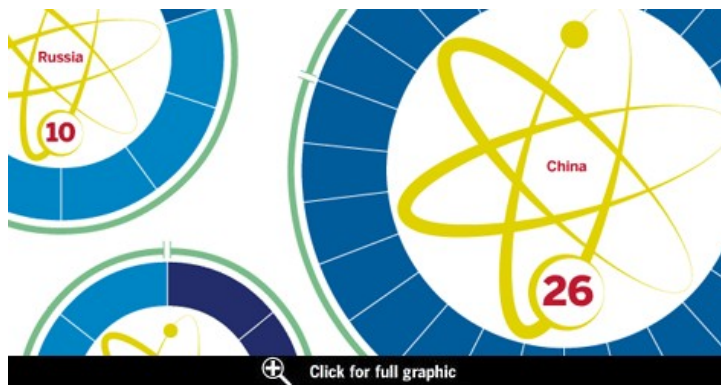


Nuclear power: Atomised approach

By Ed Crooks and Sylvia Pfeifer

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On Saturday April 16, a tornado hit the Surry nuclear plant in Virginia, cutting off the supply of power from the grid to the US site's two reactors.

A "station blackout" – the loss of the power supply needed to keep the reactors' cooling systems working – is the most serious threat a nuclear plant can face. That was what had caused the **crisis at Tepco's Fukushima Daiichi plant** in Japan a bare five weeks earlier. Reactors there began to **melt down** once the tsunami that followed the **March 11 earthquake** knocked out the back-up power supply used to pump water to cool the nuclear fuel.

It is the sort of threat that the **nuclear industry** must be able to handle if it is to have a future. With the world assessing the **impact of Fukushima**, nuclear executives know they need to regain the public's trust. As Jim Ellis, president of the Institute of Nuclear Power Operations, the US self-regulatory body, said last month, the industry is at a "pivotal point" after a "visible, visceral setback".

With fossil fuels becoming more expensive, concern about the threat of global warming remaining high and many renewable methods still unproven as large sources of electricity, this should have been nuclear's moment. Reactor suppliers such as **Areva** of France and the US-Japanese GE Hitachi and Toshiba Westinghouse – as well as generators such as **EDF** of France, **RWE** of Germany and Italy's **Enel** – were looking forward to a "nuclear renaissance" of investment in new reactors, in abeyance since the Chernobyl disaster of 1986.

About 440 nuclear power reactors are in operation around the world, according to the World Nuclear Association, an industry grouping. Another 60 are under construction and 493 more are planned or proposed, creating a market that could be worth thousands of billions of dollars over the coming decades.

In the aftermath of Fukushima, those hopes remain alive but have been cut back. In **Germany**, existing plants are facing closure. Nuclear power currently provides 14 per cent of the world's electricity but its future share is in question. The WNA's global nuclear stocks index has fallen by 12 per cent in US dollar terms since the Japan quake, compared with a fall of about 2 per cent in the US S&P 500 index. At a meeting of energy executives in New York on Monday, companies including **American Electric Power** and **Duke Energy** of the US as well as EDF, RWE, Enel and **Tepco** warned agitatedly that limiting nuclear use could bring countries "significantly higher costs, less CO2 free emission capacity and risks to reliability" in electricity supplies.

Yet the industry also has to reassure people not just that the specific failures at Fukushima cannot happen again but also that systems and procedures will minimise the risk of a different crisis hitting another reactor somewhere else. Any solution is likely to involve companies submitting to a much higher level of scrutiny.

At Surry, the back-up systems worked. Although a fuel tanker used to supply the on-site diesel generators was damaged by the tornado, they could be started up immediately and no unusual release of radioactive material occurred. The incident showed the face that the nuclear industry wants to present: able to deal with problems smoothly, according to well understood procedures.

Fukushima, however, has exposed a different picture. A preliminary report last week from the **International Atomic Energy Agency**, the Vienna-based watchdog, praised the response by the Japanese government and industry but pointed to weakness in the country's preparedness and regulations. "Nuclear regulatory systems should address extreme external events adequately, including their periodic review, and should ensure that regulatory independence and clarity of roles are preserved in all circumstances in line with IAEA safety standards," it said. As Dieter Helm, professor of energy policy at Oxford university, puts it: "How could a sophisticated country like Japan put its back-up generators in the path of a large wave? The question is, what else hasn't been checked?"

Worldwide reviews of nuclear safety have already begun to expose flaws in other countries. In the US, the government's Nuclear Regulatory Commission conducted a rapid assessment that found that of 65 operating reactor sites, 12 had "issues" with some of its safety requirements, often connected to training. Dave Lochbaum, a former NRC instructor who is now with the Union of Concerned Scientists, an environmental group, says: "The history of the industry is that it is very good at finding out what the problems are and what needs to be done. It is not very good at working out how to get that implemented."

Certainly, the industry is having to speak more humbly. "More than ever, we need to be seen as trustworthy, as fair and as transparent," says Vincent de Rivaz, head of France's EDF in the UK, where it is leading one of the developed world's most ambitious nuclear programmes. He adds: "There will be a before and an after Fukushima. The industry is determined to learn all the lessons." The company plans to establish a permanent focus group made up of industry stakeholders. The aim, he says, is to have "a third-party voice in our plans".

Craven Crowell, a former chairman of the Tennessee Valley Authority, the power company, now at the consultancy Oliver Wyman, says the public is "looking for reassurance". Moreover, that reassurance must cover the industry. As another nuclear executive puts it, "an accident that happens to one of us, happens to all of us".

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Solutions proposed address both crisis response and prevention. On the response side, Mr Ellis of Inpo and others are calling for skilled staff and equipment such as mobile pumps to be on permanent standby. Other proposals focus on tightening regulation to prevent the lapses that made the Fukushima calamity possible.

Pierre Gadonneix, the former EDF chief executive who chairs the World Energy Council, an industry grouping, says the current arrangement – where the IAEA makes recommendations but national authorities are mainly responsible for overseeing safety – "allows for too much variance between countries". In the longer term, "we need to promote a truly international level of governance".

BERLIN'S NUCLEAR EXIT

Germany calls time on ageing reactors in about turn

The German government's reaction to nuclear disaster in Japan has been drastic, writes **Gerrit Wiesmann**. **Angela Merkel**, chancellor, and ministers last week decided to close the eight oldest of the country's 17 nuclear plants by the end of this year. Another six will close between late 2015 and the end of 2021, and the last three by the end of 2022 if electricity demand still requires them.

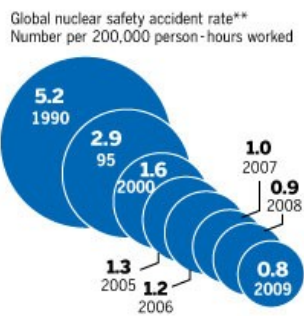
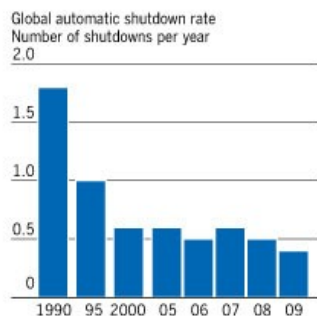
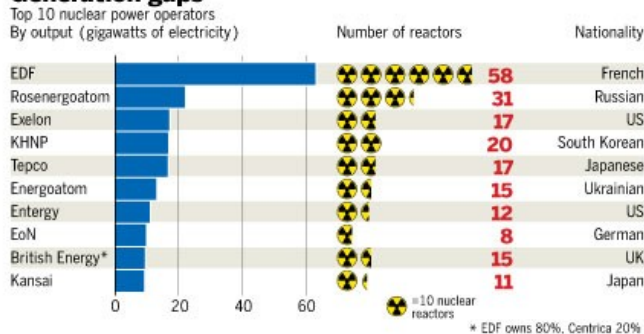
The government expects nuclear power, which produces 23 per cent of the nation's electricity, to be replaced in part by **gas**, but mainly by renewable energy, whose proportion of electricity production is meant to double to 35 per cent by 2020.

Simplified planning procedures, government loans and reforms to feed-in tariffs are among the bills the cabinet passed on Monday. These are meant to stimulate private investment in wind turbines, gas-fired power stations, transmission

Russia, which has a large domestic nuclear power industry and high ambitions for exports, wants the IAEA's safety standards to be compulsory. But member states are split and the IAEA's mandate is expected to be discussed at a meeting this month. Many experts are sceptical that the IAEA, which focuses on controlling proliferation, could regulate as well. Pat Upson, head of the security of supply working group at the WNA, says that with global regulation "you'd end up with the worst common system". Seth Grae, chief executive of Lightbridge, a US nuclear fuel company, adds: "I'm not saying the IAEA doesn't have a role, but I find it hard to see that it could be a regulator."

Instead, the answer may lie in a more vigilant system of self-regulation. In the US, Inpo provides an extra level of supervision beyond that offered by the NRC. Set up after the 1979 Three Mile Island accident, Inpo sends inspectors from its staff and other nuclear companies to grade every reactor in the country. To make the reviews as frank as possible the ratings are not widely published, but they can still have a significant impact. Insurers use them to calculate the cost of a plant's policy. They are also generally reported to the NRC and poor plants can face action.

Generation gaps



Sources: World Nuclear Association; World Association of Nuclear Operators ** Lost work time, restricted work or fatalities

Perhaps the strongest sanction, though, is that every year industry chief executives gather at Inpo's Atlanta headquarters for a closed-door meeting at which the operators of plants that are not rated as up to scratch are obliged to explain the remedial steps they plan to take.

Mr Crowell argues that the best way to improve safety and restore confidence is to globalise that model, through Inpo's international equivalent, the London-based World Association of Nuclear Operators. Wano already carries out peer reviews of its members. It does not award ratings, however, and has no means of forcing corrective action if problems are uncovered. "We need to put some teeth into it," Mr Crowell says.

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Wano has launched a 14-member "high-level commission" of present and former nuclear chief executives, led by Tom Mitchell of Canada's Ontario Power Generation, to look at how to strengthen its role. "The industry works best when you have both credible regulation and a strong industry association," says George Felgate, Wano managing director. "If either one is weak, then you have a problem."

The US system is not perfect. The Union of Concerned Scientists' Mr Lochbaum points out that since Three Mile Island, 48 US reactors have had to shut down for more than a year – suggesting Inpo did not catch and avert impending threats early enough. But he accepts Inpo does a good job of setting standards for training, and in sharing information. At US reactors, the number of "significant events" causing safety concerns dropped from 2.5 per plant in 1985 to just 0.1 by 2007. That is a better rate of improvement than for the industry globally, where "scrams" – unplanned shutdowns – fell from 1.8 per reactor per year in 1990 to 0.5 in 2008, according to Wano data.

Olli Heinonen, senior fellow at the Belfer Center for Science and International Affairs at the Harvard Kennedy School and a former deputy director general of the IAEA, supports the general approach but says the process should be more open. "There needs to be some kind of peer review of reactors and the conclusions of these should be made public," he says.

Mr Grae warns that many nations will be reluctant to open themselves up to scrutiny. "In a lot of countries the power sector is run by the government, and those governments won't want people going around making judgments about what they are doing," he says.

Yet many nuclear executives accept that the threat facing the industry is so serious that radical change is unavoidable. "Every nuclear executive I speak to shares the view that we need a stronger Wano," says Mr Felgate. "We just cannot have another accident, particularly not one caused by human error."

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networks and pump-storage systems. Germany's DIW economic research institute estimates investments could reach €200bn (\$293bn) in the next decade – but big industrial companies such as carmaker Daimler are **warning of a surge in electricity prices** and an end to a hitherto reliable supply.

Ms Merkel and ministers have dismissed such warnings, arguing nuclear phase-out will add less than one cent to the 10 cents per kWh that industrial users pay for electricity. That, says Ms Merkel, is a price worth paying to put Germany at the front of the green-technology charge.

The government had committed itself last year to shifting Germany to renewable energy sources, but it planned to keep nuclear power for another quarter century as a low emission "bridging technology". Less than five months before the mid-March disaster in Japan, the German parliament passed Ms Merkel's plan to extend the lifetime of Germany's nuclear plants by 12 years on average, shifting the nuclear phase-out to 2036 from 2022, a date set by a government of Social Democrats and anti-nuclear Greens almost a decade ago.

Within hours of the start of the disaster at Fukushima, the chancellor was moving back to the old date. The nuclear lifetime extensions had roused a largely **anti-nuclear public** and Fukushima threatened a full-blown popular backlash.