Walking a Nuclear Tightrope:
Unlearned Lessons of Year-plus Reactor Outages

No U.S. nuclear power reactor has experienced significant core damage since the partial meltdown at Pennsylvania's Three Mile Island (TMI) in 1979. This passage of time suggests nuclear power is safer today, but is it safe enough? A car speeding through a school zone at 90 miles per hour is safer if it slows to "only" 75 mph, but it isn't safe enough. Likewise, nuclear power may be safer today but it is not safe enough.

In the 27 years since the TMI meltdown, 38 U.S. nuclear power reactors had to be shut down for at least a year while widespread problems within each plant were fixed and safety margins were restored to minimally acceptable levels. Including those prior to TMI, 51 reactor outages of a year or longer have occurred. While these reactors shut down before they experienced a major accident, we cannot assume our luck will continue.

Federal regulations require nuclear plant owners to have quality assurance (QA) programs that find and fix problems in a timely manner. But the recurring theme of the year-plus outages has been owners failing to find serious problems and/or failing to properly fix them, leading to an erosion of safety margins. The accompanying theme has been the Nuclear Regulatory Commission (NRC) either being unaware of the QA program deficiencies or knowing but being unable or unwilling to enforce the applicable federal safety regulations.
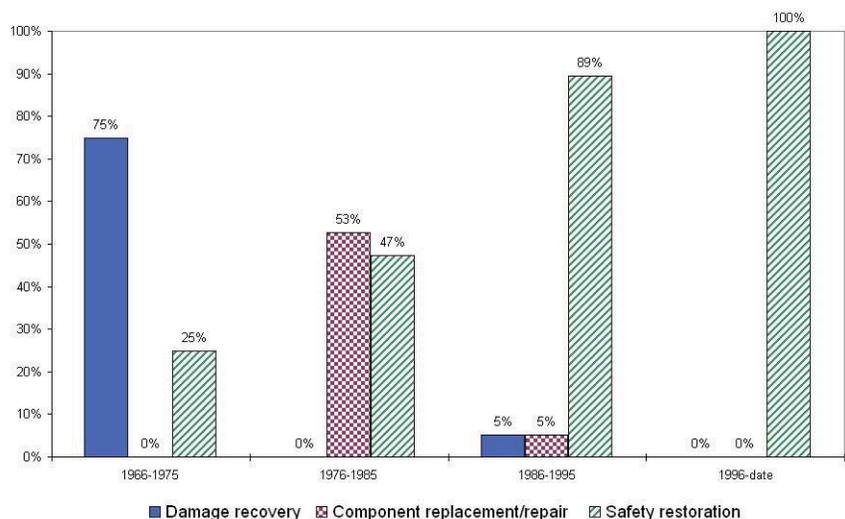
Nuclear power is clearly not safe enough when so many reactors have to shut down for so long to restore safety to the minimum level considered acceptable. The recurring year-plus outages constitute *prima facie* evidence of how far safety levels fell below minimally acceptable levels, making nuclear power far more dangerous and costly than necessary. The chronic violations of federal safety regulations must stop before the increased safety risks yield an even higher cost – human tragedy.

Our review of year-plus reactor outages found a silver lining. The extended outages fell into three cause categories: (1) *damage recovery outages* resulting from an event, such as an accident, causing extensive damage that took a long time to repair, (2) *component replacement or repair outages* resulting from degradation to a major component, such as the steam generator, that forced its replacement or repair, and (3) *safety restoration outages* resulting from cumulative, systemic degradation of many reactor components, which flawed QA programs failed to prevent, detect or fix. The figure strongly suggests that damage recovery outages and component replacement/repair outages have been eliminated – no such outage has occurred in over a decade – due to NRC attention to these problems. The lack of effective NRC attention to the third problem allowed safety restoration outages to proliferate. The silver lining is that proper NRC attention to the causes of safety restoration outages will likely be as successful in curbing their recurrence as proper attention to the other causes has been.

Causes of Extended Reactor Outages

Legend: ■ Damage recovery ▨ Component replacement/repair ▨ Safety restoration

- 1966-1975: Damage recovery 75%, Component replacement/repair 0%, Safety restoration 25%
- 1976-1985: Damage recovery 0%, Component replacement/repair 53%, Safety restoration 47%
- 1986-1995: Damage recovery 5%, Component replacement/repair 5%, Safety restoration 89%
- 1996-date: Damage recovery 0%, Component replacement/repair 0%, Safety restoration 100%

UCS recommends the following steps be taken to improve safety levels at nuclear power plants:

1. **The NRC must significantly improve its assessment of QA programs at nuclear power plants.**

The most crucial reform is in the way the NRC evaluates QA at nuclear power plants. Federal regulations require power plants to have QA programs that find and fix problems at the plant. If NRC inspectors find problems when they visit, it means that the plant's QA program has failed. Yet today when NRC inspectors find problems, that information is merely entered into the very same QA program just demonstrated to be flawed.

2. **The NRC must alert plant owners about non-hardware problems that have reduced safety levels.**

The NRC currently alerts plant owners about hardware problems identified at a specific plant. During our review of the year-plus outages, we did not find a single instance in which the NRC had alerted plant owners about programmatic breakdowns—problems with procedures or training—that led to broken equipment and, ultimately, extended outages. The lessons of non-hardware problems must also be communicated so that they can be incorporated into procedures and training at all nuclear power plants.

3. **The NRC must expand the scope of its oversight efforts when programmatic breakdowns at a nuclear plant are identified to ensure that other plants operated by the same company do not experience declining performance while the company focuses on restarting the troubled plant.**

Companies operating multiple nuclear power plants seldom shut down all of their reactors when one plant experiences a programmatic breakdown of the kind that has caused most of the year-plus outages. Yet programmatic breakdowns are unlikely to be confined to only one facility owned by a poorly managed company. When programmatic breakdowns are identified at a plant, the NRC must (1) determine whether other plants operated by the same company have the same problems, and (2) ensure that performance does not deteriorate at those plants while the company focuses on restarting the troubled facility.

4. **When longstanding problems are identified at a plant, the NRC must require the owner to determine why its testing and inspections failed to find the problems earlier and remedy those failures.**

Our review of year-plus reactor outages revealed the fact that numerous safety problems "invisible" to plant workers and NRC inspectors during years of tests and inspections magically materialized after an extended outage caused a sea change in how that plant was perceived. The NRC must break the longstanding pattern of NRC inspectors and plant workers repeatedly overlooking safety problems until operations grind to a halt.

5. **The NRC must develop a central repository for all current information about plant safety levels, potential safety problems, and generic safety issues so that all agency employees have access to the same data when making regulatory decisions.**

The post-mortems on year-plus outages conducted by the NRC, the NRC's inspector general, and the General Accountability Office show that the NRC had known about many of the problems but had not "connected the dots" to see the picture of a plant headed for trouble. Why? Because the dots resided in numerous places within the agency: some with regional staff, some with headquarters staff, and some with a different program office. There is no excuse today for not making all of the dots readily available to all NRC staff.

6. **The Congress must require the NRC to provide periodic status reports on progress made towards implementing these five steps.**

The NRC has much on its plate (e.g., security issues, license renewals, new reactor design certifications, etc.). It is critical that the Congress provide active oversight of the important work being conducted by the NRC, especially progress on reforms intended to prevent future safety problems at U.S. nuclear plants.