SCIENCE & DIPLOMACY

A quarterly publication from the AAAS Center for Science Diplomacy

Robin W. Grimes, Yuki Chamberlain, and Atsushi Oku, "The UK Response to Fukushima and Anglo-Japanese Relations," *Science & Diplomacy*, Vol. 3, No. 2 (June 2014). http://www.sciencediplomacy.org/perspective/2014/uk-response-fukushima-and-anglo-japanese-relations.

The UK Response to Fukushima and Anglo-Japanese Relations

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SCIENTIFIC advice and communication played a significant role in the response of the UK government to the accident at the Fukushima Daiichi nuclear power station after the Great East Japan Earthquake and Tsunami on March 11, 2011. The UK government, like many governments and organizations, used science to understand the progression of the accident and the implications for society. It also used science to inform its citizens through the British embassy in Tokyo and through the media. Most UK citizens based in Japan remained in the country throughout this period. The UK government was confident in supporting this stance, as it was in explaining many comments made by the Japanese government and providing context for the data being issued. The UK response has had a beneficial effect on UK-Japan relations since the incident and has led to a detailed discussion of science advisory systems.

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Background of the Fukushima Incident

The Tokyo Electric Power Company (TEPCO) operated a series of six nuclear power plants known collectively as Fukushima Daiichi.[1] On March 11, 2011, prior to the earthquake in the Fukushima area, three of the plants were operating normally, while the other three were in a condition known as cold shutdown. After the 9.0 magnitude earthquake, a tremor in the Fukushima area induced a successful automated shutdown of all the operating nuclear plants. As is normal, the cores of the reactors required further cooling by circulating water because any power reactor core continues to generate heat for weeks after being shut down. However, the massive tsunami generated by the earthquake, which inundated the coastal area and resulted in a catastrophic loss of life, overwhelmed the sea defenses at the Fukushima Daiichi site. The tsunami caused enormous damage including the destruction of backup diesel generators that would have powered the reactor water pumps.

Inevitably, the temperatures of the three reactor cores began to rise, leading to pressure increases within the steel reactor containment vessel. Once the temperature exceeded about 800°C, the water or steam began to react with metallic components within the pressure vessel, releasing hydrogen gas that escaped into the reactor buildings. Upon contact with the air, the hydrogen gas mixed with oxygen and detonated. That caused extensive damage to the reactor buildings and released radioactive material into the environment. As a consequence, on April 11, 2011, the Japanese government declared Fukushima Daiichi to be a Level 7 incident on the International Nuclear Event Scale. Although this is the same level as that for the 1986 Chernobyl accident, the extent of radioactive release at Fukushima was far lower and the destruction of the reactor environment much less extensive.

The UK Response

In response to the emergency, the UK government activated its Scientific Advisory Group for Emergencies (SAGE). This group is usually chaired by the UK government chief scientific adviser, who was at that time Sir John Beddington. It consists of the chief scientists and appropriate sector technical experts from each of the main government departments and in this case members of the nuclear laboratories and lead academics. SAGE convenes in a matter of hours and typically meets once a day until the emergency situation is resolved. As such it works on a different time scale than other advisory groups within the UK government system. SAGE first met in 2009 in response to the H1N1 influenza pandemic and then again in 2010 to address the impact of the Icelandic volcanic ash disruption on the United Kingdom. For the Fukushima accident, SAGE was responsible for helping to compile, peer review, and interpret scientific information relevant to the evolving situation, turning it into science advice for the prime minister and members of the

Cabinet Office Briefing Room, which makes decisions in emergency situations.[2, 3] The foreign secretary chaired the first SAGE meeting regarding Fukushima.[4]

At the time of the Fukushima incident, in order to understand the progression of the accident and its likely impact, scientists working in SAGE required information concerning the reactor designs, the state of the reactors before the accident, the release data from monitoring around Fukushima, and the forecast weather patterns. In this regard, a considerable amount of information was exchanged among similar groups in other countries and analysis was provided by the International Atomic Energy Agency, although the lack of real-time data was a problem. This exposes one big difference between delivering science advice for an emergency occurring within national boundaries as opposed to one outside. SAGE would have benefited from being better connected to decision-making groups in other countries. Moreover, SAGE is still evolving. Fukushima was only the third time SAGE had met to address a real event. It was not clear what roles and responsibilities various national agencies should take on, and this ambiguity became apparent during the heat of the incident. Because such problems are quite difficult to anticipate, exercises have been held subsequent to Fukushima to identify issues in advance.

Ultimately, from its assessment, the SAGE group was able to predict that the radionuclide release would be mostly confined around Fukushima. This meant that the hazard to people around Tokyo, where most UK citizens in Japan live, would be very small and thus there would be no need for an evacuation. Of course, people from areas besides Tokyo were also informed of any potential impact.

This recommendation, as well as other scientific recommendations during such circumstances, was based on a balance of probability with science informing the direction of the decision to be made. In this case, scientific evidence provided the confidence that underpinned the UK government advice to UK citizens in Japan and the decision not to mount an evacuation program for embassy staff. While the most cautious approach might seem to be to evacuate, that is associated with significant emotional, physiological, and health risks—to the people being evacuated and to their families and friends in Japan and back home.

Scientists in the United Kingdom also played roles. Of particular importance was the way scientists were given opportunities to present ideas and interpret the science to the public through the media, particularly through the independent Science Media Centre. At times, hardly an hour went by without an academic appearing on the main news channels. Thus, the public was able to hear both what scientists knew about the situation and what scientists were trying to understand. Among those appearing was Sir John, the government chief scientific advisor. The public was therefore able to hear that leading scientific knowledge was being used to underpin government decisions. Furthermore, other independent scientists were able to comment upon Sir John's views, offering a form of peer review. Ultimately, this contributed to public confidence in how the UK government developed strategies.

Response by the British Embassy in Tokyo

In just under twenty-four hours after the main earthquake and tsunami, world media attention was shifting toward and increasingly focused on Fukushima Daiichi, despite the other terrible events and consequences that occurred as a result of the earthquake and tsunami. News outlets carried stories of the potential power failure at the nuclear plant and potential meltdown of the cores by the end of that weekend. Concern over a potential nuclear accident was growing among UK citizens in Japan who were not directly affected by the natural disaster. Staff at the British embassy in Tokyo, which was not affected by the earthquake, were mobilized to form a Crisis Response Centre to guide relief efforts. The embassy team also provided consular assistance to displaced UK citizens who were directly affected, and it constantly monitored information in the media and from the Japanese government to brief colleagues in London.

Prior to the advice starting to flow in from SAGE, the embassy was advising UK citizens in Japan to follow the Japanese government's advice. At that time, the media were reporting varying levels of severity concerning the situation at Fukushima Daiichi; this uncertainty was becoming the principal concern of UK citizens. Other foreign missions in Tokyo were also providing advice—some were recommending a different evacuation radius around Fukushima, and some were advising citizens to leave Tokyo for other parts of Japan. Others went as far as to evacuate their embassies. Although as a whole Japanese society remained resilient and calm, there was considerable worry.

The UK government, through its embassy, was unusual in how it directly used science to inform its citizens in Japan. Sir John participated in four telephone conferences during which he provided information and engaged in Q&A sessions with both embassy staff and UK citizens in Japan. Transcripts and recordings of the conversations, along with other statements, were published on the embassy website for public view and were readily available through social media. This allowed people to hear directly of any possible implications and understand what constituted the "reasonable worst-case scenario."

The direct public engagement reinforced the perception of the evidence-based nature of UK government decision making. Not only did UK citizens find this information useful, it also reassured the Japanese public. At a time when the public was confused and unsure of the credibility of information carried by the media, an overseas science voice undoubtedly helped to calm the situation.

Japanese Perspective on the UK Response

After the earthquake and tsunami struck, TEPCO notified the Japanese government of the emergency situation at Fukushima Daiichi. The Japanese prime minister then made the Declaration of a Nuclear Emergency Situation[5] based on the Special Measures of Nuclear Disaster Act. Following this, the emergency

response systems, including the prime minister's Nuclear Emergency Response Headquarters and the Regional Nuclear Emergency Response team, were established, and they led the coordination of emergency response measures. This included the gathering and sharing of information concerning the development of the accident and the response and deciding what measures should be taken to protect nearby residents. However, these functions could not be carried out as planned. The simultaneous occurrence of the earthquake, tsunami, and nuclear accident disabled the prepared systems planned for use in a disaster, including the communication and transportation infrastructure. Furthermore, the division of responsibilities among the various organizations was not sufficient.

Although the Japanese government did not have as much information as it wanted regarding the accident progression, it did announce, mainly through the chief cabinet secretary, the information that could be gathered. The Japanese government focused on providing accurate information, which inevitably meant that overall the public felt they did not get information sufficiently quickly. In addition, the plethora of varying opinions and announcements and their contents engendered a degree of distrust between both the Japanese people and foreign residents in Japan and the Japanese government.[6]

The science analysis provided by the UK government, through its embassy, had been developed primarily to support UK citizens in Japan. But given the rate of information disseminated by the Japanese government, the UK analysis was also taken up by Japanese citizens. By putting the available information into a scientific context for their citizens, the UK government helped the Japanese government to regain confidence and afforded credibility to the information that had been announced, as well as some assurance to Japanese citizens. Other nations also contributed by, for example, sending radiation monitoring and decontamination equipment.

In contrast to the UK situation, no comparable processes or mechanisms existed for Japanese nuclear experts to provide equivalent advice to their government regarding Fukushima Daiichi. Thus, the existence of SAGE (as well as similar bodies in other countries) and mechanisms for providing advice have been informative as Japanese government officials consider revising the country's emergency response systems. Also, confidence in Japanese nuclear experts fell among Japanese citizens following the accident. Consequently, the advice of the United Kingdom's nuclear experts concerning the nuclear emergency response that Japan made, its nuclear-related organizations, nuclear safety regulations, and their participation in the expert meetings of related Japanese ministries and TEPCO were particularly useful.

With this in mind, the Japanese government has begun to review the role of the experts and the significance of their scientific advice, mostly in the area of nuclear energy policy and science and technology policy. The UK's knowledge and experience in using expert advice were introduced at: a meeting of the UK-Japan

Joint Committee on Cooperation in Science and Technology, which is held every two years; at the UK-Japan Nuclear Dialogue, established when UK Prime Minister David Cameron visited Japan in April 2012; and at the international advisory meetings of Japan's Nuclear Regulation Authority.

These processes are likely to continue, with UK nuclear experts and those from other countries, as Japan decommissions the Fukushima Daiichi nuclear power station and decontaminates and restores the surrounding area. UK experts, including Adrian Simper, director of strategy at the Nuclear Decommissioning Authority, have contributed by joining as international advisors of TEPCO and related organizations. While the custodial challenges of Fukushima will be considerable, the site provides an opportunity for the international nuclear community to gain unparalleled insights into such issues as water and radionuclide transport.

Effects on the UK-Japan Relationship

Following the Fukushima Daiichi accident, the UK secretary of state for energy and climate change asked Mike Weightman, the UK chief inspector of nuclear installations (of the Office for Nuclear Regulations), to review the accident and lessons learned to enhance the safety of UK nuclear facilities. This required close coordination with counterparts around the world—most importantly those in Japan—to gather details and facts. This functioned as an opportunity to share the expertise of the United Kingdom's nuclear industry and regulation framework with Japanese colleagues. An interim report[7] was published in May 2011, and the full report, commonly known as the Weightman Report, was issued later that year.

Although the conclusions made clear that the situation in Japan (such as its vulnerability to natural disasters) differed substantially from the UK, the report did derive important lessons. Most of these focused on the importance of resilience to natural disasters and potential power loss on nuclear sites. Many similar conclusions were reached by the reports[8] of the nuclear reactor stress tests that followed (such as the review of safety at European nuclear power plants requested by the European Council).

The United Kingdom also engaged proactively with the international community in its response to the Fukushima accident. In May 2011, Weightman traveled to Japan as the lead of an International Atomic Energy Agency (IAEA) expert mission. The main finding of this mission, as reported to the IAEA ministerial conference that month, was that risks associated with tsunamis in several sites in Japan had been underestimated. The mission's report[9] also suggested changes to Japan's regulatory structure to ensure that countermeasures for such extreme events could be addressed and periodically reviewed.

The formal and informal assistance provided by the United Kingdom to Japan in the aftermath of the Fukushima accident undoubtedly took bilateral relations

to another level. The functioning of the UK chief scientific adviser and wider science advisory structure was highlighted, and the value of UK technology in decommissioning and decontamination was rediscovered.

Sir John's visibility after the Fukushima incident shed light upon the structure of the science advisory system in the United Kingdom. The "voice of science" was clear in the United Kingdom, and scientists were confident in being able to say what they did and did not understand regarding the facts and circumstances. The chief scientific adviser and SAGE helped ensure that a fair and accurate scientific assessment was available. The clear presence of a government chief scientific adviser whose role in communicating to the public as a scientist (not merely as a government spokesperson) was presented as good practice; interest by the Japanese government for a similar system is growing. The two nations are conducting a dialogue to share the development of a similarly designed system.

Today, the United Kingdom and Japan are increasing the extent to which they collaborate in nuclear regulation, business, and research.[10] The UK government, mainly through the Office for Nuclear Regulations, is sharing its expertise in the non-prescriptive, goal-setting approach to regulation. The Nuclear Decommissioning Authority is sharing the extensive expertise of the UK nuclear industry, especially in setting up decommissioning strategies and introducing the related supply chain. Research and academic links are expanding. Japanese manufacturers are also moving into the UK nuclear new build market with the potential to cooperate much more in the supply chains of the two countries.

The decisions taken by the UK government have had additional and unanticipated benefits. First, the UK government's science-based communication and decision-making processes have been discussed internationally as a model of good practice. Second, UK nuclear sector experts enhanced their reputation by demonstrating they could be an effective community in this emergency situation. Third, the United Kingdom and Japan have developed a much closer nuclear cooperation in areas from research and development to new build projects and regulation.

Of course, taking a scientifically rational approach to decision making during incidents such as Fukushima Daiichi is more straightforward when the incident is not happening in one's own country. Notwithstanding, the United Kingdom's experience demonstrates how central the role of science and its communication has become in such circumstances, as are the benefits of shared resource and understanding and the help of relevant international agencies. Therefore, political considerations must not hinder the exchange of science knowledge and understanding in an emergency, which requires forethought in the form of science diplomacy. SD

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