

***SIREN 2015 Lecture Review: Nuclear Leadership***  
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*“Good ideas are not adopted automatically. They must be driven into practice with courageous impatience.”—Admiral Hyman G. Rickover*

The fifth lecture of the Seminar on Interdisciplinary Research and Education in Nuclear Emergency Response (SIREN), “Fukushima: An International Wake-Up Call,” was given by retired U.S. Navy Admiral James O. Ellis in May 2015. SIREN is sponsored by a National Science Foundation (NSF) CAREER grant that is bringing together international experts on nuclear power plants to consider innovative ways to address nuclear emergencies. SIREN is hosted by Dr. Sonja Schmid of Virginia Tech.

Admiral Ellis has an unprecedented level of expertise and experience with large, extraordinarily complex sociotechnical systems and organizations to include being entrusted with America’s nuclear arsenal as Commander, U.S. Strategic Command. In thirty-five years as a naval officer he flew supersonic fighter planes from the decks of ships, was trained as a test pilot, and commanded a nuclear powered aircraft carrier. Being captain of a nuclear carrier not only required being a rated aviator, but also a trained and operationally qualified nuclear reactor officer.

Clearly, the Navy entrusts the leadership of its high reliability sociotechnical organizations to only those with intensive training, long experience, real-world mastery of system technologies and, most importantly, tremendous leadership ability. After retiring from the Navy, Admiral Ellis went on to become the CEO of the Institute for Nuclear Power Operations (INPO); an independent organization that promotes excellence in the safety and reliability of U.S. nuclear power plants. Admiral Ellis was leading INPO when the Fukushima Daiichi nuclear disaster occurred in 2011.

**Historical View**

Admiral Ellis began his talk by providing the familiar historical context of nuclear energy from Fermi’s atomic pile at the University of Chicago, through Eisenhower’s 1953 Atoms for Peace address at the United Nations, to the nation’s imagination being captured by thoughts of atomic powered rockets, airplanes and even automobiles. While atomic vehicles never became a reality the idea of “electricity too cheap to meter” was the intrinsic theme of atomic technology and American progress. Admiral Ellis commented that we might not realize the significance of this history and that, “atomic energy was the dot-com of its time.”

In 1957 the Shippingport atomic power station in Pennsylvania became the first nuclear plant designed specifically to produce electricity for the commercial market. As a joint public/private venture Shippingport kicked off the nuclear power industry in the U.S. with 237 nuclear plants ordered between 1965 and 1978. Again, a familiar narrative, but as part of this story Admiral Ellis reminded us that the initiation of the commercial nuclear power industry was put underway primarily because the U.S. Navy, with the omnipresent leadership of Admiral Hyman Rickover, pioneered the atomic power reactor

concept. “Under way on nuclear power” was the simple message that then Commander Eugene P. Wilkinson sent, as the captain of the atomic submarine USS Nautilus, when it became the first vessel to be propelled by the atom in 1955. This naval technology became the plant at Shippingport and eventually led to the commercialization of nuclear power. The influence of military culture and strong leadership upon the development of safe and reliable nuclear power systems is a recurring theme throughout Admiral Ellis’ lecture.

### **Three Mile Island**

With its inception at Shippingport subsidized with both government funding and technical expertise, nuclear power was brought online in the U.S. private sector. Over two decades passed with hundreds of nuclear power plants being ordered, built or construction started. The commercial nuclear power industry became just that, another for profit customer serving industry with a hugely expensive, complex and hazardous infrastructure. Admiral Ellis then presented the dramatic turning point that changed the nuclear industry; the reactor accident at Three Mile Island (TMI) Pennsylvania in 1979. A partial reactor core meltdown of TMI Unit 2 and release of radiation, caused by loss of coolant due to a stuck-open valve, shocked not only the American public, but the nuclear industry and government regulators.

All had perceived that nuclear reactors were “too safe to fail” with state-of-the-art engineering, redundant safety systems and multiple layers of protection, from fuel rod cladding to massive concrete containment structures. No one had imagined that a nuclear accident would be caused by a combination of poor system design, human performance, emergency unpreparedness and lack of information exchange. Admiral Ellis understatedly summed up the post TMI situation by saying, “Clearly a huge impact. It took the bloom off of nuclear energy.” Ninety-seven nuclear plants were cancelled and Ellis pointed out that something was needed “for the survival of the industry.” Nuclear power production had to become something more than an industry.

### **INPO and Excellence**

President Jimmy Carter (himself a former Navy nuclear officer) established the Kemeny Commission to investigate the TMI accident and its final report heavily criticized technical, management and human performance factors. Admiral Ellis related a conversation he had with the TMI operator-on-duty at the time of the accident: “Admiral, I want you to take away one thing from this visit, *I am not an idiot*. This is why I saw what I saw and what I believed was happening and why I took the actions that I did” [emphasis added]. This honest assessment clearly emphasized that nuclear power plants were enormously difficult to operate and maintain due to their high level of complexity and tight system component coupling (Perrow 1999). For the nuclear power industry to survive it had to rapidly and effectively respond to the commission’s findings. Admiral Ellis stated that “there was a question of industry safety and integrity.” Furthermore, there was a “severe loss of public trust and confidence ... the industry had to do something and had to do it quickly.” The nuclear industry quickly established the *Institute for Nuclear Power Operations* (INPO) a few months after the TMI accident with

now retired Vice Admiral Eugene Wilkinson as its first CEO. Twenty-five years after putting the first naval vessel underway with nuclear power the same leader was, in effect, putting the nuclear power industry underway with a mandate of nuclear operations excellence. Navy culture, expertise, and leadership were now poised to change commercial nuclear power operations from an industry to a professionally operated and maintained system of, as Admiral Ellis put it, “excellence.”

Admiral Ellis emphasized, with tongue in cheek, that INPO is not funded by “bake sales,” but through the membership dues of *all* 26 U.S. nuclear power utilities. Although INPO membership is not mandatory, Ellis points out that the U.S. Nuclear Regulatory Commission (NRC) most likely would not license a utility if they were not a member and, interestingly, INPO’s effectiveness also requires a “strong and effective regulator.” This complementary working relationship between INPO and the NRC is key since INPO’s mandate, true to the professional and safety culture of the nuclear Navy, is to “establish standards of excellence and not minimum regulatory compliance.”

These standards of excellence, according to Admiral Ellis, have contributed significantly to the operational effectiveness of the nuclear industry since INPO’s inception. The Admiral showed that in 1979 the percentage of time that power plants were online and producing electricity averaged 63%; today online time is at 92%. Prior to the TMI accident the industry averaged seven emergency shutdowns per reactor, per year while the average today is zero. Finally, nuclear workers’ exposure to ionizing radiation is one-sixth of what it was in 1979. All of these successes Ellis attributes, in part, to the effectiveness of INPO’s self-regulation.

### **Self-Regulation and Responsibility**

Admiral Ellis detailed five key aspects of INPO’s self-regulatory model: 1) “CEO engagement,” 2) “nuclear safety focus,” 3) “industry support,” 4) “accountability” and, 5) “independence and integrity.”

First, Ellis said when he was INPO CEO he only talked to utility company CEOs. While others at INPO obviously worked with the utilities’ nuclear power plant operators, Ellis emphasized that his direct, top level contact ensured unfiltered leader to leader communication.

Second, regarding the focus on nuclear safety, this is INPO’s sole organizational mission. While they have been asked to engage other aspects of the nuclear system, e.g. security and waste storage, Ellis emphasized that “INPO doesn’t do anything but operational nuclear safety.”

Third, what might initially seem unusual is that the industry support of INPO is not just financial; each utility company also provides personnel to be members of the INPO inspection teams. Ellis said, “They join us and help write the standards against which they are going to be evaluated.”

Fourth, accountability means several things. It's financial since "insurance rates are set on the basis of the grade that INPO assigns." It's also personal. Why did Ellis make it a point to directly connect with the electric utility CEOs? One of the reasons is that a CEO is held personally accountable for the performance of his or her utility company; accountable not only to INPO and the NRC, but to their fellow CEOs. Every year the CEOs of the bottom three INPO ranked companies must "stand up in front of their peers and describe how they put it [their utility] in the ditch and what they're doing to get it out."

Finally, Ellis says, INPO's independence allows it to rapidly react and address problems of operational safety. This practical effectiveness is reinforced with an organizational integrity that instills critical trust with both the regulator and the nuclear power plant operators.

### **Chernobyl and WANO**

Admiral Ellis did not speak extensively about the nuclear disaster at Chernobyl Ukraine in 1986. He mentioned it because it "resulted in the formation of the World Association of Nuclear Operators or WANO which came three years, as opposed to six months, in INPO's case, three years after the event at Chernobyl. With full support of the Russians, by the way." WANO works internationally, similar to INPO, to promote nuclear safety, but its effectiveness is limited by the constraints of national sovereignties. In regard to WANO, Admiral Ellis said that "the same type of leverage that INPO has domestically doesn't necessarily translate internationally."

Fukushima Daiichi made dramatically clear that an international nuclear accident response capability is needed and the development of nuclear safety self-regulation, perhaps similar to INPO, must be mutually constructed by international stakeholders, under strong leadership, and not simply translated or transferred. Admiral Ellis tells us that Fukushima Daiichi is pushing WANO to redefine itself since an "international event demands an international response ... and [WANO] cannot change the world, but it should support the world's efforts to change itself."

### **Fukushima Daiichi**

Looking specifically at the situation at Fukushima Daiichi, Ellis spoke of an apparently flawed risk analysis of plant siting and in areas of system design. For example, historically, the location of Fukushima Daiichi had experienced similar magnitude earthquakes and size of tsunami so a taller seawall might have been constructed. Also, backup electrical switching equipment and generators might have been located on higher ground as these were destroyed by the tsunami. Ellis stated that what the U.S. nuclear industry learned from this was that the Japanese "... considered things in isolation. They considered the tsunami, they considered the earthquake ..." but they did not consider these events happening simultaneously and causing the complete destruction of emergency backup systems. Ellis said that INPO took this as both a challenge and an opportunity. A challenge to possibly force movement toward an international response capability for nuclear disasters and an opportunity for the international nuclear

community to recognize something said by Abraham Lincoln, “The dogmas of the quiet past are inadequate to the stormy present.” Change was needed.

### **Global Relationships**

A short time after the Fukushima Daiichi accident Ellis gave a speech where he made it clear that to meet these challenges INPO and the nuclear community could not wait to take action. Here, Ellis emphasized, is where the independence of INPO and leadership based on Navy culture was critical. Ellis said, “You can’t be asking for permission or vetting everything you’ve decided to do with the broader industry and who it’s got to fall to execute.” INPO *told* the industry what it needed to do *immediately* in terms of inspections and planning as informed by events at Fukushima Daiichi. Besides having the ability for immediate and decisive actions, Ellis asked, “Now what do you do?” and then outlined what he did in the military and also at INPO. He called his methodology the “four M’s:” measure your risk, minimize the risk, manage the risk and mitigate the risk. “You have to be able to deal with things when they happen. Not the severe catastrophic thing. If you’ve done all the others things well you hold those events down to a level where they never adversely affect society and the population.”

With this in mind he proposed a response team called “NERO” for Nuclear Emergency Response Organization. Ellis said that such an organization couldn’t simply be created on the fly to respond to an accident, but required a foundation of knowledge and, most importantly, *relationships* among all stakeholders. Leaders and experts in all areas must literally know each other, have established and good working relationships and known roles and responsibilities. According to Ellis, “There’s lots of things that need to be done and done better and building relationships among all stakeholders, process, training, interaction and most importantly trust.” He also agreed with Sonja Schmid concerning the international aspect of nuclear accidents: “It’s an international event and Sonja’s spot on. I still believe that if there’s a shortfall somewhere it’s the speed at which with we’ve been able to move internationally.”

### **Leadership**

Working toward an initial foundation of rapid emergency response capability, INPO and the U.S. nuclear industry have “looked for a more flexible response that can be rapidly moved and shifted to assist others within the industry.” Ellis explained that this is known as the FLEX strategy that pre-positions emergency response equipment such as transportable generators, pumping equipment, exposure suits and respirators. These are ready for use and can be rapidly air transported to nuclear accident sites. Furthermore, as Ellis continually stresses, INPO developed and anchored strategic leadership by taking every electric power utility’s Chief Nuclear Officer (CNO) to Fukushima Daiichi. As Ellis said, “You gotta walk the ground ... because that’s what it takes ... the visceral understanding of the importance and the implications of the things that you [the CNOs] are doing.” Ellis then again emphasized the importance of actual, hands-on leadership, “There’s a real personal impact and involvement that’s necessary if you’re going to get above minimum regulatory compliance to the standards that are expected.” The last word of his last presentation slide was “LEADERSHIP.” Ellis pointedly explained that

leadership was absolutely necessary in order to “do this as well as it can possibly be done. Not minimum regulatory compliance, but as well as it can be done. That's why the last word is in all caps, because in the final analysis it comes down to leadership.”

## **Conclusion**

How was the nuclear accident at Fukushima Daiichi a wake-up call to the international nuclear power community as described by Admiral Ellis? Historically, Three Mile Island roused the U.S. nuclear community and forced the creation of INPO to guard against failures with its dedication to excellence of operations. Chernobyl eventually resulted in the formation of WANO that established international assistance for nuclear operators to achieve high levels of safety and reliability. Fukushima Daiichi caused the nuclear industry and INPO to assess its own approach to nuclear safety, with its critical focus on operational safety and accident prevention. It also moved them to include planning for accident response as was evident with the creation of the FLEX strategy and actual staging of emergency equipment. Furthermore, Admiral Ellis has contemplated the concept of the international “NERO” with its emphasis not only on response technologies, but upon establishing organizational and *personal* relationships prior to any accident.

In other words, it's critical for the people making up response organizations and teams to actually know each other before a crisis occurs. During a disaster is not the time to introduce yourself. In order to safely operate a nuclear power system and to rapidly respond to world nuclear accidents, a transnational culture of professionalism, integrity and unfailing commitment to excellence must be in the fabric of the world's nuclear sociotechnical system. Admiral Ellis would emphatically say that this cannot be accomplished without strong and sustained leadership. It remains to be seen if organizations such as WANO and INPO can lead the way.

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## **References**

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