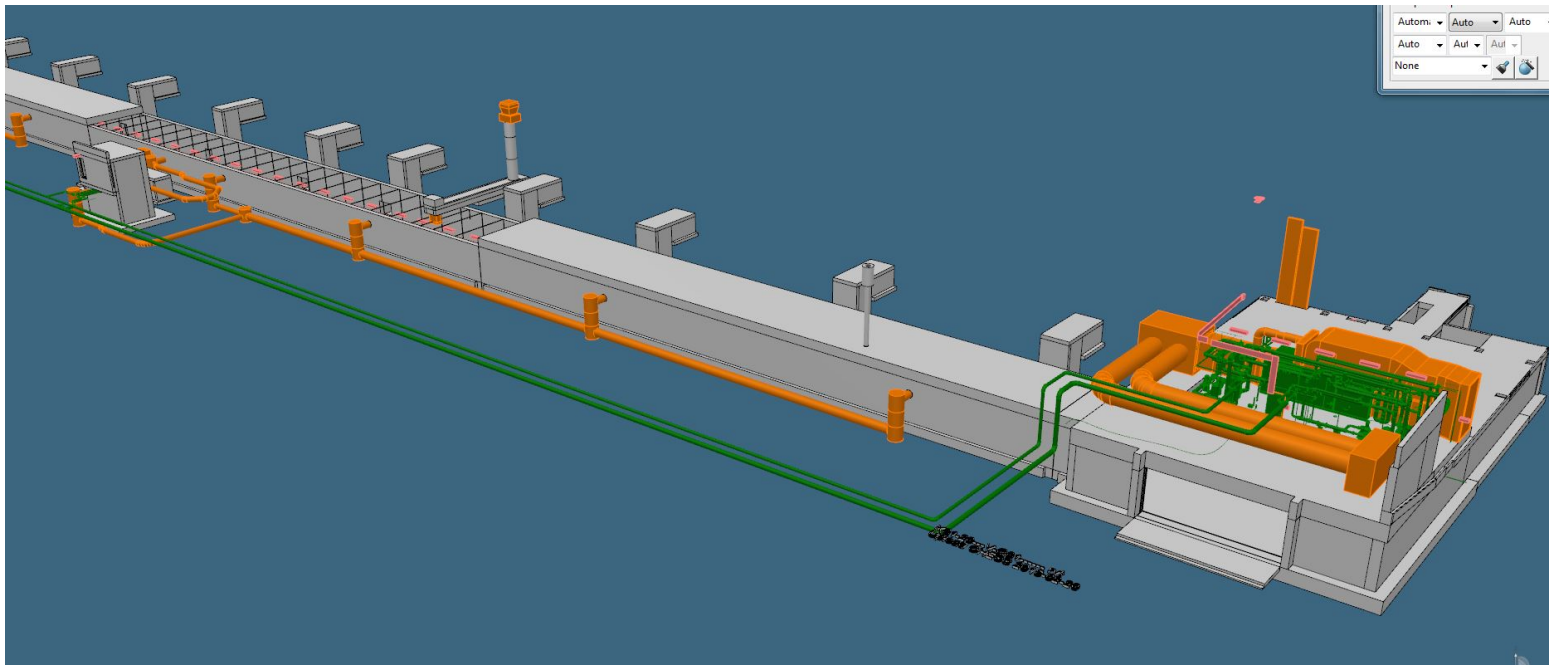
- Activation of cooling water
- Air activations/release
  - Preliminary work done by D. Ene (ESS-1093060) and L. Tchelidze (ESS-0009092)
- Skyshine calculations
- Support for radiation monitoring
  - PSS radiation monitors: generate gamma & neutron particle flux maps in the klystron gallery, recommend on number, type and position of the monitors
- Radiation impact on electronics
- Materials classification to radiation resistance: preliminary study by L. Tchelidze ESS-0007659
- Heat load/energy deposition studies

Temporary settings

- Short list:
  - Test stand - ongoing
  - Commissioning/removable beam dump & instrumentation
  - Local shielding (shielding of front-end electronics)
  - n-catcher
  - X-rays from klystrons

“Non-radiation safety” related activities

- Redesign of the linac ventilation system (proposal)
  - Not required to use any international standards (ISO 17873).
  - Removing the HVAC in emergency exist, keeping one air-flow from the front-end to the stack
    - Keep a dynamic confinement, redundancy, monitoring of environmental releases, etc.
  - Fire accidents, scenarios and mitigation steps
  - Radiological consequences during normal operations and fire accidents (D. Ene)



Conclusions

- Work in progress to
  - Introduce and follow procedures
  - Document previous work in CHESS
  - Address change requests and document related work in CHESS
  - Support ES&H in licensing process
  - Support beam-machine interaction studies for various applications
- Progress on all activities through JIRA
- Final reports in CHESS

Thank you!