How will coronavirus affect nuclear power plant safety in the United States? The good news is that measures to fight COVID-19 elsewhere in society help minimize any adverse impact. But the measures pose a challenge to successful management of nuclear power’s risks. The challenges differ depending on whether a nuclear reactor is operating, shut down for refueling, or experiencing an accident as described below.

**Routine Reactor Operation**

U.S. nuclear power reactors typically operate for 18 to 24 months before having to shut down to refuel. Decades ago, the periods between refueling outages would include numerous shut downs caused by equipment malfunctions or worker miscues. More recently, the reactors operate 24/7/365 with perhaps only a shutdown or two between refueling outages.

The reactors are far from being on cruise control between refueling outages. The reactors’ pumps, motors, valves, fans, gizmos and gadgets must be periodically inspected, tested, and maintained to preserve the necessary safety margins. The operating license issued by the U.S. Nuclear Regulatory Commission (NRC) dictates the frequency of such efforts for equipment having safety functions. Not performing a required test or inspection on time starts a clock — overdue tasks must be completed soon or the reactor shut down. So, plant owners will ensure such tasks get done if at all possible even with a work force depleted by COVID-19 measures.

The bulk of the inspections, tests, and maintenance are not governed by the NRC’s operating license. Instead, performance of these tasks comes from recommendations by equipment suppliers, advisories from reactor vendors, and operating experience (both good and bad) of the worldwide nuclear industry. Deferring or canceling such tasks does not require prior NRC review and approval. If staffing restraints prevent all required and discretionary tasks from getting done, discretionary tasks will be the first targeted for postponement or elimination.

Postponing a discretionary task like preventative maintenance on a pump or its motor does not start a breakdown clock. It does, however, lessen the component’s reliability. If doing the task preserves the component’s reliability, not doing the task must lessen that assurance.
If COVID-19 prevents some nuclear plant staffers from reporting for work, routine reactor operation may be impacted in two other ways. First, their absence may force other staffers to work longer hours or more days to compensate. Second, less qualified and less experienced workers may conduct critical tasks in their absence. Whether due to fatigue or inexperience, the chances for human error can increase with a corresponding reduction in safety margins.

The backstops against significant safety margin erosion from either deferred/deleted test, inspection, and maintenance tasks or human performance impairments includes the required checks of safety equipment and the redundancy of safety systems. These backstops are intended to prevent the proliferation of component impairments to the level that a minor problem escalates to disaster.

The NRC’s Reactor Oversight Process (ROP) serves as a backstop to the backstops. The ROP includes seventeen (17) Performance Indicators reported quarterly to the NRC and posted online. Equipment malfunctions and/or worker mistakes can be manifested in one or more of the Performance Indicators, such as Unplanned Power Changes and Cooling Water System reliability. The Performance Indicators flag degrading trends, allowing plant owners and the NRC to intervene before safety margins are significantly compromised. The Performance Indicators are color-coded Green, White, Yellow and Red in order of increasing significance. Whenever a Performance Indicator crosses a threshold (i.e., Green to White), the NRC should assess whether it is merely bad luck or indicative of a broader systematic problem caused in whole or in part by COVID-19 resource limitations.

**Refueling and Outage Operation**

Refueling and outage operation poses a similar challenge to nuclear safety. Plant owners bring in dozens of temporary workers to supplement the full-time staff in performing hundreds of tasks while the reactor is shut down. Some tasks require expertise that the plant staff lacks in-house; thus, the temporary workers supply not only the labor but also the skill set for such tasks.

The quarantine, travel, and social distancing restrictions complicate efforts by plant owners to get the right number of right individuals needed to do all the tasks. Consequently, some tasks may get deferred while others may get performed by persons not as experienced doing the work.

In additional to the backstops described above for routine reactor operation, the backstops in this case also include mandatory post-maintenance and post-modification tests. For example, if an emergency diesel generator (EDG) is taken apart during an outage for a thorough examination, the required test following its reassembly is more rigorous than merely checking that no parts are left lying on the floor. The EDG is started and monitored for vibration, voltage, and other measures of proper performance.

The NRC has resident inspectors assigned full-time to each operating reactor that are supported by specialists from its regional and headquarters offices. During the COVID-19 period, the NRC’s inspectors should expand their evaluation of the plant owner’s justifications for deferring and cancelling discretionary tasks to ensure what needs to get done gets done. Sometimes, deferring Task X is based on Tasks Y and Z providing the desired safety assurance. Someone needs to check that Task Y is not deferred based on Tasks X and Z at the same time that Task Z is deferred based on Tasks X and Y. By analogy, I know from painful experience that I can survive a hornet’s sting; I do not know, and seek not to learn, whether I can survive 100 hornet stings at the same time.

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1 Studies that supported the NRC adopted working hour limits in 2008 showed that simply being awake for 15 hours can impair human performance equivalent to that experienced from a blood alcohol concentration of 0.05% — the legal limit for a nuclear power to be considered unfit for duty.

2 See [https://www.nrc.gov/reactors/operating/oversight/pi-summary.html](https://www.nrc.gov/reactors/operating/oversight/pi-summary.html)
Even without COVID-19’s thumb on the nuclear safety scale, all U.S. operating reactors have the potential — hopefully small — of experiencing a serious accident. That’s why the NRC requires operating plants to have emergency plans that get tested via exercises at least once every two years. Emergency plans are the last-ditch measure to get folks out of Dodge before Dodge becomes radioactively contaminated.

The NRC classifies nuclear plant emergencies into four levels: Unusual Event, Alert, Site Area Emergency, and General Emergency in order of increasing severity. The classification levels govern the amount of engagement from plant staff, local responders, state officials, and federal government agencies.

Social distancing guidelines conflict with getting the cavalry to the nuclear plant’s rescue. But the Hostile Action Based drills conducted at nuclear plants since 9/11 have developed alternate means of providing the needed response. Many of these methods are transferrable to an emergency response during a COVID-19 environment. In other words, first responders as well as local, state, and federal officials have a template to apply if needed.

Depending on the nature of the accident and current meteorological conditions, the Governor may order the sheltering of members of the public downwind from the plant or their evacuation. The COVID-19 measures may reinforce the efficacy of sheltering. But they certainly complicate the evacuation option.

Are evacuation centers limited to accepting only the first ten persons who arrive? Are individuals arriving at evacuation centers screened for potentially having COVID-19? Must persons within an evacuation center maintain six-feet separation from all others?

When state and federal officials get a spare moment from their proper concentration on COVID-19, revisiting emergency plans and making any applicable adjustments to protect against both radiation and COVID-19 exposure may be fruitful.

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3 For fuller details, see https://www.nrc.gov/about-nrc/emerg-preparedness/about-emerg-preparedness/emerg-classification.html