SAFETY PHILOSOPHY IN PLOWSHARE

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ABSTRACT

A nuclear device can be detonated safely when it can be ascertained that the detonation can be accomplished without injury to people, either directly or indirectly, and without unacceptable damage to the ecological system and natural or man made structures.

This philosophy has its origin in the nuclear weapons testing program dating back to the first detonation in 1945 and applies without reservation to Plowshare projects.

This paper therefore will outline the mechanics employed by government in implementing this safety philosophy. The talk will describe those types of actions taken by safety oriented organizations and committees to assure that necessary and desirable safety reviews are conducted.

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The Atomic Energy Commission is responsible for public safety for all U. S. nuclear detonations. Within the Continental United States, the Commission implements this responsibility through its Nevada Operations Office. The AEC's philosophy is to avoid any unnecessary risks, this necessitates evaluation of proposed operations to identify possible problems, taking such measures as are necessary to protect people and minimize damage to property. Although the title of this presentation is "Safety Philosophy for Plowshare" the same policy and safety procedures apply to all of our nuclear operations.

The Nevada Operations Office conducts those studies and reviews which are necessary to reliably predict the effects of nuclear detonations which may affect the safety of people and property. You will hear about some of these studies and

prediction activities later in this program. We do not consider ourselves infallible in defining safety problems or at arriving at credible and practical solutions to these problems. For this reason recognized experts in the pertinent scientific disciplines are consulted. These disciplines include but are not limited to: health physics, radiobiology, seismology, hydrology, geology, structural effect from ground motion, and rock mechanics.

This continuing effort on the part of NVOO, its contractors, and consultants, has permitted the programs - involving nuclear detonation both as a part of the weapons program and Plowshare - to go forward essentially without injury to the public or damage to property. I mentioned the efforts of the Nevada Operations Office and its contractors, but would be remiss not to include the efforts of the AEC's Scientific Laboratories and other Governmental Agencies which have contributed so much to our safety program.

Preparation for the safe conduct of an event is based upon prediction of the effects of the maximum credible accident which could befall that event. Necessary steps are taken as indicated by the predictions to ensure that NO limits or guides are exceeded. Precautionary measures are taken to ensure that public safety will be protected, should an accident materialize. NVOO measures and documents the actual effects in order to take emergency action to protect life and property, if necessary, and to accurately identify the effects to improve the accuracy of the predictive effort for future tests.

There are two very important aspects to the predictive and measurement efforts. First, in order to successfully carry on tests, the neighboring population outside the Test Site must be protected from injury. The people must also be adequately informed. Only by dependable predictions can this be done satisfactorily. Good public relations with these people means informing them of possible effects of the event prior to its execution and having that information as accurate as possible.

The second very important function of the measurement effort is to be able to form a firm basis for settlement of valid damage claims and to protect the Government against invalid claims. We must ensure that every effort is made to obtain correct measurements and that these measurements are properly interpreted and made accessible to the public and interested organizations. It is important that the people and interested organizations not only be assured that all steps are taken for protecting the public, but also that they be made aware of the extent and nature of this effort.

Prior to any nuclear detonation there are a series of reviews to ensure that the detonations are conducted safely and within the constraints of the Limited Test Ban Treaty. To achieve the safety in nuclear testing that we desire, a system for review and approval was developed. Slide No. 1 illustrates this system. All nuclear tests do not necessarily involve all of the individual steps depicted; however, unusual tests do receive reviews from the entire system. Slide No. 2 shows a listing of various safety review organizations.

The sponsoring laboratory performs safety evaluations related to nuclear systems safety, that is, procedures associated with assembly of the device, transportation, and emplacement as well as the detonation system. These nuclear safety procedures are later independently reviewed by a group of knowledgeable persons (nuclear safety survey group or nuclear safety study group) and when appropriate, recommendations are made to improve or assure safe assembly, transportation, etc. These study groups are comprised of individuals from different organizations, and as a composite group have a thorough understanding of the nuclear device and associated systems. The stated objective of this review program is to prevent an accidental or unauthorized nuclear detonation.

For contained underground detonations, the sponsoring laboratory independently evaluates and assesses those man-made and natural mechanisms which influence containment of the planned explosion. Each event is then reviewed several times by a Test Evaluation Panel composed of individuals with considerable experience in nuclear testing. The organizations furnishing such individuals are the Los Alamos Scientific Laboratory, Lawrence Radiation Laboratory, Sandia Laboratory, Department of Defense, Air Resources Laboratory-Las Vegas, U. S. Public Health Service, AEC, and independent consultants. Every aspect of the event which might affect containment is reviewed by this Panel several times as preparations for the event are made. A detailed study of the geological features around the shot point is made by the U. S. Geological Survey and presented to the Panel. If there are indications of possible faults or other geologic anomalies which may affect containment, new shot points are recommended by the U. S. Geological Survey. Additional geological information is also obtained by the U. S. Geological Survey from satellite holes drilled to accommodate instrumentation around the emplacement hole. A careful study is made of the drilling, casing, and grouting history of each of the emplacement and satellite holes to ensure that there will be no man-made path to the surface. If there are indications that grouting and casing have left voids, corrective measures are taken and the hole is abandoned.

The proposed stemming plan (that is, the method to be used for filling the emplacement and the instrument holes) is reviewed by the Test Evaluation Panel. If there are doubts as to the capability of the stemming material to contain radioactivity, then appropriate changes are made in the stemming plan. The stemming may range from alternate layers of pea gravel and fine sand to complete cementing of the entire length of the hole, depending upon the shot, media and the location. The same type of review is made to assure containment of a test to be made in a tunnel instead of a drilled hole. Even though these reviews are made and every possible precaution has been taken to ensure that no radioactivity will reach the surface, preparations for detonation of the device assume that the maximum credible release of radioactivity will occur.

AEC Headquarters staff, and finally the Commission, reviews the safety of each event, and if they are satisfied, grant authority for its execution. For detonations where it is anticipated some radioactivity will be released to the atmosphere, such as for cratering experiments, a somewhat similar review is made of the factors which will affect the quantity and nature of the release, including a review of the Laboratory's predictions on the effects of the experiment.

In all cases, regardless of whether the detonation is anticipated to be contained or to vent to the atmosphere, plans are made and steps taken to keep radiation exposures within acceptable levels either by evacuation or asking people to take cover.

The U. S. Public Health Service places off-site radiation monitors in the downwind direction in order that we may get full documentation and take corrective action if there is an accidental release. Mr. John R. McBride of the U. S. Public Health Service will describe this in his paper.

The Test Manager has established an Advisory Panel made up of specialists in meteorology, radiation, and medicine to advise him as to the hazards to be expected from each event. Other disciplines are added to the Panel as conditions warrant. The Panel is chaired by a scientific advisor who is familiar with the nuclear device, timing and firing systems, and program objective.

Although the Test Manager's Advisory Panel may meet several times, months in advance, to discuss specific problems on difficult or unusual shots, the Panel always meets the day before the detonation to hold a readiness briefing in which the control plans are reviewed. A complete weather

picture with predictions for shot time meteorological conditions is given and review made of the preparation for on-site and off-site population control. If it is determined that, with the maximum credible accident, the test can be safely carried out, recommendation is made to the Test Manager to proceed with the detonation. The Test Manager's Advisory Panel also reviews the last minute preparation to ensure that the recommendations of the Test Evaluation Panel have been, in fact, carried out in the field.

Complete field preparations are made to document even the smallest release of radioactivity. A system of remote reading monitoring instruments is installed around ground zero and in most cases a remote reading instrument is in the emplacement hole; there is also a ring of air samplers around the ground zero site. We have in the air at shot time at least two airplanes - one equipped with monitoring instruments, the other with sampling equipment. Should there be a release of radioactivity, the monitoring plane makes passes over ground zero and through the radioactive cloud and then keeps track of the leading edge of the cloud. The sampling plane comes in through the cloud and takes samples. These samples are immediately brought back to the Southwestern Radiological Health Laboratory for analysis so that we know exactly what radionuclides are present.

Two additional monitoring planes are also utilized as necessary. These planes are equipped with extremely sensitive detection instruments and with proper equipment aboard to constantly analyze the radioactivity picked up by the detectors. This then provides us with immediate and continuing knowledge of the cloud's contents. The sensitivity of these instruments is such that they can detect changes from natural radon concentrations and are able to discriminate between the debris in the cloud and the natural radioactivity. The tracking effort of these planes is used to position ground monitors in areas which may have been or will be affected.

As you perhaps know, testing has been carried out at the Nevada Test Site for 17 years - underground detonations for about 11 years. We maintain three or more camp sites constantly. The largest of these is Mercury. There are also camps in the forward area, one near the Control Point, and one at Area 12. The population at these camps may vary from 500 to 2,500 people. Although this relatively large number of people live and work within a few miles of the ground zero of even the largest yield tests, there has never been an injury among them as a direct result of a detonation.

We are constantly striving to improve the accuracy of our prediction capabilities in all areas, and have made much

progress. We also have come a long way in devising techniques to assure the containment of radioactivity during shot and post-shot related activities. This progress in prediction capability and containment techniques was necessitated by the increased complexity of experiments. In the last analysis all those involved in the test program recognize the potential hazards involved. Therefore, we rely on a proven system based upon taking those actions necessary to protect against the effects of the maximum credible accident.

QUESTIONS FOR ROBERT THALGOTT

1. From Donald E. Barber:

Why is some information concerning Plowshare Programs classified? It is not obvious how national security is at risk.

ANSWER:

So far as I know, the only things that are classified about Plowshare, the Plowshare Program, are those aspects of the device itself which may be classified. The rest of it is completely open.

2. From G. H. Cruelers:

How is a maximum credible accident defined especially when it is known that the stemming was designed to completely contain the products?

ANSWER:

I think this will be touched on in some other talks, but let me briefly go through a series of things that gets us to where we operate. The first is all of our detonations are determined in yield or listed in yield as a design yield and a maximum yield. One of the laboratory people can do this much better than I, but essentially the maximum credible yield is a calculated yield based on the best possible burn efficiencies and so forth. We operate then not from what we expect the device to produce, but this maximum number which gives us one maximum. As far as a release of radioactivity goes, unless we have a great deal of experience in identical geological media and the same location, we go back to a model developed from measurements of an actual venting which was a surprise to us. More or less arbitrarily we've stayed with that. When we are faced with problems which this does not cover, then we dip into somebody's mind and try to envision the worst possible case and develop a model from that. In the case of the upcoming Rulison Project, we will operate both models - one for shot time and one for the possibility of delayed venting. I'm not sure that answered it, but that's about the best I can do.

3. From R. L. Long:

Are the assumed maximum credible accidents as unrealistic as many of those assumed for nuclear reactor analyses?

ANSWER:

I am not familiar with nuclear reactor analyses. I will say again what I stated before. We and the people who preceded us in the testing

business have tested for 17 years and the underground testing for 11 years without injury to people and we've done it on the basis that if we are surprised, we will hurt no one. I don't know how you can hang dollars and cents on this. If the Plowshare Industrial Program advances and we have the experience in the field, rather than a single shot in a new location with unknown effects, then we probably can back off from this. But as long as you have a single shot in a single location, new people, new systems, then as long as I'm Test Manager, we will be able to take care of the worst possible accident that anyone can conceive.

4. From R. C. Pendleton:

If all people downwind are informed of hazards, why have the people of Utah not been given this consideration?

ANSWER:

I think I can repeat what you already know, that we do not execute an event either underground or Plowshare if anyone in our system feels that there is an actual safety hazard. When we do have an unexpected venting, or when we have a Plowshare experiment, as soon as we know the content of that cloud, the approximate concentrations of activity in the cloud, and what we expect on the ground, through the Southwestern Radiological Health Laboratory, the State Department of Public Health in Utah is notified where we expect the cloud to go, what we expect to see in the cloud and what we expect on the ground. So through that method at least we thought we were notifying the people in Utah of what happened.

5. From Walt Kozlowski:

You spoke of unnecessary risks, would you please tell us what you would consider necessary risks?

ANSWER:

Any time you deal with explosives or almost any mechanical contrivance there is some risk. There is a risk in walking across the street, there is even a risk in getting out of bed. I consider those risks unnecessary where we are aware of the problem and fail to take care of it. We do not shoot any nuclear detonation under circumstances where we are aware of problems and have no solutions.

6. From J. E. Wallen:

Geological studies are made to study the effects of the detonation on the geology of the area. Why do you not make studies of the total effects of the detonation on the biology of the area? Why do you study only radioactivity effects on man and only radiobiology?

ANSWER:

This question, I guess, is really in two parts, and I am afraid that we have fallen into a trap by not describing more fully our program. Later, I think, in this program there will be a discussion of ecological studies where we are doing total biological studies in several areas where we had no previous experience. Again the same problem with radiobiology when, in fact, we are studying biology or the biological environment and then applying those factors to it which will give us concern because of radionuclides which may be released.

7. From Dr. Tom Rozzell:

Please give more information on the camps at the NTS - what type of people, etc.

ANSWER:

The camps are located at the south edge of the Test Site, the middle point and the northernmost point. They are established mainly for economical reasons - it is cheaper for the people to stay there and work than to bring them back and forth to town. The highest percentage of the population of the Area 12 camp, which is the northernmost camp, is craftsmen. Probably more miners than any other craft because that is the area in which we do mining. This camp population runs usually about 800 people. The Area 6 camp in the center of the Test Site again is mainly occupied by craftsmen and this will pretty well run the gamut since these people work in the so called Yucca Flats area and it is quite convenient to them. The Mercury facility is the largest one. I think we can house around 3,000 people there. This camp is populated by a mixture of crafts, professional people and technicians with, I suspect, a higher percentage of the scientific types than any other type of people. I might point out one fact. All of our water for construction and our potable water comes from water wells on the site. The townof Mercury draws its drinking water from what is known as Well 5 which, aquiferous speaking, is downstream about 1-1/2 miles from a shot, an underground detonation, that was fired there a couple of years ago very close to the water table in that area and in no well have we seen radioactivity. The only place we've found radioactivity in water is when we drill back in the shot points looking for it.