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FACT SHEET

Natural Disasters and Safety Risks at Nuclear Power Stations

November 2004 by Paul Gunter

The public health threat from a catastrophic nuclear accident caused by operator error, mechanical failure or sabotage is widely acknowledged as a credible event. However, public safety risks associated with a nuclear power accident stemming from natural disasters are mistakenly presumed to be negligible. The following storm-related events suggest that Mother Nature may have already brushed closer to nuclear disaster initiated than previously discussed.

FLOODING

In mid-July 1993, the operator of the Cooper nuclear power station, built on a 100-year flood plain, encountered rapidly rising flood waters on the Missouri River near Brownville, Nebraska and was forced to shutdown the reactor as dikes and levees collapsed around the site closing many emergency escape routes in the region.

Global warming inundation? In fact, this photo shows the 1993 flood on the Missouri River as it recedes from Nebraska's Cooper nuclear power station.
Photo: Diane Krogh/Lighthawk

Throughout the event the Nuclear Regulatory Commission (NRC) and station operators assured the public that the nuke was safely under control. On July 26th, the U.S. Army Corp of Engineers reported that Federal Levee 550 located upstream of the station collapsed acting “like a pressure valve for Cooper nuclear power plant.” An NRC Information Notice subsequently issued nearly a year later (NRC IN-94-27) indicated that below grade rooms in the reactor and turbine buildings had extensive leakage with rising water levels. The notice stated that “the floor drain system had backed up so that standing water from within areas known to be radiologically contaminated had migrated out into designated clean areas.”[1] The NRC inspectors noted that plant personnel “had not established measures to divert the water away from important components.” For example, water levels rising inside the reactor building impinged on electrical cables and equipment such as the Reactor Core Isolation Cooling (RCIC) pump room causing the circuitry to ground out. “This event demonstrates that flooding problems and degradation of equipment may be caused by water inleakage even though flood waters are not above grade elevations,” the information notice indicated. The RCIC system is critical to plant safety in the event of loss of offsite power and a condition known as “Station Blackout.”

TORNADOES

The tornado that leveled the town of La Plata, Maryland on April 27, 2002 is shown passing within one mile of the Calvert Cliffs nuclear generating station located on the shores of the Chesapeake Bay in Lusby, Maryland. **Photo: Anonymous**

[1] Information Notice 94-27, “Facility Operating Concerns Resulting From Local Area Flooding,” U.S. Nuclear Regulatory Commission, March 31, 1994.

On June 24, 1998 the Davis-Besse nuclear power station near Toledo, Ohio while at 99% power was hit by a "significant" tornado with winds between 113 and 156 miles per hour (Fujita Scale Category F2).

The station had not been notified of the approaching storm. Lightning strikes to the station's switchyard and winds caused a loss-of-offsite power automatically shutting the reactor down. Departing security guards saw multiple funnel clouds above the station. Three independent offsite power lines were knocked down along with the station's telephone fiber optic system. The Emergency Diesel Generators (EDG) A and B were energized to power priority safety systems. Diesel generator A had to be started locally after bad switch contacts in the control room prevented its remote start. Faulty ventilation equipment problems threatened to overheat the emergency diesel generators rendering the emergency backup power system inoperable. Even with emergency diesel generators running, the loss of offsite power meant the loss of certain equipment including the cooling system for the onsite irradiated fuel storage pond not rated as an emergency priority system where the water temperature rose from 110° F to 137° F. Offsite power was narrowly restored to Davis-Besse safety systems after 23 hours just as diesel generator B was also declared inoperable.

On April 27, 2002 the Calvert Cliffs nuclear power station on Maryland's Chesapeake Bay was narrowly missed by a "severe" tornado with 260 mph winds. Originally rated as an F5 tornado (261-318 mph winds) the storm was later downgraded to an F4. According to NRC documents the F4 and F5 rated tornadoes can produce winds and tornado missiles which can badly damage steel reinforced concrete structures.[2] It was assumed that an F2 to F5 rated tornado could also significantly damage support systems for onsite irradiated fuel storage ponds such as the offsite power supply, emergency onsite power supplies, cooling pumps and make-up water supply. The low frequency of such violent storms is used to minimize the perception of the radiological risk to public health by making a tornado strike at a nuclear facility an extremely remote possibility.

HURRICANES

At about 4:00 AM August 24, 1992, Hurricane Andrew passed directly over the two-unit Turkey Point nuclear power station just south of Miami, Florida with a sustained wind speed of 145 mph and gusts of at least 175 mph. The plant lost all offsite power during the storm and the following five days. Emergency diesel generators provided onsite power and maintained the plant during recovery operations until offsite power was restored on August 30, 1992. All offsite communications were lost for 4-hours during the storm and access to the site was blocked by debris and fallen trees. The nuclear power station's fire protection system was destroyed when winds and wind-generated missiles toppled a tower supporting a water storage tank containing 100,000 gallons of water used for fire fighting. Additionally, the high water tank collapsed on Raw Water Storage Tank #1 (500,000 gals) and ruptured a water main draining the remaining Raw Water Storage Tank #2 (750,000 gals). The collapsed structure also destroyed the fire protection

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[2] "Technical Study of Spent Fuel Pool Accident Risk at Decommissioned Nuclear Power Plants," U.S. Nuclear Regulatory Commission, October 2000

electrical pumps beyond repair. Turkey Point's fire suppression system was declared inoperable prompting a station "Alert" to be declared. Following the storm, pumps and hoses were deployed to a near-by salt water lagoon to compensate for the loss of the fire suppression system.

However, the risk of a fire at Turkey Point was not fully acknowledged. The nuclear power station is one of the few US reactors with electrical power cables used for shutting down the reactor installed on the exterior of the reactor containment buildings. These cable trays and conduits were coated with a fire-resistant material. The hurricane force winds stripped much of the fire resistant coating off these exterior applications exposing the reactor shutdown cabling to any subsequent fire. This was very significant because the Turkey Point site includes two fossil-fueled Units 1 and 2. Unit 1's fuel oil storage tank was ruptured by a wind-generated missile spilling over 100,000 gallons of combustible fuel oil onto the site. The wind blew the combustible fuel over the nuclear site as well as an oil slick over the lagoon later designated the source for backup fire suppression water inventory. As Lady Luck would fortunately have it, the fuel oil did not ignite with the passing storm.

Additional storm damage to the Turkey Point radiological monitoring equipment would have significantly hampered emergency operations and civilian evacuation because any radiation release, its intensity and direction, could not have been monitored.

FROM NATURAL DISASTER TO NUCLEAR DISASTER?

Other natural phenomenon like lightning, earthquakes, ice storms, drought and wild fire can contribute to increased safety risks at nuclear power stations. All U.S. nuclear power plants receive their electrical power for reactor safety systems primarily from the offsite electrical grid system. A typical nuclear power station will be connected to the electric grid through three or more transmission lines. Should these power lines go down or a regional electrical grid collapse occur, onsite emergency generators (diesel, gas turbines or in few cases hydroelectric dams) are designed to automatically start with manual backup capability. Emergency power is then prioritized to a limited number of safety-class (1-E) circuits. "Station Blackout" is defined as the simultaneous loss of all off-site alternating current and on-site emergency power backup systems. Over 50% of all postulated accidents leading to a core melt accident begin with a station blackout according to NRC studies. For example, a natural disaster that disables the incoming power lines to a nuclear power station coupled with the failure of on-site emergency generators (i.e. fouled diesel fuel in leaky storage tanks) can result in the depletion of the emergency battery supply system after 4 hours. Without electricity (AC and DC) the operator loses instrumentation and control power leading to an inability to cool the reactor core. According to one U.S. NRC report "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," in the event of station blackout at the Surry or Peach Bottom nuclear power stations "core damage was estimated to begin in approximately 1 hour if the auxiliary feedwater system and HPI (high pressure injection) flow had not been restored in time."[3]

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[3] "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," NUREG/CR-1150, U.S. Nuclear Regulatory Commission, October 1990, page 3-1

Moreover, there are the converging risks associated with nuclear power stations aging and deteriorate in safety margins and defense-in-depth, nuclear power operators cut maintenance costs by reducing inspection and maintenance programs and a steady retreat of federal oversight from enforcement of safety regulations all can contribute to a natural disaster resulting in a nuclear disaster.