Five years ago scientists recommended a thyroid protection strategy in the event of a nuclear reactor accident. Why is it that the Nuclear Regulatory Commission has not yet adopted these emergency safety measures?

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The NRC and thyroid protection —one excuse after another

On March 1, 1954, the United States fired off a large nuclear weapon over Bikini in the South Pacific. Five hours later coral blown miles high by the blast filtered down like snow over the inhabited atoll of Rongelap, some 100 miles downwind. This fallout was radioactive. The population was evacuated before anyone received a lethal dose of radiation, but years later the children began one after another to develop thyroid tumors. By the time these children reached the age of 21 almost all had undergone thyroid surgery and had been place on thyroid medication for the rest of their lives.[1]

The cause of the damage to the children's thyroids was the radioactive iodine in the fallout, which had contaminated their drinking water. Because the thyroid gland, whose function is necessary to normal growth and metabolism, concentrates any iodine in the body, the children's small and rapidly developing thyroids had received a greatly magnified dose of radiation.

Since the story of the Rongelap children was written up in the medical literature, there have been periodic proposals to have a thyroid protection strategy available in case there should be a large release of contaminated steam containing radioiodine during a nuclear reactor accident.[2] Particular attention has been focused on thyroid protection because, measured in terms of the numbers of people who could be affected, thyroid damage is potentially the largest single hazard from an accident.

The number of damaged thyroids that would have resulted from a meltdown accident with failure of containment at Three Mile Island could have ranged, depending upon the wind direction, from thousands to hundreds of thousands of cases.[3]

Fortunately medicines exist that could protect the thyroid from radioiodine. In 1979 one of these, potassium iodide, an inexpensive chemical found in small amounts in "iodized" table salts, was certified "safe and effective" for use in a radiation emergency by the Food and Drug Administration.[4] If taken in the recommended dosage just before exposure, the nonradioactive iodine in the potassium iodide will saturate the thyroid and block the uptake of radioiodine inhaled or swallowed during the next 24 hours.

In order to be able to protect thyroids in an emergency, however, it would be necessary to have large quantities of potassium iodide available in the proper dosages. For this reason a study group of which I was a member made a recommendation to the Nuclear Regulatory Commission in 1975 that "a national policy of stockpiling thyroid-blocking chemicals for possible emergency distribution should be established."[5]

The Commission did not follow up on our recommendation—perhaps because its regulations required that nuclear power plants be designed so that the risks from major releases of radioactivity would be "negligible."[6]

In March 1979, however, the events at Three Mile Island made the probability of a major release seem not so negligible after all; at some moments a large release appeared likely. Therefore, three days after the accident began, in a frantic effort initiated at 3:00 a.m., the Food and Drug Administration asked first one drug company and then others to begin production of potassium iodide solution. Air Force and commercial jets and Army trucks brought 250,000 one-ounce bottles of the thyroid-blocking chemical, and 250,000 eye droppers together for assembly and then shipment to Harrisburg.[7] The government moved with impressive speed once it had made its decision. But if there had been a major radioactive release at Three Mile Island, the drug probably would have arrived too late.

One might have expected that after this experience the government would immediately have taken steps to make sure that it would not be caught again without either the thyroid-blocking chemicals or a distribution system. However, the Nuclear Regulatory Commission's staff has given one reason after another for not acting.

The first reason was concern about the possible side effects of potassium iodide. When asked, however, to explain why the staff disagreed with the FDA's conclusions that "the risks from the short-term use of relatively low doses of potassium iodide in a radiation emergency are outweighed by the risks involved from exposure to radioiodine," Harold Denton (Director of the NRC's Office of Nuclear Reactor Regulation) responded in July 1979 that they had none. But Denton had another reason for opposing thyroid protection: "For higher doses of radiation to the thyroid (greater than 1 rem), it may be better to evacuate the population."[8]

If the staff's previous concern about possible side effects from potassium

iodide was surprising, the implications of this new proposal were mind boggling. Thyroid doses of tens to hundreds of rem are possible more than 100 miles downwind from a reactor accident. Washington (at 90 miles) and New York (at 160 miles) would have been well within the range of thyroid-damaging doses of raioiodine had there been a major release at Three Mile Island. And there are many other nuclear power plants much closer to both cities. Did Denton really prefer the possibility of facing a decision to evacuate Washington or New York within a matter of hours to the alternative of having thyroid protection available?[9]

Such questions apparently had some impact because there were no more assertions from the Nuclear Regulatory Commission that evacuation was an adequate alternative to thyroid protection medicine. Early in 1980, however, a new argument against potassium iodide was discovered. The NRC staff had done a cost-benefit analysis that concluded that stockpiling "potassium iodide appears only marginally cost-effective at best."[10] The "proof" assumes, among other things, that given a population of approximately 100 power reactors such as the United States has today, a large release of radioactive iodine from a reactor accident will occur only once in a thousand years.

Stockpiling potassium iodide against such an unlikely event would obviously be a waste of money. But can we be confident that a serious reactor accident is that improbable? Where did the staff get the one-in-a-thousand reactor years release probability anyway?

The probability estimate came from the NRC's 1975 Reactor Safety Study (also known as WASH-1400 or the Rasmussen report). The calculations made in this report became so controversial, however, that in 1977 the NRC was forced to set up a special outside committee to review them. As a result of this review,[11] in early 1979 the Commission announced that:

"In the light of the Review Group conclusions on accident probabilities, the Commission does not regard as reliable The Reactor Safety Study's numerical estimate of the overall risk of reactor accident."[12]

The staff's cost-benefit calculation was therefore based on an estimate of the likelihood of an accident that the Commission had more than a year earlier officially dropped as unreliable.

It is now five years since our group recommended a thyroid protection strategy, and the NRC staff is apparently still unwilling even to *think* seriously about the subject. Why? Perhaps the answer lies in the history of the Commission.

Until 1975 the Nuclear Regulatory Commission was part of the old Atomic Energy Commission (AEC), an agency whose primary civilian mission was to promote nuclear power. Because of its promotional orientation, the AEC tended to play down the serious hazards associated with nuclear power. This tendency is what ultimately caused Congress to break up the AEC in 1974 and split off the Nuclear Regulatory Commission as a separate regulatory agency. Most of the NRC's senior staff dates back to the AEC, however, and these old-timers brought along with them some of the original reluctance to face "sensitive" regulatory issues.[13]

The question of stockpiling potassium iodide is a sensitive issue because if the Commission visibly prepares for the possibility of a large release of radioactivity, the public may become convinced that such an accident is not only possible but probable.

It is no longer part of the NRC's job description, however, to make the political environment safe for nuclear energy. And even if it were, the agency should have learned from the history of the Atomic Energy Commission. whose overprotectiveness ultimately backfired and became the nuclear industry's biggest liability. Now it seems that the NRC has come to the same crossroads. Unless the public soon sees the Commission making some of the hard decisions on reactor safety that the Atomic Energy Commission refused to make, it is likely to become a majority view that the only safe nuclear power plant is the one that has not been completed. It might seem an irrational conclusion in view of the fact that the public has quietly accepted much greater hazards such as nuclear weapons in its midst—but it would be an understandable one.□

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1. Robert A. Conard and others, *A Twenty-Year Review of Medical Findings in a Marshallesic Population Accidentally Exposed to Radioactive Fallout,* BNL 50424 (Upton, N.Y.: Brookhaven National Laboratory, 1975).

2. R. O. Chester and C. V. Chester, "Emergency Planning for Accidental Radioactivity Releases from a Licensed Nuclear Facility," in *Health Physics Division Annual Progress Report for Period Ending July 31, 1973,* ORNL-4903 (Oak Ridge, Tenn.: Oak Ridge National Laboratory, 1973), p. 172; "Report to the American Physical Society by the Study Group on Light Water Reactor Safety," *Reviews of Modern Physics,* 47 (Summer 1975), p. 109; National Council on Radiation Protection and Measurements, *Protection of the Thyroid Gland in the Event of Releases of Radioiodine* (NCRP, 1977), p. 55.

3. The calculated number of cancer deaths

under the same assumptions ranged from hundreds to tens of thousands. Jan Beyea, "Some Long-Term Consequences of Hypothetical Major Releases of Radioactivity to the Atmosphere from Three Mile Island." Draft Report to the President's Council on Environmental Quality (Princeton University, Center for Energy and Environmental Studies, Sept. 7, 1979).

See also U.S. Nuclear Regulatory Commission, *Reactor Safety Study* (WASH-1400, 1975), pp. 117-25.

4. *Federal Register* (Dec.15, 1978). p. 58798.

5. "Report to the American Physical Society."

6. Since in early 1975 the Nuclear Regulatory Commission had just been severed from the old Atomic Energy Commission, I must refer to an AEC document for a contemporary articulation of this position. The following passage is taken from the AEC publication, *The Safety of Nuclear Power Reactors and Related Facilities* (WASH-1250, 1973), p. 5-19:

"Defense in depth through multiple physical barriers, quality assurance for design, manufacture and operation, continued surveillance and testing and conservative design are all applied to provide and maintain the required high degree of assurance that potential accidents more severe than the design basis accidents will remain of such low probability that environmental risk is negligible."

The NRC has estimated that in a design basis accident only one in 10 million radioactive iodine atoms in the reactor core would be released from the containment building of a pressurized water reactor and even less from the containment of a boiling water reactor. In contrast, for an accident involving a reactor core meltdown and a failure of the containment building (as a result of over-pressure or a steam explosion), it was estimated that 10 to 90 percent of the radioactive iodine in the core would be released to the atmosphere. See U.S. Reactor Safety Study, Table VI-2-1.

7. Robert Reinhold, "Frantic Team Effort Provided Vital Chemical for Endangered Area," New York Times, April 4, 1979, p. A-16.

8. Memorandum for Commissioners Richard T. Kennedy and John Ahearne from Harold R. Denton, Director, Office of Nuclear Reactor Regulation, "Use of Thyroid Blocking Agents in an Emergency Response Program" (July 13, 1979). Enclosure, "Response to Commissioner Ahearne's Questions Concerning Thyroid Blocking Agents," p. 3.

9. Frank von Hippel, letter to NRC Commissioner John Ahearne, August 14, 1979.

For two calculations of average thyroid doses versus downwind distance that are in close agreement with each other, given the same assumptions about the magnitude of the release, see D. C. Aldrich, P. McGrath, and N. C. Rasmussen, *Examination of Offsite Radiological Emergency Protective Measures for Nuclear Reactor Accidents Involving Core Melt* (Nuclear Regulatory Commission, NUREG/CR-1130, 1978); or Jan Beyea, "Some Long-Term Consequences."

The NRC report shows *adult* thyroid doses of 130 and 30 rems respectively at distances 90 and 160 miles downwind from a large release of radioactive iodines from a reactor accident. Thyroid doses to children would be 2 to 5 times higher. The NRC value (n.3) for the child/adult dose ratio is two (which is approximated then as one). The EPA value is five. (U.S. EPA "Environmental Analysis of the Uranium Fuel Cycle, Part II: Nuclear Power Reactors," EPA-520/9-74-003-C, p. 113-18.)

10. David C. Aldrich and Roger M. Blond, *Examination of the Use of Potassium Iodide (KI) As an Emergency Protective Measure for Nuclear Reactor Accidents* (U.S. NRC Draft NUREG/CR-1433, March 1980), p. 31.

Two other assumptions made in this widely distributed draft report are as follows:

- In discussing the benefit side of its "cost-benefit" analysis the report mentions but does not take into account in its calculations the fact that the thyroid blocking medicines would protect the thyroids of a large fraction of the U.S. population from reactor accidents at more than one reactor. Within 200 miles of New York City, for example, there are 13 operating power reactors. Within about 100 miles from Washington, D.C. there are 10 operating reactors. The quantitative cost-benefit analysis assumes implicitly, however, that each person in the United States is within 200 miles from, at most, one reactor.
- On the cost side of the analysis, the report assumes that any thyroid protection strategy would necessarily require the stockpiling of 200 million bottles, each containing a 14 days' supply of potassium iodide for an adult.

11. *Risk Assessment Review Group Report to the U.S. Nuclear Regulatory Commission,* NUREC/CR-0400 (NRC, 1978).

12. Nuclear Regulatory Commission, "NRC Statement on Risk Assessment and the Reactor Safety Study Report (WASH-1400) in Light of the Risk Assessment Review Group Report," January 18, 1979.

13. The President's Commission on the Accident at Three Mile Island (generally known as the Kemeny Commission) expressed its concern about this attitude in its report:

"While some compromises between the needs of safety and the needs of an industry are inevitable, the evidence suggests that the NRC has sometimes erred on the side of the industry's convenience rather than carrying out its primary mission of assuring safety."

The Need for Change: The Legacy of TMI (1979), p. 19.