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The Fukushima Dai-Ichi nuclear plant in Japan experienced a station blackout. A station blackout occurs when a nuclear power plant loses electrical power from all sources except that provided by onsite banks of batteries. The normal power supply comes from the plant's own main generator or from the electrical grid when the reactor is shut down. All the equipment needed to operate the plant on a daily basis as well as the emergency equipment needed during an accident can be energized by the normal power supply. When the normal power supply is lost, backup power is supplied from onsite emergency diesel generators. These generators provide electricity only to the smaller set of equipment needed to cool the reactor cores and maintain the containments' integrity during an accident.

At Fukushima, the earthquake caused the normal power supply to be lost. Within an hour, the tsunami caused the backup power supply to be lost. This placed the plant into a station blackout where the only source of power came from batteries. These batteries provided sufficient power for the valves and controls of the steam-driven system—called the reactor core isolation cooling system—that provided cooling water for the reactor cores on Units 1, 2, and 3. When those batteries were exhausted, there were no cooling systems for the reactor cores or the spent fuel pools. There are clear indications that the fuel in the reactor cores of units 1, 2, and 3 and some spent fuel pools has been damaged due to overheating.

Had either normal or backup power been restored before the batteries were depleted, we would not be here today discussing this matter. The prolonged station blackout resulted in the inability to cool the reactor cores in Units 1, 2, and 3, the spent fuel pools for all six units, and the consolidated spent fuel pool. There are lessons, learned at high cost in Japan, that can and should be applied to lessen the vulnerabilities at U.S. reactors. And I cannot emphasize enough that the lessons from Japan apply to all U.S. reactors, not just the boiling water reactors like those affected at Fukushima. None are immune to station blackout problems. All must be made less vulnerable to those problems.

As at Fukushima, U.S. reactors are designed to cool the reactor core during a station blackout of only a fairly short duration. It is assumed that either the connection to an energized electrical grid or the repair of an emergency diesel generator will occur before the batteries are depleted. Eleven U.S. reactors are designed to cope with a station blackout lasting eight hours, as were the reactors in Japan. Ninety-three of our reactors are designed to cope for only four hours. But unless the life of the on-site batteries is long enough to eliminate virtually any chance that the batteries would be depleted before power from another source is restored, one lesson from Fukushima is the need to provide workers with options for dealing with a station blackout lasting longer than the life of the on-site batteries. In other words, the moment that any U.S. reactor enters a station blackout, response efforts should proceed along three parallel paths: (1) restoration of the electrical grid as soon as possible, (2) recovery of one or more emergency diesel generators as soon as possible, and (3) acquisition of additional batteries and/or temporary generators as soon as possible. If either of the first two paths leads to success, the station blackout ends and the reenergized safety systems can cool the reactor core and spent fuel pool. If the first two paths lead to failure, success on the third path will hopefully provide enough time for the first two paths to achieve belated success.

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The timeline associated with the third path should determine whether the life of the on-site batteries is adequate or whether additional batteries should be required. For example, the existing battery life may be sufficient when a reactor is located near a facility where temporary generators are readily available, such as the San Onofre nuclear plant in California, which is next to the U.S. Marine base at Camp Pendleton. When a reactor is more remotely located, it may be necessary to add on-site batteries to increase the chance that the third path leads to success if the first two paths do not.

The second lesson from Fukushima is the need to address the vulnerability of spent fuel pools. At many U.S. reactors, there is far more irradiated fuel in the spent fuel pool than in the reactor core. At all U.S. reactors, the spent fuel pool is cooled by fewer and less reliable systems than are provided for the reactor core. At all U.S. reactors, the spent fuel pool is housed in far less robust structures than surround the reactor core. This means that any release of radiation from the pool will not be as well contained as radiation released from the reactor core. It also means that spent fuel pools are more vulnerable to terrorist attack than is the reactor itself. More irradiated fuel that is less well protected and less well defended is an undue hazard. There are two measures to better manage this risk: (1) accelerate the transfer of spent fuel from spent fuel pools to dry cask storage, and (2) upgrade the guidelines for how to address an emergency and the operator training for spent fuel pool problems.

Currently, the U.S. spent fuel storage strategy is to nearly fill the spent fuel pools to capacity and then to transfer fuel into dry cask storage to provide space for the new fuel discharged from the reactor core. This keeps the spent fuel pools nearly filled with irradiated fuel, thus maintaining the risk level about as high as possible. Added to that risk is the risk from dry casks stored onsite, which is less than that from the spent fuel pools but not zero.

A better strategy would be to reduce the inventory of irradiated fuel in the pools to the minimum amount, which would be only the fuel discharged from the reactor core within the past five years. Reducing the spent fuel stored in the pools would lower the risk in two ways. First, less irradiated fuel in the pools would generate a lower heat load. If cooling of the spent fuel pool was interrupted or water inventory was lost from the pool, the lower heat load would give workers more time to recover cooling and/or water inventory before overheating caused fuel damage. And second, if irradiated fuel in a spent fuel pool did become damaged, the amount of radioactivity released from the smaller amount of spent fuel would be significantly less than that released from a nearly full pool. Reducing the amount of irradiated fuel in spent fuel pools would significantly reduce the safety and security risks from a nuclear power plant.

Following the 1979 accident at Three Mile Island, reactor owners significantly upgraded emergency procedures and operator training. Prior to that accident, procedures and training relied on the operators quickly and correctly diagnosing what had happened and taking steps to mitigate the consequences. If the operators mis-diagnosed the accident they faced, the guidelines could lead them to take the wrong steps for the actual accident in progress. The revamped emergency procedures and training would guide the operators' response to an abnormally high pressure or an unusually low water level without undue regard for what caused the abnormalities. The revamped emergency procedures and training represent significant improvements over the pre-TMI days. But they apply only to reactor core accidents. No comparable procedures and training would help the operators respond to a spent fuel pool accident. It is imperative that comparable emergency procedures and training be provided for spent fuel pool accidents to supplement the significant gains in addressing reactor core accidents that were made following the TMI accident.

The Nuclear Regulatory Commission has announced a two-phase response plan to Fukushima: a 90-day quick look followed by a more in-depth review. If the past three decades have demonstrated anything, it's that the NRC will likely come up with a solid action plan to address problems revealed at Fukushima, but will be glacially slow in implementing those identified safety upgrades. A comprehensive action plan does little to protect Americans until its goals are achieved. We urge the U.S. Congress to force the NRC to not merely chart a course to a safer place, but actually reach that destination as soon as possible.