From: Jeffrey Epstein <jeevacation@gmail.com>
To: Boris Nikolic <[redacted]>
Subject: Fwd: Matter over Mind, part 2: March 17, 2011
Date: Thu, 17 Mar 2011 17:38:45 +0000
Attachments: 03-17-11_-_EOTM_-_Matter_over_mind,_part_2.pdf
Inline-Images: image003.png; image001.png; image002.png; image005.png; image004.png

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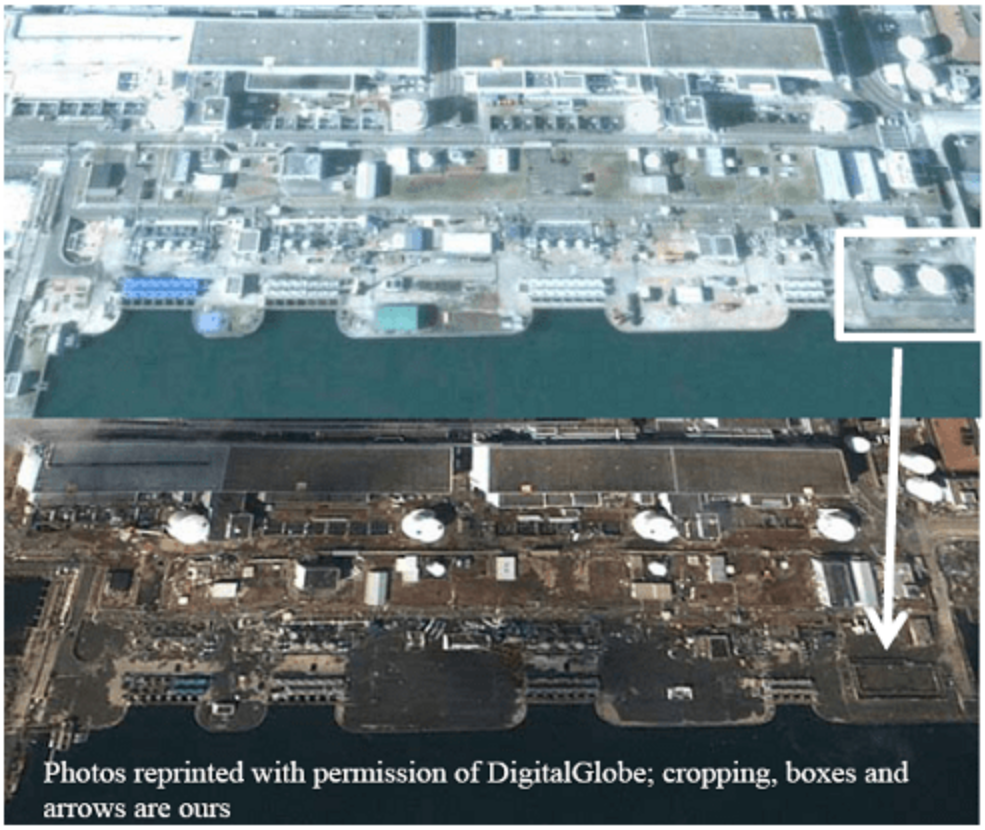
a good explanation of what and why

---------- Forwarded message ----------
From: **US GIO** <[redacted]>
Date: Thu, Mar 17, 2011 at 10:21 AM
Subject: Matter over Mind, part 2: March 17, 2011
To:

Eye on the Market, March 17, 2011 (today's version has color pictures and tables better viewed in the PDF)

Topics: **Japan update, what's next for nuclear power and implications for Asia/US**

"Matter over Mind, Part 2". In our note from Tuesday, we said that the next 72 hours would be critical. The grid below is an update from the Japan Atomic Industrial Forum as of 10 pm March 17, and there's a lot of **red** on it. Before getting into the details, I wanted to show a picture, since it gets at why the situation deteriorated so rapidly at the Fukushima Dai-Ichi plant. It's a before and after shot of what happened to the fuel storage tanks which supply power to the back-up generators. By having them on the beach and not under the ground, they appear to have been washed away by the tsunami. It is entirely possible that all subsequent problems (hydrogen explosions, exposure and possible melting of active and spent fuel rods) emanated from the lack of electricity to power cooling systems. Note how other structures just a few hundred yards away from the shore withstood the tsunami. Fukushima's Daini reactors (10 miles from Dai-Ichi) are in normal cold shutdown mode since they did not lose their emergency power fuel source.



What's happening as of March 17 at 10 pm Japan Standard Time:

** Backup generators not functioning, which is why cooling systems are not working properly (line 9, 10), which led to…

** …water level pressure falling and exposing uranium/plutonium rods to air, which raises their temperature and makes them more likely to melt (line 12)

** Building integrity (line 11) has been compromised due to hydrogen explosions and possible containment or reactor vessel breaches

** Reactor units 1, 2 and 3 are in serious trouble, with sea water injections being attempted on all three (line 15, line 16) to cool nuclear reactions

** Green sections on units 4, 5 and 6 are not "good news", since they were in outage mode when the earthquake hit (line 5)

** In one or more units, there might have been a breach in containment vessels which house the reactor vessels (line 8)

** Spent fuel rods are becoming a serious problem (line 18), a topic worth reviewing in more detail on the next page

	Status of nuclear power plants in Fukushima as of 22:00 March 17 (Estimated by JAIF)						
1	Power Station	Fukushima Daiichi Nuclear Power Station					
2	Unit	1	2	3	4	5	6
3	Electric / Thermal Power output (MW)	460 / 1380	784 / 2381				1100 /3293
4	Type of Reactor	BWR-3	BWR-4	BWR-4	BWR-4	BWR-4	BWR-5
5	Operation Status at the earthquake occurred	In Service -> Automatic Shutdown			Outage	Outage	Outage
6	Core and Fuel Integrity	Damaged	Damaged	Damaged	No fuel rods	Not Damaged	Not Damaged
7	Reactor Pressure Vessel Integrity	Unknown	Unknown	Unknown			
8	Containment Vessel Integrity	Not Damaged	Damage Suspected	Damage Suspected	Not Damaged	Not Damaged	Not Damaged
9	Core cooling requiring AC power	Not Functional	Not Functional	Not Functional	Not necessary	Not necessary	Not necessary
10	Core cooling not requiring AC power	Not Functional	Not Functional	Not Functional	Not necessary	Not necessary	Not necessary
11	Building Integrity	Severely Damaged	Slightly Damaged	Severely Damaged	Severely Damaged	Not Damaged	Not Damaged
12	Water Level of the Rector Pressure Vessel	Around half of the Fuel	Higher than half of the Fuel	Around half of the Fuel	Safe	Safe	Safe
13	Pressure of the Reactor Pressure Vessel	Stable	Unknown (run out of battery)	Stable	Safe	Safe	Safe
14	Containment Vessel Pressure	Unknown	D/W: Unknown, S/P: Atmosphere	Stable	Safe	Safe	Safe
15	Water injection to core (Accident Management)	Continuing (Seawater)	Continuing (Seawater)	Continuing (Seawater)	Not necessary	Not necessary	Not necessary
16	Water injection to Containment Vessel (AM)	Continuing (Seawater)	to be decided (Seawater)	Continuing (Seawater)	Not necessary	Not necessary	Not necessary
17	Containment venting (AM)	Continuing	Preparing	Continuing	Not necessary	Not necessary	Not necessary
18	Fuel Integrity in the spent fuel pool	(No info)	(No info)	Level Low, Starting Water Injection	Level Low, Preparing Water Injection Damage to Fuel Rods Suspected	Pool Temp. Increasing	Pool Temp. Increasing
	Environmental effect	NPS border: 646.2μSv/h at 11:10, Mar. 17					
	Evacuation	20km from NPS* People who live between 20km to 30km from the Fukushima #1NPS are to stay indoors.					

Source: Japan Atomic Industrial Forum, Inc.

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Spent fuel pools and what "spent" really means (a)

When back-up generators failed, systems which add and cool water to "spent fuel" pools failed as well. There is something important to understand: "spent" does not mean "inert" or "reduced power". In fact, it's kind of the opposite. Nuclear power relies on uranium (b) that behaves in a predictable way, where "predictable" refers to heat generated when rods are placed near other uranium rods. This way, nuclear reactions can be modulated by plant operators using boron control rods. But over time, U-238 accumulates neutrons produced from the fission of U-235, eventually becoming neptunium and then plutonium. *Why does this matter?* When this happens, rods become *more* uncontrollable and radioactive. That's what is meant by "spent", in that their USEFULNESS is spent. The fission reaction results in a variety of radioactive elements such as iodine-131, cesium-137, strontium-90 and gases like xenon and krypton. Spent rods are *not* harmful if there is no damage to their zirconium casings, but melting of these rods release these isotopes into the environment. Why spent fuel pools can be worrisome:

** There are more radioactive fission products in spent fuel pools than in the operation reactors themselves

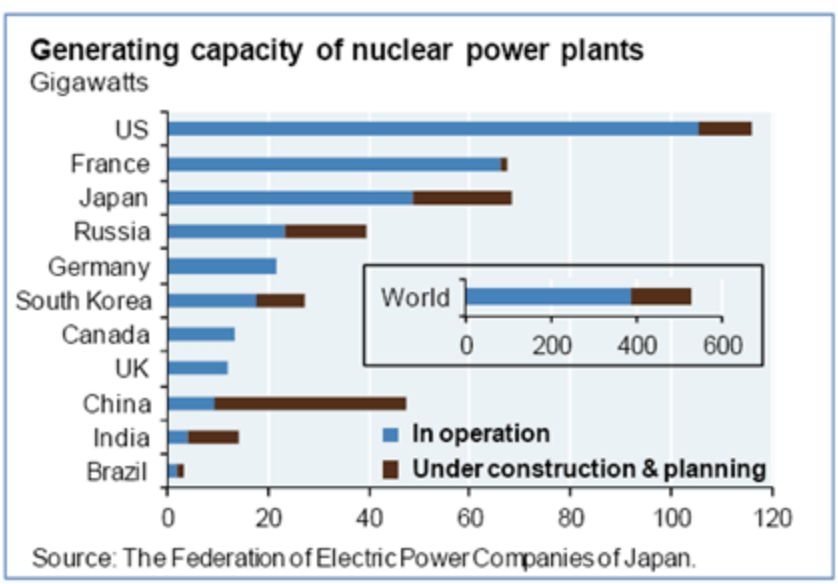
** Without cooling, spent fuel pool water evaporates and exposes these radioactive materials to the atmosphere. Yet they are not housed inside a containment unit like nuclear reactors are.

** Opinions about the rate of evaporation differ. According to the Nuclear Energy Institute (c), the rate of evaporation at plants like Fukushima is slow, only a few percent a day. But a Brookhaven National Laboratory study (d) on Boiling Water Reactors like those used in Fukushima estimates that **within 40 hours, all the water would evaporate**, and that plant operators only have 25 hours to address the problem. Furthermore, the Brookhaven study dealt with shutdown plants whose fuel rods were older and less "hot" than the more recently spent rods at Fukushima (implying an even *shorter* evaporation period).

** Fukushima spent fuel pools are located near the top of the reactors, making them harder to access. Even if plant operators refill emptied spent fuel pools, **they may not want to**: scientists we spoke with said the behavior of exposed rods to water (if they have begun to melt and lose their zirconium casing) is not predictable; is it like gas on a fire?

The spent fuel pool at unit #4 was reported to be out of water by the U.S. Nuclear Regulatory Commission. Either its water evaporated (e), or the pool suffered structural damage during one of the hydrogen-fueled explosions and leaked. Either way, exposed spent fuel rods render the area highly radioactive and less viable for human intervention. As for the nuclear reactor vessels themselves, there is still hope that even if exposed rods (lines 6 and 12) melt, they will be contained inside the vessel (line 7) with cooling powered by emergency pumps. But the 1800-degree melting point of the reactor vessel may be exceeded by the theoretical temperature of molten nuclear materials, which could rise to 2400 degrees.

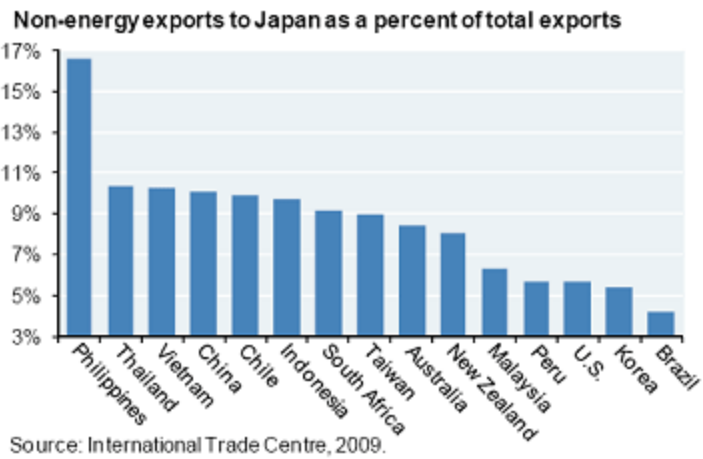
Why on earth are we going into this level of detail in an investments newsletter? What's happening is more than just a tragedy for Japan and its people. It's also a potential turning point in the approach to energy policy**.** The chart shows how planned nuclear capacity is 40% of the current installed base. Will Fukushima change anyone's plans? The U.S. Nuclear Regulatory Commission generally recommends a 10-mile barrier between U.S. nuclear plants and residential areas. However, the NRC recommended a 50-mile evacuation zone around Fukushima. This may surface questions about safety issues. The Union of Concerned Scientists just released a document entitled "*The NRC and Nuclear Power Plant Safety in 2010: Brighter Spotlight Needed*" after briefing Congressional staffers. Their conclusion: the chances of a disaster are low, but the NRC gets mixed reviews after 14 "near-misses" at U.S. nuclear plants during 2010. The events exposed a variety of shortcomings, such as inadequate training, faulty maintenance, poor design, and failure to investigate problems thoroughly. **The problem: there are not many easy answers for replacing planned nuclear bars in the chart**, **particularly in China**.



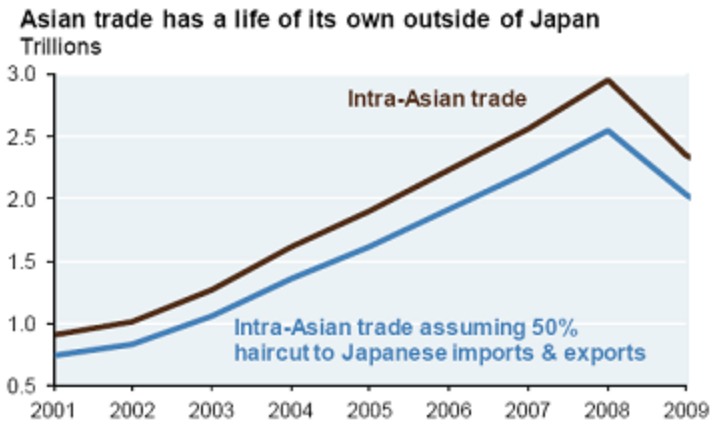
Whatever the outcome for nuclear power, we have been positioning in various ways for a world with increasing and changing energy needs. We are working with managers who focus on the exploration and development of oil and gas fields, mostly in the U.S., as well as on "midstream" businesses involved in the gathering, storage and distribution of oil and gas products. Other dedicated energy managers we work with focus on renewable energy, primarily in solar, wind and bio-mass power generation. Our generalist private equity managers are involved as well, including a 2009 investment in the Marcellus shale gas field which was subsequently sold to a strategic buyer for a substantial premium. On natural gas specifically, shale gas only accounted for 1% of North American gas supply in 2006. It's currently 20% and is expected to grow to 50% by 2030, which is why it has been an area of focus for our managers.

Potential economic impacts in Asia: we remain optimistic on the region's prospects

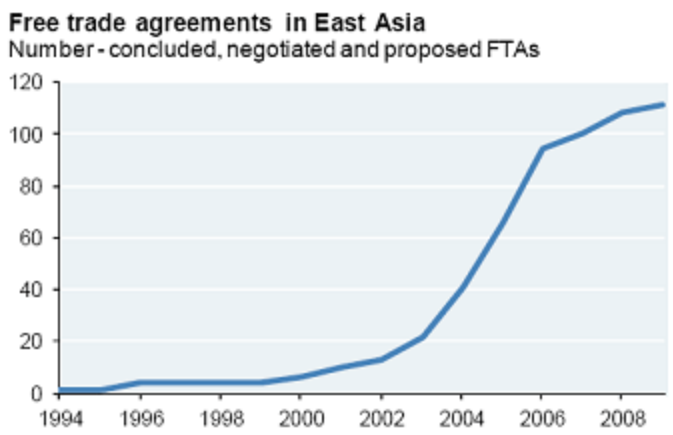
The first chart looks at which countries export a lot to Japan, excluding energy. Asia is clearly the potential loser. **However, Southeast Asia is likely to withstand reduced demand from Japan.** After all, Japan has only been growing at 1% over the last 5, 10 and 20 years. Furthermore, East Asia entered into a rising number of free trade agreements over the last decade which improved its ability to manage around disruptions to supply chains and production gaps. When you strip out Japan from the Asian trade picture, it's clear that **Asian trade has a life of its own**. We do not foresee a serious hit to regional growth, outside Japan itself. More evidence of how well-integrated economic regions withstand a crisis: note how **Texas** became a regional shock absorber after Hurricane Katrina, as some industrial and service sector activities migrated there on a temporary basis.



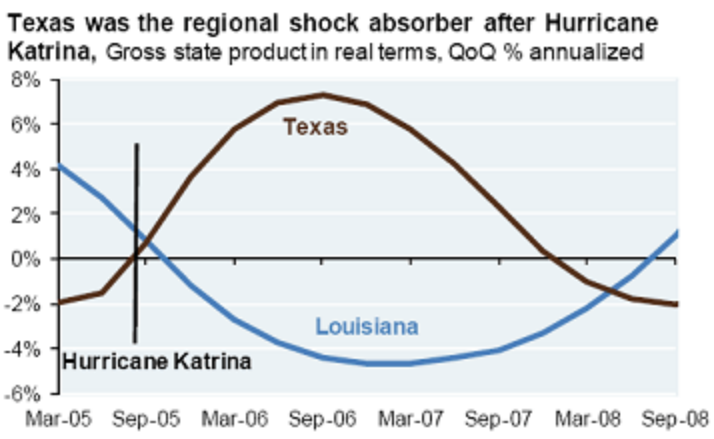
Source: International Trade Centre, 2009.



Source: International Trade Centre



Source: Asian Development Bank Asia Regional Integration Center.



Source: Moody's Analytics, Bureau of Economic Analysis.

As for the US, Japan accounts for around 1.5% of total S&P 500 revenues, with higher numbers (>10%) for multinationals like IBM, Corning, Altera and KLAC (f). The largest sector exposures are civilian aerospace, agriculture, drugs/medical equipment and telecommunications equipment. *Mitigating factor*: Japan is a relatively stagnant market for U.S. firms

(U.S. exports to Japan grew just 25% versus 82% to the rest of the world from 2003 to 2008) and tend to generate much lower margins there than elsewhere. After the initial demand shock, we expect some companies to benefit from rebuilding efforts in Japan, particularly those companies focused on heavy equipment, software for engineers and project managers, insurance brokerage, electrical equipment/process controls and construction.

I hope to return to normal investment commentary very soon, and if there are financial assets that are indiscriminately oversold, we will be sure to highlight them. We are *not* making any changes to our portfolio allocations, which is our way of saying that we do not expect the situation in Japan to tip the global economy into recession. We still believe that the manufacturing and service sector recoveries taking place in the US, Germany and China, coupled with exceptionally easy monetary policy, are strong enough to survive the various obstacles that have surfaced during the worst March I can remember (or at least since 2009).

Michael Cembalest

Chief Investment Officer

Notes

[a] This section incorporates conversations with David Walker (Higgins Professor of Earth and Environmental Sciences, Lamont-Doherty Earth Observatory), and a separate source with 40 years of experience in the industry as a Naval and private sector nuclear operations engineer, engineering manager and project coordinator for the construction and operation of nuclear power plants.

[b] Not all Fukushima facilities use uranium rods. Some rely on MOx fuel (a blend of plutonium, natural uranium, reprocessed uranium, or depleted uranium). Our understanding is that MOx fuel has a lower melting point; there is less experimental experience with it; and that it may be less sensitive to boron as a reaction moderator. Plutonium is cheaper to use due to the surplus of decommissioned weapons.

[c] "*Fact Sheet: Used Nuclear Fuel Storage at the Fukushima Dai-Ichi nuclear power plant*", Nuclear Energy Institute, March 15, 2011

[d] "*A Safety and Regulatory Assessment of Generic BWR and PWR Permanently Shut Down Nuclear Power Plants*", Brookhaven National Laboratory, August 1997. Our sources inform us that the technology used in spent fuel pools have not changed a lot since that time.

[e] It's possible that hydrogen explosions jostled the spent fuel rods or the boron dampers between them, accelerating their rate of evaporation

[f] "*Japan and S&P 500 EPS"*, UBS Global Equity Research, March 16, 2011

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