

Water monitoring for WCTE

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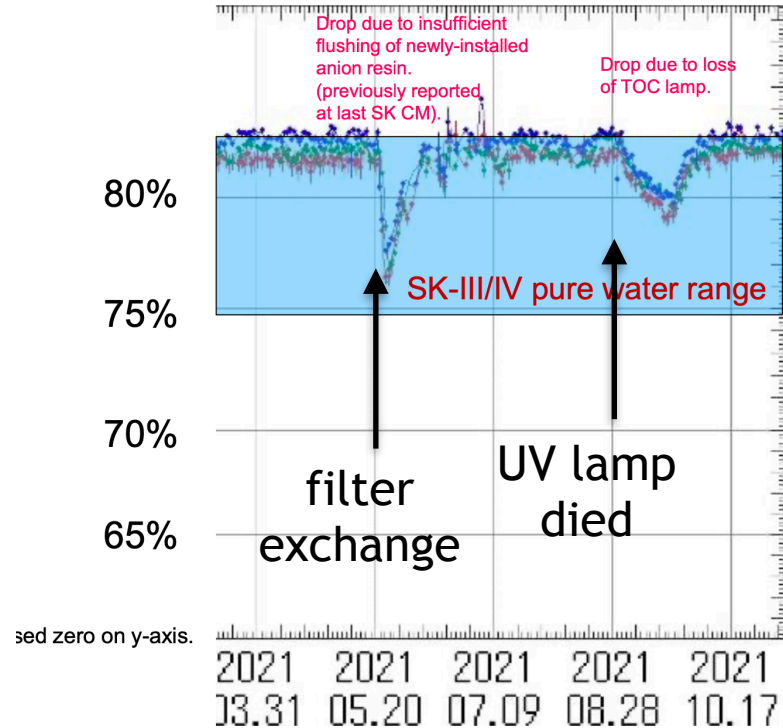
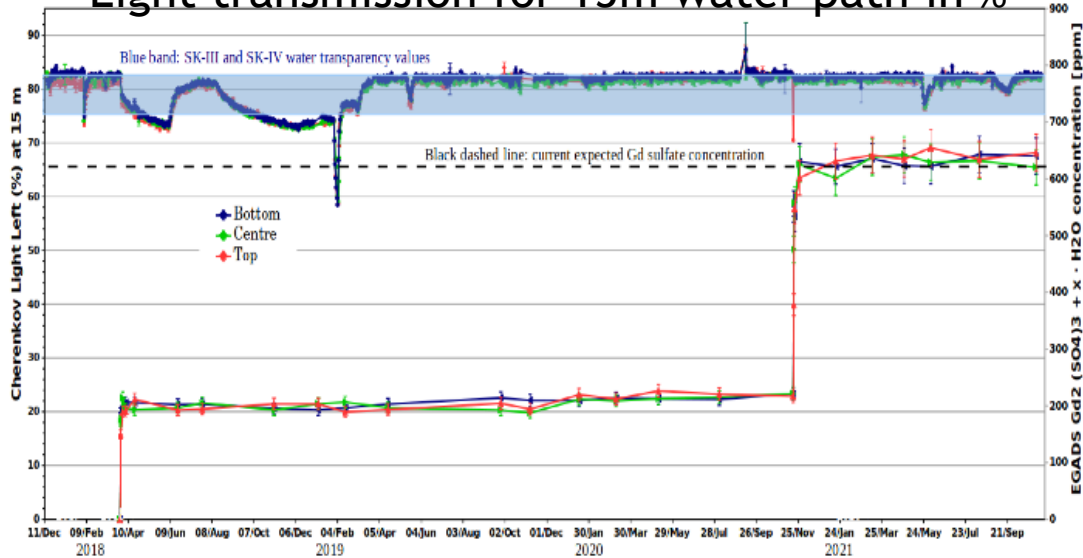


- Transmission in 15m water is 80% in SuperK
 - only a few % loss is expected in small WCTE in principle if the water quality is kept at SuperK level
- WCTE water quality is expected to be worse than SuperK
 - A higher water temperature: 13.6 degrees → 20 degrees?
 - depending on the chiller power and thermal isolation
 - bacteria growth increases rapidly above 15 degrees
 - Limited water cleaning system be installed to save costs
 - UV filter, microfilter, and chiller
 - potential uncertainty from bacteria, chemical leaching
- Water monitoring system to detect problems before impacting physics
 - bacteria growth, deterioration of the microfilter
 - prototype for IWCD which is also a smaller detector than SuperK

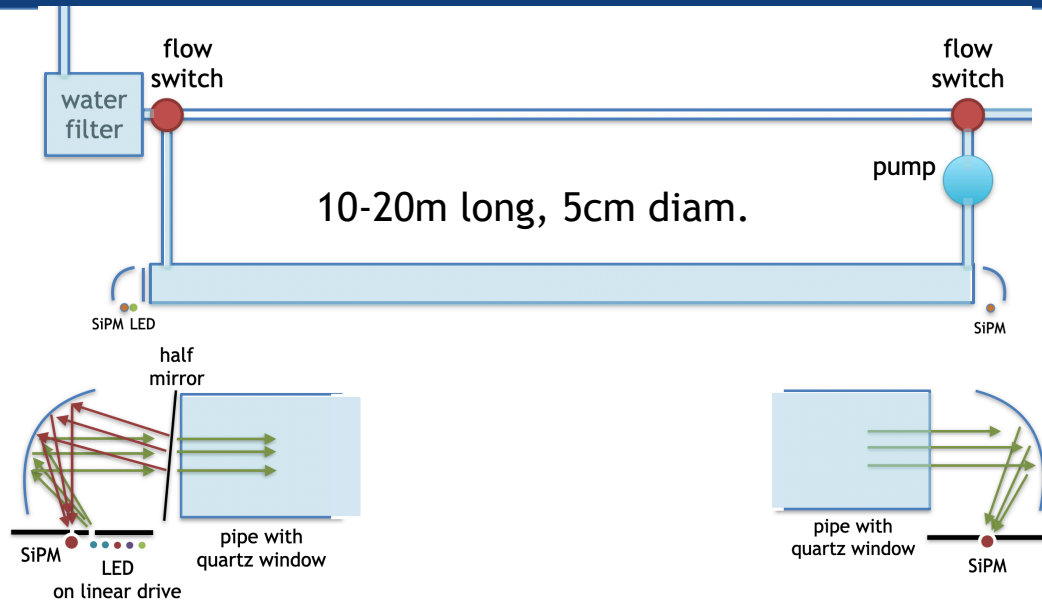
Continuous water monitoring of SuperK detector

- Transmission continuously monitored
 - time correlation is a powerful tool in identifying the source
- Huge impact in water monitoring
 - instead of water sampling and lab. test

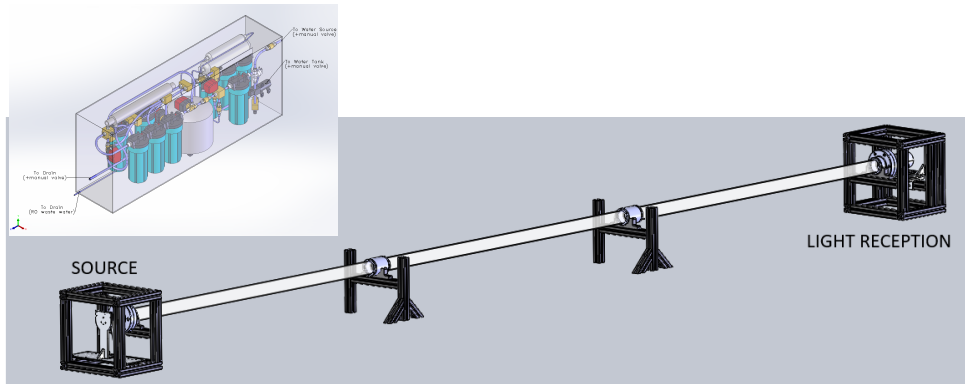
Light transmission for 15m water path in %

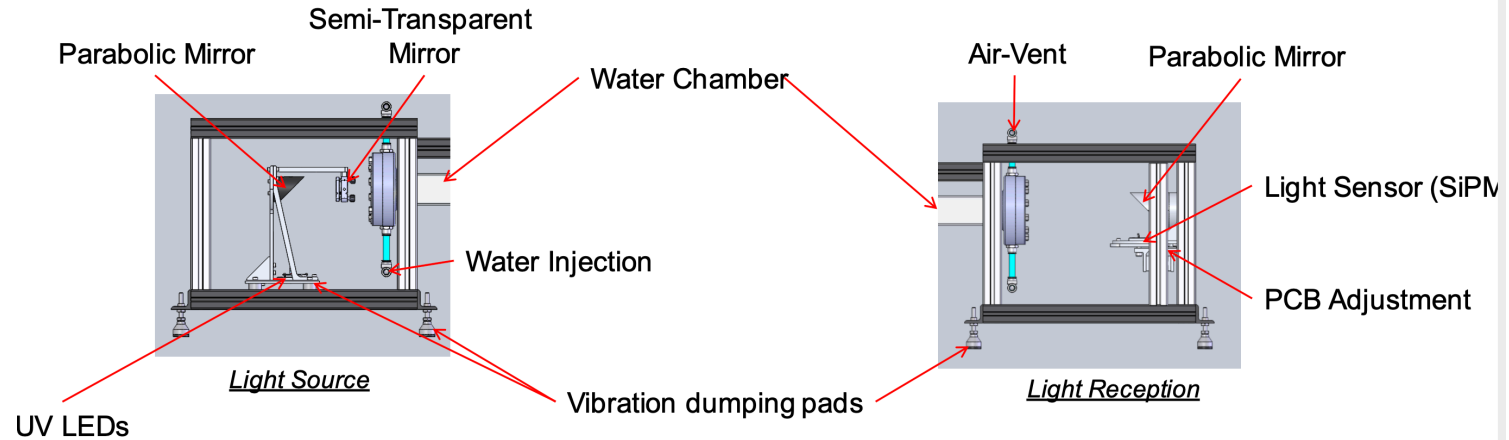


Water monitoring concept



- In-line continuous monitoring of the return water
- Pulsed LED light through 10-20m sample water
 - 230 - 700nm
 - parabolic mirror focus
 - SiPM at source/reception
- Relative to purified water
 - ultra-pure (RO)
 - particle filter (MF,NF)
 - ion exchange resins
 - UV steriliser (organic)





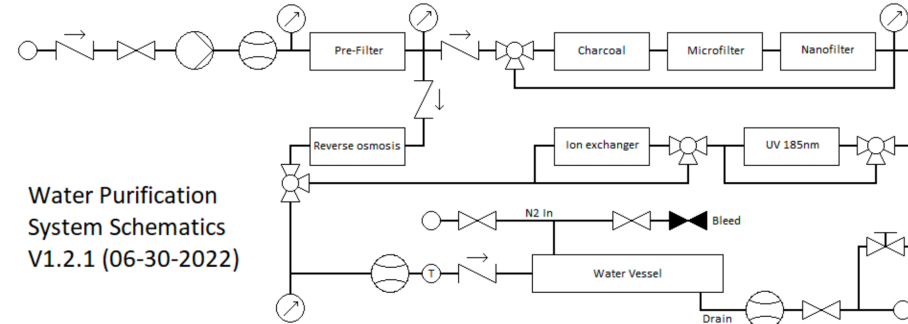
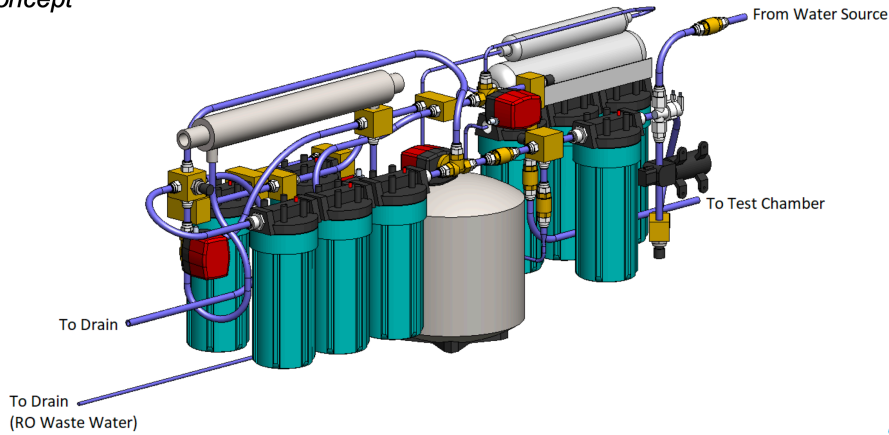
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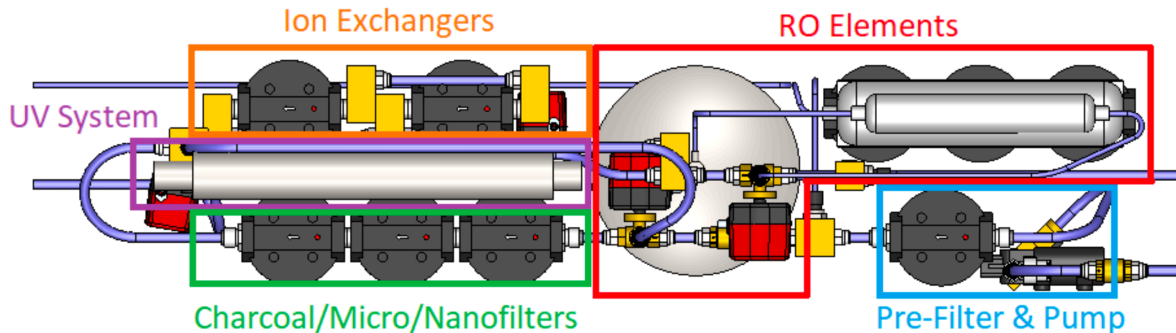
modular design for assembly and maintenance

Water filtration system

Concept

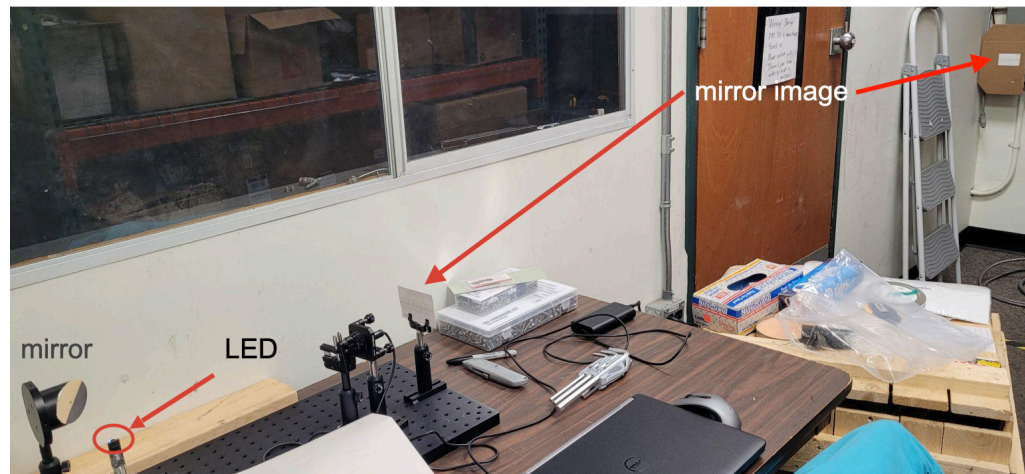


Water Purification System Schematics V1.2.1 (06-30-2022)

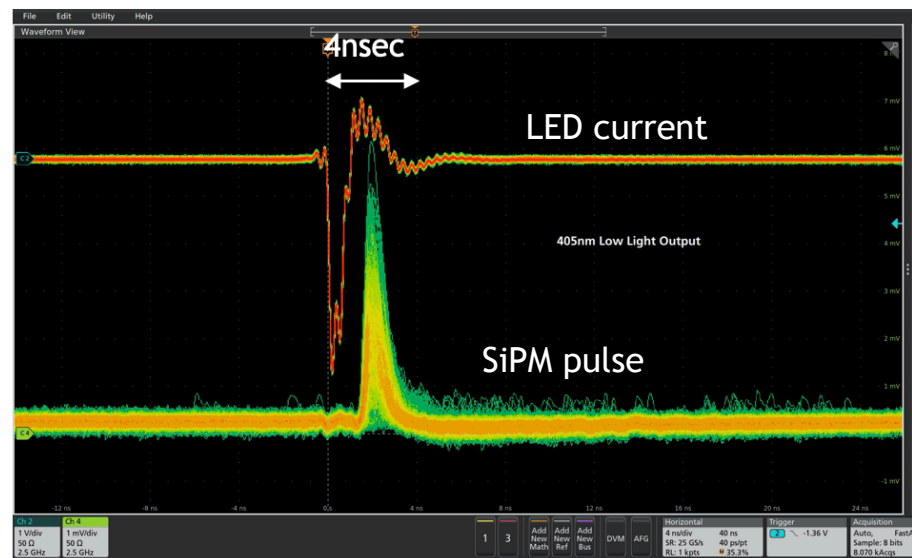
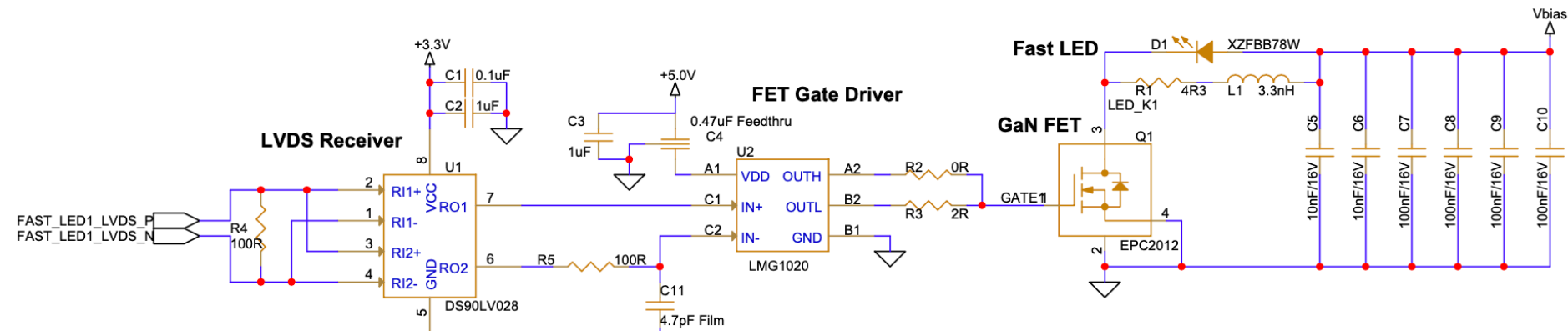


- use home water purification parts
- valve and sensor control using Raspberry-pi

- parabolic mirror test to develop
 - 1mrad collimation (1cm @ 10m)
 - stray light
 - baffle design
 - vibration effect
 - alignment method

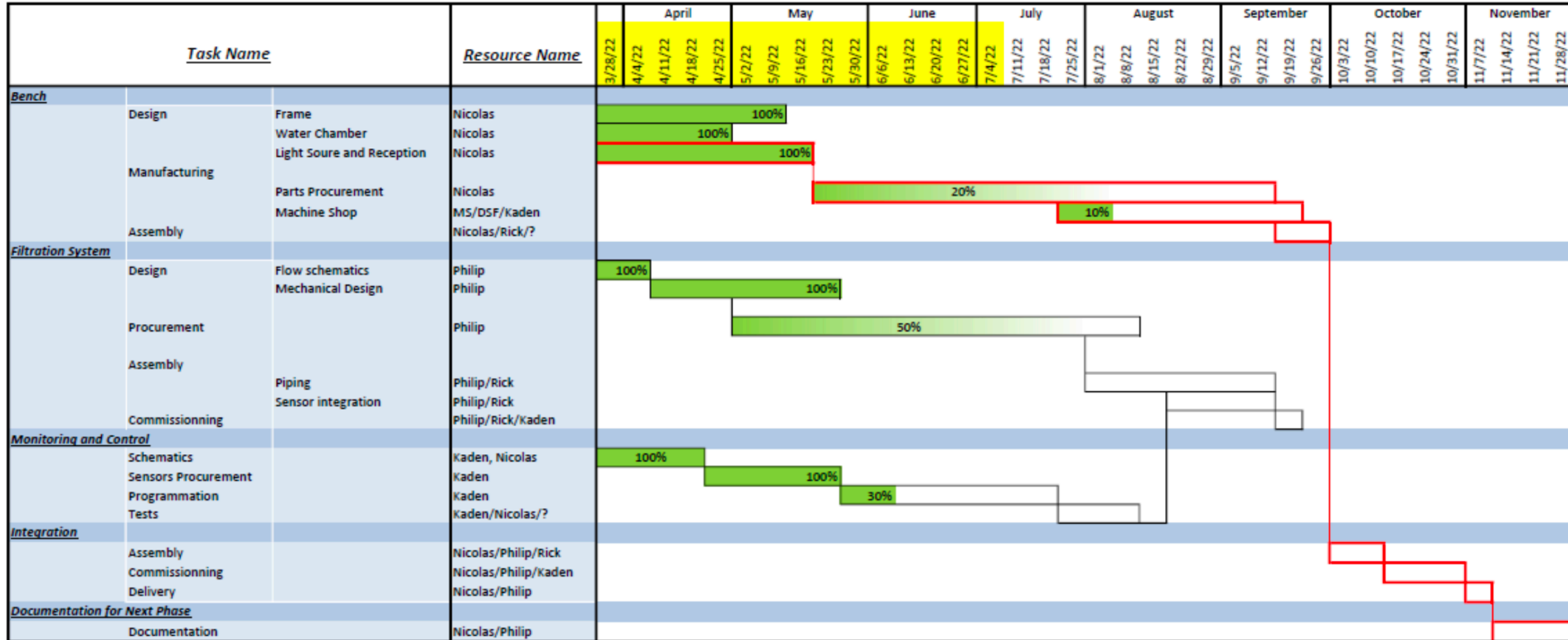


Sub-nsec pulsed LED



- LED: deep UV-LED available
 - 230nm - 700nm
 - a pulse width of 0.6nsec FWHM achieved
- Driver circuit
 - GaN gate FET (new technology)
 - Capacitor bank to over-drive
- Low cost: \$15-25 per channel
 - except for LEDs below 270nm (~\$100)

Prototyping status



The first full prototype will be ready in November 2022 for testing

- Water quality may quickly change in WCTE
 - bacteria growth, chemical leaching, corrosion
 - Gd loading could make a significant impact
- Water monitoring could detect the change early and take an action before it gets worse
 - replacing the filter or UV lamp, lowering water temperature, speeding up the water circulation speed, etc.
 - adjust the speed of loading Gd
- Full scale prototype is under construction
 - ready by November this year