Book Review

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Fukushima: The Story of a Nuclear Disaster
David Lochbaum, Edwin Lyman, Susan Q. Stranahan, and the Union of Concerned Scientists

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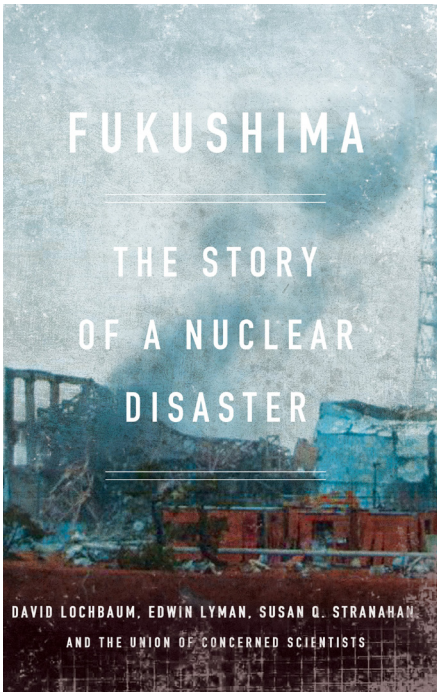
Disclosure: the book reviewer, Mark L. Maiello, is a member of the Union of Concerned Scientists.



With four years of hindsight to guide them, the authors begin their narrative on that now historic day of March 11, 2011, with a blow-by-blow reenactment of the nuclear crisis at the Fukushima Daiichi Nuclear Power Plant (NPP). Their story arc includes many perspectives ranging from that of heroic plant superintendent Masao Yoshida, who fought valiantly to save the plant while accommodating the constant inquiries of his prime minister, Naoto Kan, to U.S. Nuclear Regulatory (NRC) Commissioner Gregory Jaczko and his boots-on-the-ground subordinates Charles Miller and Jim Trapp, who were attempting to ascertain the situation in the face of Japanese secrecy and intransigence. In the later chapters, the book moves away from the historical account into a discourse contending that a Fukushima-type disaster is possible in the United States, largely due to the effects of regulatory capture of the NRC by the nuclear industry and the manner in which nuclear power self-polices, often taking what are considered expedient steps to head off onerous regulations that the NRC might impose.

The book appears to be well-researched with ten pages of references supported by an eight-page glossary and list of key figures involved in the incident. An appendix concerning itself with the underlying causes of the incident is really there to argue that computer modeling of reactor accidents is inadequate for simulating these complex occurrences. The writing is crisp and largely free of confusion considering the simultaneity of events and the large number of personalities involved.

The initial chapters of the accident are compelling. Indeed, the actual events lend themselves to good storytelling. Of competing interest are the people caught in an intractable situation imposed by nature that went beyond the control of technology to remedy. There are moments when much like the victims of the classic technological disaster involving *RMS Titanic* no solution appears possible because potential strategies were either considered unnecessary *a priori* and therefore were not provided for or were removed from consideration by the consequences of the natural forces involved.

The authors eventually take the discourse to the broader issue of nuclear power safety and its current status in the United States. The prognosis is not good according to their analysis. Fukushima exposed inadequacies that they contend will disappear not by technical solution but only metaphorically, by fading over time in the collective public memory.

The reasoning behind this forecast is partially attributed to the alleged aforementioned regulatory capture by the commercial nuclear industry of their overseer. The industry through its trade associations, such as the Nuclear Energy Institute (NEI), can present solutions for problems before the NRC can demand potentially expensive and/or burdensome regulations. The NRC reviews and can disapprove these procedures of course, but such a relationship falls short of the traditional, effective policing and inspection methods of old in the eyes of the authors. After all, public safety should take precedence over profit, and the protection of profit appears to be a reason that the industry attempts to cir-

cumvent the traditional regulatory framework. An example of the alleged deteriorating relationship that the authors provide relates directly to the primary cause of the Fukushima accident: inundation of a NPP by water.

According to the authors, some thirty-four NPPs in the United States can be flooded due to dam failures (or perhaps by weather-related flooding of nearby rivers) with the same catastrophic results as at Fukushima: a "station blackout" leaving the operators with little or eventually no electrical power to run the pumping systems that cool the reactors so as to prevent core meltdowns. The U.S. nuclear industry through the NEI developed a contingency plan whereby electrical generators and other emergency equipment are stored off-site to be transported to the affected NPP post event. The authors' preferred alternative is the construction of "sea walls" of adequate height and strength to keep the flood waters at bay. The NEI ran their "FLEX" plan to the NRC before regulations anticipated in the wake of Fukushima could be put forth. The authors contend that the NRC acceptance of the plan was a triumph of cost savings over public safety. They explain the inadequacies of the plan emphasizing that even after witnessing Fukushima, the industry scripts accident scenarios in a manner that guarantees successful remediation. The reader is left to ponder whether that is true and whether the industry's tactics of getting ahead of the regulator is a valid way to promote public safety.

One of the arguments made in the book is that the philosophy of "defense-in-depth" used by the NRC and the industry worldwide to mitigate accident repercussions was proven by Fukushima to be inadequate. Even a system of deeply embedded multiple backup systems was made to fail, given the correct circumstances. Inadequate statistics (the plant began construction in the 1960s), "predicted" that tsunamis greater than ten feet in height were so improbable that they could be ignored in the plant design. These inadequacies, particularly the reliance on earthquake statistics, the modeling of reactor accidents, and the predictions of radioactive material plume dispersal, are given significant importance by the authors. The concept of the defense-in-depth strategy, if adequately executed, is sound. However, it is subject to review especially if new data such as provided by the evolving science of seismology reveal that modifications to the strategy are in order. Fukushima plant owner TEPCO never fully responded to updated tsunami height predictions, illustrating that institutional inertia can be just as devastating as Mother Nature.

Another story arc of the book is the question of what constitutes adequate protection. When do we say that we are "safe enough"? It is intimately related to the "it can't happen here" philosophy espoused by the domestic nuclear industry and its regulator. These attitudes are the authors' dragons that must be slayed. But death comes slowly or not at all for such institutionalized thinking. The writing team claims that only major reform will derail the regulatory regime from the feedback loop it finds itself in. They argue that the NRC will not take actions that call into question its previous decisions. Essentially, the accusation is that the NRC will not allow itself to be seen as fallible. Contending that the NRC fears alarming the citizenry, the authors claim that significant moves to increase safety provide evidence that safety was, in fact, previously compromised. This, they decide, has caused NRC to make choices that too often align with the desires of its licensees while not fully mending the nuclear safety net. Even the consequences of inadequate planning at Fukushima Daiichi apparently have not changed the thinking at the NRC.

The authors are careful to point out that the NRC technical staff is at times at odds with the NRC commissioners who make the final decisions. The NRC Near-Term Task Force that was formed to analyze whether a Fukushima-like accident could happen in the U.S. apparently called for moderate reforms to the regulatory structure to cover accidents beyond what was studied before March 11, 2011. According to the authors, it called for, among other things, less reliance on industry initiatives and more on a robust program for dealing with the unexpected, severe accident scenario. They report that the recommendation was scuttled by the NRC commissioners.

The issues concerning NRC reform are not easily resolved nor is this book necessarily the place for that. However,

it is clear that the authors desire foremost that the NRC reestablish its primacy in the regulator/licensee relationship and that the licensees expend their money to adequately protect their plants against station blackouts. The industry may believe it has done so and with NRC approval, but not so the authors who put public safety on the highest of all pedestals.

In general, the authors' claims do not read as exaggerated or unreasonable and appear to be based in fact. On rare occasion, in particular concerning decisions made to mitigate the incident or later in reference to NRC oversight of the industry, their tone veers toward the mildly sarcastic. This is somewhat unhelpful. Objectivity and admittedly a blander narrative, lend themselves to an atmosphere of impartiality and a scientific viewpoint that readers with a technical background would likely prefer. Derision, however mild, speaks to some readers negatively, especially on a topic as polarizing as nuclear power.

The point of the book is succinctly summed up in its final chapter. The writers assert that the Fukushima Daiichi NPP accident should not have come as a surprise. As unlikely as it was, it came to fruition as a result of an initial improper assessment of nature's power that was not effectively acted upon while coupled to an inadequate collaboration between government oversight and industry operations. Further, it was also partially due to shortsightedness concerning the price society would have to pay if catastrophe struck. It was not considered that the upfront costs for excellence in engineering and safety would be much less than the remediation of 1,500 square miles of contaminated property and the plant itself. We are reminded that to prevent another such accident, wholesale regulatory and safety changes are needed not only abroad but here in the U.S. as well.

This book is an intellectually healthy read for one particular reason. A book such as this, when presented with an honest factual foundation, asks questions that periodically need to be raised to test the status quo. Books like this keep us honest. They ask hard-to-answer questions and raise concerns that periodically need to be addressed. Even if this reviewer is as much at the mercy of the authors as most other readers when it comes to evaluating the assertions made, one observation that the writers pass down to us is difficult to disagree with: The nuclear industry has had its share of heroes from previous accidents and at Fukushima as well. It does not need any more.

Erratum

A History of U.S. Nuclear Testing and Its Influence on Nuclear Thought, 1945-1963, is a single volume and not two volumes as indicated in the title section of the review that appeared in Volume 43, No. 1. We regret the error.

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