INTRODUCTION

FIRST: Our next speaker is Dr. Dade Moeller, also a long-time attender at the Air Cleaning Conferences, and for many years a member of the Program Committee. He has taken a very active role in the conduct of the Conferences, and has made major contributions with his technical papers. He is currently President of Dade Moeller and Associates, located at New Bern, North Carolina. He worked for the US Public Health Service as a commissioned officer from 1948 to 1966, with assignments that included Oak Ridge National Laboratory, Los Alamos National Laboratory, and the headquarters offices of the US Public Health Service in Washington, DC. From 1968 to 1983 he was Professor of Engineering and Environmental Health, and Chairman of the Department of Environmental Health Sciences at the Harvard School of Public Health. During those years, Dade and I worked very closely together, and it was a delightful experience for me. He is a first-class scientist and a wonderful person to work with. From 1983 to 1993 he became Associate Dean for Continuing Education at Harvard School of Public Health. It is interesting that Dade was a member of the Advisory Committee on Reactor Safeguards from 1973 to 1988, and for a number of those years was Chairman. I invited him to introduce our current chairman but he said their tenures did not overlap and he thought perhaps he didn't know quite enough about the speaker to undertake that assignment. Dade is a certified health physicist and a diplomate of the American Academy of Environmental Engineers. He has received the distinguished achievement award of the Health Physics Society, and a meritorious achievement award from the US Nuclear Regulatory Commission in 1988. He is a member of the National Academy of Engineering, dating from 1978. He is author of a textbook, now going into its second edition, entitled Environmental Health. Dade has many more honors, but I'm taking up too much of his time, so I will stop at this point. It is a delight to have you here, Dade. The topic of his talk is, "Application of Innovative Policies for Controlling Radionuclide Releases: The 'Open-market Trading Rule'". I think you will find this a very interesting concept.

APPLICATION OF INNOVATIVE POLICIES FOR CONTROLLNG RADIONUCLIDE RELEASES: THE "OPEN-MARKET TRADING RULE"

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Abstract

In the past, most efforts for reducing airborne radionuclide releases and controlling radioactive wastes have been directed to the development of new and improved technologies. Little attention has been paid to the possible application to these problems of new, innovative policies. Yet, experience in other fields shows that such applications could be beneficial. A prime example is the "open-market trading rule," now being widely used in the U.S. for the control of a range of environmental problems. Through this rule, nuclear facility operators would be permitted to control airborne emissions in a more cost-effective manner, and those responsible for decommissioning and decontaminating nuclear facilities no longer in operation could do so at far lower costs while generating significantly smaller volumes of radioactive wastes. Application of such a policy would also significantly reduce the demands on existing, and the need for research to develop new, improved, control technologies.

I. Introduction

Most efforts for reducing airborne radionuclide releases from operating nuclear facilities have been directed to the development and application of new and improved technologies. This is also true in the case of the decommissioning and decontamination of commercial nuclear power plants and the cleanup of nuclear installations under the control of the U.S. Department of Energy (DOE), as well as in the management and disposal of the associated radioactive wastes. Little attention has been paid to the possible application of new, innovative policies. Yet, experience in other fields of environmental protection shows that the application of such policies might be beneficial. The purpose of this paper is to review one such policy that may prove useful, namely, the "open-market trading rule."

II. The "Open-Market Trading Rule"

Through the "open-market trading rule," the U.S. Environmental Protection Agency (EPA) permits an industry that is having a problem with excessive releases of a given toxic chemical either: (a) to spend whatever is required to reduce the releases; or (b) to "make room" for the releases either by purchasing and shutting down other industries discharging the same toxic

chemical within the same geographic area, or by assisting other dischargers of the same pollutant in reducing the quantities of their releases.

One of the major benefits of this approach, sometimes called "emissions trading," is that it enables industrial and governmental organizations to control pollutants in the most cost-effective manner.(1) That is to say, if one company can control their releases of a given toxic agent at a lower cost than another, it is wiser for the second company to assist the first in its cleanup efforts than to spend more money in trying to reduce its own releases.

Initially, the "open-market trading rule" was applied solely to the control of a single toxic chemical within a single environmental medium. Under the Clean Air Act, for example, U.S. industries are permitted to optimize releases to the atmosphere based on mitigative technologies, thereby "trading" exposure rights.(2) In effect, this Act permits industries to buy and sell pollution rights and encourages one industry to assist another in reducing its airborne releases, if this can be accomplished at lesser costs. The same type of optimization is permitted under the Clean Water Act to control discharges to lakes and rivers. With the increasing success of this approach, however, its applications have been extended to broader arenas. For example, through an emission allowance program, the rule is being used to control airborne emissions that cause acid rain, thus providing opportunities for additional low-cost reductions of sulfur dioxide emissions. In fact, an allowance market for such emissions has been established by the Chicago Board of Trade.(3) The rule is also being applied to trade-offs in which industrial and community organizations have been given permission to create artificial wetlands to replace those that have been (or will be) destroyed by industrial and commercial development.

But the broadening of the applications of this rule has not stopped here. In recent months, still wider applications have been explored and implemented. EPA, for example, is now exploring trade-offs among different pollutants within the same medium (for example, trade-offs between releases of oxides of sulfur and oxides of nitrogen to the atmosphere), as well as trade-offs among several media, so called "cross-media" trading whereby releases of one or more pollutants to the atmosphere can be balanced against releases of other pollutants to the water environment.(4)

To exploit the benefits of this rule, EPA is proposing that it be applied on a generic basis and they are encouraging State and local agencies to create new, innovative programs for its application.(5) In fact, the EPA Assistant Administrator for Air and Radiation has stated that "EPA's experience with these trading programs, and with our own successful acid rain program, (has) led us to conclude that properly structured programs can reduce emissions earlier and cheaper than would otherwise be

possible."[6] Dan W. Reicher, J.D., Chief of Staff, U.S. DOE, has also expressed interest and support for the concept. Concurrently, application of the "open-market trading rule" has received widespread endorsement from various independent "watch-dog" agencies, such as the U.S. General Accounting Office.[7,8] In addition, the concept has been endorsed by a variety of other groups,[9,10] and it is being applied internationally as part of the worldwide efforts to reduce airborne emissions that could lead to global warming. One of the major benefits of this concept is that it requires that an integrated or systems approach be applied to the control of environmental releases of various pollutants.

III. Applications of the Concept to Nuclear Facilities

Although the applications cited above have proven extremely successful, it appears that the "open-market trading rule" would have even greater benefits in the control of airborne releases from operating nuclear facilities, in the cleanup of contaminated nuclear facilities, and in the control of associated wastes. These benefits, which are unique due to the origin of the radiation sources affecting typical population groups, include those of a technical and economic nature as well as public education and goodwill. Perhaps surpassing all of these benefits, however, is the fact that applications of the "open-market trading rule" to the control of environmental radiation exposures may prove to be exactly the vehicle needed to expedite the cleanup of decommissioned commercial nuclear power plants and various DOE facilities. It may also enable State and local regulatory groups and nuclear facility operators to ensure that financial resources for the control of radiation exposures are being directed to those sources that contribute the highest dose and can be controlled at least cost.

As an example, consider the operation of an existing nuclear facility or the cleanup of a facility that is no longer in operation. As in most such cases, the goal will be to assure that offsite population groups will not be exposed to radiation doses in excess of the applicable limits. The basic steps required in applying the rule to such a situation, and the benefits that would be accrued, are outlined below. As will be noted, in certain cases, application of the concept requires changing the ways in which exposures from such sources have been viewed in the past.

Basic Steps

1. As an initial step, there would be a need to assess the full range of radiation sources that affect nearby population groups. Such sources include natural background radiation, medical and dental uses, and consumer products, as well as contributions from the nuclear facility.

   The benefits of this exercise would be several. First of all, it would require all concerned parties, both within

and outside the facility, to apply an holistic approach to the assessment and evaluation of the various radiation sources affecting nearby members of the public and stakeholders. Other benefits would be gained in terms of public education since it would reveal to nearby groups the major sources of their exposures. In essentially all cases, the nuclear facility would prove to be a minor contributor.

2. The next step would be to rank the various sources according to their relative contributions to the doses to offsite population groups. Once this had been done, the dose rates from each source would be compared to the relevant mandatory limits, where such limits exist. This would lead to the identification of those sources to which controls must be applied and the quantification of the degree of reduction that is necessary. It is only after these basic reductions in dose rates have been achieved that the "open-market trading rule" would be applied.

   For facilities being decommissioned and/or decontaminated, such an assessment would need to include the decision on whether the site on which the facility is located is to be released for unrestricted or restricted use -- with appropriate consideration of the degree to which this affects the amount by which the associated dose rates must be reduced. As a minimum, restoration efforts would probably need to be applied to the nuclear facility to reduce the accompanying dose rates to neighboring population groups to the long-term standard dose rate limit of 1 mSv (100 mrem) per year, as recommended by the International Commission on Radiological Protection and the National Council on Radiation Protection and Measurements,[11] and as required by the regulations of the U.S. Nuclear Regulatory Commission.[12] Under terms of the "open-market trading rule," additional cleanup of the facility would be required only if it were more cost-effective as compared to other sources affecting local population groups.

3. Subsequent to this step, each individual contributor (from both onsite and offsite sources) to the radiation dose rates to offsite population groups would need to be evaluated in terms of its feasibility for control, including a review of the applicable control technologies, associated costs, and potential societal impacts. On the basis of this evaluation, each source would then be ranked in terms of its priority for reduction and/or control.

   Following this approach, public health and regulatory agencies, as well as members of the public, would soon learn that, in many cases, it would be far more effective and less expensive to reduce exposures to offsite groups from indoor radon or medical sources, than to continue to

pursue additional controls on airborne releases from operating facilities or to proceed with additional cleanup of a nuclear facility that is no longer operating. Studies have shown, for example, that reductions in exposures to indoor radon (and its decay products) can be accomplished at relatively low cost.[13,14] Other steps that could be taken include the installation of a more modern (reduced dose) mammography x-ray unit or an improved fluoroscopy screen in the local hospital, as well as encouraging wider scale application of newer techniques, such as endoscopy and colonoscopy, in place of x-ray fluoroscopy, as a primary means for conducting gastrointestinal examinations. Additional steps that might be considered include developing better controls for handling the excreta from medical patients to whom radiopharmaceuticals have been administered.

4. Once doses due to releases from the nuclear facility had been reduced to the basic mandatory standard, attention would be directed to the control of other sources for the required additional dose reductions, for example, down to perhaps 0.1 to 0.25 mSv (10 to 25 mrem) per year. As explained above, this would be accomplished by reducing those sources that can be reduced most effectively and at least cost.

Based on this information, a definitive plan of action for remediating the dose rates to the offsite population living in the neighborhood of the given facility would be proposed, taking into account the input of the facility operators, regulatory authorities, the local populace, and related stakeholders.

IV. Benefits of the "Open-Market Trading Rule"

There is a multitude of benefits that would be generated as a result of the application of the "open-market trading rule" to the cleanup of nuclear facilities.

Benefits

1. First and foremost, this rule would require the use of an integrated or systems approach in assessing and controlling radionuclide releases and associated radiation exposures. One of the immediate outcomes would be to provide significant latitude to State and local regulatory officials, as well as facility operators, in selecting which sources should be addressed to accomplish the required dose rate reductions.

   a. Having been provided this latitude, such officials and facility operators could direct their attention to sources, such as natural radiation background and medical radiation applications, which currently contribute over 95% of the total dose to the average member of the U.S. public.[15]

b. This would also permit regulatory officials and facility operators to direct their attention to those sources that can be most effectively controlled at least cost.

2. Another benefit would be significant reductions in the associated costs of nuclear facility operation and/or cleanup and the volumes of radioactive wastes being generated.

   a. Because of the reduced controls and cleanup required, there would be ancillary reductions in the demands on associated technologies.

   b. There would be similar reductions in the expenditures required for research on the development of new, improved technologies.

3. This approach would serve as an outstanding tool for educating the public on the relative importance of various radiation sources. In this regard:

   a. The procedures involved would offer unusual opportunities for involving and gaining the approval of offsite populations and stakeholders for programs proposed for the operation and cleanup of nuclear facilities.

   b. This approach would enable nuclear facility operators to demonstrate on a one-on-one basis their interest and concern for controlling dose rates to local population groups. In many cases, application of this approach would enable facility operators to reduce the dose rates to neighboring populations to levels less than they were prior to the original construction and operation of the facilities. This becomes possible, as noted above, because of the relatively high dose rates currently coming from medical and natural background sources, such as indoor radon, and the fact that many of these sources can be readily controlled.

4. Application of this rule would enable nuclear facility operators to begin now to reduce the dose rates to offsite population groups, not having to wait until all the environmental and associated administrative and regulatory requirements had been met.

5. It would provide a cushion in case the engineered barriers installed to control environmental releases did not perform as designed, or unanticipated failures occurred in various natural and engineered control systems. In such cases, facility operators could immediately apply additional controls to other radiation sources while awaiting corrections to be made in the controls being applied to the nuclear facility.

6. Application of this policy would enable State and local regulators to apply a risk-based approach to the cleanup of nuclear facilities. This has long been a major goal of the EPA, the U.S. Congress, and many State and local regulators.

7. A program such as this would provide a stimulus to the efforts of the EPA and various State and local environmental and public health groups to encourage the monitoring and control of exposures to members of the public from indoor radon. It would also provide a stimulus for increased assessment and evaluation of the radiation doses associated with medical procedures.

8. In the case of U.S. Federal nuclear facilities, such a program would provide a new and challenging mission for the DOE National Laboratories. These Laboratories represent a rich resource of scientists and engineers whose expertise would be extremely beneficial in evaluating, analyzing, and applying the concepts associated with such a program. Participation in such activities would bring them into the mainstream of DOE's environmental restoration program.

9. This approach would provide an initial step in the ultimate development of a system for making similar tradeoffs among the various human and environmental impacts of toxic chemicals and radiation sources. Here, again, the DOE National Laboratories could play a major role.

V. Commentary

As noted above, application of the "open-market trading rule" would offer a range of benefits to State and local officials and industrial organizations in their efforts to improve the control of airborne releases and the cleanup of nuclear facilities as well as to apply a risk-based approach to associated decision-making.

In addition, it appears that application of such a rule would be entirely consistent with directives issued by the President. Under Executive Order 12866, all Federal agencies, including DOE, are required, in setting regulatory priorities, to "consider, to the extent reasonable, the degree and nature of the risks posed by various substances or activities within its jurisdiction," and to "design their regulations in the most cost-effective manner to achieve the regulatory objectives.(16) In doing so, each agency shall consider incentives for innovation, consistency, predictability, the costs of enforcement and compliance (to the government, regulated entities, and the public), flexibility, distributive impacts, and equity," and "each agency shall indentify and assess alternative forms of regulation and shall, to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt."

What is needed is the conduct of several pilot studies to demonstrate the feasibility of the concept through its application to one or more nuclear facilities. In terms of the commercial nuclear utilities, such studies might be directed to several of the plants for which decommissioning operations are underway or contemplated. In terms of DOE, such studies might be directed to the control of radionuclide releases from one or more operating faciities or to the cleanup of sites such as Hanford, Idaho Falls, and West Valley. Although application of this approach might not prove viable for the control of facilities in which the principal radionuclide contaminants (for example, ^{239}Pu) are extremely long-lived, it would be directly applicable to the control of doses from facilities in which shorter-lived radionuclides, such as ^{3}H, ^{60}Co, ^{90}Sr, and ^{137}Cs, play dominant roles. For many facilities, this is the case.

Once these studies have been completed, the resulting reports and analyses could be submitted to the National Academy of Sciences/National Research Council for review and evaluation. Assuming that such a review would result in their endorsement, Federal, State and local regulatory agencies and plant operators would be armed with a powerful tool for the more effective control of radiation doses to offsite population groups. They would also be provided with a vehicle that would enable them to move ahead with the cleanup of the vast array of Federal nuclear facilities now awaiting action. Proving success in the radiation arena could well lead to more widespread applications of the concept. Such applications might ultimately include trade offs in exposures derived from combinations of radioactive materials and toxic chemicals.

Application of the "open-market trading rule" to the control of doses to offsite populations from nuclear facilities would represent professional environmental and public health practices at their best. This approach would also serve as a superb tool for educating the U.S. public in gaining a better understanding of the relative significance of various radiation sources in their everyday lives.

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DISCUSSION

FIRST: I was wondering about the aspect of not requiring reductions by nuclear facilities as an offset. How do you reconcile that with the ALARA principle?

MOELLER: I have no problem whatsoever reconciling it, because I am practicing ALARA at the highest level. This is more ALARA than any nuclear facility ever thought of, because I am looking at all sources. I am saving money, that's ALARA.

FIRST: But the reality is that the regulation applies only to nuclear facilities.

MOELLER: Correct. And that is where we obviously need to make some changes. But I think we would have very little difficulty making these changes because of the support of the concept by the congress, by all of the federal agencies, and so forth. I don't mean to be flippant, but I really think that once people understand it, we will have no problems. Obviously it is going to take education of the public, the technical community, and our politicians.

FIRST: Do you think it is possible to educate the public? Look what has happened over the past fifty years with regard to trying to educate the public, not only with nuclear power, but also sanitary landfills, incinerators, and Olestra, the latest on the hit list. What gives you hope?

MOELLER: What gives me hope is the following example. At a public meeting around the XYZ Nuclear Facility, I would say all of you are taxpayers. For fifty dollars per person, (or five hundred or whatever the number is), I can reduce your dose fifty millirems a year. Would you rather have me do that by controlling something in your personal environment, radon, medical x-rays, consumer products that you use or would you rather control the same amount of dose within this nuclear facility at a cost of a million dollars per person. I think if that approach is used often enough, we will prevail, I am an optimist. I know it is going to be difficult, but if there is ever to be any hope of educating the public about the risk associated with various sources of ionizing radiation, this policy may provide a vehicle. And at the moment it seems to me to be one of our best vehicles.

DAUBER: Do you think we will have to have a congressional or a bureaucratic implementation of this principle to make it work, or can simply education do the job?

MOELLER: I believe we already have much of what we need. As I mentioned, the Chief of Staff of DOE is for it, the top people in EPA are for it. In fact they've spoken out, and have written on it. Congress is for it. I am not a lawyer or even a legislative authority, but I can see no obstacles to it if we can get the right people to get going. What is needed, immediately, is to conduct a pilot study at Hanford, at Idaho Falls, West Valley, at Oak Ridge. We need a few pilot studies. Once they have been completed the results should be submitted to the National Research Council for an independent review.