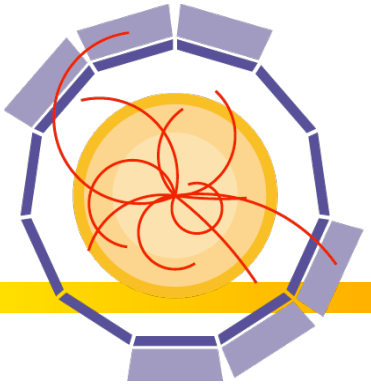

AIDA 2020

Transport System for Large objects at Ljubljana JSI TRIGA Reactor

(part of WP15.5)

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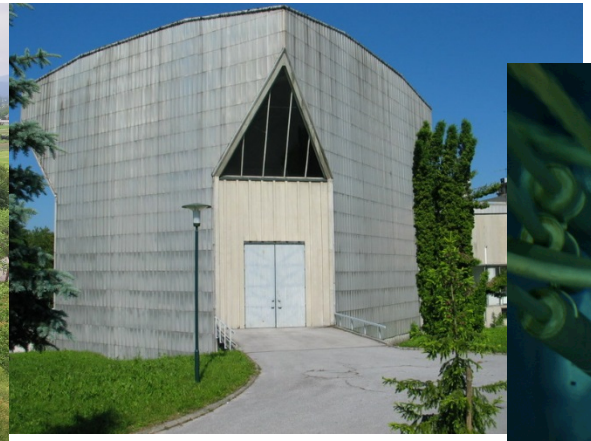
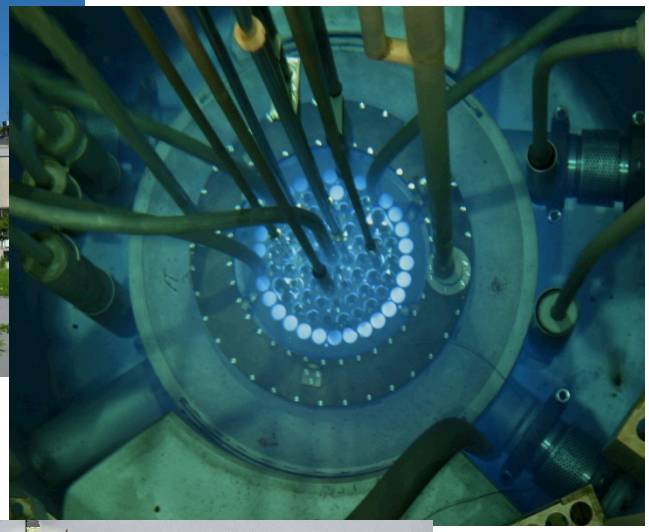
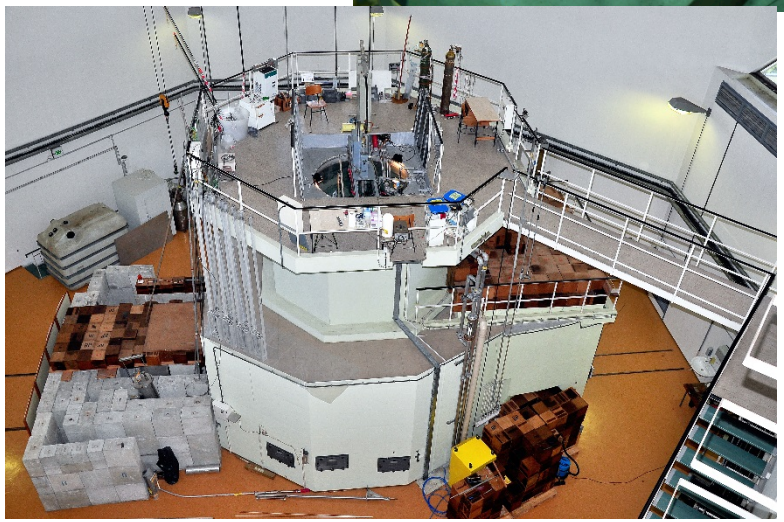
AIDA2020 Annual Meeting, DESY, June 14, 2016

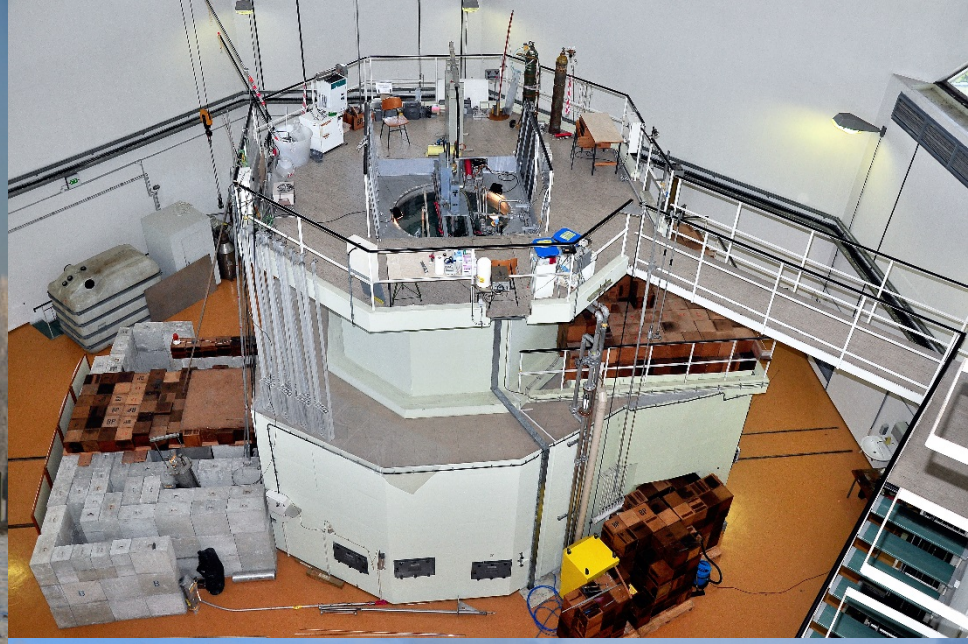
TRIGA Mark II Reactor Ljubljana

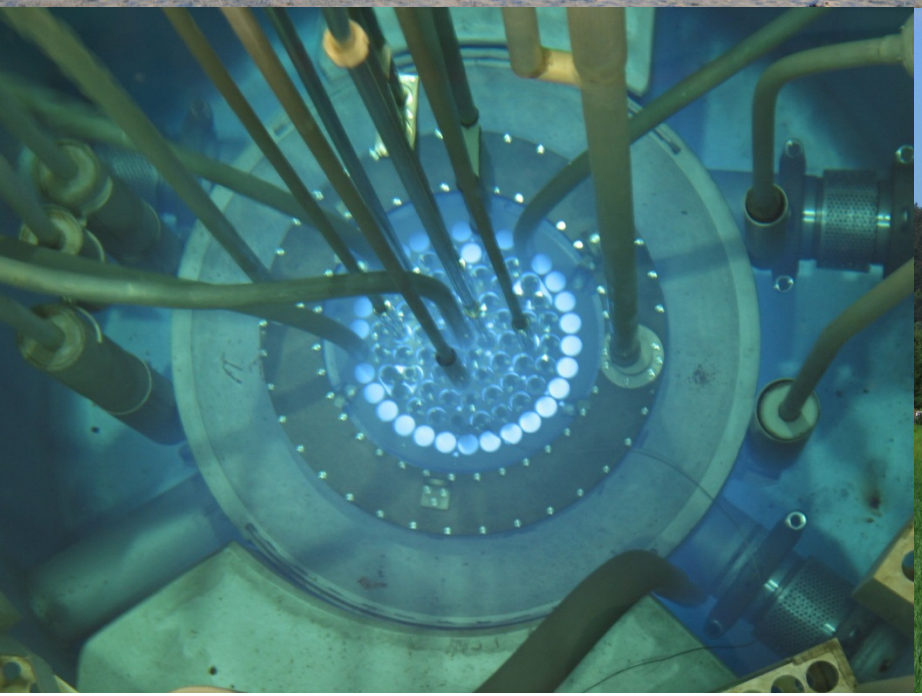


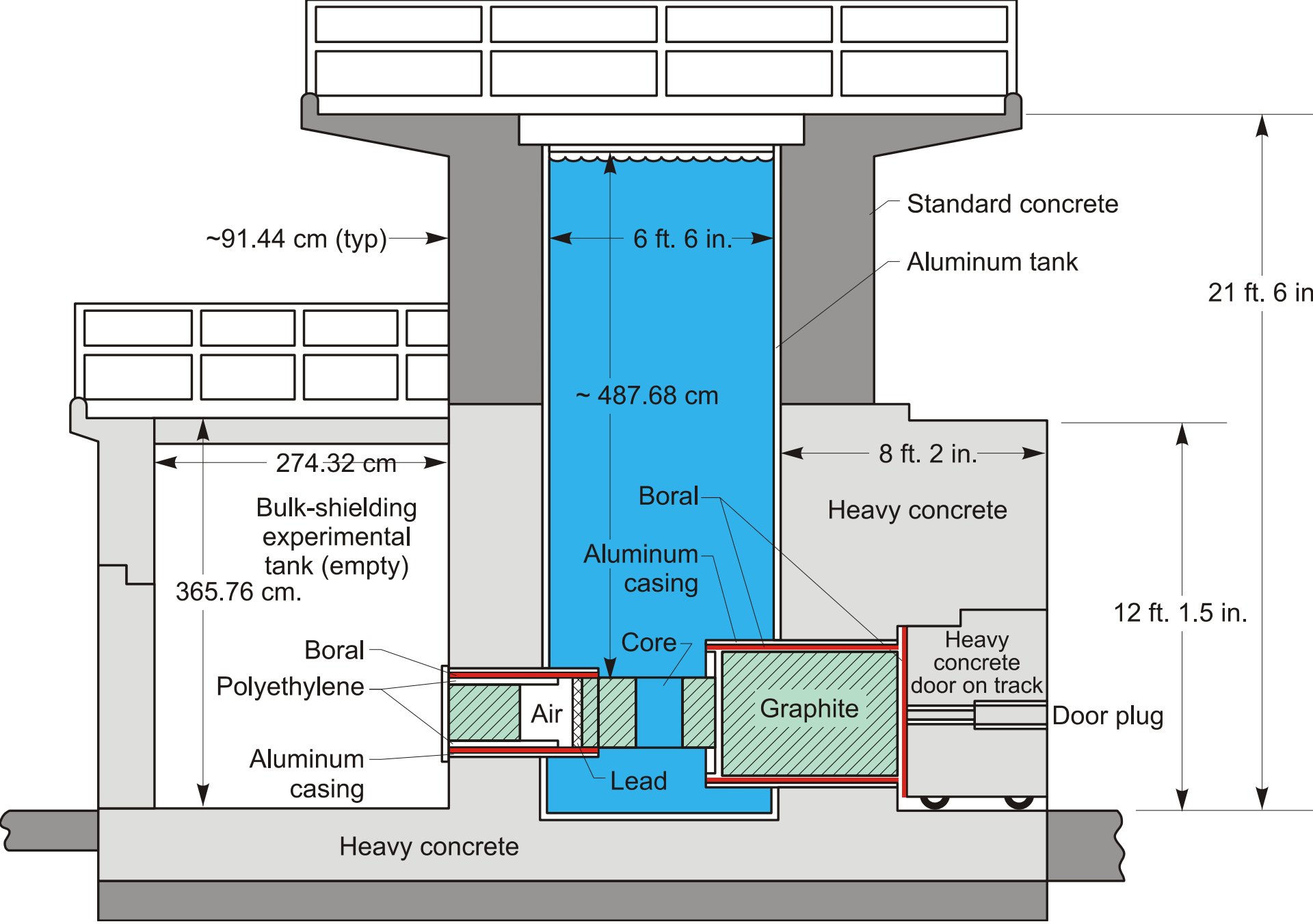


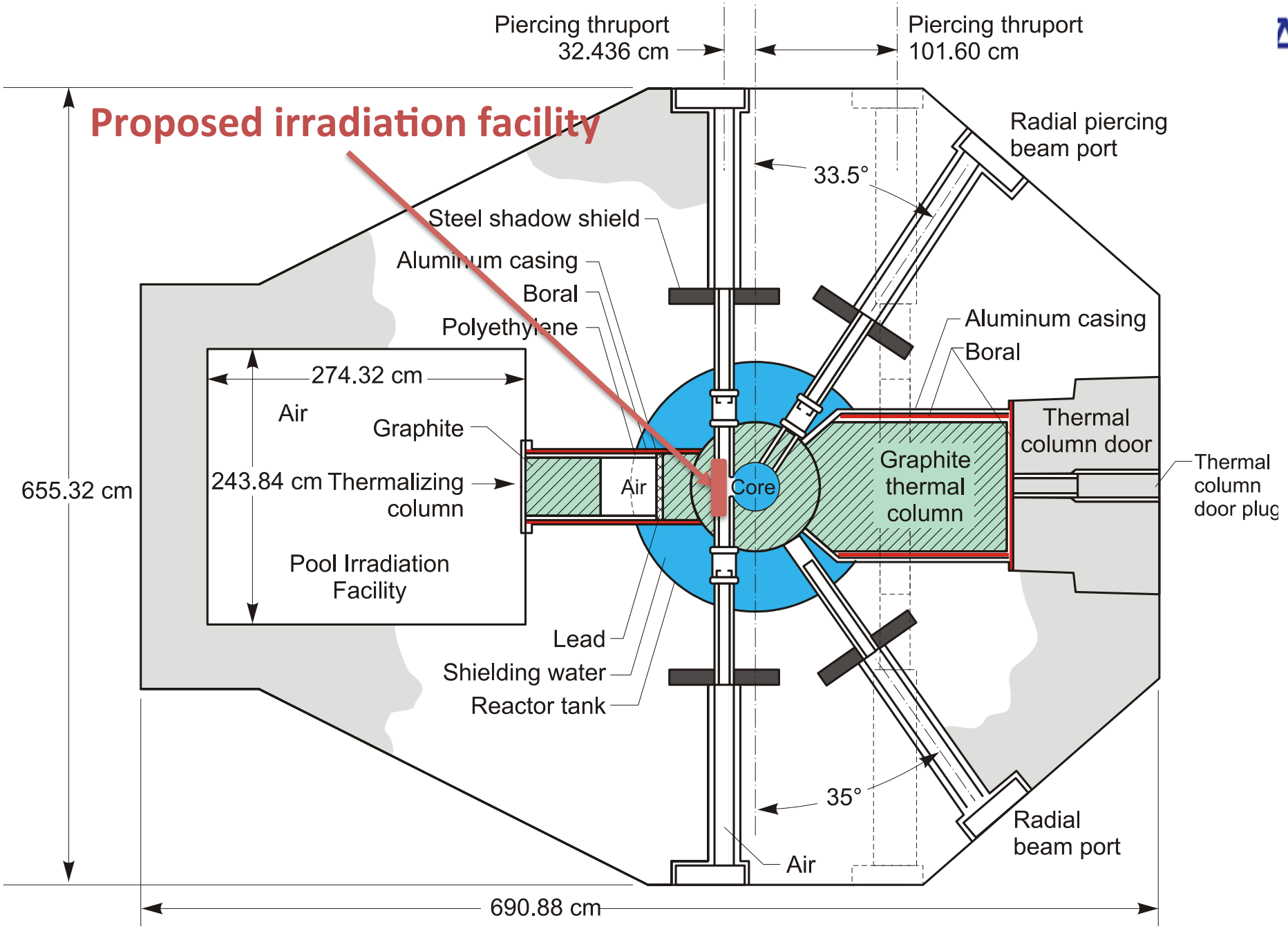
- 1st criticality:
  - 31st May, 1966
- P_{max}
  - 250 kW (steady state)
  - 1 GW (pulse)
- Fuel
  - UZrH (12 wt. % U)
  - E= 20 %



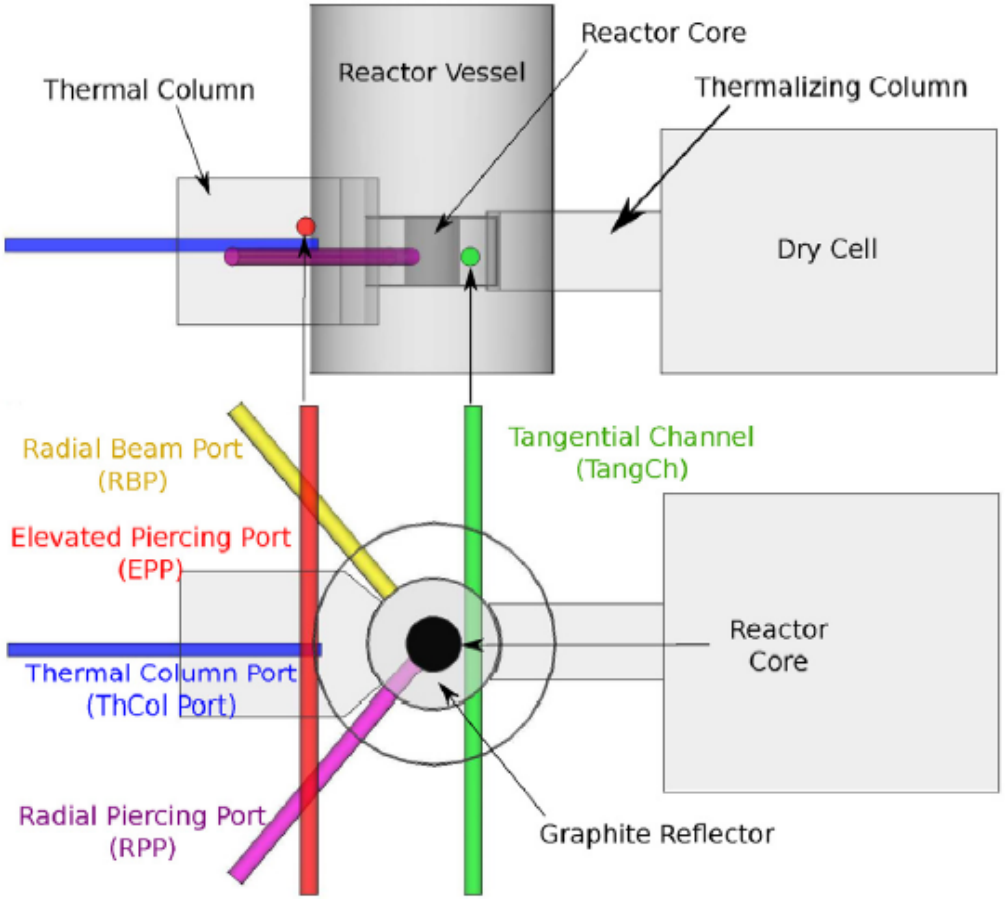





~91.44 cm (typ)
6 ft. 6 in.
Standard concrete
Aluminum tank
21 ft. 6 in
~ 487.68 cm
274.32 cm
Bulk-shielding
experimental
tank (empty)
365.76 cm.
8 ft. 2 in.
Heavy concrete
Boral
Aluminum
casing
12 ft. 1.5 in.
Core
Boral
Polyethylene
Air
Graphite
Heavy
concrete
door on track
Door plug
Aluminum
casing
Lead
Heavy concrete


Piercing thruport
32.436 cm
Piercing thruport
101.60 cm
Proposed irradiation facility
Radial piercing
beam port
33.5°
Steel shadow shield
Aluminum casing
Boral
Polyethylene
Aluminum casing
Boral
274.32 cm
Air
Graphite
243.84 cm Thermalizing
column
Pool Irradiation
Facility
655.32 cm
Air
Core
Graphite
thermal
column
Thermal
column door
Thermal
column
door plug
Lead
Shielding water
Reactor tank
35°
Radial
beam port
Air
690.88 cm

TRIGA Irradiation Channels



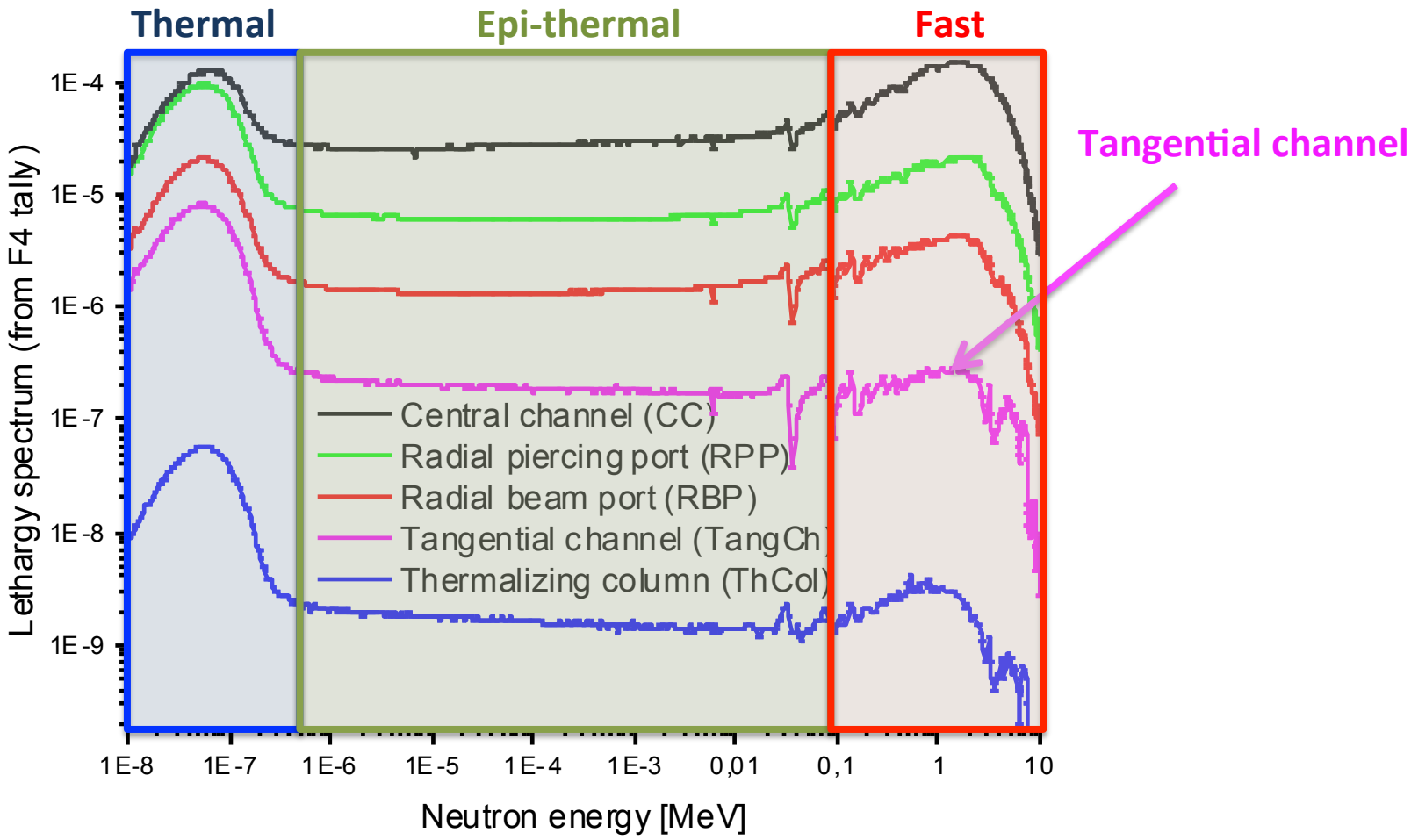
Goal

- Develop and install a large sample irradiation (2R < 15 cm) facility in the tangential channel of the JSI TRIGA reactor

Tangential Channel Characteristics

- Inner diameter: 15 cm
- Neutron flux characterisation:
  - L. Snoj et al., Appl. Rad. Isot. 70 (2012) 483–488
- Neutron flux: 1.3e12 n/cm^{2}s
  - Thermal (E<0.625 eV): 58 %
  - Epithermal (0.625 eV < E < 100 keV): 25 %
  - Fast (E > 100 keV): 17 % -> 2.2 E11 n/cm^{2}s
    - 1e15 n_{eq}/cm^2 in 1 ½ hours

Neutron Spectra

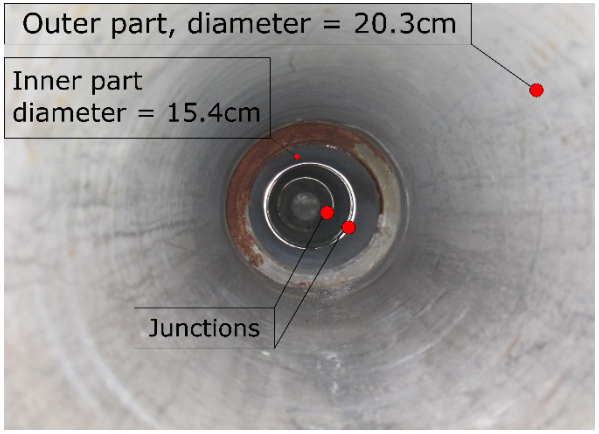


Milestone for M12

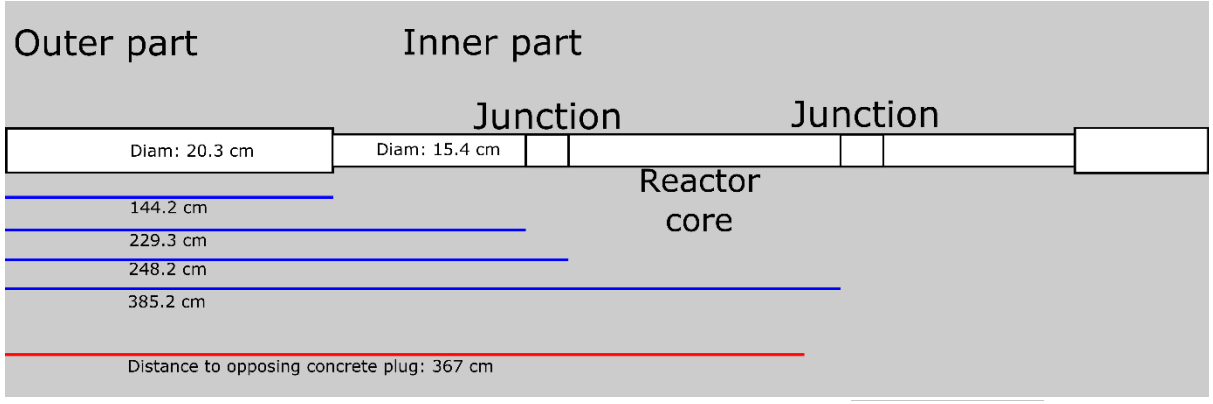
- MS15.9 (MS17): Design of a transport system for neutron irradiations of large samples:
  - *The design of a transport system for large objects of a diameter of up to 12cm into the Ljubljana reactor irradiation position including the possibility for electrical and cooling connections to the samples has been documented.*
- Report to StCom – submitted to WP15 management 27/04

Tangential channel

Measurement of internal dimensions



Channel interior

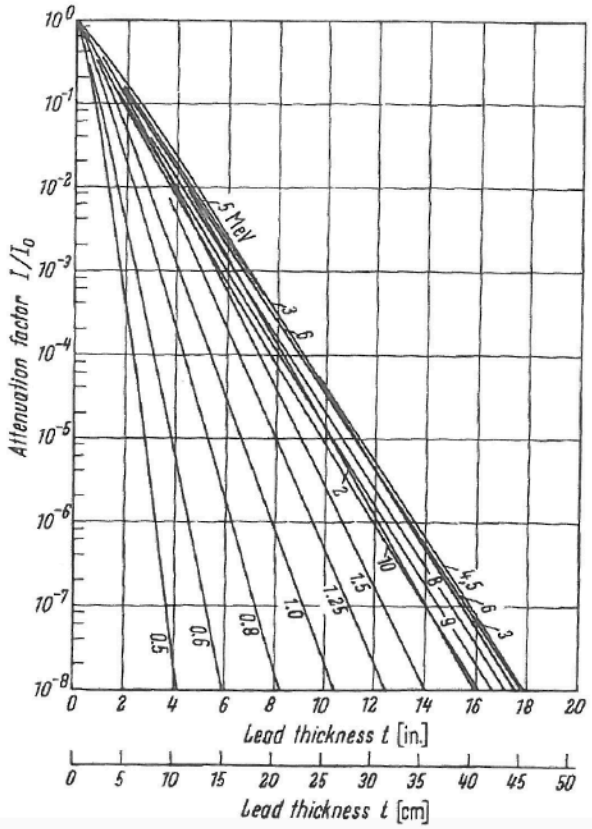


Dose rate measurements with a neutron / gamma shield mockup:

- 75 cm, Ø 20 cm neutron shield (borated paraffin)
- 15 cm lead gamma shield
- Measurements at 0.1% and 1% of full reactor power
- Scaled neutron doses (to full power, 250kW) very low (40 µSv/h), scaled gamma dose rates smaller than 1mSv/h

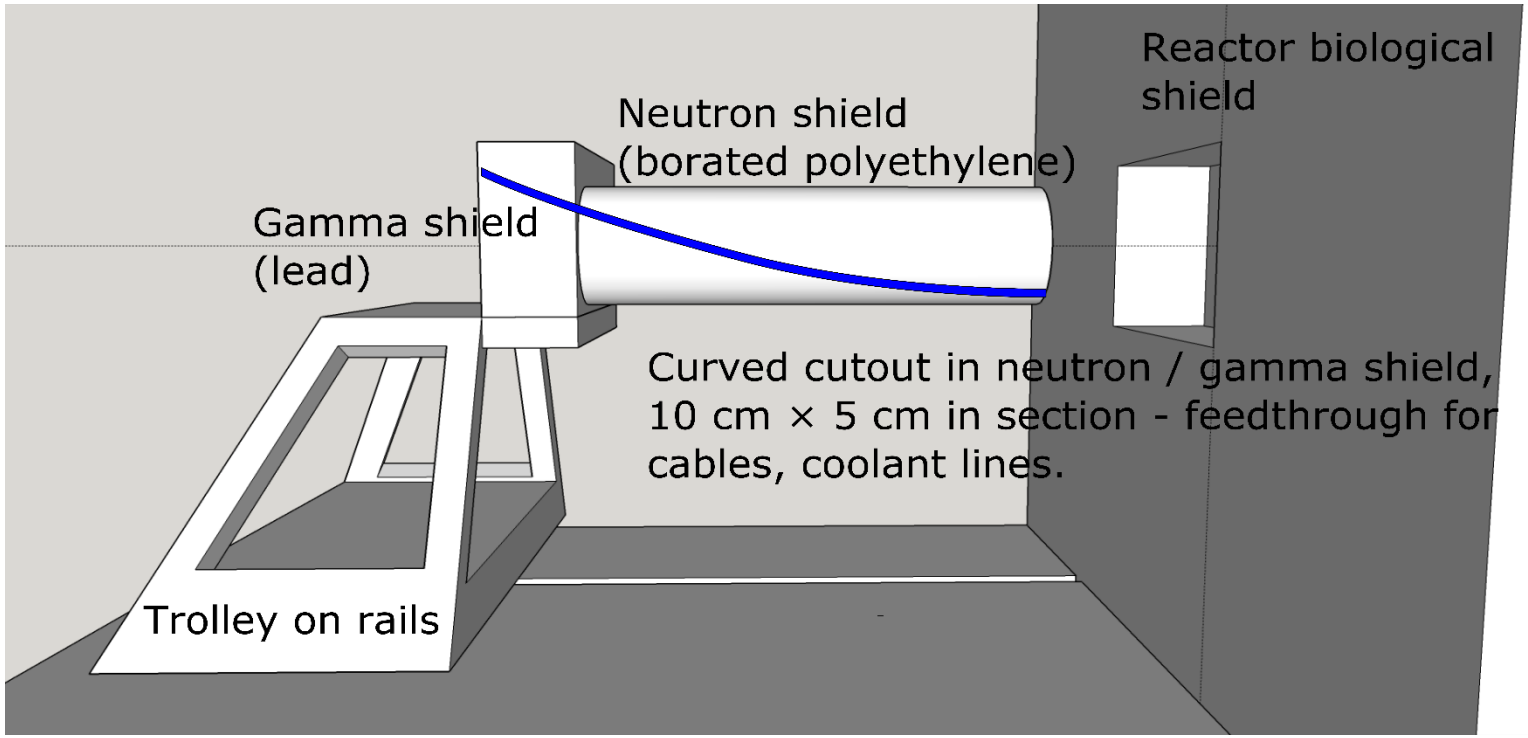
Shielding Design

- Based on test measurements with the current channel configuration
- Neutrons shielded ok by borated (5% B) parafine plug
  - Φ = 20 cm, l = 75 cm
- Need to shield gammas
  - additional attenuation 10^{-3} sought for $E\gamma$ = 1-10 MeV
  - Pb and concrete evaluated
  - 30 cm Pb chosen
- Concrete blocks as backup if measurements reveal more than 10 µSv/h at full reactor power



Conceptual design

1) Internal aluminium liner, inner diameter 14.6 mm
2) Outer neutron / gamma shield + concrete shielding, to reduce dose rate from ~ 1mSv/h to under 10µSv/h (acceptance criterion).
3) Samples fitted into polyethylene caddies, fastened by a rod to the neutron shield.



Towards the Deliverable

- D15.9: JSI TRIGA Reactor Transport system:
  - *The transport system for large objects of a diameter of up to 12cm into the reactor irradiation position including the possibility for electrical and cooling connections to the samples has been installed and commissioned. (Task 15.5)*
  - Deliverable for M18

Status

- Design report submitted to Reactor Safety Committee – in evaluation
- System produced at Institute's workshop
  - lead time 30-45 days
- Installation and commissioning
  - irradiate a couple of own devices first to gain operational experience
- Could make it by late fall, in time for M18