that Bush requested. Under Obama, the project may stop altogether.

"Leaving it where it is, putting it centrally or reprocessing it can all be done. But in all cases, there has to be a final resting point for the solid waste," says Corradini. "It's pretty clear from an international perspective that geologic disposal of high-level waste, and probably of any nuclear waste, is the favoured option," adds John Garrick, chairman of the US Nuclear Waste Technical Review Board, based in Arlington, Virginia.

Some countries are well on their way towards siting a repository: Finland is working on a repository at Olkiluoto, which could be operational by 2020. Sweden is finalizing research on two candidate disposal sites and expects to choose one by the end of the year.

In both Finland and Sweden, the key to success was that governments adopted a cautious time schedule and a stepwise approach and involved the local community from the start, says Barbara Pastina, a nuclear-waste scientist at the Helsinki-based engineering firm Saanio and Riekkola Oy. In Finland, she says, "the whole nation was represented in the decision to build the repository" at Olkiluoto. The community had the right to veto the location at the beginning, and parliament voted on the decision. After early setbacks, Canada and the United Kingdom are also on track to find geologic repositories for long-term storage. Canada reorganized its national waste-management efforts in 2002 and is moving towards a siting phase, whereas the United Kingdom restarted in 2001.

By contrast, powerful states' efforts to avoid hosting the repository have stymied US attempts to find a site. Senator Harry Reid (Democrat, Nevada), now the Senate majority leader, has fiercely opposed the project from the beginning, and many Nevadans are still fighting the Yucca Mountain proposal. "They've always felt that it was hoisted on them rather than them volunteering," says Todd Allen, an assistant professor of nuclear engineering at the University of Wisconsin.

Public consent has been the missing ingredient in Yucca Mountain from the beginning, agrees McCombie. The trick to finding another location, he says, is a "modern approach that combines good science with a consensus of enough people that it's the right thing to do". The United States hasn't built a nuclear power plant in three decades, but a resurgence of nuclear power is on the horizon. The NRC is considering licences for 26 new nuclear power plants, and construction could begin as early as 2012 — increasing the pressure on the country to solve long-term disposal once and for all. ■

Amanda Leigh Mascarelli

CALTECH

ENERGY-SCIENCE CZAR Steve Koonin heading for US Department of Energy post.
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Brain imaging skewed

Double dipping of data magnifies errors in functional MRI scans.

Nearly half of the neuroimaging studies published in prestige journals in 2008 contain unintentionally biased data that could distort their scientific conclusions, according to scientists at the National Institute of Mental Health in Bethesda, Maryland.

Experts in the field contacted by *Nature* have been taken aback by the extent of the methodological errors getting through the supposedly strict peer-review systems of the journals in question.

Nikolaus Kriegeskorte, Chris Baker and their colleagues analysed 134 functional magnetic resonance imaging (fMRI) studies published last year in five top journals — *Nature*, *Science*, *Nature Neuroscience*, *Neuron* and *The Journal of Neuroscience*. The survey, published in *Nature Neuroscience* on 26 April (N. Kriegeskorte, W. K. Simmons, P. S. F. Bellgowan and C. I. Baker *Nature Neurosci.* 12, 535–540; 2009), found that 57 of these papers included at least one so-called 'non-independent selective analysis'; another 20 may also have done so, but did not provide enough information to confirm suspicions.

The non-independence of the analysis lies in using the same data to set up the conditions to test a hypothesis, then to confirm it. "We are not saying that the papers draw wrong conclusions, because in some cases the error will not have been critical," says Baker. "But in other cases we don't know, and this creates an ambiguity."

"It is a poor reflection on the quality of peer review of prestige journals — they really need to up their game in terms of rigour," says Karl Friston, scientific director of the Wellcome Trust Centre for Neuroimaging at University College London.

Brain imaging provides vast quantities of data in the form of voxels (three-dimensional pixels), from the entire brain. Neuroscientists sometimes focus on an area of interest by searching for voxels that are activated when subjects perform different tasks in an experiment — for example, looking at a face or an inanimate object.

But fMRI data are intrinsically very noisy, producing many 'false voxels'. Problems arise when researchers use the same data to select a particular brain region and then to quantify the experimental effects there — for example, by asking how much more strongly the region responds to a face compared with an inanimate object.

"It is crucial to analyse your results with a set of data that are independent of that used in the earlier selection process," says Chris Baker. "It is even OK to split your total data and use one half to select the voxels, and the other to further analyse the response in these voxels."

A similar type of error has been addressed by Edward Vul of the Massachussetts Institute of Technology in Cambridge and his colleagues (E. Vul, C. Harris, P. Winkielman and H. Pashler, *Perspect. Psychol. Sci.* 4, 274–290; 2009). A preprint of their research caused uproar in the field earlier this year by referring to 'voodoo correlations' and naming labs it considered guilty of circular analysis (see *Nature* 457, 245; 2009).

"The issue of selection bias doesn't require special understanding of statistics — it is not rocket science."

In contrast, the study by Kriegeskorte and Baker does not single out any researchers. "We didn't name names because the error is just too common," says Baker. "And we saw no reason to be personal — our idea was to highlight a problem so people are less likely to fall into the trap."

"This new paper is less controversial, but potentially more worrying," says Friston. "The issue of selection bias doesn't require special understanding of statistics, just the following of good practice — it is not rocket science."

Baker points out that circularity errors creep into many areas of neuroscience. "It applies equally to single-unit electrophysiology, electroencephalography, gene microarray studies or even behavioural data," he says. But fMRI data are particularly vulnerable because of the complex analysis demanded by their huge volumes, and because so many untrained outsiders are entering the field. "For those of us with a few years of fMRI experience the issue is entirely passé, but there will always be a substantial minority on a steep learning curve," says Friston. "What surprised me is how frequent the errors are."

Baker notes that the increasing complexity of the data "probably leads people to take their eye off the ball so that the more fundamental aspects don't get taken care of". ■

Alison Abbott