TRIUMF

UCN runs with the vertical source

To run or not to run, that is the question…

R. Picker

Topics

Manpower:
The whole collaboration is involved

- Schedule
- Outstanding tests
- Manpower
- Decision making plan

Vertical source operation

A major milestone

- Installation of the vertical source in 2017 was a **very important milestone** after the originally planned horizontal source became unavailable.
- It pretty much **saved the project**.
- Having UCN at TRIUMF also changed the **dynamic of the collaboration** with many more people coming on site during runs and **attracted more collaborators**.
- **Training tool** for ^{3}He cryostat operation and **debugging platform** $\Rightarrow$ many lessons learned!

Experimental campaigns 2017-2019

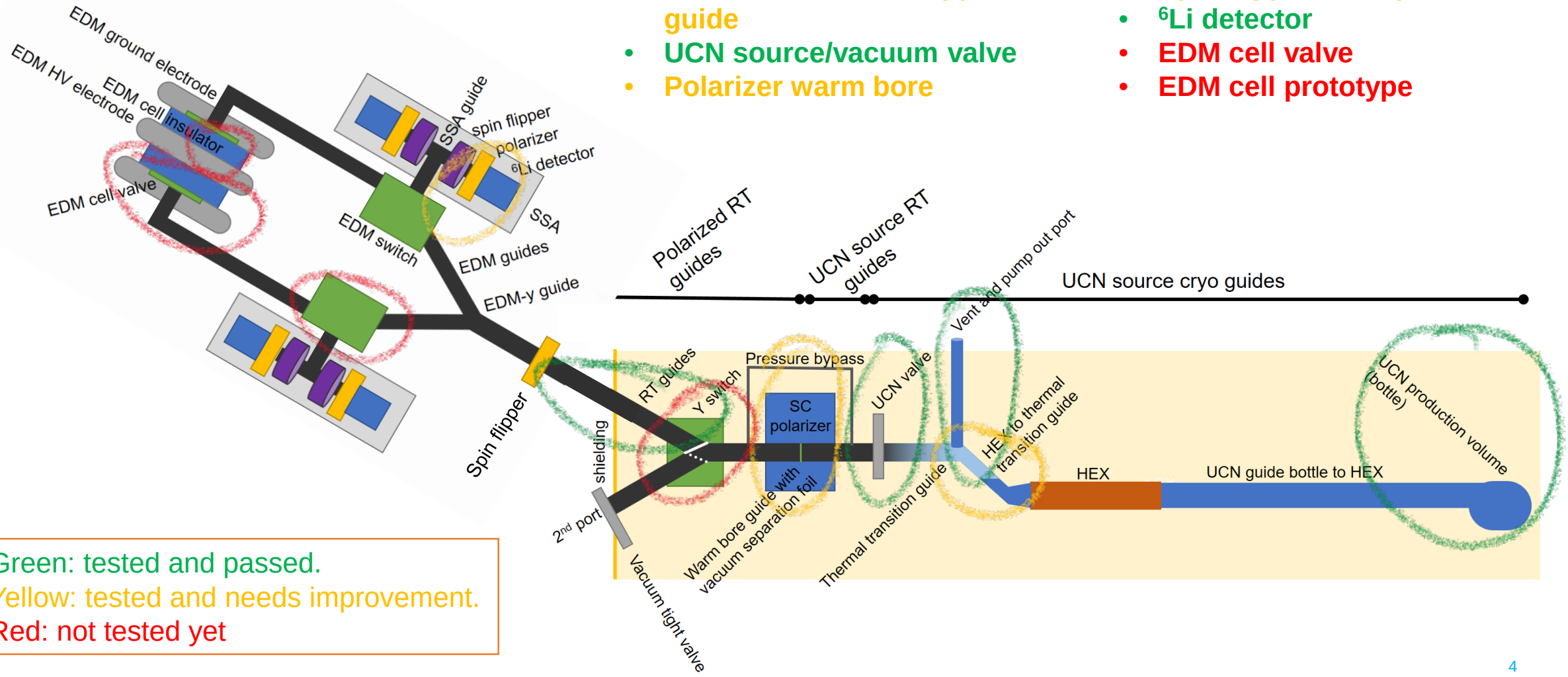
Devoted to

1. **source characterization** with a focus of understanding its cooling power, UCN yield vs temperature behaviour and degradation over time,
2. **testing prototypes** of UCN handling hardware required for the UCN source and EDM experiment and
3. **developing UCN measurement techniques**.

Priority of the runs is to support the new UCN source and EDM design!

Component development aided by the vertical source

- UCN production volume ??? prototype
- Vent port
- Thermal radiation suppression guide
- UCN source/vacuum valve
- Polarizer warm bore
- Length adjuster
- Y switch
- Spin preserving guides
- Spin flippers and polarizers
- ^{6}Li detector
- EDM cell valve
- EDM cell prototype



Green: tested and passed.
Yellow: tested and needs improvement.
Red: not tested yet

What's left? Should we test them before the new source install?

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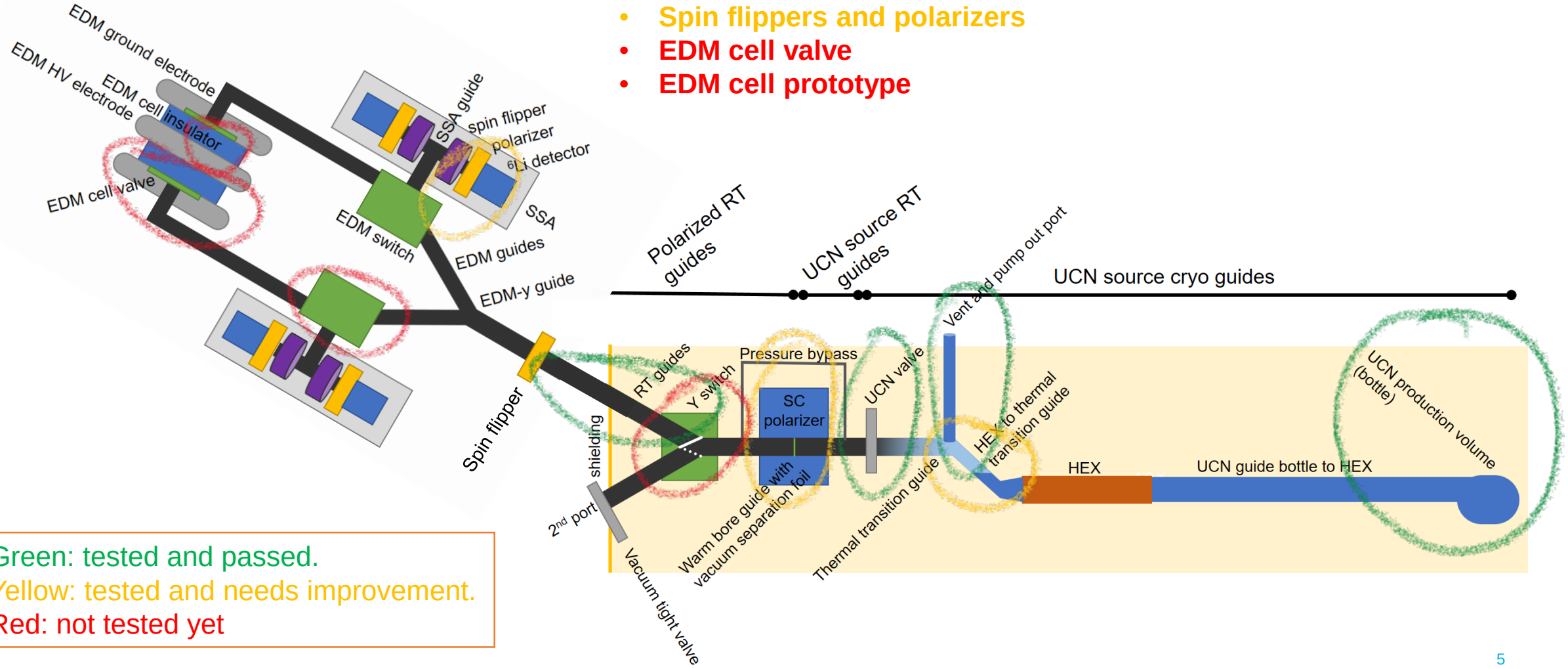

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- Up to 1 W in thermal radiation onto SF He.
- DLC promising: can produce coating, soon.
- Could start without it, but increases risk of lower cryostat performance.
- Could just install it without testing ⇒ adds an unknown performance part

- **Polarizer warm bore**
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- First warm bore test provided only 60 % polarisation.
- Need to check simulation results predicting small bore size is preferred.
- Could run without foil to start with ⇒ increases risk of contaminating isopure and delays full source operation
- Could perform test with new source outside shielding ⇒ delay in full source operation

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- Could install a guide elbow first and test outside shielding ⇒ delays second port
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Spin flippers and polarizers

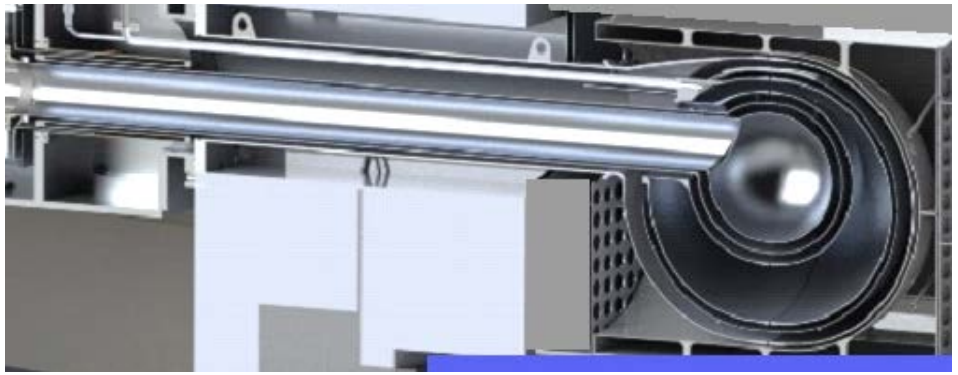
EDM cell valve

EDM cell prototype

- Outside shielding, but PhD theses depend on them and more iterations might be required
- No run in 2020 ⇒ increases risk of EDM delay

UCN production volume / tail section

- NiP on Al “hat” plated in Japan
- Experiment in 2018 proved that baking is important and 100 degree C are enough
- 75 s storage lifetime
- Chem Processing NiP on Al storage lifetimes in 85 mm guides 40 s (without baking)



Is this test enough to prove the tail section?

- We know the coating is in general good enough…
- … but the tail section is special
  - it is the most essential storage vessel
  - > 2.5 m long
  - transition from Al to SS
  - cannot be cleaned as thoroughly
  - it is almost impossible to fix once completely welded together

- It would certainly be great to measure UCN storage lifetime before the rest of the shells are added.
- Can we time our run to fit this schedule?
- Can we measure somewhere else?
- If the whole tail section is finished, it might still make sense to test it to know its status ahead of time.

Pro's and con's of a vertical source vs new source run next

Vertical source run

- Essential UCN handling hardware for the new source can be tested with UCN before installation (Y-switch, polarizer warm bore, thermal radiation suppressor).
- Student thesis relevant experiments would not be delayed by at least 1.5 years.
- Opportunity for collaborators to come to TRIUMF in 2020 and participate in experiments on-site.
- Significant manpower required.
- Could compromise new UCN source installation if too much manpower is diverted.

New source run

- Does not divert manpower from new source development.
- Some UCN source parts would have to be installed without UCN tests or simple placeholders installed so that the actual part can be tested in a new source run.
- If delays make UCN production impossible with the new source in 2021, there would not be a UCN run for two years. $\Rightarrow$ could delay EDM schedule

Manpower and timing

Manpower for vertical source run

- Very minimal engineering manpower required since parts required were made for 2019 run that was cut short.
  - < 5 FTE days
- Physicists manpower
  - ≈ 50 FTE days preparation
  - ≈ 150 FTE days for a 14 day run for operation
  - plus analysis
- Project schedule impact analysis was performed
  - Favored a Fall Run, but has detailed design later as now assumed.

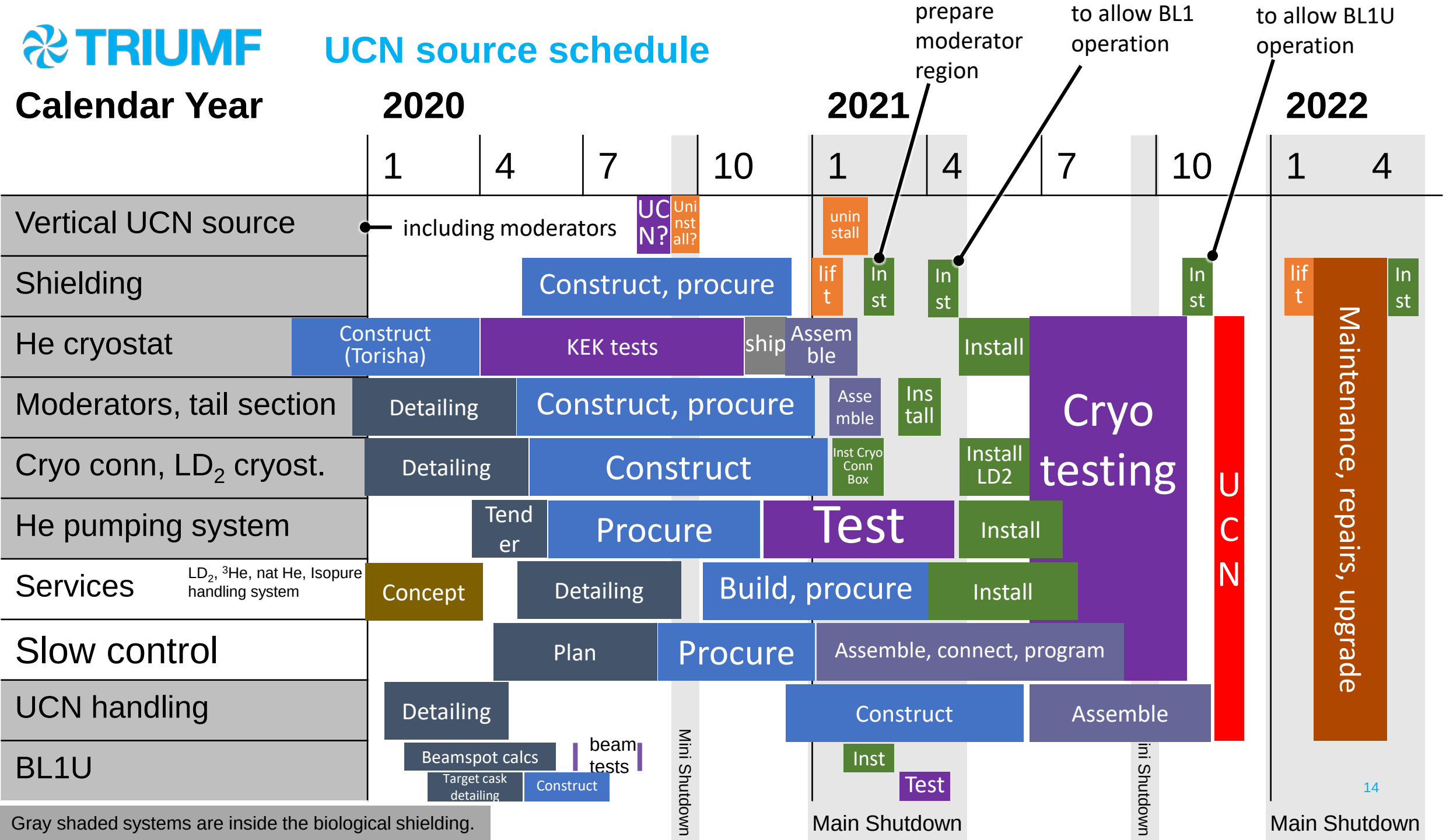
Summer or Fall?

- Detailed design of UCN source components inside shielding has to finish early summer 2020 if we want a shot at installing them in 2021.
- Towards the end of 2020 shutdown preparation, installation and test planning is important.

I would suggest a later summer run.

Also allows early start of source removal.

UCN source schedule



Gray shaded systems are inside the biological shielding.

The plan

Run vertical source if it does not compromise 2021 new source installation:

- Plan a run for summer or fall 2020
- Cancel if manpower required compromised installing the moderator section during the shutdown 2021
- Use only negligible engineering or design manpower
- Reduce prep work to a minimum required to perform the high-priority experiments
- High-priority: Y-switch, polarizer warm bore and thermal radiation suppressor.
- Thesis-relevant experiments will be performed if time permits.
- We will limit the experimental time to around two weeks.

Any input from the EAC on this is highly welcome!

Thank you
Merci

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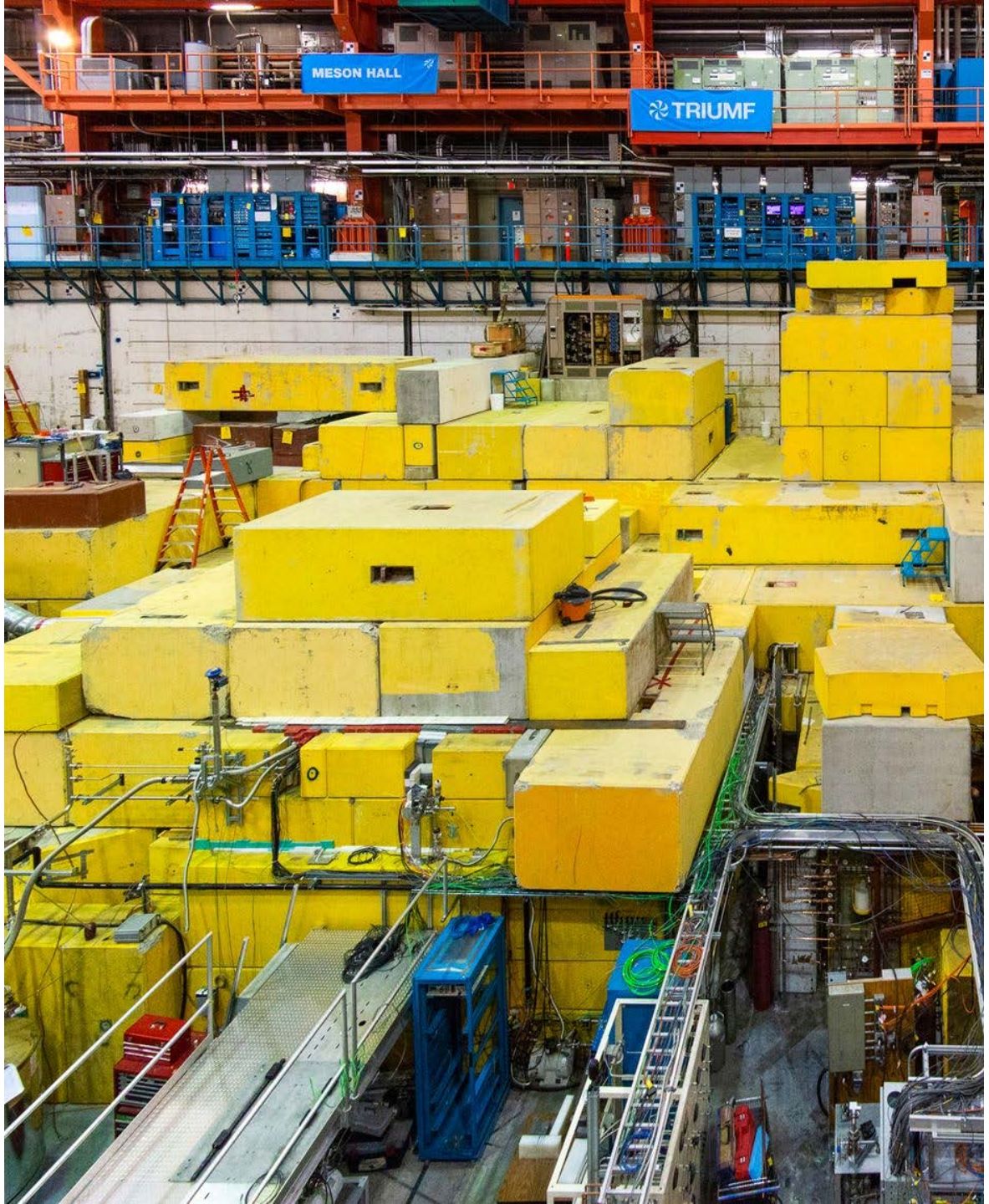
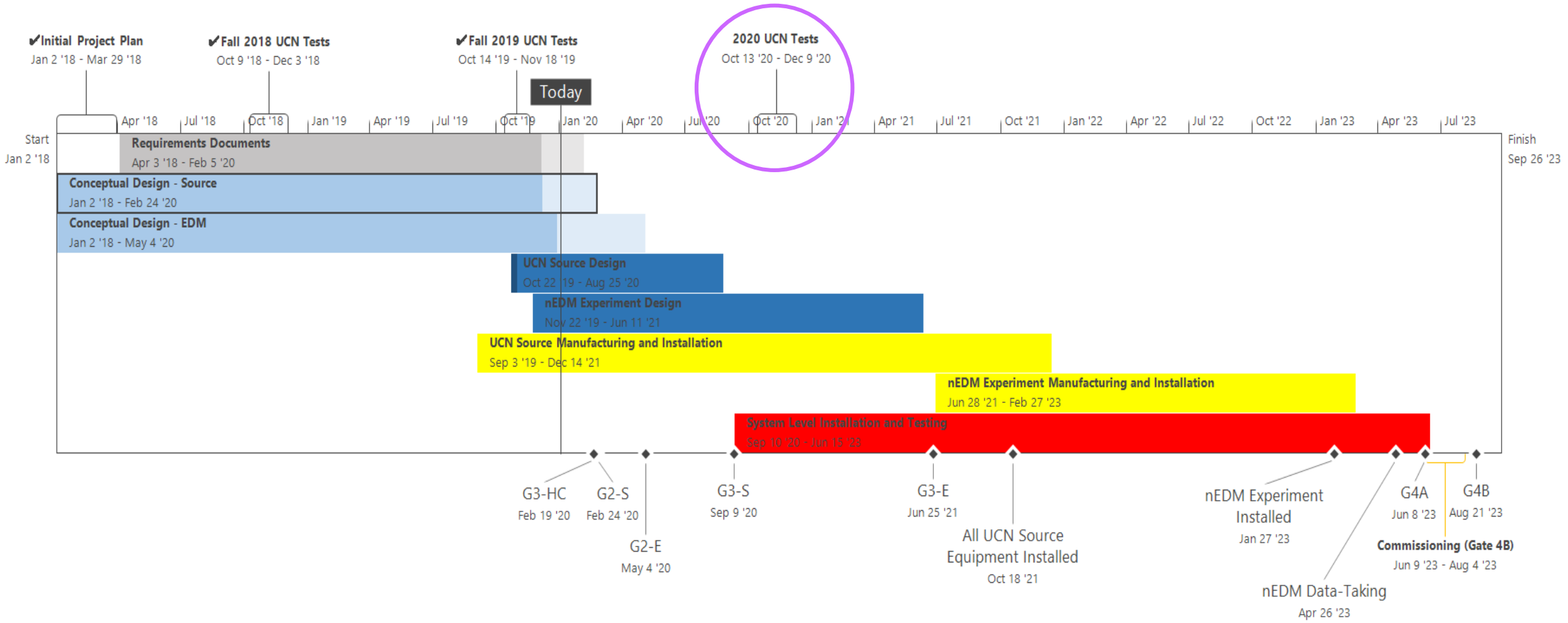


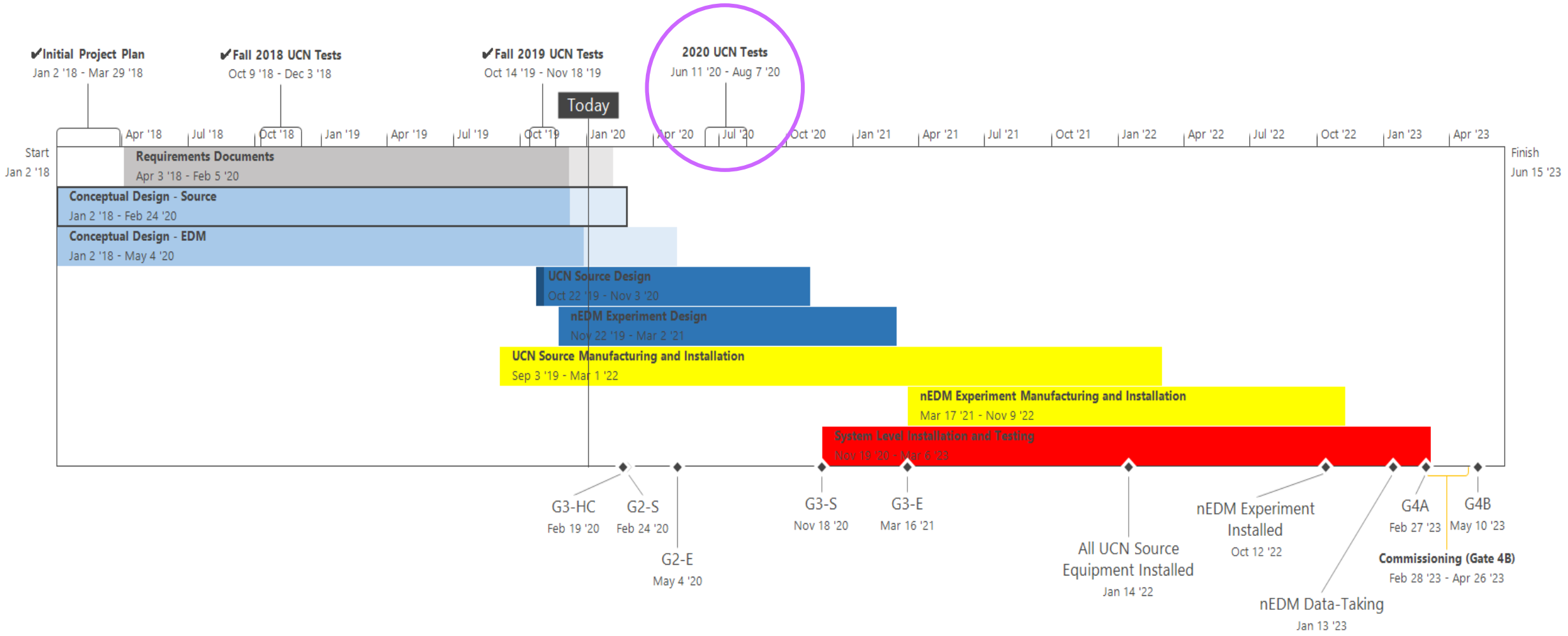
Discovery, accelerated

Fall 2020 UCN Run

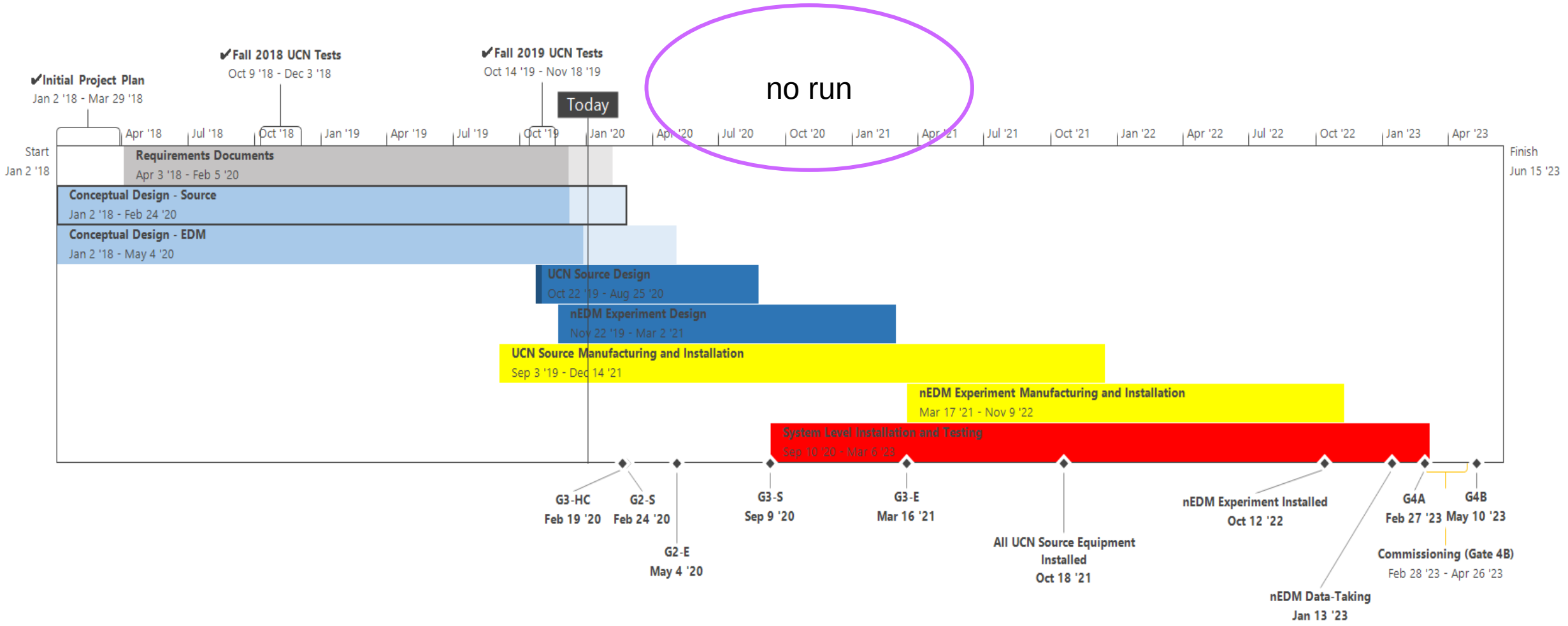
Jan 2020 Impact Analysis On UCN Run



Summer 2020 UCN Run



No 2020 UCN Run



Possible layout for measuring the tail section

TCN20-001
Tail section storage lifetime

Y switch (rotated by 180 deg), IV3 as storage valve (rotated by 180 deg), adapter 85 to 148 and tail section