PUBLIC HEALTH SERVICE SAFETY PROGRAM

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ABSTRACT

Off-Site Radiological Safety Programs conducted on past Plowshare experimental projects by the Southwestern Radiological Health Laboratory for the AEC will be presented.

Emphasis will be placed on the evaluation of the potential radiation hazard to off-site residents, the development of an appropriate safety plan, pre- and post-shot surveillance activities, and the necessity for a comprehensive and continuing community relations program.

In consideration of the possible wide use of nuclear explosives in industrial applications, a new approach to off-site radiological safety will be discussed.

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The Public Health Service Safety Program began in 1954, when the U. S. Atomic Energy Commission (AEC) and the Public Health Service (PHS) entered into a contractual arrangement called a "Memorandum of Understanding."

This document stipulates that the PHS is responsible for assuring the safety of the public - off the test site proper - from any nuclear tests conducted by the AEC. Although the original document referred to the Nevada Test Site, just north of Las Vegas, we have since participated in tests conducted in New Mexico, Mississippi, Alaska, Central and Northern Nevada, and the Pacific.

There were four oriiginal objectives of the PHS program:

1. To verify the off-site radiological situation associated with tests to insure protection of the public from radiological and other effects of nuclear testing; and, in the event unacceptable situations develop, to effectuate appropriate protective actions as required.

2. To document, through radiation monitoring and environmental surveillance, the radiation exposure to off-site areas.

3. To assure the public, through personal contact and a program of community relations and public education, that all reasonable safeguards are being employed to protect public health and property from the effects of testing.

4. To investigate incidents involving radiation or its effects which could result in claims against the U. S. Government or create unwarranted adverse public opinion.

In recent years these objectives have been supplemented with three additional objectives:

a) To document any increase in environmental levels of radioactivity due to nuclear testing.

b) To conduct special studies to determine transport phenomenology of radioiodine in environmental and biological systems and to determine its effect on man.

c) To assist other agencies in the protection of the public from injury due to the seismic effects of nuclear tests.

The surveillance program was initially limited to the area within approximately 300 miles of the Nevada Test Site. Subsequently, the program objectives were expanded to include the 22 contiguous states west of the Mississippi River, and to the other areas when tests are held outside this region.

Keeping the aforementioned objectives in mind, the PHS program can be subdivided into six general categories:

1. Monitoring and surveillance programs.

2. Population and milk cow statistics and distribution.

3. Community relations and public education.

4. Veterinary investigation.

5. Medical investigation.

6. Bioenvironmental research.

At this point I would like to briefly review with you the essence of these six categories and then take you through an actual Plowshare project, Gasbuggy, to illustrate how the program and objectives are carried out.

Monitoring and surveillance includes routine surveillance of air, water, milk, and vegetation, and event-oriented surveillance performed by mobile teams in conjunction with specific events. Detailed population and milk cow surveys are conducted around sites prior to tests. This census is detailed as to numbers of adults and ages of children by specific location. The survey includes all individual family cows as well as grade grade A dairy cows.

The results of monitoring and surveillance efforts just mentioned are continuously scrutinized to determine the possibility that there was or will be significant ingestion or inhalation of radioactivity.

The Southwestern Radiological Health Laboratory (SWRHL) operates a sophisticated and extremely sensitive whole-body counting facility as a part of our Medical Program. The mobile monitors and aircraft crews are more directly exposed to any effluent cloud than the general population. As soon as possible, these men are returned to the laboratory, appropriate bio-assays are made, and each man is given a whole-body scan to determine the amount and distribution of radionuclides in the body. These data, together with dose estimates derived from radioactivity in milk and water samples, furnish conservative estimates as to the maximum doses that could have been received by the general population.

Continuous efforts are made to retain good relations with the public through personal contact, the dissemination of timely information on nuclear events, and an explanation of the steps being taken to assure public safety. An important part of this program is the day-to-day contact of SWRHL monitors with the people in the performance of their duties.

To the general public, nuclear explosions instantly recall the horrors of Hiroshima. This association and the resulting fears must be treated with respect by the field monitors, who at the same time explain technical details of the particular event being conducted and the associated safety measures that have been or are being taken. In many cases the public actively participates in the safety program by operating air, milk, and water sampling stations as well as exposure rate recorders.

The safety program is not only concerned with radiation effects on man, but the animal population as well. The veterinary or animal investigations program was originally established during the atmospheric testing days to investigate claims of beta burns to domestic livestock and wildlife. Although since the advent of the limited test ban treaty, the number of such claims has diminished considerably, we still, from time-to-time, receive complaints from ranchers with sick animals. Each of these claims is carefully and thoroughly investigated and the disease or ailment is diagnosed. The veterinarians assigned to this program work closely with local veterinarians and participate actively in professional veterinary organizations. In addition to these activities, an experimental beef herd, in excess of 40 animals, has been maintained on the Nevada Test Site, from which samples of bovine tissue and bone are taken periodically to determine the concentrations of fission and activation

products. A comprehensive study of wildlife on and adjacent to the test site has, and is, being conducted in cooperation with other agencies to assess the radionuclide content of edible species. The results of these studies are available in the open literature and show no radiation either to the animal or the consuming public.

Physicians on the laboratory staff, trained in radiation medicine, investigate claims of personal injury from the public. They also operate what is called the Medical Liaison Officer Network, also referred to as MLON. This network is comprised of physicians in almost all of the 50 states who are knowledgeable in radiation injury. Local investigations in the area immediately surrounding the NTS are made by the Laboratory's physicians, whereas those at greater distances are handled through the MLON physicians. Whichever method is used, local specialists may be called into the investigation for consulation or assistance; for example, in an investigation involving a skin condition, a dermatologist may be consulted.

The philosophy of the MLON is not to state simply that this is or is not a radiation injury, but rather to make a definitive diagnosis.

Simultaneously with the above mentioned action programs, the Laboratory conducts long-range safety studies as part of the Bioenvironmental Research Program. As an oversimplification, this program's mission is to investigate the transport and biological effect of radionuclides as they move from the source to man through the food chain. Initially, the program was established to investigate the behavior of radioiodine, although other radionuclides of concern are or will be investigated. Again, stated quite simply, the objective of this research is to develop reliable predictive models, whereby having a known source term and known meteorological conditions, you can predict to an accuracy of a factor of two at the 90% confidence level the amount of radioactivity in the food chain available to man within a fallout area. It is anticipated that our investigations into radioiodine will permit us, by mid-1969, to predict the average peak levels of radioiodine in the milk of dairy cows fed feed from a fallout area - when the source of radioiodine and the meteorological conditions are known.

Other speakers have referred to "Project Gasbuggy." I too would like to use it as a typical Plowshare underground engineering experiment and illustrate how the above-mentioned safety program operates.

As has been mentioned, Gasbuggy was detonated on December 10, 1967, in a gas-bearing media approximately 55 air miles east of Farmington, New Mexico. The actual concept of the experiment was developed some years before, and in 1965 the Laboratory was first approached to do a paper study of the environment. This feasibility study, with participants from many AEC contractors and the Lawrence Radiation Laboratory, resulted in the conclusion that the project could indeed be carried out with safety and a promise of success in fulfilling the technical objectives. When the agreement was signed on January 31, 1967, between the Government and industry, the full program effort began.

At this point, our Laboratory made the initial contact with officials of the State Health Department of New Mexico. We outlined the project as proposed by the AEC and asked the State's assistance in conducting the Off-Site Radiological Safety Program. Working in complete partnership, the staffs of the Laboratory and the State commenced the initial gathering of census data on population, domestic livestock, wildlife, and other environmental media necessary to develop a comprehensive program. After receiving source term information and possible meteorological conditions, these data together with the census data were consolidated and analyzed, and a draft operational safety plan was developed. This plan, which pointed out certain limiting conditions, i.e., evacuation areas or the need for post-shot protective action procedures, was forwarded to the AEC for review.

The AEC safety review considered all factors affecting the safety of the project; among these were the depth of the device, the proximity of an aquifer to the detonation, and the location of gas production wells with respect to ground zero. The device was considered to be overburied by safety standards at the Nevada Test Site since it was emplaced at a depth of 4,240 feet. A device of the same yield would be considered safely emplaced at a depth of approximately 1,200 feet. The nearest aquifer was considered to represent no problem since the lowest water-bearing formation was approximately 560 feet above the shot point. The site chosen for the project is on land leased by the industrial participant, El Paso Natural Gas Company; the only wells in the area belong to them, and the closest production well was 3,400 feet from ground zero. As an added precaution, all producing wells within a five-mile radius of ground zero were physically separated from the gas transmission system. Nevertheless, the AEC hypothesized all possible failure modes which could release radioactivity into the atmosphere, the ground water, or into the natural gas production system. Although these failure modes were considered highly unlikely, the AEC authorized the Laboratory's comprehensive radiological safety program for Project Gasbuggy.

In accordance with the operations plan, the SWRHL pre-shot preparations were begun in June 1967. During the summer of 1967, the census was completed out to a distance of 100 miles of the shot point. In addition, all mining and tunneling operations within 50 miles were located. As the census information was collected, SWRHL personnel distributed printed information to the public explaining the nature of the experiment and answered questions by the local population regarding their activities. The community relations program was intensified during later periods when the SWRHL Project Officer and the State Health Department officials visited local officials in the surrounding communities. The initial environmental sampling was begun in August 1967. This included the collection of daily air samples at 35 locations around the site; the collection of milk from 22 stations - 13 representing family milk cows and nine grade A dairies; 34 water sampling stations were established, 6 representing municipal water systems, the others open or well water sources.

A new dimension was added to the environmental sampling program for Project Gasbuggy in that 15 samples of natural gas from producing wells in the area were sampled and analyzed pre-shot. Natural gas produced in the San Juan Basin was known to contain measurable quantities of Radon-222. Some had hypothesized that the ground shock and resulting ground motion from the explosion would shake the medium to such an extent that the amount of Radon found would markedly increase in the natural gas. Incidentally, this did not happen.

A network of thermoluminescent dosimeters (TLDs) and film badges was established at 50 stations surrounding the test site in October of 1967. The TLDs are, in our opinion, reliable personnel monitoring devices with a low sensitivity of 4 mR.

Medical and veterinarian activities began during the summer of 1967 when the respective officers made visits to various state and local physicians and veterinarians and briefed them on the safety programs as well as the medical aspects.

Approximately 30 people from SWRHL and the State Health Departments of New Mexico and Colorado were assigned to the program and were on station on December 1, 1967. A short training course was given for State personnel on procedures to be used and all personnel were oriented with the area around the site. At shot time of December 10, 33 personnel were on station, including monitoring teams in two aircraft orbiting the site.

As you all know, the experiment was fully contained. Had there been any prompt venting or seepage from the project, we would have been fully prepared. An on-site remote area monitoring system would have telemetered information back to the AEC control point, and the aircraft teams would have measured and tracked any airborne radioactivity. This information would have been instantly available to the PHS Project Officer who was in constant communication with the mobile ground monitoring forces. These teams would have been deployed into the path of any cloud to assess actual radioactivity levels at downwind distances. Should the situation so warrant, the populace could either be asked to remain indoors during the cloud passage or to evacuate in accordance with a prearranged plan.

In addition to this emergency type action, our protective action plan incorporates provisions to reduce radioactivity levels in the food chain. These may involve the covering of forage used by milk cows, substituting "clean" forage, or as a last resort diverting milk supplies to cheese or other dairy products to allow for radioactive decay.

Since there was no venting, the environmental sampling program was greatly reduced shortly after the experiment; otherwise, these programs would have been continued until background levels were reached. (A reduced safety program has been continued at the Gasbuggy site in connection with the flaring operations of the experimental well.)

It is our conclusion that from the safety standpoint the project was a success. The population was not exposed to any airborne radioactivity from the event; no evidence has been found of any contamination to the ground or surface waters; and there has been no migration of radionuclides into other gas-producing wells or the existing natural gas distribution system. We also believe we were well prepared so that our personnel could effectuate pre-developed emergency procedures to insure the protection of the public health had an unforeseen accident occurred.

In closing, I would like to leave you with a thought and a challenge for the future . . .

As you all know, the Atomic Energy Act of 1949 reserves exclusive jurisdiction to the AEC for all health and safety matters connected with the detonation of nuclear devices. If the use of nuclear explosives proves to be a success in the recovery of gas, oil, or minerals, it is doubtful that either the AEC or the PHS would have the manpower or other resources to handle all of the possible commercial utilization of this new tool. What then? Some discussion is presently taking place that industrial organizations could accept the safety responsibility along with the site development, drilling, etc.

What is the role of the State? PHS? AEC? What kind of safety program is adequate to protect the public when the application of this energy is moved from the experimental into applied use. Who decides when this transition takes place? How many experiments are necessary to conclude the program is no longer experimental? How many experiments are necessary before existing comprehensive safety programs can be reduced in scope? Does this new resource enter into the same category as an oil refinery, a chemical plant, or a nuclear power plant? There are, of course, other questions relating to public health, dealing with appropriate standards as to the consumer product. These will be covered in other papers. Nevertheless, public health agencies must think of the future now for, if industry is to seek the benefit in the peaceful application of nuclear explosives, the time to consider the inevitable changes is fast approaching. The questions I have raised and to be frank I do not have the answers are mostly jurisdictional in nature. We can not afford, however, to become involved in such jurisdictional disputes, when the need for adequate protection of the public's health is at stake.

QUESTIONS FOR JOHN R. McBRIDE

1. From Robert Karsh:

Do you monitor children who are known to be strategic bio-concentrators of iodine-131, or do you merely extrapolate from measurements on cows, milk, and adult employees?

ANSWER:

Although this didn't happen with a Plowshare experiment, we do have accidents that occur and we make all the effort that we can to prevent them. One of the weapons shots did vent and activity was sent north over the Test Site and a community called Hiko. There were about 80 people living in the town and we monitored every one of them including the children. And for some reason if you extrapolate from milk to people, you will find that their dosage should have been about five times higher than they actually were. I think part of this is because the FRC standards assume that a child drinks a liter of milk and I don't think this is so. We do monitor, we do look at the children very closely and we are concerned with them.

2. From Robert Karsh:

What warning system is used or contemplated when iodine-131 is found to be too high in the milkshed?

ANSWER:

We have a source term - this is given to us before the shot occurs - so we can calculate from the amount that under certain meteorological conditions that should exist at distance. This is worked out before the shot even goes. Now if, and by the way I serve and Dr. Carter serve as members of the AEC Safety Panel before each shot, and if it appears that this is in excess of the FRC guides, the shot is postponed until favorable conditions develop. Now even with all this care is taken, if the meteorology changes and it does, we take immediate action. In a case say in the collection of milk from family cows, when we sample the milk, we take all the milk available. Therefore, the family is not the receptor. In other cases, we are prepared to bring clean feed in for the cows. We are also prepared to substitute milk and of course notify the appropriate state and local officials of this action in advance.

3. From F. Chin:

Could you comment on the extent of the PHS role in assistance for off-site seismic effects which you briefly mentioned as a supplemental activity?

ANSWER:

Since we have so many people in the off-site area and we have contact with miners and ranchers and the populous in general, we more or less do this as an additional duty. We take the ground motion experts' predictions, and then warn the populous of the shot advising for instance to stay out of a mine during this period, asking to stay off of scaffolding and precarious perches and high places. Basically, we have been used to carry the message.