Proposal for Reopening Yale University Cleanroom

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[Background]

Due to covid-19, the Yale University Cleanroom started enforcing new access rules in the beginning of March 2020. The precaution includes (1) wipe down common area with 70%IPA: 30%H2O daily; (2) log users' body temperature with IR temperature gun as they enter/exit the cleanroom. We also purchased extra cleanroom supplies to prepare for unexpected interruption.

On Mar. 14,2020, following the research continuity guidance provided by the Provost Office, we decided to shut down the cleanroom starting from Mar. 18, 2020. The initial shutdown was expected to last 2 weeks. During this period, most cleanroom equipment was kept idling, the toxic gases cylinders and cryopumps were turned off. However, by Mar. 23, 2020, further guidance was announced to limit the number of people on campus. Following the new guidance, the cleanroom shutdown was further extended.

On May 13, 2020, campus contingency plan was announced by the Provost. Some research labs, including the Yale University cleanroom, are expected to reopen in the beginning of June 2020. The following is the proposal for Phase I reopening of Yale University Cleanroom.

[Safety First]

As a University Service Provider, Yale University Cleanroom regards User Safety as our No. 1 priority. The current Covid-19 situation in Connecticut is quite severe. As of 5/18/2020, 170,607 people in CT had been tested, with 37,419 Covid-19 cases reported, 3,408 deaths, and 937 hospitalized. New Haven was among the hardest hit counties, with 10,159 Covid-19 cases, 817 deaths, and 336 hospitalized. The dire Covid-19 situation requires the staff to be extremely safety conscious during Phase I reopening of the cleanroom. Additional safety measures must be taken before authorizing users access to the cleanroom.

The Covid-19 virus is highly infectious. From our limited understanding so far, potential Covid-19 infection can happen through:

(1) Touching the virus contaminated surface.
Common area, such as door handle, faucet, public computer keyboard & mouse, can allow Covid-19 virus to survive for over 24 hours or longer. During that period, anyone touching the virus contaminated surface can potentially become a victim of the virus.

(2) Breathing the virus contaminated air.
A covid-19 patient, can spread the virus into a huge space simply by breathing, speaking, yelling or singing, coughing and sneezing (ranked by order of severity of patient actions in discharging virus-containing aerosol particles into the space). The spreading of virus is exacerbated when (i) people stay with Covid-19 patients in a closed space for an extended period of time; (ii) when the virus contaminated air is continuously recirculating in the closed space.

By examining the Covid-19 virus transmission paths, and with the user safety in mind, we recommend the following new cleanroom rules as additional safety measures:

(1) For users with potential Covid-19 symptoms (e.g. fever, chills, shortness of breath or difficulty breathing, muscle pain, sore throat, cough, new loss of taste or smell), please visit your doctor first, confirm that you're not symptomatic before coming to the cleanroom. We'll provide an IR temperature gun in the gowning area for users to measure their body temperature. Typical Covid-19 fever temperature is 100.4F (38C) or higher. Please note that this temperature check is voluntary, no personal temperature log data will be published.
(2) For users who have potentially contacted other symptomatic covid-19 patients, please visit your doctors first for advice. On CDC website, such users are recommended to work from home, self-quarantine for at least 14 days. After the self-quarantine, if users continue to have no symptoms, then they may come back to work in the cleanroom.
(3) For Users with no Covid19 symptoms, please reserve the specific time slots in FOM for both the cleanroom and equipment before accessing the cleanroom. At any given time, the max number of users allowed in the cleanroom is 5, the max number of user allowed in every bay (the 5 bays are: Lithography, wet, deposition, etching and metrology) is 1, the max number of users allowed in the gowning area is 1, the max number of users allowed in Student Cleanroom is 1.
(4) Users working in the cleanroom, are required to (i) wear gloves, cleanroom supplied face masks and other appropriate PPE; (ii) disinfect the common area after touching (e.g. tool door handle, keyboard, mouse); (ii) disinfect individual PPE (e.g. goggles) and other personal items; (iii) disinfect the shared PPE before & after every use (e.g. apron, face shield); (iv) avoid touching one's face. The cleanroom staff will also disinfect the common area at least twice every day with 0.5% H2O2. Users who come with their personal face masks or other PPE should place them in zip bags and store them in the lockers;
(5) Users should avoid or minimize one-on-one conversation while working inside the cleanroom, if such conversation is necessary, users should do so while maintaining 6ft social distance, or via phone or other online meeting platforms. For the same consideration, during Phase I, the staff will not offer one-on-one cleanroom training or new user orientation. We'll continue looking for alternative solutions (e.g. online videos or virtual training, to be updated when available);

[Facility Preparation]

To get the cleanroom ready, a few steps must be taken to mitigate the risk of virus exposure & spreading. If the safety part of the cleanroom is addressed by Jun. 01, 2020, and all critical supplies are in place, the cleanroom staff should be able to restore the cleanroom operation right away, and the cleanroom users may start working inside the cleanroom on Jun. 02, 2020.

(1) Cleanroom garment storage
Risk - currently used cleanroom garments are hanging on rails, these used garments are collected for laundry service every Wednesday. In a typical week, there are easily over 30 pairs of cleanroom garments cluttering on the rails, which is a source of concern. Usually users have to

push aside other garments to reach for their own. By doing so, a single Covid-19 patient can lead to the wide spread of Covid-19 virus.

Solution – We propose replacing the hanger/rail with lockers (already purchased), users will roll their garments and store them in individual lockers. They can also store other personal items (e.g. goggle, used face masks) in the lockers, which should minimize the cross transmission of virus.

(2) Cleanroom safety goggle storage

Risk – currently all safety goggles are stored in one single bin, which is the perfect environment for virus to spread across.

Solution – We propose to store goggles and other personal items in individual lockers.

(3) Cleanroom trash disposal

Risk – all used gloves, face masks and other trash are currently tossed into the big trash can in the gowning area, which has no lid. It's possible that the trash in an open container may be disturbed and spread the virus.

Solution - (i) short-term, we'll provide a spray bottle with 0.5% H2O2, and ask users to disinfect their trash before tossing into the trash can; (ii) long-term, we may purchase multiple trash cans with lid/liner, replace a full trash can with an empty one, then let the trash sealed for 2 days, wait for the virus to be harmless before disposing the trash.

[Phase I Cleanroom Reopening Guidelines]

Yale University cleanroom serves about 30 research groups on campus, spanning across 13 departments. Roughly 120 users use the cleanroom facility every year, and on average, about 40-70 users every month. With that many people moving in and out, it is critical for the cleanroom staff to mitigate the risk of virus infection, especially when the Covid-19 cases continues to rise in New Haven. The following are the latest guidelines we will enforce to ensure the user safety during the Phase I Cleanroom Reopening, which is projected to start on Jun. 01, 2020.

(1) Disinfect, Disinfect and Disinfect

70% IPA : 30% H2O spray bottles will be available in every bay and the gowning area. Users are required to disinfect wherever they have come into direct contact. The only exceptions are: vacuum chamber, loadlock, quartz tube furnace, quartz chamber. In these case, users should either wear clean nitrile gloves before reaching inside, or use tweezers or other tools.

0.5% H2O2 will be used to disinfect the common area in cleanroom (e.g. floor, desk top, etc.) at least twice every day by the cleanroom staff.

(2) Wear Face Masks At All Time

Users are required to wear face masks at all time while working in the cleanroom. The cleanroom will provide 3-ply medical masks in the gowning area. Users should not wear their personal face masks into the cleanroom. The used face masks can be placed in zip bags and stored in their lockers in the gowning area.

In case the cleanroom masks are not available in early June 2020, users should request their own face masks from EHS: <link>. Every researcher can request 30 medical face masks from EHS, the cleanroom will provide storage for new medical face masks.

(3) Maintain 6ft Social Distance

Users should maintain 6ft social distance while working inside the cleanroom, that means (i) max 1 person in the gowning area; (ii) max 1 person at every bay; (iii) max 5 persons in the cleanroom. Please check the FOM calendar first, reserve the time slots on specific tools & Becton Cleanroom before coming to work in the cleanroom. No casual walk-in is allowed. No group or one-on-one training is allowed. Users should also refrain from group gathering either inside the cleanroom or outside the cleanroom in the alcove area.

The cleanroom staff will follow the same guidelines when coming to work on Jun. 01, 2020. Specifically the cleanroom staff will take turns to work from home, so that in any given day, at most two staff members are available on campus, and no two staff will be sharing the same office space.

[Contingency Plan]

Same as other cleanroom safety measures, we need to prepare for the worst Covid-19 scenario and devise the appropriate response to handle different situations during the Phase I Cleanroom Reopening. That means, before the cleanroom is open, the following preparation has to be in place:

- A channel for users to report and update their current health status related to Covid-19
  The cleanroom has established a dedicated Slack account for this purpose: <link>. Users who plan to work in the cleanroom during the Phase I Cleanroom Reopening, should send an email to Yong, requesting access to the Slack channel.
- A system to continuously monitor the users' health status
  Ideally this should be done at every building entrance, where a monitoring station could be set up to check users' body temperature (e.g. with an IR temperature gun). If that's not available, the cleanroom has our own check station in the gowning area, with IR temperature gun and log book.
- Contact tracing
  The contact tracing information is necessary when new Covid-19 infection cases are reported. Currently we can only use the cleanroom video footage and FOM log data to trace the activities. The Slack channel also provides an honest system for reporting & updating the staff and users health status. Ideally, it would be better to have a contact tracing app installed on smart phones to automatically do the contact tracing (not sure whether Yale will approve it).
- A plan to fall back to in case Covid-19 gets worse or new infection is reported
  (1) If a second wave of Covid-19 infection is happening in New Haven
  The Yale research labs (University Cleanroom included) will be shut down following updated guidelines from the Provost Office or the CT government.
  (2) If a Covid-19 symptom is reported by cleanroom staff or users.
  The University Cleanroom will be shut down immediately for further investigation. The cleanroom shutdown will remain so until the suspicion case is cleared, in that case no action will be taken, the cleanroom operation can safely resume; if the suspicious case is confirmed to have Covid-19, then actions in step (3) should be taken.
  (3) If a Covid-19 infection is reported by cleanroom staff or users
  The University Cleanroom will be shut down for a minimum 14 days. The Covid-19 case will be reported to Yale EHS, and those who have potentially come into contact with the Covid-19 patient will be notified and sent home for a 14-day self-quarantine.