received regular stipends or one-time grants from the nuclear industry. Nuclear engineer Akio Yamamoto of Nagoya University, for example, has received at least ¥50,000 (US$630) over the past three years from each of three companies related to nuclear energy, including Nuclear Engineering, a firm in Osaka that is affiliated with Kansai Electric Power. Although there is no suggestion that Yamamoto has done anything wrong, he also received some ¥27 million in grants from eight nuclear-energy companies during that period, as well as an undisclosed amount from Mitsubishi Heavy Industries, which builds reactors.

An NRA spokesman defended the team's composition, arguing that the report will be used only as a reference for the five NRA commissioners who will ultimately decide on the policy. (Those commissioners do not have similar ties with industry.) If the NRA had tried to rule out everyone with any connection to the industry when choosing the experts, the spokesman said, it would have run out of people.

These are fair points, and the fact that the team members had to disclose their contributions at all was a laudable nod to transparency. But playing down the importance of the report by saying it will just be used as a reference is unconvincing.

Much of the uproar over the handling of the Fukushima disaster came from the public perception that conflicts of interests led regulators, who were too tightly tied to the nuclear industry, to favour cost-savings over safety. The NRA, created in large part as an answer to that criticism, has itself been lambasted for moving many staff from the old regulatory structure to the new organization, including its head, Shunichi Tanaka. It seems that Japanese policy-makers, despite the many public demonstrations, still haven't got to grips with the tendency for conflicts of interest to lead to bad decisions and, even if they don't, to breed mistrust.

Similarly troubling is the rush with which the government reopened two of the country's shuttered nuclear reactors in July without fully evaluating the seismology of the ground beneath. Last week, at its second meeting, a subcommittee of the NRA could not confirm whether a fault line running under a seawater-intake channel — used to cool the reactors in an emergency — is active.

"Japan was supposed to emerge with a new respect for reactor safety."

At stake is whether the fault is a landslide fault or a more dangerous, deeper tectonic one. The NRA has ordered Kansai Electric, the plant's operator, to dig trenches to investigate the geology more thoroughly. That should take less than two months, but existing facilities at the plant are in the way, making it much more complicated — and expensive.

Even if the risk from that fault is trivial, as many think, critics point out that the threat of shaking from nearby faults, the potential size of a tsunami and the possibility of structural defects like those found at Fukushima have not been adequately characterized.

Large sectors of the public opposed the reactor restarts with demonstrations of a fervour not seen in Japan in decades. The country had already proved that it could get by, at least in the short term, with no nuclear power. Some scientists had pointed out the uncertainty over the seismic fault, and suggested how to deal with it, before the reactors were restarted. Japan was supposed to emerge from the Fukushima crisis with a new respect for reactor safety and better awareness of the need to convince people of that safety. It hasn't made a very good start. ■

Save scientific sites

The push to conserve cultural-heritage sites must not leave out areas of interest to science.

It is possible for an outsider to visit and enjoy the ancient city of Samarkand in Uzbekistan, home to the fifteenth-century observatory of the astronomer Ulugh Beg. That is in part thanks to the United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Convention, which this week celebrates its 40th anniversary (see page 328). Samarkand was put on the World Heritage List in 2001; the listing gives it important protection from the ongoing political chaos that has followed the collapse of the Soviet Union.

The observatory must have been lovely during the two decades that it was active. Contemporary reports describe splendid architecture and exquisite tiling and mosaics. Frescos illustrating the orbits of the planets and the exact positions of stars adorned the observatory's inner walls. It was largely destroyed by God-fearing hordes in 1449, but the innovative work of its scientists survived to influence Western astronomy and algebra. Using a sextant 40 metres in radius, astronomers at the observatory recalculated the positions of nearly 1,000 stars and compiled their results in the widely translated 1437 star catalogue *Zij-i Sultani*. They stabilized the sextant by anchoring it in a 2-metre-wide trench dug into a hill in the plane of the meridian. The measurements were of unprecedented accuracy: the astronomers used them to recalculate trigonometric tables and to calculate the length of the sidereal year (the time taken for Earth to orbit the Sun once in relation to the fixed stars) to within one minute of the measurement now accepted. Archaeologists discovered the remains of the observatory in 1908.

A place on the World Heritage List means that a site must be maintained with international-standard conservation methods, and not spoiled with inappropriate building development. International inspection teams visit to ensure compliance. Inspections of Samarkand revealed in the mid-2000s that conservation was under par, and that city planners, supported by local politicians, alarmingly failed to respect the integrity of the site. UNESCO called for increased monitoring of the site and threatened to place it on the List of World Heritage in Danger — although it has so far avoided this designation.

In the past few decades, scientists from many disciplines have developed techniques — ranging from lasers to nuclear technologies and microbiology — for conserving and restoring artworks and monuments. Scientists at the Foundation for Research and Technology — Hellas in Heraklion, Greece, for example, invented a laser with one beam in the ultraviolet range and another in the infrared to clean a frieze on the Parthenon, part of a World Heritage Site, without damaging its surface. The widely publicized work on the frieze was completed in 2005.

Understandably, scientists would like more funding to allow them to fine-tune such techniques. That is hard to justify generically — each archaeological site or monument has its own problems, with technical solutions that must be worked out on an individual basis. The story of Samarkand shows that politics — and thus the World Heritage List — is at least as important as science to the conservation of important monuments around the world. Funds for cultural-heritage technologies must be maintained as part of a broad approach to consider cultural heritage more widely. City and regional plans to cope with climate change, for example, should be required to consider the impact on cultural heritage. The European Commission is quietly voicing support for such a push, and it should be encouraged to speak louder.

Very few of the 962 entries on the World Heritage List involve scientific sites, perhaps because science is not automatically thought of as a part of culture. However, astronomers have begun to do something about this. In the 2009 International Year of Astronomy, astronomers worked with a UNESCO advisory group, the International Council on Monuments and Sites, to produce a list of astronomical sites that they think are, like the Samarkand Observatory, worth saving. These include the nineteenth-century Royal Observatory in Cape Town, South Africa. If this site is designated as a World Heritage Site, interest surrounding it might encourage the much-desired development of science in the country. Other scientists should follow the astronomers' example. ■

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