Engineering Ethics: The Fukushima Nuclear Plant Disaster

An Online Continuing Education Course for Engineers

Course Number: ET-1040

Credit: 1 Hour / 1 PDH / 1 CPD

Engineering Ethics: The Fukushima Nuclear Plant Disaster

Edward P. Brunet, P.E.

Prologue

"On Friday, at 2:46 p.m. Tokyo time, the quake struck. First came the roar and rumble of the temblor, shaking skyscrapers, toppling furniture and buckling highways. Then waves as high as 30 feet rushed onto shore, whisking away cars and carrying blazing buildings toward factories, fields and highways.

By Saturday morning, Japan was filled with scenes of desperation, as stranded survivors called for help and rescuers searched for people buried in the rubble…

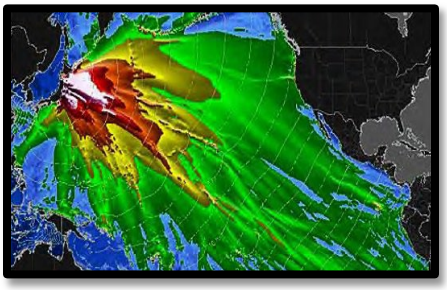
On Friday, television images showed waves of more than 12 feet roaring inland in Japan. The floodwaters, thick with floating debris shoved inland, pushed aside heavy trucks as if they were toys. The spectacle was all the more remarkable for being carried live on television, even as the waves engulfed flat farmland that offered no resistance. The tsunami could be seen scooping up every vessel in the ocean off Sendai, and churning everything inland. The gigantic wave swept up a ship carrying more than 100 people, Kyodo News reported.

Vasily V. Titov, director of the National Oceanic and Atmospheric Administration's Center for Tsunami Research, said that coastal areas closest to the center of the earthquake probably had about 15 to 30 minutes before the first wave of the tsunami struck. 'In Japan, the public is among the best educated in the world about earthquakes and tsunamis,' he said. 'But it's still not enough time.'"[i]

Introduction

The earthquake that hit Japan on Friday, March 11, 2011 was the strongest ever recorded in Japan and one of the strongest ever recorded in the world. Measured at magnitude 9.0, it was centered near the east coast of Honshu, Japan.[ii] The earthquake was so strong that it sent surges racing across the Pacific Ocean that generated nine-foot waves in California and Oregon. Waves that hit the West Coast of the United States sank boats in the Santa Cruz harbor.

The official death toll was 18,500, with other estimates as high as 20,000. The economic damage was estimated at approximately $500 billion USD.[iii]

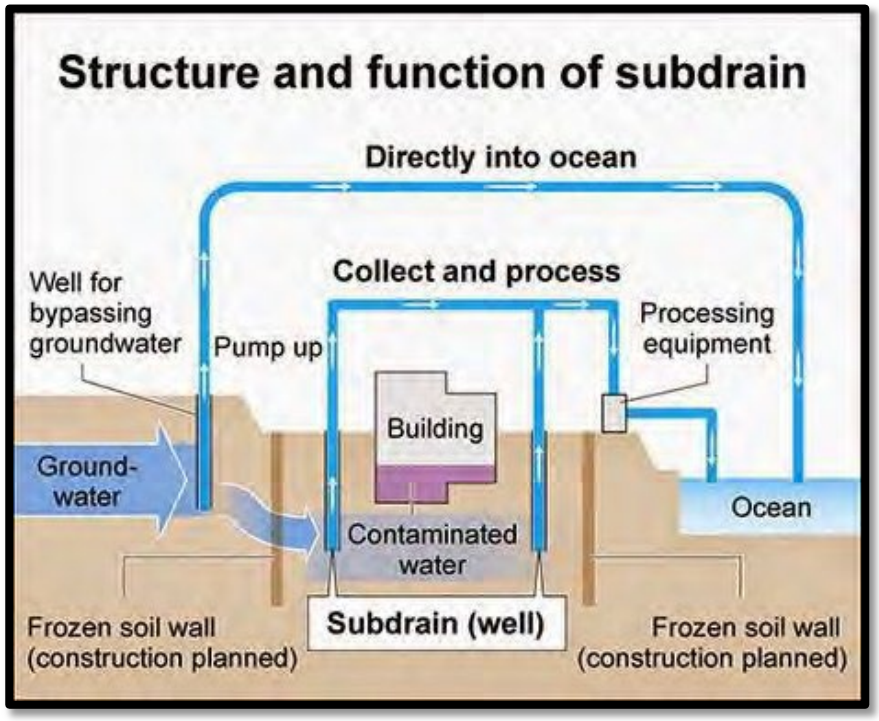


In the aftermath of the earthquake and tsunami, Japan struggled with the horrors of the loss of lives and property, yet more catastrophes were yet to come. Japanese officials issued evacuation orders for people near two separate nuclear plants the day after the earthquake. While seeking to reassure the public, officials warned of the possibility of small radiation leaks after breakdowns in the facilities' cooling systems.

The Fukushima Daiichi No. 1 (Daiichi) plant was owned and operated by the Tokyo Electrical Power Company (TEPCO), the country's largest energy utility company. Despite the reassurances of TEPCO's management, a chain of events leading to the unthinkable occurred within days of the natural disasters. The plant suffered a series of hydrogen explosions and core meltdown.

Japan was contaminated with radioactive fuel, water, debris, soil, and other waste. Radioactive particles from released material settled downwind from the plant and spread to other parts of the globe; radioactive seawater washed up on the shores of continents around the Pacific Rim.

The Daiichi disaster was not a single, discrete event; TEPCO continued to fight radioactive leaks years later. A Japanese government advisory group believes that radioactive leaks, with resulting contamination to soil, groundwater and ocean water may go on for up to five years. In September 2013, TEPCO released the results of a groundwater flow simulation showing that 400 tons of contaminated water leaks into the Pacific daily.[iv]



At the time of this writing, leaks continue. In January 2014 officials announced the investigation of a new radioactive leak[v] and in February 2014, 100 metric tons of contaminated water leaked from a storage tank. [vi]

Course Objectives

The earthquake and tsunami activated emergency systems in five nuclear power stations (NPS) in the region and some of the plants sustained damage from the natural disasters. Yet only the Daiichi experienced catastrophic failure. What did the other four plants do correctly—or why did the Daiichi plant fail?

In the opening of the investigative report by the National Diet of Japan Fukushima Nuclear Accident Independent Investigation Committee (NAIIC), the Chairman of the Committee wrote:

> "The earthquake and tsunami of March 11, 2011 were natural disasters of a magnitude

that shocked the entire world. Although triggered by these cataclysmic events, the subsequent accident at the Fukushima Daiichi Nuclear Power Plant cannot be regarded as a natural disaster. It was a profoundly manmade disaster – that could and should have been foreseen and prevented. And its effects could have been mitigated by a more effective human response.

How could such an accident occur in Japan, a nation that takes such great pride in its global reputation for excellence in engineering and technology?

…Our report catalogues a multitude of errors and willful negligence that left the Fukushima plant unprepared for the events of March 11. And it examines serious deficiencies in the response to the accident by TEPCO, regulators and the government."[vii]

This course will examine the major "errors and willful negligence" by TEPCO's engineers and management that lead to the disaster. You are encouraged to consider those actions in light of the National Society of Professional Engineers' (NSPE) Code of Ethics:

I. Fundamental Canons

Engineers, in the fulfillment of their professional duties, shall:

1. Hold paramount the safety, health, and welfare of the public.
3. Issue public statements only in an objective and truthful manner.
5. Avoid deceptive acts.

II. Rules of Practice

1. Engineers shall hold paramount the safety, health, and welfare of the public.
    a. If engineers' judgment is overruled under circumstances that endanger life or property, they shall notify their employer or client and such other authority as may be appropriate.

III. Professional Obligations

1. Engineers shall be guided in all their relations by the highest standards of honesty and integrity.
    a. Engineers shall acknowledge their errors and shall not distort or alter the facts.
3. Engineers shall avoid all conduct or practice that deceives the public.
    a. Engineers shall avoid the use of statements containing a material misrepresentation of fact or omitting a material fact.

Construction of The Fukushima Daiichi Plant[viii]

Daiichi is located on the Ring of Fire, the coastal area surrounding the Pacific Basin that is affected by a very large number of earthquakes, volcanic eruptions, and tsunamis. However, TEPCO considered the risk at Daiichi to be minimal. A report included with the application to the government explained, "In the past 700 years, Fukushima suffered almost no noteworthy damage from earthquakes except in the Aizu area (in current Fukushima Prefecture)." The writers concluded, "Thus the si
described as an ar
compared with all

The plant was built ate 1960s. The bluff was originally 35 m rtificially prepared ground 10 meters ab oved to construct basement facilities be

Daiichi's backup emer the basement.

The bluff was excavate mitigate earthquake temblors. H ial factor in the siting decision. Very hea e facility by boat and the low level provide ditionally, locating the seawater pumps for the c ground reduced operating costs.

To view the remainder of the course material and to take the quiz for PDH credit, you must purchase the course.

Close this window and click "Add to cart" on the product page.

The Japan Times cited Hiroshi Kaburaki, then deputy head of the TEPCO's construction office at the Daiichi plant, writing in a 1969 technical magazine: "We decided to build the plant at ground level after comparing the ground construction costs and operating costs of the circulation water pumps."[x]

Planners did consider the possibility of a tsunami. At the time the plant was constructed, TEPCO estimated that the maximum possible tsunami would be only 3.1 meters. After new information emerged, the facility was upgraded to withstand a tsunami of 5.7 meters in 2002.