MOODY'S
INVESTORS SERVICE

SPECIAL COMMENT

Re-evaluating Creditworthiness for Global Nuclear Generators:

Post Fukushima political intervention depends largely on society's willingness to accept risks

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- Japan's Fukushima nuclear accident creates a material credit negative for all issuers that own and operate nuclear generation due to increased political intervention; emboldened opposition forces; intensified regulatory scrutiny and higher costs.
- None of our rated nuclear issuers will escape from the negative implications associated with this accident, but most issuer ratings and rating outlooks appear well positioned at this time.
- The principal credit risk relates to political intervention, which creates unpredictable unintended consequences with contagion effects that can last for years. Political intervention is influenced by society's willingness to accept nuclear risks. We believe the sentiment is turning more negative.
- From a credit perspective, the causes that triggered the Fukushima accident represent low probability but high severity event risk. We see little rationale to change our view that nuclear accidents are remote probability events, but we are reevaluating whether our views adequately capture their high severity nature and we do not anticipate any rating changes solely related to event risk.
- We see meaningful differences between countries in the degree to which the nuclear operating environment becomes more difficult, although the impact will be negative in all cases. Some issuers will need to increase revenues to compensate for this more challenging environment in order to hold their current ratings.
- The magnitude of the liabilities unfolding at Fukushima create near-term credit pressure on two sectors: issuers with high ratings and weak financials, where strong governmental support and rate setting autonomy exists (e.g., Japanese utilities; US municipal utilities; US Generation & Transmission Cooperatives), and; issuers with unregulated nuclear generation where cost recovery is more uncertain (e.g., European unregulated utilities, US unregulated power companies).
- We still see a strong suite of fundamental benefits associated with nuclear generation, most notably its ability to reliably produce large quantities of base-load power without producing the air and water emission pollution on the same scale as other fossil-powered plants. Notwithstanding the current situation in Japan, nuclear generation also has a very impressive long-term safety record.
- In this Special Comment, Moody's elaborates on how we are revising our thoughts with respect to creditworthiness for owners and operators of nuclear generating facilities in a post Fukushima environment.

Overview

The Fukushima nuclear power accident continues to unfold and will have negative credit implications for operators of nuclear generation in many countries, not just Japan. The cause of the accident is irrelevant to our credit analysis, what matters is event risk. Event risk can be associated with earthquakes, tsunamis, hurricanes, cyber-attacks, equipment failure or operator error, but we continue to ascribe a low probability to event risk occurrence for this power sector. In addition, we do not anticipate any rating changes solely related to remote probability but high severity event risk.

What is changing is our view of the sheer magnitude of liability associated with an event risk occurrence. For companies with nuclear activities, Fukushima highlights two important fundamental assumptions incorporated into our credit analysis: an assumption that a population is willing to accept the costs of radiation and that its government will stand behind long-term liabilities. These assumptions are expected to be tested over the next 12 to 18 months.

Today, we see increased political intervention across many regions and intensified regulatory scrutiny across all jurisdictions. More importantly, emboldened opposition forces are mobilizing their arguments against nuclear power, a material wildcard for the US, where a presidential election cycle in about to commence. We expect delays in the permitting and licensing process for both new reactors as well as those looking to extend their license. These delays are partly a function of more regulatory scrutiny, but are also caused by increased social opposition.

We see many governments intervening into their nuclear generation sectors, an easy step given the highly regulated nature of these critical infrastructure assets. While the level of intervention varies by country, in all instances the credit implication is negative.

In our opinion, all of these reactions will combine to invariably lead to higher costs for generators and higher electricity costs for consumers. A struggling global economy exacerbates the risk of consumer tolerance to absorb higher utility costs. Delays in cost recovery can contribute to financial metric deterioration, a credit negative when accompanied by a higher business and operating risk profile.

We still view nuclear power as a key source of electricity for many countries. Nuclear power plants provide large quantities of base-load electricity, 24-hours a day for hundreds of days in a row without producing any of the air and water emission pollutants of alternative forms of generation, including coal and natural gas. The countries with the largest amount of nuclear generating capacity also tend to have sizable, developed economies which are better positioned to absorb potential large liabilities.

In Japan, government intervention to absorb the Fukushima-related liabilities is actively being considered. The ratings for Tokyo Electric Power Company (TEPCO), the owner of the Fukushima nuclear station, has already been downgraded by 5-notches, to Baa1 from Aa2 and remains on review for further downgrade. We are concerned with statements from some government officials that appear to indicate that TEPCO may need to shoulder a portion of the liabilities.

The resolution regarding Japan's government support for liabilities can have contagion effects on other jurisdictions. For example, in the United States, the Price Anderson Act limits liability to nuclear operators at only $12.5 billion, a figure which now appears relatively low. Any liabilities above that level are expected to be absorbed by both state and federal governments, a concept that could create a political backlash for the sector due to the weak economic recovery and deteriorating state of

government finances. At this time, we would not rule out the potential for significant changes to the US nuclear sector's liability insurance framework.

Still, we take some comfort in the fact that the majority of operating nuclear plants are located in large, industrialized economies. As noted in the table below, the top 10 largest nuclear countries (measured by capacity) represent approximately 84% of the total worldwide nuclear generation capacity and 52% of the total worldwide estimated GDP.

TABLE 1

Largest nuclear generation capacity, by country

Country	Gigawatt Capacity	GW % of worldwide total	2011 Est. GDP ($T US Equivalent)	GDP % of worldwide total
United States	100.7	27%	$15.1	24%
France	53.3	14%	$2.6	4%
Japan	46.8	13%	$5.7	9%
Russia	24.0	6%	$1.7	3%
Germany	20.5	6%	$3.4	5%
South Korea	20.5	6%	$1.1	2%
Ukraine	13.1	4%	$0.2	0%
Canada	12.6	3%	$1.6	3%
China	10.1	3%	$6.4	10%
United Kingdom	10.1	3%	$2.4	4%
Top 10 total	**311.7**	**84%**	**$32.2**	**52%**
Total worldwide	**370.1**		**$62.0**	

Source: IAEA, International Monetary Fund World Economic Outlook, October 2010.

Event risk remains remote possibility but financial implications upon occurrence revisited

From a credit perspective, the events that triggered Fukushima (an earthquake and a tsunami) are irrelevant. We see the accident as event risk, which despite its extremely low probability of occurring, occurred. For our purposes, event risk can represent almost anything, but for purposes of this report, event risk is defined as a reactor that ignores the instructions from its control room. This can be triggered by an earthquake, tsunami, hurricane, cyber-attack, equipment failure or operator error. We will, most likely, continue to view the potential occurrence of nuclear accident event risk as a remote probability. However, we are now re-evaluating the impact on creditworthiness when an event does occur.

Any changes to our perception of business and operating risk will be made on an issuer-specific basis. In some cases, a higher risk profile will need to be mitigated by stronger financial metrics in order to maintain a given rating. Nevertheless, we do not anticipate any rating changes solely related to remote probability but high severity event risk.

Our views are still developing, in part due to the continued unfolding of events in Japan and the related reactions of governments. In the table below, we summarize our initial reactions:

TABLE 2

Current status of developing views incorporated into credit analysis

	Previous View	Emerging View	Rationale for changing view
Event risk occurrence	Remote probability	Remote probability	"Black swan" event risk is not zero probability
Financial impact upon event risk occurrence	Manageable over long-term horizon	Manageable over long-term horizon but sustained financial weakness	Potential size of liabilities appear larger than initially expected raising need for government support and backstop
Regulatory oversight	Material oversight	More intrusive oversight likely to be temporary	Increasing scrutiny results in delays and higher costs, but result will be strengthened systems and emergency response
Government support	Strong	Strong; varies by region	Support influenced by social priorities; support expected to be tested
Population acceptance	Growing more supportive	Growing less supportive, but varies by region	Increasing concerns over radiation; costs; conclusion of Fukushima likely to influence level of tolerance

Initial impact on issuer creditworthiness

At this time, we still feel it is premature to make any definitive conclusions regarding creditworthiness for nuclear generators, in part due to the still unfolding events in Japan and the uncertainty that may follow in other regions. We continue to incorporate a relatively positive view of the science and engineering that stands behind nuclear power, and we expect a thorough review and assessment of potential reactor vulnerabilities once Fukushima is ultimately resolved, a process that is likely to take several months (to stabilize and contain) and several years (to clean up).

Nevertheless, our initial assessment includes the following:

» Issuers with high credit ratings but weak financial profiles, where reliance on strong government support or rate setting autonomy is critical, appear most at risk over the near-term horizon. A material strengthening of the financial profile for some issuers may be in order to justify existing credit ratings. This could become a more important consideration as government support is tested in Japan. In the US, several municipal electric utility issuers and a few G&T cooperatives are potentially exposed.

» Issuers that own nuclear generating assets within the unregulated power market frameworks are more exposed than issuers operating within a traditionally regulated market framework. Recovery of increased costs associated with political intervention and heightened regulatory scrutiny are more assured in a regulated framework. Similarly, the US municipal electric utility and G&T cooperative issuers, virtually all of whom have full rate setting autonomy, can recover increased costs provided they fully exercise that autonomy even in the face of a potential consumer backlash.

» Issuers pursuing the construction of new nuclear generation are already being ascribed a higher risk profile. The potential for delays during construction can increase costs, which could raise regulatory prudency/disallowance risks. This scenario was last evidenced in the US in the 1980's, post the Three Mile Island accident.

» Issuers pursuing operating license extensions are exposed to higher risks, especially for reactors that share the same design as the Fukushima nuclear power station or are located near earthquake prone regions or along coast-lines. This concern is comparable to the US Davis-Besse reactor vessel head experience, but we note that all operating licenses are equally exposed, regardless of reactor design or geographic location. More intensive regulatory reviews and organized local opposition are expected.

Highly rated issuers with weak financials that rely on government support and rate setting autonomy

Prior to the 11 March incident, Japanese utilities had the same above average credit quality as U.S. municipal electric and G&T cooperative utilities - Aa2 stable for Japan, an average A1 stable for U.S. municipal electric utilities and an average A3 stable for US G&T cooperatives. In these cases, strong ratings rely heavily on governmental support and rate setting autonomy in tandem with strong contractual relationships with customers. Combined, these factors represent good mitigants against financial profiles that compare weakly with peers in Europe and the US. The Japanese, US municipal utility and US G&T cooperative sectors have financial profiles characterized by higher leverage ratios, lower cash flow metrics, and weaker liquidity profiles[1].

In addition to the rating actions taken on TEPCO, Moody's placed on review for possible downgrade the long-term ratings for nine other Japanese utilities. The review is prompted by the lasting consequences of the earthquake and tsunami for the nation's power and utility sector; the challenging economic environment which increases the risk of recovery delays and; their comparatively weak financial profiles and limited financial flexibility relative to their rating category.

In the US, there are 20 municipal electric utilities and a few of the rated US G&T cooperatives that have direct ownership interest in existing nuclear assets. To date, we have taken no rating action on any of these issuers as a result of the Fukushima incident.

[1] For many municipal utilities, we acknowledge that liquidity is evaluated under a different methodology than corporate issuers. For the municipal utilities, many issuers have self-liquidity provisions and sizeable cash balances.

TABLE 3

Selected nuclear operators with high credit ratings, weak financial profiles and reliance on government support and rate setting autonomy with strong contractual relationships with customers

($ Billions)

Region	Issuer	Rating	Outlook	Revenue	Debt	Assets
Japan: regulated utility	Chubu	Aa2	RUR – down	$24.1	$34.7	$56.5
Japan: regulated utility	Chugoku	Aa2	RUR – down	$11.2	$20.1	$30.0
US: municipal utility	CPS San Antonio	Aa1	Stable	$2.2	$4.2	$8.7
Europe: unregulated power	EdF	A2	Stable	$86.5	$103.5	$326.5
Japan: regulated utility	Hokkaido	Aa2	RUR – down	$5.9	$12.4	$17.9
Japan: regulated utility	Hokuriku	Aa2 SS.	RUR – down	$5.1	$10.6	$15.4
Japan: unregulated power	J-Power*	Aa2	RUR – down	626.5	662.9	2027.0
Japan: regulated utility	Kansai	Aa2	RUR – down	$28.1	$48.5	$73.4
Japan: regulated utility	Kyushu	Aa2	RUR – down	$15.6	$29.4	$43.8
US: municipal utility	MEAG	A1	Stable	$0.7	$4.0	$5.0
US: G&T cooperative	Oglethorpe	Baa2	Stable	$1.3	$5.5	$6.9
US: municipal utility	Santee Cooper	Aa2	Stable	$1.7	$4.9	$7.5
Japan: regulated utility	TEPCO	Baa1	RUR - down	$54.0	$101.1	$138.5
US: regulated utility	TVA	Aaa	Stable	$10.9	$27.4	$43.0

* JPY ¥

Un-regulated nuclear generation issuers

Issuers that own nuclear generating assets within the unregulated power market frameworks are more exposed than issuers operating within a traditionally regulated market framework. Recovery of increased costs associated with political intervention and heightened regulatory scrutiny are more assured in a regulated framework.

In the US, Exelon Corp. (Baa1 stable), Entergy Corp. (Baa3 stable), Constellation Energy (Baa3 stable), and Public Service Enterprise Group (Baa2 stable) are the most exposed.

Other unregulated companies that operate nuclear power plants are capitalized with higher levels of debt and are, therefore, even more sensitive to absorbing higher costs. These include NRG Energy (Ba3 negative) and Energy Future Holdings Corp. (Caa2 negative), which has a whopping $37 billion in outstanding debt.

TABLE 4

Selected unregulated nuclear power operators

($ Billions)

Region	Issuer	Rating	Outlook	Revenue	Debt	Assets
Europe: unregulated power	CEZ	A2	Stable	$10.4	$9.9	$28.3
US: unregulated power	Constellation	Baa3	Stable	$15.6	$5.5	$23.8
US: unregulated power	Dominion	Baa2	Stable	$15.2	$18.7	$43.7
Europe: unregulated power	E.ON	A2	Stable	$111.5	$73.3	$219.9
Europe: unregulated power	EDF	Aa3	Stable	$82.4	$116.6	$350.0
US: unregulated power	EFH	Caa2 CFR	Negative	$9.5	$37.0	$60.3
Europe: unregulated power	EnBW	A2	Stable	$21.7	$22.4	$50.3
Europe: unregulated power	Endesa	A3	RUR - down	$34.1	$32.4	$86.5
Europe: unregulated power	ENEL	A2	RUR - down	$86.7	$103.6	$234.7
US: unregulated power	Entergy	Baa3	Stable	$10.8	$14.1	$38.0
US: unregulated power	Exelon	Baa1	Stable	$17.3	$16.9	$52.9
US: unregulated power	First Energy	Baa3	Stable	$13.3	$18.5	$37.0
Europe: unregulated power	Fortum	A2	Stable	$7.6	$10.9	$29.4
Europe: unregulated power	GDF SUEZ	A1	Stable	$111.4	$76.4	$251.2
Europe: unregulated power	Iberdrola	A3	Negative	$36.1	$45.2	$124.6
US: unregulated power	Nextera	Baa1	Stable	$15.3	$19.4	$52.9
US: unregulated power	NRG	Ba3 CFR	Negative	$9.0	$10.0	$24.1
US: unregulated power	PPL	Baa3	Stable	$8.5	$15.0	$33.6
US: unregulated power	PSEG	Baa2	Stable	$11.8	$9.8	$29.9
Europe: unregulated power	RWE	A2	Negative	$64.4	$46.3	$116.1
Europe: unregulated power	Vattenfall	A2	Stable	$27.0	$33.7	$84.8

Issuers pursuing new nuclear construction

In the US, we believe the Nuclear Regulatory Commission (NRC) will cast a closer eye on applications for new nuclear reactors, particularly with respect to their safety and emergency response systems but also on all aspects of the new nuclear projects.

For example, while promoted as a significant advancement in the safety of nuclear reactors, the two new nuclear projects in the US will utilize the AP 1000 reactor design which uses passive safety features such as gravity and natural processes such as condensation to cool the reactor vessel and fuel. The design is touted as being able to eliminate the dependence upon mechanical and electrical support to keep the fuel cool during an event. The AP 1000 design is not in operation anywhere in the world and, therefore, has first-in-kind engineering risk and we expect additional questions will be raised about what happens should the passive system fail and under what conditions could that occur. We expect there could be a delay in the issuance of the new plant license as the public demands further assurances about safety.

We currently see two new nuclear generating facilities with potential exposure, both of which are in the early stages of construction. These potential new reactors will be operated by regulated utilities, which can recover their operating expenses through customer rates, and are therefore less vulnerable to cost increases than their unregulated peers. The two new reactors are the Vogtle station in Georgia, owned by Southern Co. (Baa1 stable) and its subsidiary Georgia Power Co. (A3 stable); Oglethorpe Power (Baa2 stable); City of Dalton, Georgia (Aa3 stable) and the Municipal Electric Authority of Georgia (A1 stable).

The other two reactors are slated for the VC Summer station in South Carolina, owned by SCANA Corp. (Baa2 negative), its subsidiary South Carolina Electric and Gas (Baa1 negative), and the South Carolina Public Service Authority (Aa2 stable).

Prospects for the development of a third nuclear facility, South Texas Project 3 & 4 (STP 3&4), appear less likely as one of the potential major investors of STP 3&4 is Tokyo Electric Power, the owner of the affected Fukushima Daiichi and Daini nuclear plants. NRG is the primary owner and developer of this project.

TABLE 5

Selected new nuclear generation construction exposure

($ Billions)

Region	Issuer	Rating	Outlook	Revenue	Debt	Assets
Asia: regulated utility	KHNP	A1	Stable	Private	Private	Private
US: municipal utility	MEAG	A1	Stable	$0.7	$4.0	$5.0
US: unregulated power	NRG	Ba3 CFR	Negative	$9.0	$10.0	$24.1
US: G&T cooperative	Oglethorpe	Baa2	Stable	$1.3	$5.5	$6.9
US: municipal utility	Santee Cooper	Aa2	Stable	$1.7	$4.9	$7.5
US: regulated utility	SCANA	Baa2	Negative	$4.6	$4.9	$13.1
US: regulated utility	Southern	Baa1	Stable	$15.7	$22.1	$56.1

US issuers pursuing an operating license extension

We anticipate a material increase in regulatory scrutiny and believe it is likely that numerous governments and regulators will establish various panels or commissions to review the status of their nuclear fleet and reconsider the fleet's role. Regulators are likely to impose more stringent safety, evacuation, and emergency response measures, which will increase operating costs for nuclear reactors.

In the US, we believe the NRC will take a closer look at both existing US nuclear operating plants, many of which are about the same age as Japan's Fukushima Daiichi and Daini plants and have similar overall reactor and safety designs, as well as the new reactor designs being reviewed for next-generation nuclear plants.

Nevertheless, all operating reactors in the US are subject to increased regulatory scrutiny and organized local opposition. From a cost perspective, we are especially focused on waste management issues, including the spent fuel cooling pools.

TABLE 6

Selected issuers seeking nuclear operating license extensions

($ Billions)

Region	Issuer	Rating	Outlook	Revenue	Debt	Assets
US: unregulated power	Constellation	Baa3	Stable	$16.0	$5.5	$20.2
US: municipal utility	CPS San Antonio	Aa1	Stable	$2.2	$4.2	$8.7
US: municipal utility	Energy Northwest	Aaa	Negative	$0.5	$6.4	$6.7
US: unregulated power	Entergy	Baa3	Stable	$10.8	$14.1	$39.1
US: unregulated power	Exelon	Baa1	Stable	$17.8	$17.1	$52.9
US: unregulated power	First Energy	Baa3	Stable	$13.3	$18.5	$37.0
US: unregulated power	NRG	Ba3 CFR	Negative	$9.0	$10.0	$8.8
US: unregulated power	PSEG	Baa2	Stable	$12.4	$9.9	$29.9
US: regulated utility	Southern	Baa1	Stable	$15.7	$22.1	$56.1
US: regulated utility	TVA	Aaa	Stable	$10.9	$27.4	$43.0

Increased political and regulatory intervention create uncertainty

We believe government support will be tested in Japan, Europe and in the U.S. as the aftermath of the Fukushima nuclear crisis yields political and regulatory scrutiny over fleet safety. Evaluation of backup safety systems, security of spent fuel storage and safe location of nuclear generation sites will be some of the items reviewed.

In Europe, Moody's notes that the European Union's Energy Commissioner has called for all nuclear plants across the EU and in neighboring countries to undergo stress tests to prove their safety. Moody's will monitor the outcome of these tests and safety reviews, and the implications they may have for nuclear plants across Europe, including the additional costs from more stringent safety measures, which at this stage seems a likely outcome.

If significant costs are mandated by new regulations, the willingness of utilities and regulators to pass on those costs, despite legal precedents, could create consumer backlash issues. While Moody's still expects operators will maintain a profile that ensures timely payment of debt service, heightened political opposition to nuclear generation could place significant pressure on a governing board's supportiveness of nuclear asset ownership.

Already, we see a number of governments asserting their rights to intervene in the sector. As critical infrastructure assets, governments can easily move to slow the construction plans for new nuclear plants, halt the extension of expiring plant licenses, or close certain operating plants while the ramifications of events in Japan are evaluated.

The nature of government reactions to the nuclear accident to date varies substantially, but in all instances are viewed to be negative for credit. Several jurisdictions have already indicated a moratorium, delay or review of proposed new nuclear developments. These includes countries such as China and India, which represent the largest new nuclear construction opportunities. Other jurisdictions have reiterated their support, such as South Africa and France. The most severe reaction has emerged in Germany, which has traditionally been a heavily anti-nuclear jurisdiction.

TABLE 7

More supportive: Strong statements of continued support; no immediate actions taken that reduces timeliness of licensing / permitting procedures	Directionality of support still developing: Too early to conclude due to either conflicting statements regarding support or no clear directionality	Less supportive: Statements indicate a reduced timeliness for licensing / permitting procedures or other increases in regulatory scrutiny.
France	United States	Germany
South Africa	United Kingdom	India
	Sweden	South Korea
	Finland	
	China	

Past experiences of US governmental support

A reliable supply of electricity represents a critical infrastructure asset for all economies, so some degree of evidence associated with governmental support and intervention in times of stress can be expected. But in all cases, the magnitude of the response and scope of support remains uncertain. Nevertheless, over the past few decades, there have been examples of support and intervention in the US that demonstrates federal or state government willingness to step forward to mitigate worst case scenarios.

» In 2000 - 2001, California experienced an energy crisis where electric utilities encountered a material amount of financial distress. Two of the larger investor-owned utilities experienced a default. Arguably, the situation could have gotten worse if the state didn't take direct action. So, in 2001, due to the absence of credit worthy counter parties (the utilities), the State of California stepped in with its General Fund and purchased power on behalf of the utilities. The State then issued $11 billion of municipal revenue bonds to reimburse the fund. Regulators also took action to restructure and stabilize the power market.

» Related to this crises, Seattle Light (the Aaa-rated City of Seattle electric utility), faced some financial distress when low water levels combined with the enormous rise in the price of energy during the 2001 Power Crisis. Seattle Light had to procure replacement energy at prices well above their forecasted level which created a significant budget gap. Seattle Light had authorization to utilize the city's $1 billion liquidity pool to assist in cash flow until water flows improved hydroelectric production and market pricing improved.

» During the last nuclear build cycle, Duke Power experienced some financial distress as it was burdened with significant new post-Three Mile Island regulatory costs and a high interest rate environment. The State of North Carolina intervened by creating two joint municipal power agencies, North Carolina Municipal Power Agency No.1 and North Carolina Eastern Municipal Power Agency, that issued over $5 billion of tax-exempt bonds to assist in the completion of the nuclear units.

» After the 1973 Mideast oil embargo and a four-fold increase in oil prices, Con Edison experienced some financial distress. The State of New York intervened by directing the New York State Power Authority (NYPA) to buy, complete and operate two nuclear power plants that Con Edison was building.

» In a similar natural disaster experience, Entergy New Orleans experienced some financial distress following the devastation caused by Hurricane Katrina. The utility recovered with the support of government. The company's financial and operational recovery was partly attributable to the receipt of community development block grant funds, insurance proceeds following the storm, as well as the credit supportive regulatory decisions on the part of the New Orleans City Council.

Potential scenarios to consider

When considering the creditworthiness of our rated issuers, we incorporate a view regarding various factors, such as event risk and government support. In addition, our ratings take into consideration our expectations regarding the longer-term prospects for the sector in general, as well as for nuclear power specifically. We acknowledge that the unfolding events in Japan are likely to influence the ultimate implications for other jurisdictions, especially with respect to political intervention, regulatory scrutiny and, most importantly, the general public's sentiment.

Today, we see two principal scenarios related to the longer term prospect for nuclear power, both of which are biased to the negative side. The first scenario is our base case scenario, where the reduction in public sentiment and government support for nuclear power as a result of the Fukushima incident is temporary, even though the overall cost structure for nuclear operators changes. The second scenario is our downside case, where there is a material and more permanent decrease in both public sentiment and political support for nuclear power.

TABLE 8

Illustrative scenarios

	Base case	Downside Case
Fukushima resolution	Situation stabilizes and is contained over near-term; radiation leakage and contamination is controlled with little additional impact on region; government supports TEPCO with costs / liabilities.	Situation remains uncontrolled for an extended period; radiation and contamination spreads across wider regions; TEPCO experiencesless than full government support.
Public sentiment	Less supportive but no material increase in organized opposition.	Material swell of organized anti-nuclear sentiment; increased NIMBY exposure; highly politicized issue for government elections.
Political intervention	Increased, but temporary. Commissions and studies provide political cover but most governments remain supportive over longer-term.	Increased for prolonged period of time; significant legislation thwarts new nuclear development plans and creates material unintended consequences regarding higher cost structure, making older plants uneconomical. Elected officials abandon previously supportive positions.
Regulatory scrutiny	Reviews and assessments aimed at lessons learned; vulnerability mitigation based on science and facts.	Reviews and assessments aimed at lessons learned; vulnerability mitigation based on science and facts, but forced to implement new legislation which creates material oversight burdens.

The Davis-Besse reactor vessel head replacement reaction

In the US, we view the experience that occurred in 2004 at the Davis-Besse reactor (owned by First Energy Baa3 senior unsecured / stable outlook) as providing guidance as to possible regulatory responses to the Fukushima incident and the financial and operational implications for nuclear generators. First Energy notified the US Nuclear Regulatory Commission (NRC) of significant corrosion in its Davis-Besse reactor vessel head. The NRC promptly ordered all comparably designed reactors to assess the status of their reactor vessel heads. Material costs were then incurred to replace, often well in advance of any planned replacement, reactor vessel heads. Davis-Besse was off line for approximately 22 months.

We believe it is conceivable that a similar review of reactor vulnerabilities could be ordered post Fukushima, starting with the 35 GE boiling water reactors that share Fukushima's design characteristics and; reactors located on active fault lines or near coastlines or flood areas and with a focus on spent fuel cooling pools. However, we also not that all operating reactors will be exposed to increased regulatory scrutiny and, more importantly, potentially organized local opposition groups.

TABLE 9

Selected issuers with increased exposure to regulatory scrutiny and the estimated number of GW's exposed**

Reactors comparable to Fukushima design	Reactors located near earthquake fault lines	Reactors located near coasts
Exelon (~6.3 GW's)	PG&E (~2.2 GW's)	Dominion (~3.6 GW's)
TVA (~3.4 GW's)	Edison Intl (~1.8 GW's)	NextEra (~2.8 GW's)
Progress (~1.9 GW's)	Entergy (~2.0 GW)	Progress (~2.7 GW's)
Southern (~1.8 GW's)		Entergy (~2.7 GW)
Entergy (~1.5 GW's)		PG&E (~2.2 GW's)
DTE (~1.1 GW's)		Edison Intln (~1.8 GW's)
PSEG (~1.2 GW's)		Constellation (~1.7 GW's)
NextEra (~0.6 GW's)		Exelon (~1.6 GW's)
Constellation (~0.6 GW's)		PSEG (~1.3 GW's)
Xcel (~0.6 GW's)		

** GW capacity can be repeated across columns. For example, PE&G Diabolo Canyon nuclear generation station is located near an earthquake fault line and sea-level, whereas only some of Exelon's plants are similar reactor designs and some are located near sea-level.

The Three Mile Island reaction

We recall that after the Three Mile Island accident, the population quickly turned against nuclear generation's benefits in exchange for more safety assurances. Significant political and regulatory intervention resulted, and many utilities, which were in the middle of reactor construction, found themselves being forced to redesign their plants. The impact on both utility ratepayers and investors was material due to the delays and additional costs, significant portions of which were ultimately not recoverable as regulators deemed them imprudent.

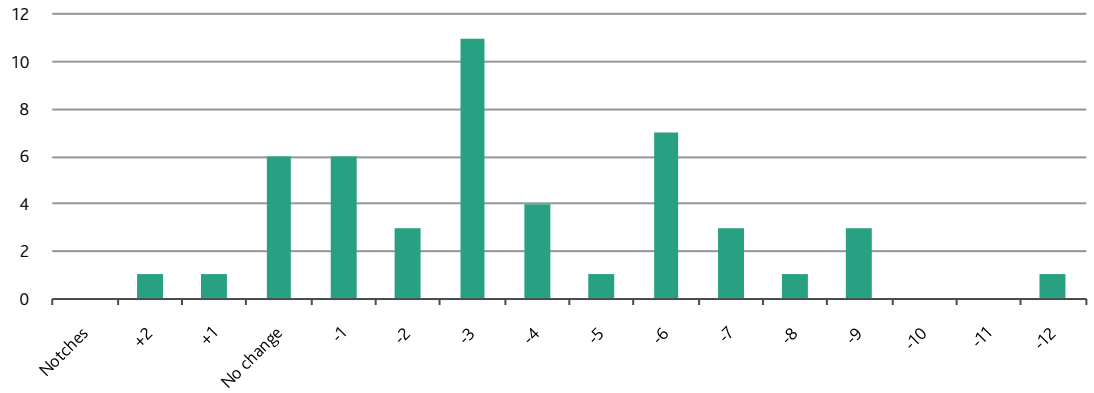
Moody's also expects that it is possible the government support model that was used in the U.S. during the last building cycle could reappear should nuclear expansion in the U.S. falter. During the 1970s and 1980s several new state agencies were created to assist in the development of new nuclear generation as their investor-owned counterparts were buried under cost overruns caused by the significant cost increases blamed on the regulatory reaction to Three Mile Island.

For example, the two agencies in North Carolina (North Carolina Eastern Municipal Power Agency and North Carolina Municipal Power Agency No . 1) were established to assist then beleaguered Duke Power using tax-exempt debt to complete several nuclear plants. It is not surprising that in the U.S. thus far, the two new nuclear projects that remain scheduled for a construction and operating license (COL) in 2011 include municipal agencies.

From a credit rating perspective, the impact of the shift in public sentiment, the increase in political and regulatory scrutiny and implications for financial metrics was severe. Although credit rating downgrades can not be directly tied to nuclear implications in all cases, we observe that on average, credit ratings for US utilities exposed to new nuclear development fell by 4-notches. In the chart below, we show the number of issuers that were exposed to this negative rating activity and the number of credit rating notch changes during the period of 1970 – 1990.

CHART 1

Rating changes for nuclear-exposed issuers between 1970 - 1990



Conclusion

The nuclear generation sector operates within a "fraternity" structure, both globally and nationally, where an operating system is viewed to be only as good as its weakest link. This collaborative approach was born out of the Chernobyl and Three Mile Island accidents, when the sector realized a strong safety record, which was a key ingredient to achieving a population's acceptance of radiation risk.

Today, one of the largest and more respected members of that fraternity, Tokyo Electric Power Company (TEPCO), represents the weakest link. All nuclear operators, whether regulated utilities or un-regulated power companies, will suffer the consequences that emerge from a post Fukushima environment.

Nevertheless, we believe our ratings and rating outlooks for the vast majority of affected issuers are appropriate at this time. However, the accident at Fukushima represents a stark reminder of the unpredictable liabilities that can result from nuclear-related misfortunes. Some issuers might require stronger balance sheets and bolstered liquidity sources to maintain a given rating. Governmental support arrangements and the benefits of rate setting autonomy and strong contractual relationships with customers might also be revisited.

We see the Fukushima accident creating a material amount of contagion risk which is now reverberating across the global regulated utility and un-regulated power industry sectors. These risks include:

» increased political intervention;

» an expectation for increased regulatory scrutiny;

» potential delays (which are highly correlated to increased costs) associated with established licensing and permitting protocols; and

» emboldened opposition groups.

Once the events unfolding in Japan are stabilized, extensive technical and engineering reviews to assess all reactor vulnerabilities are likely. But the magnitude of any assessment is highly subject to political influences which, in turn, are highly susceptible to changing social demands. We believe Fukushima could ignite a popular backlash against nuclear generation, the implications of which should not be taken lightly. New nuclear generation is already more expensive to build than most other sources of electricity, its liability insurance is effectively socialized and material questions are being raised regarding its waste products.

The benefits of nuclear power include competitive margin power costs, strong base-load operating characteristics and a favorable environmental footprint. But Fukushima is a sobering reminder of the downside characteristics related to nuclear power, primarily accidental releases of radiation and challenges in managing spent fuel wastes. Prospectively, we expect delays and increased scrutiny for issuers in the process of obtaining new operating licenses or operating license extensions.

Appendix A: Assessing the implications of event risk for Japanese electric utilities

Tokyo Electric Power Co. (TEPCO, Baa1- on review for possible downgrade), as the owner of the troubled Fukushima nuclear power plant, is the company most clearly exposed to increased costs associated with rebuilding currently lost generating capacity, decommissioning its damaged reactors and replacing those power supplies. Even if TEPCO is able to bring the Fukushima Daiichi plant under control without further damage and environmental contamination, the company's cash outflows will be greater than they otherwise would be for several years owing to the high costs for replacement power and higher capital spending for repairs and new generating plants. Other utilities in Japan may also be affected by greater government scrutiny, tighter power supplies, and regulatory lag for rate increases to recover higher costs for fuel and purchased power. Nevertheless, we expect strong government support to continue, which includes the liquidity support provided by the Japanese megabanks.

Prior to the crisis, all Japanese electric utilities were rated Aa2 stable, even though their financial profiles compared weakly with peers in Europe and the US, as they are characterized by higher leverage ratios, lower cash flow credit metrics, and weaker internal liquidity profiles. These weaknesses were offset by greater government support, more sure cost recovery mechanisms, and the monopoly business framework established under Japan's Electric Utility Law.

Today, all of the Japanese electric utilities and one gas distribution utility (Tokyo Gas Company Aa1) are under review for possible downgrade. Another Japanese gas distribution utility, Osaka Gas Co. Ltd., had its rating outlook to negative from stable.

TEPCO's credit quality depends on the near and longer-term financial impact of the disaster, and the company's ability to sufficiently raise rates to recover its elevated expenses. While we believe that TEPCO will eventually recover its costs, we expect a sustained period of weaker financial performance. Moreover, TEPCO will be heavily reliant on external liquidity sources from the Japanese banking system and/or the Japanese government. Most importantly, a full recovery is not necessarily assured. Aside from the risk that the company may need to permanently absorb some costs, TEPCO could also be exposed to additional liabilities.

TABLE 10

Japanese utility ratings, rating outlooks and selected financial metrics (3-yr average)

Issuer	Rating	Outlook	Debt / Cap.	CFO pre-w/c / Debt
TEPCO	Baa1	RUR - down	79%	8%
Chubu	Aa2	RUR - down	64%	14%
Kansai	Aa2	RUR - down	70%	14%
Chugoku	Aa2	RUR - down	74%	7%
Hokuriku	Aa2	RUR - down	75%	11%
Kyushu	Aa2	RUR - down	71%	11%
Hokkaido	Aa2	RUR - down	71%	4%
Okinawa	Aa2	RUR - down	64%	12%
J-Power	Aa2	RUR - down	78%	11%
Tokyo Gas	Aa1	RUR – down	47%	28%
Osaka Gas	Aa2	Negative	47%	26%

The full extent of infrastructure damage within Japan is unknown, and the government's ultimate response to TEPCO's situation is unknown. From a credit rating perspective, the electric utility sector in Japan has benefitted from the strong and consistent support provided by the government. The sector operates under the Electric Utility Law, which provides strong assurance for cost recovery under a vertically integrated (generation, transmission and distribution), monopoly utility framework.

We continue to incorporate a view that government support will remain strong, but we are also mindful of the government re-assessing its own internal policies and agenda given the enormity of this natural disaster. While we understand that utilities are compensated for damages caused by nuclear reactor operations through an indemnity agreement with the government, we are concerned with the scope of the infrastructure damage and how TEPCO will be able to raise its rates (on its remaining customers) to ensure financial recovery on a timely basis.

We see a prolonged period of rolling power outages and grid reliability problems. This risk is not a primary credit rating consideration, but it will impact near-term cash flows and could contribute to increased complaints from consumers and industry, and potentially hamper the long-term recovery effort. A less reliable electric grid could contribute to supply chain issues and impact other important exporting sectors, such as automobile manufacturing, technology, chemicals, pharmaceuticals and steel[2].

A weakening of the political and regulatory support framework or cost recovery mechanisms in Japan could create negative credit pressure on the other Japanese electric utilities, all of which are currently under review for possible downgrade.

[2] Recall, Japan is home to the Japan Steel Works, one of the few manufacturers of ultra-heavy forgings, which are critical for developing large generation assets, such as nuclear and coal plants.

Appendix B: Initial Examples of Political Intervention

Germany's nuclear power moratorium

In Germany, the government ordered a three-month moratorium on lifetime extensions of nuclear power stations and a temporary shutdown of seven nuclear plants. This is credit negative for the four owners and operators of German nuclear generation facilities, E.ON (A2 stable), RWE (A2 negative) EnBW (A2 stable),and Vattenfall (A2 stable).

» The order partially reverses October 2010 legislation permitting the lifetime extension of Germany's 17 nuclear power plants as a way to reduce carbon emissions.

» The seven affected plants were commissioned before 1980. EnBW owns two plants (GKN 1 and KKP1), RWE owns two plants (Biblis A and B), and E.ON owns two plants outright (Isar 1 and Unterweser), and has a minority stake in a third, Brunsbuttel, which is controlled by Vattenfall.

» The temporary shutdown will immediately impact the utilities' cash flows, as actual power generation will fall short of plan. Aggregate cash flow lost by E.ON, RWE, and EnBW from the three-month suspension will be roughly 1.6% of the approximately €20 billion in funds from operations they generated in aggregate in 2010.

» The aggregate shortfall in output will be approximately 11 terawatt hours, just under 2% of the country's annual energy consumption. The utilities will need either to increase output at other plants, or make up the difference through purchases in the market. Neither offers any upside for the utilities: in cases where such market purchases are made at prices above the forward sale price achieved, the utility will incur a loss; additional power produced in-house is likely to be at a lower margin.

The moratorium and safety review declared in Germany will likely presage substantial changes in the shape and scale of nuclear power generation in the country. Following the three-month moratorium and review, it is possible that previously approved lifetime extensions of these plants are rescinded, which would increase the credit negative impact on nuclear power plant operators. This would also have a significant effect on the generation mix in Germany, and the price of power and carbon dioxide.

The actions of the German government highlight differences in the social and political acceptance of nuclear generation across Europe. While stressing an intent to learn from the implications of the disaster in Japan, neither UK or French authorities seem likely to call for near-term power plant shutdowns. In the meantime, the European Union's Energy Commissioner has called for all nuclear plants across the EU and in neighboring states to undergo stress tests to prove their safety. These are likely to result in additional costs from more stringent safety measures, a somewhat more manageable (?)credit negative for the industry.

South Korea's evaluation of safety procedures

In Korea, the president ordered inspections for all four of Korea Hydro and Nuclear Power's (KHNP: A1 stable) nuclear-power plants (approximately 20GW's total capacity) to quell rising public anxiety. In addition, the Korean government is requiring all new plants to cope with more powerful earthquakes.

» Nuclear power accounts for only about 4% of Korea's total fuel costs but generates nearly one-third of its electricity.

» The Korean government has plans to reduce its dependence on fuel imports and meet its goals for reduced emissions by increasing the share of nuclear energy in its total fuel consumption.

» The generation targets are 39% by 2015, 46% in 2020, and 48% in 2022.

» Nuclear's share of generation was 31% in 2010.

KHNP is Korea's only nuclear-power generating company and a wholly owned subsidiary of state-run Korea Electric Power Company (KEPCO, A1 stable). KHNP has plans to build seven new nuclear reactors.

KHNP said strengthening its new nuclear reactors as protection against large earthquakes will raise its design costs alone by at least KRW100 billion ($90 billion). KNHP estimated the cost of changing a planned reactor's blueprint to withstand a 7.0-magnitude earthquake rather than the existing 6.5-magnitude specifications would be "considerable." Japan's earthquake on 11 March measured 9.0.

It is not yet clear whether Korea will slow or curtail its future nuclear development, but costs to ensure compliance with more stringent safety regulations will only increase. Moreover, KHNP has been active in exporting its nuclear know-how and has won bids to construct or refurbish plants in Finland, Romania, and the United Arab Emirates.

Other country responses

China has significantly stepped up its investment in nuclear plants over the past few years, as an alternative to its current highly polluting coal-fired generation and to help it meet its commitments to reduce CO2 emissions. For the most part, China has essentially exhausted most of its hydropower development opportunities (they have development projects underway or already identified) and other sources of clean energy still have reliability and intermittency challenges.

» Today, nuclear generation accounts for about 2% of total power generation in the country.

» These are the projects scheduled to be launched in 2012 and 2013 (none in 2011)

- 2012:
  - Hongyanhe 4 X 1110MW
  - Ningde 4 X 1000MW
- 2013:
  - Sanmun Phase 1 2 X 1250MW
  - Fuqing Phase 1 2 X 1080MW
  - Fangjiashan 2 X 1080MW
  - Yangjiang 6 X 1000MW
  - Taishan 2 X 1750MW
  - Shidaowan 1 X 2000MW?

Even if these projects commence operations, nuclear power will account for about 5% to 6% of total power generated. So, putting all of them on hold will not affect power supply much. Although the Chinese power groups are reluctant to halt or delay the launch given the huge investments, the Premier ordered a review of the operating plants and projects under construction, and suspended new projects applications.

Separately, the prime ministers of both Thailand and Indonesia said the Japanese catastrophe would affect their decisions on whether to build nuclear power plants.

Appendix C: U.S. Municipal electric utility systems with nuclear exposure

TABLE 11

Municipal Participant	Senior Muni Debt Rating	Name Of Plant	Operator	Net Mw	%Muni Ownership(1)
Austin	A1	South Texas Project 1	STP Nuclear Opco	1,280	16.0
		South Texas Project 2	STP Nuclear Opco	1,280	16.0
Dalton	Aa3	Hatch 1	Georgia Power	776	2.2
		Vogtle 1	Georgia Power	1,169	1.4
Florida Municipal Power Agency(2)	A2	St.Lucie 2	Florida P&L	839	8.8
Gainesville ,Fl.	Aa2	Crystal River3	Florida P&L	825	1.4
Long Island Power Authority	A3	Nine Mile Point 2	Constellation Generation	1,148	18.0
Los Angeles (LADWP)	Aa3	Palo Verde	Arizona Public Service	3,872	5.7
SCPPA(5)	A1	Palo Verde	Arizona Public Service	3,872	5.9
Salt River Project	Aa1	Palo Verde	Arizona Public Service	3,872	17.5
Massachusetts Municipal Wholesale	A3	Seabrook	FPL Group, Inc.	1,245	11.6
		Millstone 3	Dominion	1,233	4.8
Municipal Electric Auth of Georgia	A1	Vogtle 1	Georgia Power	1,152	22.7
		Vogtle 2	Georgia Power	1,159	22.7
		Hatch 1	Georgia Power	876	17.7
		Hatch 2	Georgia Power	883	17.7
Nebraska Public Power District	A1	Cooper	NPPD (Entergy)	767	100.0
North Carolina Municipal Power Agency 1	A2	Catawba 1	Duke	1,145	75.0
		McGuire 1	Duke	1,180	4.0
		McGuire 2	Duke	1,180	4.0
N.C. Eastern Municipal Power Agency	Baa1	Brunswick 1	Progress Energy	821	18.3
		Brunswick 2	Progress Energy	821	18.3
		Harris 1	Progress Energy	900	16.2
Omaha Public Power District	Aa1	Fort Calhoun	OPPD	484	100.0
Orlando Utilities Commission	Aa1	Crystal River3	Progress Energy Energy	825	1.5
		St.Lucie 2	Florida Power & Light	839	6.0
Piedmont Municipal Power Agency (4)	Baa1	Catawba 1	Duke	1,129	5.0
		Catawba 2	Duke	1,129	25.0
		McGuire 1	Duke	1,129	5.0
		McGuire 2	Duke	1,129	5.0
South Carolina Public Service Authority	Aa2	Summer	South Carolina Electric & Gas	660	33.3
San Antonio	Aa1	South Texas Project 1	South Texas Operating Co.	1,251	40.0
		South Texas Project 2	South Texas Operating Co.	1,251	40.0
Energy Northwest	Aaa	Columbia River -2	ENW	1,190	100.0

1. Net investments in ownership listed as % total utility investments.
2. FMPA has several different project bonds; FMPA's St. Lucie project bonds represent purchase of ownership interest in St. Lucie
3. NCMPA No. 1 has 75% ownership interest in Catawba No. 2; also agency has reliability exchange agreements to provide equal participation
4. Piedmont Municipal Power Agency has a 25% ownership interest in Catawba 2; and a similar reliability exchange with Duke for an equal amount of power from McGuire 1 & 2 and Catawba 1.
5. SCPPA has several different project bonds with different participants and different percentage ownerships in each project.

Appendix D: Boiling Water Reactors in the U.S.

No	Plant Name	Age	License Expires	Issuer Owner
1	Browns Ferry 1	37	12/20/2033	TVA
2	Browns Ferry 2	36	6/28/2034	TVA
3	Browns Ferry 3	34	7/2/2036	TVA
4	Brunswick 1	34	9/8/2036	Progress
5	Brunswick 2	36	12/27/2034	Progress
6	Clinton 1	23	9/29/2026	Exelon
7	Columbia Generating Station	26	12/20/2023	Energy North
8	Cooper	37	1/18/2034	NPPD
9	Dresden 2	20	12/22/2029	Exelon
10	Dresden 3	40	1/12/2031	Exelon
11	Duane Arnold	37	2/21/2034	NextEra
12	Fermi 2	25	3/20/2025	DTE
13	FitzPatrick	37	10/17/2034	Entergy
14	Grand Gulf 1	27	11/1/2024	Entergy
15	Hatch 1	37	8/6/2034	Southern
16	Hatch 2	36	6/13/2038	Southern
17	Hope Creek 1	24	4/11/2026	PSEG
18	La Salle 1	28	4/17/2022	Exelon
19	La Salle 2	27	12/16/2023	Exelon
20	Limerick 1	25	10/26/2024	Exelon
21	Limerick 2	21	6/22/2029	Exelon
22	Monticello	40	9/8/2030	Xcel
23	Nine Mile Point 1	36	8/22/2029	Constellation
24	Nine Mile Point 2	23	10/31/2046	Constellation
25	Oyster Creek	20	4/9/2029	Exelon
26	Peach Bottom 2	37	8/8/2033	Exelon
27	Peach Bottom 3	37	7/2/2034	Exelon
28	Perry 1	24	3/18/2026	First Energy
29	Pilgrim 1	38	6/8/2012	Nextera
30	Quad Cities 1	38	12/14/2032	Exelon
31	Quad Cities 2	38	12/14/2032	Exelon
32	River Bend 1	25	8/29/2025	Entergy
33	Susquehanna 1	28	7/17/2042	PPL
34	Susquehanna 2	27	3/23/2044	PPL
35	Vermont Yankee	39	3/21/2012	Entergy

Source: http://www.nrc.gov/reactors/operating/list-power-reactor-units.html NRC Information Digest (NUREG-1350, Volume 22), Appendix A: U.S. Commercial Nuclear Power Reactors

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