Coping with a big nuclear accident: Summary and Conclusions

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NREFS examined how best to cope with a big nuclear accident like Chernobyl (1986) and Fukushima Daiichi (2011)

- Nuclear power has grown since its inception 73 years ago to the point where it now supplies an **eighth** of the world's electricity.
- **435** nuclear power plants are in operation worldwide, with **72** new stations under construction.
- Severe nuclear accidents are rare but experience shows that they can occur and **we need to know how to cope with them**.

Chernobyl NPP accident

- 26th April 1986
- 30 immediate deaths of power station workers
- 116,000 relocated in 1986
- 220,000 relocated post 1990

Fukushima Daiichi NPP accident

- 11 March, 2011
- 160,000 evacuated
- No radiation deaths
- 1,121 deaths from the evacuation
- 267,000 people displaced after the tsunami

Objective methods are needed for rigorous justification of coping strategies:

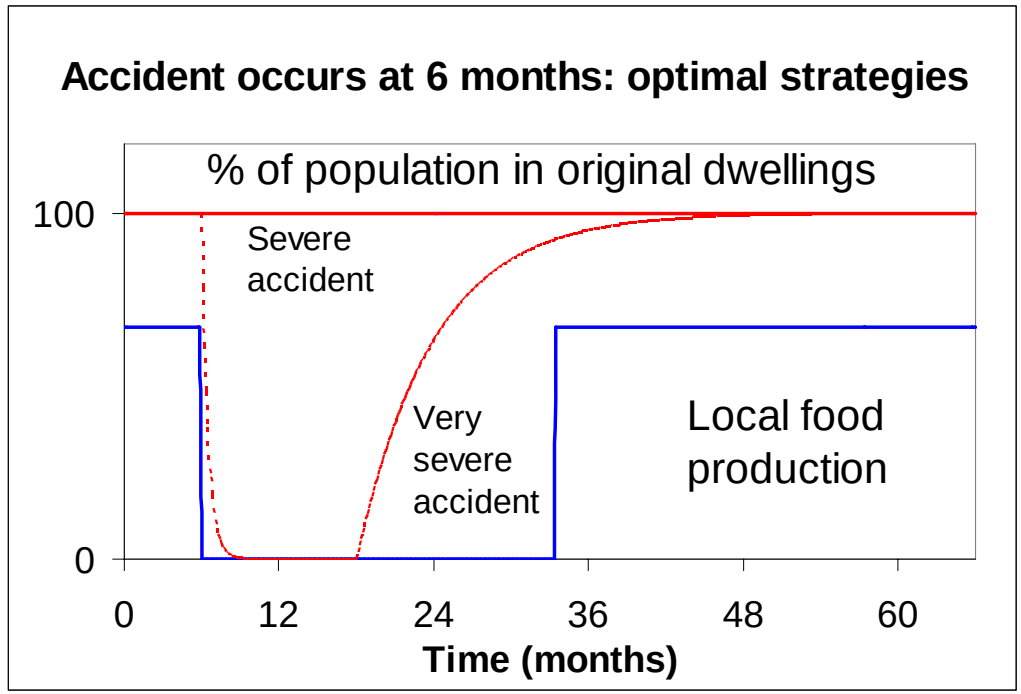
- **The Extended Marshall** method for calculating loss of life expectancy caused by radiation exposure.
- **Judgement- or J-value**, which balances the gain in life expectancy again the cost of the countermeasure.
- **Optimal control**, which minimises total economic loss (with human harm translated into money terms).
- **Cost of consequences model, COCO-2**, from Public Health England.
- "System 2" (reflective) thinking is needed rather than the knee-jerk response of "System 1".

Objectively, the scale of potential threat to the public is small **even after the worst nuclear accident**

- Even if no-one had been evacuated and relocated after Chernobyl, the loss of life expectancy amongst the worst-affected **6,000** people in Ukraine would have been about **3½** years. (*Remember London vs. Manchester*?)
- The gain in life expectancy from the worst affected **2,000** people of the **220,000** relocated in the 2nd phase was **2 months** (*Remember London's air pollution?*)

The objective models concur on the desirability of minimising long-term relocation

- **J-value** shows that **95%** of people relocated after Chernobyl should **NOT** have been.
- **Optimal economic control** shows that people should often be left *in situ*, with local food production restricted for about two years.



- The COCO-2 model of a **fictional reactor** in southern England undergoing a severe accident (equivalent to the accident at one of the 4 Fukushima Daiichi reactors) suggests that permanent relocation would be needed for only about **600** people.
- The biggest danger, as being found in **Japan** now, is of over-reaction in the face of widespread uncertainty and misperception of the limited scale of the hazard – **1121 premature deaths** in 3 years as a result of **relocation**, destruction of the local community.

UK sheep restrictions post-Chernobyl

- The restrictions on Welsh and Cumbrian lamb imposed after Chernobyl were not lifted until 2012, when they were costing hundreds of times too much and extending UK lives by **~30 seconds**.
- Keeping them in place for 26 years constituted an over-reaction to Chernobyl.

Lessons to be learned

- The big lesson is **how small** the radiation damage is to the members of the public from even the biggest nuclear reactor accidents.
- Most of the harm has come from what can now be seen to be **unjustified fear and worry** and from the **social disruption and dislocation** caused by relocation of hundreds of thousands of people.

Conclusions

- While big nuclear accidents are bad things, we can say now that the radiation harm to the public will be limited **even in the worst cases**.
- Everyone ought to know this.
- The focus should be on
  - getting this message out
  - preparation in advance
  - sensible measures (giving a Judgement-value of 1.0)
  - minimising relocation
  - measuring and monitoring
  - keeping the public informed.