J-Value Rating Service For Assessing Nuclear Safety Systems

Research area: Nuclear Hazards and Risks

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The Challenge

After both major world nuclear accidents, at Chernobyl in 1986 and at Fukushima Daiichi in 2011, mass relocation of people was the primary policy response by governments. 116,000 people living near Chernobyl were moved out by the authorities in the months following the 1986 accident, never to return. The second evacuation of 220,000 4 years later served little purpose - it averted 3 months' loss of life at most. Relocation was sensible for between 10 and 20% of the total number, 335,000, of people evacuated in total.

The aim of the research was to determine how best should you respond after a big nuclear accident has occurred?

The Solution

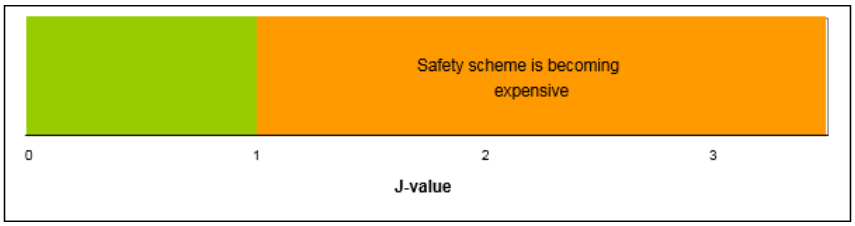
The J-Value method is a logical, objective and easily understood metric. It has now been validated against empirical data on the judgements of billions of people across the world. The game-changing J-value method can counter the suspicion of conventional cost-benefit analysis applied to nuclear plants that is widespread amongst public, politicians and the media alike.

Whilst higher expenditure on a more elaborate or more reliable safety scheme is likely to increase the gain in life expectancy, it will decrease the amount available to spend elsewhere. Individuals will stop spending on safety once the gain in overall satisfaction from living longer is exactly balanced by the decrease in enjoyment from having less money at their disposal. The J-value may then be calculated as the ratio of the actual or planned safety investment to the ideal safety spending occurring at the balance point.

A J-value of less than one indicates that the spending is justified. A J-value greater than one suggests that spending resources may not be justified. Thus, for example, J = 2 implies that twice as much as society normally wishes is being spent on this safety scheme.

SOUTH WEST NUCLEAR HUB

Figure 1



The J-value has been used to rate the post-accident management measure, mass relocation, that was applied both at Chernobyl in 1986 and at Fukushima Daiichi 25 years later.

116,000 people living near Chernobyl were moved out by the authorities in the months following the 1986 accident, never to return. But what if these evacuees had stayed in their homes? 85,000 would have lost, on average, 3 months' life expectancy, just two thirds of the 4½ months the average Londoner loses to air pollution at the current time.

J-value analysis shows that these people would have benefited more by remaining in their homes as the relocation measure applied to them gave a J-value of more than one. The J-value confirms that 31,000 people needed to be relocated as they would have lost more than 9 months of life expectancy by remaining and so $J \leq 1$ in their case.

J-value calculations show that none of the extra 220,000 people relocated in 1990 should have been asked to move out. Overall, the J-value shows that 80% to 90% of the 335,000 people in total moved away from the Chernobyl area ought to have been allowed to stay in their homes.

The arguments for relocating people from towns and villages subjected to a lower radiation dose than Tomioka are correspondingly weaker. It is difficult to justify any long-term evacuation after Fukushima Daiichi.

The Impact

The results were presented in Parliament to the All-Party Parliamentary Committee on Nuclear Power in 2015, and at a follow-on meeting with the Chief Scientific Adviser to the Department of Energy and Climate Change. Discussions have been held with the Chairman of Japan's Nuclear Damage Compensation and Decommissioning Facilitation Corporation.

The formal results of this research project were published in November 2017 and were marked by a conference and public lecture held at the University of Bristol. This launch attracted a large amount of national and international press coverage including in The Times newspaper and on the BBC.

The French Institute of Radiation Protection and Nuclear Safety (the French nuclear regulator) wishes to work with the University of Bristol to extend and apply the NREFS results. Professor Thomas has also presented the research to the Federal Emergency Management Agency in the USA and the UK Health and Safety Executive.