

## **‘Implications of the Japanese Nuclear Disaster: An ESG Research Perspective’**

**by Douglas Cogan and Jerome Le Page**

The ongoing nuclear power crisis in Japan will have lasting implications for power generation around the globe. A much-anticipated “nuclear renaissance” could be curtailed as the world absorbs lessons from the worst nuclear accident since the Chernobyl disaster 25 years ago.

The United States, with 104 operating reactors and the most nuclear capacity, and Europe, with 143 reactors in 27 countries, now plan extensive reviews of their nuclear plants and disaster preparedness. China, with 11 operating reactors, has also suspended approval of more than two dozen new reactors. With these decisions, it appears that perhaps a re-set button is being set on the world’s nuclear expansion plans.

This may give a boost to competing low-carbon generating sources, such as natural gas and renewable energy. MSCI’s Global Alternative Energy Index recorded a 10.1 percent gain in the first 10 days after Japan’s nuclear crisis began. This compares with a 22.8 percent loss for the MSCI Japan Electric Utilities Index over the same period. Coal may also get a short-term lift, since nuclear power is its chief rival in providing base-load power generation.

Stock price changes after Japan nuclear disaster	March 11 (price at open)	March 21 (price at close)	% Change
Tokyo Electric Power Company	25.00	16.00	-36.0%
MSCI Japan Electric Utilities Index	114.07	88.05	-22.8
MSCI Global Alternative Energy Index	85.74	94.37	10.1

Source: MSCI Sector and Thematic Indices

Yet the specter that the Japanese nuclear disaster will fully derail global expansion of nuclear power seems remote. This is due to the unique circumstances that contributed to the accident at the Fukushima Daiichi plant, and the momentum that nuclear power has built elsewhere around the globe — in part to address global warming. Still, the repercussions of this accident are sure to put added financial pressure and regulatory scrutiny on this high-cost energy resource.

## **MSCI ESG Research Perspective on Nuclear Power**

MSCI ESG Research has long studied and analyzed the nuclear power industry, both for its environmental and social impact and to assess the sector's investment risk profile. Over the last 50 years, the nuclear industry has posted a relatively safe performance record, except for two notable accidents at Russia's Chernobyl reactor in 1986 and the US Three Mile Island site in 1979. The disaster at Japan's Fukushima Daiichi reactor, at present, falls somewhere in-between these two industry-defining events.

However, the current crisis in Japan is not resolved. In addition to bringing the reactors under control, cooling water must be restored to spent nuclear storage pools, which are also spreading radiation to adjacent areas. This brings into focus a long-standing Achilles heel of the nuclear power industry, with many reactor sites accumulating highly radioactive waste for failure to build safe and permanent waste repositories elsewhere.

Accordingly, MSCI ESG Research has decided to re-evaluate its outlook for nuclear utilities and the electric power sector as the situation in Japan plays out. We have already downgraded our MSCI ESG Controversies Rating of Tokyo Electric Power Company (TEPCO), based on poor management of the crisis at the Fukushima complex that extends the company's troubled history with nuclear power.

An upcoming MSCI ESG Issue Brief will further explain our TEPCO downgrade and our team's ongoing approach to analyzing companies involved in the nuclear power industry.

## Seismic Shift?

Japan's 54 operating nuclear reactors make it the world's third-largest nuclear power generator, behind the United States and France. Its nine investor-owned electric utilities are among more than 50 private power companies worldwide that own and operate nuclear power plants. However, among the nuclear utilities tracked by MSCI ESG Research, Japan has the only ones where the entire country is in a zone of high seismic activity. Other utilities, including in California, operate nuclear plants in proximity to local fault zones. Relicensing of these plants, as well as other proposed reactors in high seismic areas, now face greater regulatory hurdles.

10 Largest Nuclear Power Producing Nations		
Country	Capacity in Megawatts (2008)	% of Electricity Supply (2008)
France	61,443	77.1%
Ukraine	13,045	46.7
Sweden	10,002	42.6
South Korea	18,716	39.0
Japan	43,692	24.0
Germany	20,844	23.5
United States	97,603	19.3
Russia	19,897	15.7
Canada	10,306	14.4
United Kingdom	12,728	13.1

Source: International Energy Agency. Electricity supply is generation from nuclear power.

Despite the 9.0 magnitude earthquake that struck the Fukushima complex on March 11—the fifth largest quake in recorded history—that plant's safety was not compromised by seismic activity alone. It was the 30-foot tsunami that followed, swamping underground diesel generators, which precipitated the crisis. When back-up battery-powered generators also drained down, cooling systems were no longer able to circulate water around the plant's three operating reactors and six spent-fuel storage pools. This set off a chain reaction of explosions, fires and radiation leaks in this still-unfolding tragedy.

With radiation now exposing Tokyo's water supply, the main priority at the Fukushima complex remains restoring power to its six reactors. Due to damage caused by the earthquake, and a decision to introduce corrosive seawater to avoid full-core reactor meltdowns, critical equipment must be repaired. This will add days, or even weeks, to bring the site fully under control. Decontamination of the surrounding area will take years, or even decades.

## More Scrutiny for Reactors Near Fault Lines

In response to Japan's nuclear crisis, more than a half-dozen other nations, including the United States, Germany, China and India, have announced reviews of the ability of their nuclear plants to withstand earthquakes, tsunamis and other natural disasters.

- In California, the San Onofre plant owned by Edison International and the Diablo Canyon plant owned by Pacific Gas & Electric are under particular scrutiny, given their proximity to the Pacific coastline and active fault zones.
- Ameren's Callaway Nuclear Plant and Exelon's Clinton Power Station are located adjacent to the New Madrid Fault in the Mississippi River Valley; this fault produced four earthquakes in 1811 and 1812 estimated at magnitude 7.0.
- Entergy's Indian Point Plant, 35 miles north of New York City, also rests above an ancient faultline, and will undergo a special safety review at the request of Gov. Andrew Cuomo.

Elsewhere around the globe, most nuclear plants are sited in seismically stable areas and are designed to withstand maximum forces projected from possible earthquakes. Still, the Fukushima disaster will prompt new investigations, including at controversial sites in high seismic areas where new reactor complexes have been proposed. For example:

- One planned reactor in Jordan at the Red Sea port of Aqaba is on a major fault line.
- Turkey, which is crossed by numerous geological faults, has two nuclear plants under development.
- Iran's controversial Bushehr nuclear plant also is in a fault zone. Concerns with this plant include that it could process uranium for a nuclear weapons program. The Iranian plant unloaded its nuclear fuel in February after the "Stuxnet" computer worm infected its reactor systems.
- Local community groups have also raised concerns about proposed nuclear plants in active seismic zones in China, India, Brazil, Bulgaria, Romania and elsewhere.

## **China, India Poised for Nuclear Boom**

Fast-growing economies in Asia are spurring the world's most ambitious nuclear programs. China — where electricity demand has been growing at 12 percent a year — has 11 operating reactors, but the government plans to add at least 25 more, and some are already under construction. In late February, just weeks before the Japanese crisis began, China's ministry of environmental protection announced regulations prohibiting nuclear construction near earthquake zones or major cities. Following the disaster, the Chinese government added stepped-up inspections at its existing plants, and said it was suspending new reactor approvals.

India, with 20 nuclear reactors already in operation, plans to spend an estimated \$150 billion adding dozens of new reactors around the country. Its forecast calls for nuclear power to supply about a quarter of that country's electricity needs by 2050, a tenfold increase. Following the Japanese nuclear disaster, Indian Prime Minister Manmohan Singh said his country's Department of Atomic Energy plants would review all of its plants, "particularly with a view to ensuring that they would be able to withstand the impact of large natural disasters such as tsunamis and earthquakes."

## **Industry, Government Understated Nuclear Risks**

While the tragedy at the Fukushima plant is prompting reviews of nuclear plants' disaster preparedness around the globe, Japan's own track record does not instill confidence. Decades-old company and government documents reveal that earthquake and tsunami risks were repeatedly hidden or understated by the public and private sector.

- The chairman and president of Tokyo Electric Power resigned in 2002 after they admitted the company had falsified repair reports at its nuclear plants for more than two decades.
- A seismology professor from Japan's Kobe University resigned from a government panel on reactor safety in 2006, saying the review process was rigged and "unscientific."
- Then, in 2007, a powerful earthquake struck another of Tokyo Electric Power's nuclear complexes on Japan's west coast, generating three times as much seismic acceleration as it was designed to withstand. A small leak of radioactive water reached the sea, and the plant was shut down for 21 months for repairs. While the damage was not as serious as sustained at the Fukushima Daiichi complex, three of the seven reactors at Toyko Electric's Kashiwazaki-Kariwa facility still aren't back on-line.

**More details are available in our new Global Compact profile and Controversies report on Tepco.**

Corporate malfeasance and lax government oversight are not unique to Japan. Yet that country's decision to place its nuclear reactors in zones of high seismic activity has raised the stakes of managing this high-risk energy resource. The Fukushima disaster has shaken public confidence in Japan's nuclear plant operators and government overseers. If that confidence is lost completely, so, too, will be Japan's plans to greatly expand its nuclear power generation.

Ironically, Japanese nuclear reactor manufacturers including Toshiba and Hitachi are already working on plant designs that could better withstand a natural disaster. "Generation 3" reactors rely more on gravity and natural heat transfer systems that can cool a reactor without power or human intervention. While these designs are not fail-safe, they are vast improvements over the first-generation (Mark 1) boiling-water reactors that General Electric introduced to the market in the 1960s. All six reactors at the Fukushima complex are based on this early design, as are 26 other operating reactors around the globe.

### **The Post-Fukushima Nuclear Era**

While the crisis at the Fukushima reactor complex is far from over, it has already highlighted some critical challenges now facing the global nuclear power industry:

- **Seismic matters:** Nuclear plant operators in active earthquake fault and tsunami zones will need to demonstrate to regulatory authorities and the greater public that their safety procedures are sufficient, and if they need to be upgraded, that they can continue to run their reactors safely in a "black swan" worst-case event. In addition, "stress tests" of existing nuclear plants in Europe, North America and Asia will need to be thorough and transparent to convince a wavering public that nuclear plants are safe and incorporating built-in redundancies (like close-looped cooling systems) that the aging 40-year old Fukushima plant lacked.
- **Safety zones:** Community disaster preparedness must also be part of this ongoing review process. The U.S. government now is in the awkward position of advocating a 50-mile evacuation zone around the Fukushima complex in Japan, while requiring only a 10-mile evacuation zone around U.S. nuclear plants. This discrepancy in disaster planning will have to be reconciled. A case in point is the Indian Point reactor, in close proximity to New York City and more than 10 million people.
- **Spent storage:** Another lesson from Fukushima is that on-site storage of spent nuclear fuel rods may pose as much of a safety hazard as a meltdown of the reactors themselves. Spent fuel rods cannot be safely removed from a plant for a number of years, so the design and maintenance of on-site storage is crucial. However, at many

plants in the U.S. and Japan, even spent rods that could be removed remain on site, due to limited nuclear fuel recycling capacity, and political resistance to the creation of off-site nuclear waste repositories. Resolving this impasse is a job that Japan and the United States have put off for decades.

- Nuclear economics:** Finally, health and safety issues raised by the ongoing Japanese nuclear crisis will compel a new, hard look at the basic economics of nuclear power. The stricken reactors at the Fukushima complex will never come back on-line, and decommissioning these plants will cost billions of dollars and take decades. The surrounding area also will have to be decontaminated. A million people who live within a 50-mile radius of the plant will likely to see a sustained decline in property values, due to radioactive exposure, as will crop sales in this largely agricultural region. With all of these consequences in mind, Tokyo Electric Power's stock price has dropped by one-third since March 11.

10 Largest Nuclear Power Producing Companies			
Company	Capacity in Megawatts (2009)	% of Electricity Capacity (2009)	Price Change since March 11
Electricite de France	70,613 <sup>1</sup>	51.8%	-4.3%
Korea Electric Power	17,706	24.1	-2.1
<b>Tokyo Electric Power</b>	<b>17,308</b>	<b>26.4</b>	<b>-36.0</b>
Exelon (US)	16,898	68.0	-6.7
E.ON (Germany)	11,305	15.5	-6.2
Entergy (US)	10,116	35.6	-10.9
Kansai Electric Power (Japan)	9,520	28.0	-6.6
RWE (Germany)	6,295	14.0	-6.6
GDF Suez SA (France)	6,292	11.0	-6.4
Dominion Resources (US)	5,768	22.9	-2.4

Source: MSCI ESG Research. Nuclear capacity is percentage of total installed capacity. Stock price changes are as of closing on March 21.

1. EDF nuclear capacity includes power plants in the United Kingdom and joint ownership in the United States.

## Conclusion

MSCI ESG Research regards the Japanese nuclear power plant disaster as a major setback for the nuclear power industry. However, it may not prevent the industry from growing in the long term, albeit at a more tempered pace and with greater regulatory scrutiny. Reaction among investors seems to bear out this view, at least so far.

Nuclear power is a significant source of power generation — providing nearly 15 percent of global electricity needs — and is central to a strategy for reducing greenhouse gas emissions. Economic and environmental damage from global warming could be far greater than a single nuclear power accident like the one we are now witnessing in Japan.

Consider that Japanese coastal communities wiped out by the March 11 tsunami may yet again be covered by sea level rise of up to six feet by 2100. The difference is the new flooding from carbon emissions would not only cover those communities, but also reach *all* coastal cities around the globe — and last for centuries.

Nuclear power's greatest long-term challenge may yet be its ability to generate competitively priced electricity. Many reactors under construction are facing billions of dollars of cost overruns. More government subsidies will be needed to attract investment capital to sustain global nuclear expansion. The public will need to be convinced that government and industry assessments about its cost and safety are credible and objective. Japan's nuclear disaster compounds the challenges facing this already controversial and high-risk industry.

*Douglas G. Cogan is Vice President and Director of Climate Risk Management for MSCI ESG Research. He has analyzed nuclear power and electric utilities for more than 25 years.*

*Jerome Le Page is a Research Associate who specializes in the electric utilities sector for MSCI ESG Research.*