



## Key Observations

*In terms of sentiment toward nuclear power, the failure of the Fukushima Daiichi nuclear plant represents the most significant event in the last 25 years.*

**The final outcome of the Fukushima event is not yet known.** Undoubtedly, it will take months to stabilize the reactors and years if not decades to begin decommissioning of the facilities. The area around the plant may be deemed a nuclear disaster zone uninhabitable for years to come. There will be an impact on the area's economy and on the health of a currently undetermined number workers and citizens.

**However, this will not be the end of nuclear power, old or new.** From a practical perspective nuclear energy is too large a part of electricity generation to be completely abandoned. In addition, given the worldwide initiative to reduce greenhouse gas emissions, nuclear energy's importance as an emissions-free generating source is well-established. Globally, we do expect that nuclear capacity will be reduced as a result of Fukushima, as some older plants will be retired rather than extended and some proposed plants may never be built due to location and cost considerations.

**Our focus is on the investment implications for global infrastructure companies.** We believe that nuclear concerns will lead to higher operating costs and relatively less nuclear capacity going-forward. The result will be a greater dependence on other generation sources, predominately natural gas. **The biggest beneficiaries should be regulated utilities that can construct gas-fired generation and the pipeline companies responsible for the gas transmission infrastructure.**

### *Fukushima in context: We have never seen anything like it.*

- 1) It is unprecedented for multiple nuclear units to simultaneously face the possibility of meltdown or massive radiation leakage.
- 2) **Japan is a technically sophisticated, advanced society with capable nuclear plant constructors and operators.** The plant is located just 150 miles from Tokyo, the world's most populous metropolitan area.
- 3) Given that it was not human error, but a natural disaster, brings in question our prior thoughts on tail risks and potential nuclear power accidents.

Prior to Fukushima, the Chernobyl and Three Mile Island nuclear plant accidents were the most infamous nuclear power incidents of our times. However, there are vast differences between those accidents and the Fukushima event.

We believe (and hope) that the 1986 Chernobyl disaster will remain the most severe accident in terms of radiation release and the associated human health and environmental consequences. Fortunately, the facility was located in a relatively remote area within Ukraine in the former Soviet Union. It was a single reactor that many nuclear experts consider to be flawed in its design. The reactor vessel was not surrounded by a containment structure. Human error led to a total reactor meltdown and a graphite fire that spewed extreme radiation for 10 days.

The Three Mile Island incident occurred in 1979, near Harrisburg, Pennsylvania. Like Chernobyl, the problem occurred at a single reactor and was caused by human error. Unlike Chernobyl, there was a containment structure and negligible radiation was released into the atmosphere.

Fukushima was never supposed to happen. The design-basis and backup systems were presumed to be more than adequate for any event, whether terrorist generated or natural disaster. Statistically, the probability of a 9.0 earthquake combined with a 46 foot tsunami was extremely small. **In terms of risk, Fukushima clearly represents a black swan event – high impact, hard to predict, and extremely rare.**

### *There are operational, safety, and economic ramifications for nuclear reactors worldwide.*

Even when considering the Three Mile Island accident, the nuclear industry within the developed world has an excellent track record in terms of safety. Most plants in operation are 1970s or 1980s vintage, and due to solid operating histories and extensive maintenance programs many have been granted extended life cycles by government authorities. In terms of potential earthquakes, based upon the plant's location, it has always been standard industry practice to incorporate the possibility of significant seismic activity into the original design-basis.



Given Fukushima, every country with nuclear generation facilities is reviewing and reevaluating nuclear policy:

- For existing plants we expect more rigorous safety standards for cooling, storage, and backup systems; tougher life extension criteria; and an intensive reexamination of the viability of operating nuclear reactors near earthquake fault zones.
- For proposed plants there will be a comprehensive reexamination of design-basis taking into account the exceptional circumstances surrounding the Japanese disaster.
- **For all plants we anticipate higher capital and operating costs as plant safety systems are reevaluated, reinforced, redesigned or replaced.**

We do not expect any country with existing plants to completely abandon nuclear, and even if they did, such a reversal would take years to implement. The future of new nuclear energy lies in hands of the newer third generation reactor designs which are purportedly safer due to passive cooling systems, which would prevent the type of failures experienced at Fukushima. Bottom-line, we expect that nuclear power will continue as a valuable component of the emissions-free electricity generation alternatives.

**Randle Smith, CFA**  
Sr. Portfolio Manager  
Sr. Global Electric/Gas/Transportation Analyst  
randle.smith@dpimc.com  
312.917.6584

***From an investment perspective – companies involved in natural gas infrastructure and renewable generation should benefit from economic and societal advantages compared to nuclear.***

This is particularly true in the U.S. where abundant supplies of shale gas are expected to keep prices relatively low and limit volatility. The best positioned companies should be those with the ability to benefit from a growing dependence on natural gas as higher costs and negative public sentiment dampens the attractiveness of nuclear.

We are cautious on utilities with nuclear generation, especially those that operate unregulated merchant plants that may not have the ability to pass on increased capital and operating costs to customers. We believe those with regulated nuclear plants are better positioned. **Finally, we also believe that companies with renewable generation activities may be more attractive since governments across the world have reaffirmed their commitment to alternative energy sources in response to Fukushima.**

**Connie Luecke, CFA**  
Sr. Portfolio Manager  
Sr. Global Communications/Transportation Analyst  
connie.luecke@dpimc.com  
312.917.6534

## For more information on the Global Listed Infrastructure Product contact:

Duff & Phelps Investment Management Co.  
200 S. Wacker Drive, Suite 500  
Chicago, IL 60606  
800.338.8214  
www.dpimc.com

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